Xerostomia Management in the Head and Neck Radiation Patient

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Xerostomia is a devastating and consistent complication of head and neck radiation. A detailed description of the management of this condition is presented here. Much of this material would also apply to any patient experiencing xerostomia.

Ionizing radiation results in cell damage, death, and subsequent fibrosis of the salivary glands. A decreased salivary flow has been reported at doses of 10 Gy, while permanent xerostomia results at doses greater than 35 – 52 Gy. A loss or significant reduction of salivary function is one of the most unpleasant and problematic side effects of radiation therapy involving the head and neck. Normally salivary glands produce 1 – 1.5 L of saliva per day. The average unstimulated flow rate is 0.4 ml/min and the average stimulated flow rate is 2.0 ml/min. The commonly accepted values for lower limits of normal salivary function are 0.1 – 0.2 ml/min unstimulated flow rate and 0.7 ml/min stimulated flow rate. When salivary production is compromised most individuals experience the sensation of a dry mouth, which is termed xerostomia. Loss of salivary function leads to a plethora of adverse sequelae, including:

- difficulty with tasting, chewing, and swallowing;
- esophageal dysfunction, including chronic esophagitis;
- nutritional compromises;
- higher frequency of intolerance to medications;
- increased incidence of glossitis, candidiasis, angular cheilitis, halitosis, bacterial sialadenitis;
- decreased resistance to loss of tooth structure due to attrition, abrasion, and erosion;
- loss of oral buffering capacity;
- increased susceptibility to mucosal injury;
- inability to wear dental prostheses; and
- markedly increased susceptibility to dental caries.

The increased susceptibility to decay caused by xerostomia can result in rampant caries involving teeth both within and outside of the fields of radiation. This severe caries increases the risk of osteoradionecrosis. Xerostomia can also result in difficulty sleeping due to oral dryness waking the patient during the night. The annoying problem of dealing with a constantly dry mouth can result in a loss of social and physical well-being. It can also become an emotional challenge with the possible result of withdrawal and clinical depression.

Managing the oral health of patients with radiation-induced xerostomia can be extremely challenging for the dentist. The following statement made by Dr. Ira Shannon in 1977 concerning these patients holds true today:

The maintenance of oral health in xerostomic patients is demanding for both the patient and the dentist. It requires cooperation and compliance on the part of the patient, with a commitment of time and effort well beyond that required for normal oral care. The dentist must promote and inspire this cooperation, provide detailed instructions and guidance, and follow the patient meticulously. Only in this way can the ravaging form of caries often found in these patients be prevented.

The management of head and neck radiation therapy patients with xerostomia should begin before the condition occurs; i.e., prior to the patient's receiving head and neck radiation therapy. The past performance of the patient regarding oral hygiene and the value placed on his/her dentition is a reliable predictor of future results. Patients who have not taken good care of their dentition prior to head and neck radiation therapy are unlikely to take good care of their dentition following radiation therapy. When it is predictable that these patients will have very little salivary function remaining following head and neck radiation therapy, it is usually in the best interest of these patients to remove any teeth with a questionable prognosis, especially those that will be supported by bone that will receive at least 60 Gy of ionizing radiation.

During radiation therapy, as normal meals become more difficult to ingest, patients may adopt

a more cariogenic diet and carry a cariogenic beverage to repeatedly moisten the mouth. They often do not understand that the loss of saliva's buffering, remineralizing, washing and antimicrobial functions dramatically increases their risk of caries and to a lesser extent candidiasis. When managing patients with xerostomia who have teeth or will retain teeth after radiation therapy, it is very important to educate them regarding the effects radiation will have on their saliva and teeth. They must understand that the reduced salivary flow places them at a greatly increased risk for dental caries, which cannot be controlled without their cooperation. The provider must ensure that patients understand the following requirements to maintain their dentitions:

- Avoid using cariogenic liquids to moisten the mouth such as soft drinks, citrus flavored or carbonated water, juices, punches, tea, or any other liquid containing sugar.
- Avoid using any liquid with an acidic pH as a mouth moistener.
- Avoid using items containing sugar to stimulate salivary flow such as gums, mints, candies, lemon drops, tic-tacs, etc.
- Avoid frequent between meal snacks, especially those that contain sugar or those that are composed primarily of carbohydrates.
- Perform thorough oral hygiene measures using a soft/medium toothbrush and floss or a proxy-brush (if sufficient space exists), and a fluoridated toothpaste (1,100 ppm fluoride ion) at least twice per day.
- Brush teeth after every meal.
- Use a topical fluoride rinse or gel daily. They should understand that the best method of providing daily topical fluoride treatments to the teeth is with a fluoride tray and a 1 – 1.1 percent neutral sodium fluoride gel. They must understand that the over-the-counter fluoride rinses are much less effective than prescription fluoride gels and rinses.
- Be seen for follow-up dental examinations every 3 months during the first year and from every 3 to 6 months thereafter depending on their oral condition.

The provider must also ensure that patients understand that due to their decreased salivary flow, they have lost most or all of saliva's protective functions, which include:

- the formation of a pellicle to act as a physical barrier to the invasion of microorganisms and as a moisturizing lubricant to prevent abrasive tooth wear and soft tissue trauma;
- potent antimicrobial effects which help protect against bacteria, fungi, and viruses in the mouth;
- a washing effect to help clear the oral cavity of microorganisms and food debris, especially sugars;
- a hydrating effect that moistens the mouth and aids in chewing and swallowing;
- the promotion of remineralization of the teeth and the retarding of demineralization because it is a saturated solution of calcium and phosphate ions; and
- a high buffering capacity, which protects the dentition against acids from both external and internal sources and aids in the control of the microorganisms that are responsible for dental decay and oral fungal infections..

Topical Management of Dry Mouth Discomfort
Providers should also impart the following information to their patients concerning the management of their oral discomfort and their oral health.

Over-the-counter sugar free gums and mints are safe to use to stimulate any remaining salivary function; however, the xylitol-containing gums and mints such as Koolerz® gum and Smint® mints are preferable because xylitol inhibits the growth of the type of bacteria (mutans streptococci) that cause tooth decay. There are several proprietary products that claim to increase salivary flow, such as Salix® and Saliva Tablets®. However, while they are more expensive than over-the-counter sugar free gums and mints, it is highly questionable whether they are more beneficial.

There are numerous commercial salivary substitutes available to assist in moistening the mouth, however, they are not all equal. Several of these products have been found to have a pH below 5.1. Studies have found that saliva substitutes with a pH of 5.1 or less lead to demineralization and loss of tooth structure unless they contain calcium and phosphate ions and/or fluoride ions. Presently there is no ideal salivary substitute commercially available. The best product available is VA Oralube. However, it is only available to VA dental facilities.

Because saliva substitutes are somewhat expensive, do not have a pleasant taste, and have a short duration of action, many patients prefer to use water to moisten their mouths. Because of the confirmed topical benefit of fluoridated water, patients should use water known to contain approximately 1 ppm fluoride as a mouth moisturizer. Commercially available bottled water does not usually contain significant amounts of fluoride and some home water purification systems remove the fluoride that is present in tap water. Patients must be encouraged to use unfiltered fluoridated tap water as a mouth moistener.

The Biotene® products from Laclede are formulated for xerostomic patients. These products contain natural salivary enzymes and proteins as well as xylitol. Biotene® toothpaste does not contain sodium lauryl sulfate and Biotene® mouthwash does not contain alcohol, both of which can be irritating to xerostomic patients.

Oralbalance Gel® is another Biotene® product that has met with patient acceptance. It is a clear viscous water-soluble gel that contains xylitol as well as the natural salivary enzymes and proteins. It can be used to coat the oral soft tissues to protect and lubricate them. It has a longer duration of action than water and many patients find it beneficial to use when they need something that lasts longer than fluoridated water such as in the evening prior to going to sleep.

Breathtech® from Omni® is another product often beneficial for symptomatic relief of a dry mouth. It contains a silicone molecule (poloxamer 407), which has an affinity for mucosa. It is marketed in a small spray bottle and is very convenient for patients to carry. It has a neutral pH and provides a longer lasting relief from oral dryness than water. Some patients prefer to use it to the Oralbalance Gel® prior to retiring in the evening as well as using it throughout the day.

Systemic Management of Dry Mouth Discomfort

The provider should also make the patient aware of the availability of systemic salivary stimulants. The benefits of endogenous saliva over commercial substitutes are greater patient acceptance and the contribution of natural salivary components to oral homeostasis. However, it must be determined that the patient has remaining salivary function via measuring the stimulated salivary flow rate, prior to prescribing a systemic sialagogue. If there is no measurable saliva following the collection of stimulated saliva for 6 – 8 minutes, such agents are likely to be ineffective. If there is measurable saliva, the patient should be advised that the two pharmacological agents with the most data confirming their stimulating effect on salivary glands are Salagen® (pilocarpine) and Evoxac® (cevimeline). Both are analogues of acetylcholine and stimulate exocrine glands via their actions as agonists at muscarinic receptor sites. Providers who are not familiar with these medications or who are uncomfortable with prescribing these medications should consult the patient's physician prior to prescribing them. The provider and the patient should be aware of the following:

- Salagen® (pilocarpine) is a nonselective muscarinic agent which affects both the M3 receptors in the exocrine glands as well as the M2 receptors in the heart and has a duration of action of approximately 3 hours. It is available in 5 mg tablets and the recommended dose is 5 – 10 mg t.i.d. (not to exceed 30 mg per day). It has been approved by the FDA for relief of symptoms of dry mouth secondary to Sjögren's syndrome and for dry mouth secondary to radiation therapy.
- Evoxac® (cevimeline) theoretically has a greater affinity for the M3 receptors in the glands and a lower affinity for the M2 receptors on the heart (fewer rhythmogenic cardiac effects). This difference has not been proven in clinical trials. It has a longer duration of action — approximately 5 hours. It is available as a 30 mg tablet and the recommended dose is 30-60 mg t.i.d. (not to exceed 180 mg per day). It has been approved by the FDA for symptoms of dry mouth secondary to Sjögren's syndrome and is being studied for dry mouth secondary to radiation therapy.

- Pilocarpine is also available as an ophthalmic solution. It is available in a variety of concentrations and comes in 15 ml dropper bottles. The 1 percent solution can be prescribed with instructions to place 1/2 – 1 ml on the tongue t.i.d. not to exceed 3 ml per day. Another option is a 4 percent solution, which be diluted to 600 ml with tap water to create a 1 mg/ml solution. The patient is instructed to take 5 – 10 ml (1 – 2 teaspoons) t.i.d. not to exceed 30 ml per day. The advantage of prescribing pilocarpine in a solution form is that it is much less expensive. Caution should be used in prescribing opthalmic solution and dosing should be monitored closely, as overdosing has been reported.
- Pilocarpine and cevimeline have similar unwanted side effects. The most common are: gastrointestinal upset, sweating, tachycardia, increased pulmonary secretions, increased smooth muscle tone, and blurred vision, especially at night.

Caution should be advised while driving at night or performing hazardous activities in reduced lighting.

- Pilocarpine and cevimeline have similar contraindications that include: gall bladder disease, narrow-angle glaucoma, acute iritis, uncontrolled asthma, known hypersensitivity to either drug, and renal colic.
- Pilocarpine and cevimeline have similar warnings and precautions. Risks to the patient must be considered when administering either medication to individuals with cardiovascular disease, controlled asthma, angina pectoris, chronic bronchitis, chronic obstructive pulmonary disease, or history of myocardial infarction, nephrolithiasis, or cholelithiasis.
- Pilocarpine and cevimeline may interact with various medications, including beta-blockers, other parasympathomimetic drugs, and medications that have a significant affect on the cytochrome P450 liver enzyme system.

Prevention and Treatment of Dental Caries

In a dentate individual suffering from xerostomia, the lack of salivary oral clearance, remineralization action, buffering capacity, and antibacterial activity promote rampant dental caries. Normal salivary pH is approximately 6.8 – 7.2. In xerostomic patients the oral pH can fall to 5.5. This acidic environment promotes the rapid growth of acidophilic organisms such as mutans streptococci, lactobacillus, and candida. It is critical that the treatment of dental caries follow a medical model as described by Anderson, Bales and Omnell (5). Using this model, dental caries is primarily approached as an infection of the oral cavity with treatment directed at the causative organism. This medical model must include the following:

- Eliminate existing mutans streptococci nidi of infection by removing caries from all cavitated caries lesions and obturating with glass-ionomer interim restorations as well as sealing all carious pits and fissures.
- Initiate antimicrobial therapy using a 0.12 percent chlorhexidine rinse, 1/2 oz. oral rinse for 1 minute twice daily for 2 weeks. This will reduce the number of mutans streptococci below a pathological level for 12 – 36 weeks.
- Immediately following the two week twice daily course of 0.12 percent chlorhexidine, place the patient on a 1/2 oz. oral rinse for 1 minute twice daily 1 or 2 days per week. A recent study showed that a once per week rinse maintained a low mutans streptococcus count; however, 2 days per week may be required to maintain a suppressed level of mutans streptococci in xerostomic patients because the oral environment is these patients is conducive to a more rapid growth in the number of organisms.
- Apply a fluoride varnish to all of the remaining teeth during or following the removal of caries from all cavitated caries lesions and place the patient on a brush-on 1 percent neutral sodium fluoride gel such as FluoroShield® or Prevident® to protect the teeth against demineralization and promote remineralization.
- Fabricate fluoride trays for the application of the neutral sodium fluoride gel (ideally this should be done prior to radiation therapy) and instruct the patient on the daily use of the trays as follows:

- Place a ribbon of 1 – 1.1percent neutral fluoride gel in the carriers.
- Insert both the upper and lower carrier.
- Gently bite several times to “pump” gel between the teeth.
- Leave the carriers in place for 5 to 10 minutes.
- Remove carriers and expectorate the gel but do not rinse.
- Rinse the carriers and allow to air dry.
- Do not eat or brush for at least 30 minutes.

Low concentration products such as 0.05 percent sodium fluoride rinses (250 ppm) and 0.63 percent stannous fluoride rinses (diluted 1:8 – 250 ppm) are poorly effective in xerostomic patients. The most effective products are those containing 5,000 ppm such as the 1 – 1.1 percent sodium fluoride gels and toothpastes. The recommended technique is a 1 – 1.1 percent sodium fluoride gel in fluoride trays, together with the twice daily use of a conventional 1,100 ppm sodium fluoride toothpaste. The next most favorable protocol is to brush on the sodium fluoride gel, together with the twice daily use of a conventional 1,100 ppm sodium fluoride toothpaste. A less favorable third protocol is to brush twice daily with a 1.1 percent sodium fluoride dentifrice such as Colgate 5000®.

Begin definitive restorative therapy according to the following recommendations:

Patients Compliant with the Use of Topical Fluorides

- Class 1 or 2 Direct Restorations
  - Either amalgam or hybrid composite
- Class 3 Direct Restorations
  - Either hybrid composite or resin modified glass-ionomer
- Class 5 Direct Restorations
  - Either amalgam, hybrid composite, or resin modified glassionomer
- Laboratory Fabricated Indirect Restorations
  - Consider only after caries-free for at least 6 months.
- Enamel "White Spot" or Non-cavitated Dentin Lesions
  - Apply a fluoride varnish 2 – 3 times in one week, if possible.
  - Recommend daily use of Revive® for 2 weeks in fluoride trays. (This product is a low fluoride containing gel, 0.05 percent sodium fluoride that is saturated with calcium and phosphate. This combination strongly enhances the remineralization process.)
  - Resume daily topical fluoride in trays.

There are also new products emerging that have been found to suppress tooth demineralization while enhancing tooth remineralization. One of these is casein phosphopeptide-amorphous calcium phosphate (CPP-ACP). Human in situ studies have shown that this material buffered plaque pH by stabilizing and localizing amorphous calcium phosphate within the plaque thereby helping to maintain a state of supersaturation with respect to tooth enamel. The buffering of the plaque resulted in a depression of demineralization and enhancement of remineralization as much as 63.9 percent (20 percent). Another study demonstrated that sugar-free gum is a safe and effective way to deliver CPP-ACP in order to promote remineralization enamel subsurface lesions. CCP-ACP is marketed as Recalden® and in the United States it is commercially available in Trident®.

Another similar material, casein derivatives complexed with calcium phosphate (CD-CP), has been shown to be equivalent to NaF in its caries-preventive efficacy when used as a mouth rinse in patients with xerostomia. CD-CP preparations appear to hold promise as caries-preventive agents for xerostomic patients. The acceptability of the flavor and its non-toxic properties means that it could be used to moisten the mouth throughout the day. It has a clear advantage over fluoride-based materials because it can be swallowed. A new CD-CP product designed as a mouth moistener (Dentacal Mouth Moistener) has recently become available in Australia and New Zealand, NSI Ltd., NSW, Australia. Perhaps in the near future a similar product will be available in the United States.

Patients Not Compliant with the Use of Topical Fluorides

- Class 1 and 2 Direct Restorations
  - Amalgam — glass-ionomer liner may be beneficial
  - Hybrid composite — not recommended
- Class 3 and 5 Direct Restorations
  - Resin modified (dual cure) glass-ionomer or packable (chemical cure) glass-ionomer — a protective surface coating may be beneficial for both
- Laboratory Fabricated Indirect Restorations
  - Not recommended
- Enamel "White Spot" or Non-cavitated dentin lesion
  - Place a topical fluoride varnish as often as possible, but expect to restore early.
- Initially, close follow-up every 3 months.
- Careful examination and bite-wing radiographs until at least 6 months without lesions, may then extend time between follow-up appointments.
- Reinforce oral hygiene instructions and use of topical fluorides, chlorhexidine rinses, and salivary stimulating agents.
- Assess for recurrent candidiasis.

Prevention and Treatment of Candidiasis

It is recognized that xerostomic patients' mucosa often becomes dry, sticky, rough, and may bleed easily and is more susceptible to infection. The most frequently encountered mucosal infection associated with xerostomia is candidiasis, which because of the lack of salivary protection, can become chronic. Xerostomia leads to a more acidic oral environment and an increase in acidophilic organisms such as mutans streptococci and Candida albicans. A significant correlation between lowered whole saliva and Candida albicans counts has recently been confirmed by Navazesh, et al. Previous studies have found an increased incidence of oral candida colonization in patients undergoing radiation therapy involving the head and neck. Ramirez-Amador and Silvermann, et al.,

found that in this group of patients, candida colonization significantly in-creased from the initiation of therapy (43 percent) to the completion (62 percent) and continued to increase during follow-up visits to a prevalence of 75 percent. A shift in the species of the candida organisms from 85 percent Candida albicans at the beginning of radiation treatment to 65 percent at the termination of treatment was also noted, as was an increase in populations of other candidal species, including C. glabrata, C. tropicalis, C. parapsilosis, C. cerevisae and C. krusei.

Candida organisms have been found to colonize 67.9 percent of patients with self-reported xerostomia, of which 58 percent were found to have hyposalivation. The dry mouth patient's oral mucosa should be carefully examined for the infection. It may present as a pseudomembranous form (thrush), as an atrophic (erythematous) form (often associated with a removable dental appliance) or, less commonly as a hypertrophic (white) form. It should also be suspected when xerostomic patients complain of a burning mouth or tongue. At times this infection may spread to involve the commissures of the mouth, a condition described as angular cheilitis or chelosis.

A clinical diagnosis of Candida may be supported by performing a Gram stain or potassium hydroxide (KOH) preparation from oral scrapings, especially with the pseudomembranous form, or confirmed with a fungal culture. There are several antifungal agents effective against Candida albicans. Nystatin solutions contain large amounts of sucrose (approximately 50 percent) and should be avoided in dentate xerostomic patients. Xerostomic patients may not have sufficient saliva to dissolve oral troches or pastilles. These items may also cause mucosal abrasion resulting in decreased patient compliance. Oral candidal infections in xerostomic patients should be treated using azole systemic medications. These include fluconazole (Diflucan®), ketoconazole (Ni-zoral®), and itraconazole (Spor-anox®). They are effective and do not require frequent dosing as does nystatin suspension and troches, clotrimazole troches, or amphotericin B (Fungizone®) suspension. Dosing frequency is important because compliance can be a significant problem when treating patients for fungal infections. Ketaconazole is considerably less expensive than the other two azoles, but is associated with higher liver toxicity and more frequent drug interactions. Itraconazole is also available as a solution and acts both as a topical and systemic medication. It has the advantage of containing no sugar (sweetened with sorbitol and saccharin). However, it has a drug interaction and liver toxicity profile that is similar to ketoconazole. Fluconazole, because of its efficacy and excellent safety profile, is the recommended systemic therapy for oral candidiasis. However, development of resistance to the drug may be a problem. Itraconazole solution is an alternative if this occurs. (Note: All of the azoles, including fluconazole, have the potential for drug interactions. This potential is just much less for fluconazole. This should be considered before giving any azole medication.) Chlorhexidine gluconate also inhibits the growth of candida, however, it is not recommended as a primary treatment against candidiasis.

Systemic Treatment of Oral Candidiasis in Xerostomic Patients

Fluconazole (Diflucan®) 100 mg tablets
Dispense: 8 – 15 tablets
Sig: Take two tablets p.o.
initially then one tablet daily
for 6 – 13 days

Itraconazole (Sporonox®) suspension 100 mg/10 ml
Dispense: 140 ml – 280 ml
Sig: Swish and swallow 20 ml
for 7 to 14 days

Xerostomia and Removable Prosthodontic Therapy

Xerostomia is often associated with reduced denture retention and generalized denture intolerance. It has long been recognized that the surface tension developed as a result of the layer of saliva interposed between the denture base and the supporting tissues is important for effective prosthesis retention. To achieve optimal surface tension between the denture (especially the maxillary) and the tissue, the intervening saliva must be thin and effectively wet the opposing surfaces. This allows the saliva to maximize contact between the surfaces creating an adhesive force between saliva and the denture base. Maximum extension of the denture base within the physiologic limits of the supporting tissue and a bilaterally balanced occlusion are important for adequate denture retention in xerostomic patients. However, it is appropriate to prescribe a denture adhesive to augment retention for xerostomic patients. A properly applied well-hydrated adhesive functions to enhance the surface tension between the denture and tissue. This replaces the otherwise saliva deficient film layer thereby improving adhesion, eliminating voids between the denture and the mucosa. This provides a cushioning or lubricating effect helps to reduce mucosal irritation due to friction and prevents additional tissue dehydration. A properly applied adhesive will reduce food impaction between the denture and

tissue, improve chewing efficiency and bite force, improve functional load distribution, and facilitate the psychological well-being of the patient. For best result, these materials should be spread across the entire surface of the denture and firmly seated against the tissues.

Xerostomic denture wearers are also more prone to recurrent candida infections. When the infection is confined to removable denture supporting tissues, treatment of the tissues can be effectively accomplished by placing an antifungal cream (e.g., clotrimazole 1 percent cream) or nystatin powder on the surface of the denture prior to placement. This should be done daily until the tissue appears clinically healthy and then for an additional two weeks. When the candidal infection involves other oral or pharyngeal soft tissues, the patient should be treated with a systemic agent as previously described. Additionally, the denture should be treated with one of the following protocols over the course of treatment.

Topical Treatment for Infected Dental Appliances

- Daily 30 minute soak in 0.12 percent chlorhexidine solution
- Daily 30 minute soak in diluted sodium hypochlorite solution (10 ml or two teaspoons of 5 percent bleach in 250 ml or one cup of water).

Decreased salivary output has a direct correlation with increased prosthetic functional difficulty in edentulous patients. Clinicians should consider recommending implant borne prostheses for xerostomic edentulous patients. Massad and Cagna (15) have experienced great success with these prostheses. Patients typically report improved oral comfort and function when compare with conventional prostheses.

Bacterial Sialadenitis

When salivary flow rates are diminished, secretions frequently become viscous and may block flow through the ductal system resulting in glandular swelling. This should be distinguished from swelling caused by an infection of the gland. A diminished flow rate may also result in bacteria regressing up the duct system and into the gland resulting in infection (bacterial sialadenitis). Swelling due to blockage may be relieved by glandular massage, whereas infection should be treated with antibiotics and, if possible, stimulation of salivary flow, Appropriate antibiotics are Penicillin VK®, clindamycin, or amoxicillin.

Antibiotic Treatment of Bacterial Sialadenitis

Penicillin VK® 500 mg tablets
Dispense: 40 tablets
Sig: two tablets initially then
i q 6 hrs for 10 days

Clindamycin 300 mg tablets
Dispense: 40 tablets
Sig: two initially then
i q 6 hrs for 10 days

Amoxicillin 500 mg tablets
Dispense: 30 tablets
Sig: two tablets initially then
i q 8 hrs for 10 days

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PRODUCTS FOR USE IN TREATING PATIENTS WITH XEROSTOMIA

I. ORAL MOISTURIZERS	MANUFACTURER	TELEPHONE
Oralbalance® moisturizing gel, pH -6.5 approx. 15% xylitol, enzymes (hydroxyethylcellulose) 1.5 oz tube – About $7.00 at Walgreens, Eckerd, Revco	Laclede Research Laboratories Gardena, CA www.laclede.com also available online at www.dentaldepot.com ($4.66)	(800) 922-5856
Omnii BreathTech® 1.2% poloxamer 407/dimeticone 18 ml spray bottle, pH 7.0 Available only to dentists. Case of 48 for $120 ($2.50).	Omni Oral Pharmaceuticals Gravette, AR www.omniipharma.com	(800) 445-3386
VA OraLube 6 oz spray bottle, pH 7.0 Xylitol, 2 ppm F (carboxymethylcellulose)	Only available from VA Hospitals NDC 052859-005	
Moist Plus® Mouth Moisturizer moisturizing gel, pH 7.0 xylitol, (carboxymethylcellulose)	Sage Products, Inc. Crystal Lake, IL	(800) 323-2220
available from HDIS, $^1/_2$ oz tube is approx. $6.00. Will sell to patients.	HDIS www.hdis.com	(800) 269-4663
Moi-Stir Mouth Moistener® 120 ml pump spray bottle (carboxymethylcellulose) pH 7.1, Canadian pharmacies for $5.00; not sold in U.S. pharmacies.	Paladins Labs Inc. Montreal, Canada also available online at www.dentaldepot.com ($3.89)	(514) 340-1112
Saliva Substitute® 120 ml squeeze bottle, pH 6.5 (carboxymethylcellulose) Will not sell direct to patients. Pharmacies can order at $4.85 each.	Roxane Laboratories Inc. Columbus, OH www.roxane	(800) 848-0120
Salivart® Synthetic Saliva 75 g spray can, pH 6.2–7.2 (carboxymethylcellulose) Available in pharmacies at about $11.00.	Gebauer Company Cleveland, OH www.gebauerco.com also available online at www.dentaldepot.com ($9.26)	(800) 321-9348
Stoppers4 Dry Mouth Spray® 4 oz pump spray bottle, pH 7.0 contains glycerin, xylitol www.woodridgelab.com (hydroxyethylcellulose). Will sell direct to patient ($5.00 for 12 + shipping).	Woodridge Labs, Inc Van Nuys, CA	(888) 766-7331
Dentalcal Mouth Moistener 100 ml spray bottles, contains casein derivatives complexed with calcium phosphate (CD-CP). New Product available in New Zealand.	New Zealand Pharmaceuticals LTD. PO Box 1869, Palmerston North 5330 New Zealand www.nzp.co.nz NSI Ltd., NSW, Australia, email: nsi@nulite.com.au	
* MouthKote Saliva Substitute® 8 oz pump bottle, lemon flavor (mucopolysaccharide), pH 4.0	Parnell Pharmaceuticals, Inc. Larkspur, CA www.parnellpharm.com	(800) 457-4276

* Oral moisturizers/artificial salivas having a pH < 5.5, such as MouthKote Saliva Substitute®, are not recommended.

PRODUCTS FOR USE IN TREATING PATIENTS WITH XEROSTOMIA

2. TOPICAL FLUORIDE VARNISHES	MANUFACTURER	TELEPHONE
DuraFlor® Cavity Varnish Unit Dose 5% NaF, 22.6 mg/ml F pH 7.0, 22,600 ppm 0.5 ml unit w brush, 16 – approx. $25.00	Medicam Products Buffalo, NY www.medicom.ca	(800) 361-2862
CavityShield™ - 5% NaF Varnish 5% NaF, 22.6 mg/ml F pH 7.0 22,600 ppm, 0.25 ml & 0.40 ml unit doses Trial Pk. of 16 each (10.4 ml) $31.25	Omni Oral Pharmaceuticals Gravette, AR www.omniipharma.com	(800) 445-3386

* Fluoride varnish in tubes is not preferred because the fluoride content per dose can vary significantly.

III. TOPICAL FLUORIDE GELS	MANUFACTURER	TELEPHONE
FluoriSHIELD® 1% NaF get, 5000 ppm, pH 7.0 4.0 oz bottle, approx. $6.00	Stone Pharmaceuticals Philadelphia, PA www.stonepharm.com	(800) 523-0191
Prevident Brush On Gel® 1.1% NaF gel, 5000 ppm, pH 7.0 or 2.0 oz tube approx. $6.50	Colgate Oral Pharmaceuticals Canton, MA www.colgateprofessional.com	(800) 821-2880 (800) 2-colgate
NeutraCare® 1.1% NaF Gel, 5000 ppm, pH 7.0	Oral-B Laboratories Belmont, CA www.oralb.com	8(800) 446-7252
NeutraGard® 1.1% NaF Gel, 5000 ppm, pH 7.0	Pascal www.pascaldental.com	(800) 426-8051
FluorideX® 1.1% NaF Gel, pH 7.0 5000 ppm, approx. $5.00	Discus Dental Culver City, CA www.discusdental.com	(800) 422-9448
Pro-DentX® 1.1% NaF Gel, 5000 ppm, pH 7.0 Not sold retail, dental offices only.	Pro-Dentec Batesville, AK www.prodentec.com	(800) 228-5595

* The 0.4 SnF2 gels such Gel-Kam® and Omni-Gel® are not recommended because of their acidity (pH 2.4-4.7) and lower fluoride concentration (1000 ppm) vs. 1 – 1.1% NaF (pH 7.0, 5000 ppm F).

** Many Rxs are never filled. Patient compliance may improve if you supply the patients with the products you prefer they use and it is usually less expensive.

PRODUCTS FOR USE IN TREATING PATIENTS WITH XEROSTOMIA

IV. RX TOOTHPASTES	MANUFACTURER	TELEPHONE
Prevident 5000 Plus® 1.1% NaF Dental Cream, pH 7.0 or 5000 ppm, approx. $7.00	Colgate Oral Pharmaceuticals, Inc Canton, MA www.colgateprofessional.com	(800) 821-2800 (800) 2-colgate
ControlRx® 5000 ppm F, 1.1% NaF Dentifrice Berry Flavor	Omni Oral Pharmaceuticals Gravette, AR www.omniipharma.com	(800) 445-3386
FluorideX® 1.1% NaF Toothpaste, pH 7.0 5000 ppm, approx. $6.00	Discus Dental Culver City, CA www.discusdental.com	(800) 422-9448
Pro-DentX® 1.1% NaF toothpaste, 5000 ppm, pH 7.0 Available in mint, bubble gum & redberry. Not sold retail, dental offices only.	Pro-Dentec Batesville, AK www.prodentec.com	(800) 228-5595

V. FLUORIDE MOUTHRINSES	MANUFACTURER	TELEPHONE
Fluorinse® 0.2% NaF rinse, 900 ppm, Alcohol-free.	Oral-B Laboratories Belmont, CA www.oralb.com	(800) 446-7252
Prevident® Dental Rinse 0.2% NaF rinse, 900 ppm 6% alcohol, pH 7.0 approx. $7.00	Colgate Oral Pharmaceuticals Canton, MA www.colgateprofessional.com	(800) 821-2880
CaviRinse® 0.2% Neutral NaF rinse, 900 ppm F Alcohol-free, mint flavored.	Omni Oral Pharmaceuticals Gravette, AR www.omniipharma.com	(800) 445-3386
Pro-DentX® 0.2% NaF Rinse, 900 ppm, pH 7.0 available in mint, redberry, cinnamon Not sold retail, dental offices only.	Pro-Dentec Batesville, AK www.prodentec.com	(800) 228-5595
*Reach Act® Mouthrinse alcohol free, 0.05% NaF 225 ppm, pH 5.8-6.6	Johnson and Johnson Skillman, NJ www.jnj.com	(800) 526-3967
*Oral-B® Anti-Cavity Rinse Alcohol free, 0.05% NaF 225 ppm, pH 7.0	Oral-B Laboratories Belmont, CA www.oralb.com	(800) 446-7252

* The 0.05 percent NaF rinses do not equally replace the daily use 1.0 – 1.1 percent NaF gels because of their much lower fluoride concentration (225 ppm F). If these low concentration rinses are used, they should be alcohol free such as the two listed. The 0.2 percent NaF rinses (900 ppm F) such as Prevident Rinse® are a better alternative if the patient will not use the 1.0 – 1.1 percent NaF gels, although more expensive.

** OTC fluoride rinses containing alcohol, such as Fluorigard®, are not recommended

*** The 0.63 percent SnF2 rinses such as Perio Med® or Gel-Kam Rinse® are not recommended because their fluoride concentration is low (dilute to 0.1% SnF2 =250 ppm F) and they are very acidic (pH -2.8 – 3.5).

**** The APF rinses such as Phos-Flur® are not recommended because of their acidic pH 4.0.

PRODUCTS FOR USE IN TREATING PATIENTS WITH XEROSTOMIA

VI. CHLORHEXIDINE MOUTHRINSES	MANUFACTURER	TELEPHONE
PerioGard® 0.12% Chlorhexidine Gluconate 11.6% alcohol, pH 5.0 – 7.0 approx. $8.00	Colgate Oral Pharmaceuticals, Inc Canton, MA www.colgateprofessional.com	(800) 2-COLGATE
Peridex® 0.12% Chlorhexidine Gluconate 11.6 % alcohol pH 5.0 – 7.0 $5.00 – $8.00 from Omni	Omni Oral Pharmaceuticals Gravette, AR www.omniipharma.com	(800) 445-3386
Chlorhexiguard® 0.12% Chlorhexidine Gluconate Oral Rinse — Suggested price of $11.00 from dental dealers	Pascal PO Box 1478 Bellevue, WA 98009-1478 www.pascaldental.com	(800) 426-8051
Pro-DentX® 0.12% Chlorhexidine rinse Not sold retail, dental offices only.	Pro-Dentec Batesville, AK www.prodentec.com	(800) 228-5595

VII. CHEWING GUMS and MINTS	MANUFACTURER	TELEPHONE
Koolerz® Primary sweetener is xylitol. Available in most drugstores and grocery stores.	Hershey Food Corporation Hershey, PA www.care-free.com	
Smint® Mints (Many Flavors) Primary sweetener is xylitol. Available at many drugstores and grocery stores.	Chupa Chups USA Atlanta, GA www.smint.com	
Trident® Gums TridentWhite® Trident for Kits® (Berry Bubble Gum) 12 piece pack approx. 89¢ Contain Recaldent® which is casein phosphopetide-amorphous calcium phosphate (can contribute to remineralization). Available in most drugstores and grocery stores.	Warner-Lambert Company Pfizer New York, NY www.tridentgum.com www.recaldent.com e-mail: geoff.webster@bonlac.com.au	
Xponent® Gum 100% xylitol sweetener	Global Sweet Polyols LLC Rehoboth MA www.globalsweetpolyols.com	(800) 601-0688
Biotene® Chewing gum Primary sweetener is xylitol. Available in many drugstores.	Laclede Research Laboratories Gardena, CA www.laclede.com	(800) 922-5856
B-Fresh® Gum Patented formula combining xylitol, calcium and vitamin B-12 0.72 g each piece (4-12 g/day)	Global Sweet Polyols LLC Rehoboth MA www.globalsweetpolyols.com	(800) 601-0688
Xylifresh® Gum xylitol sweetener $34.99 for 250 twin packs	Henry Schein Company Mellville, NY www.henryschein.com	(800) 372-4346
Xponent® Mints 100% xylitol sweetener	Global Sweet Polyols LLC Rehoboth MA www.globalsweetpolyols.com	(800) 601-0688

PRODUCTS FOR USE IN TREATING PATIENTS WITH XEROSTOMIA

VIII. MISCELLANEOUS PRODUCTS	MANUFACTURER	TELEPHONE
Salagen® Tablets (Pilocarpine HCl) 5 mg tab 1 – 2 tid 90 tabs — $144.69 ($.1.60/tab)	MGI Pharma Inc. Minneapolis,MN	(800) 562-0679
Evoxac® (Cevimeline HCl) 30 mg cap 1 – 2 tid 90 tabs — $135.69 ($.1.50/tab)	Daiichi Pharmaceuticals Montvale, NJ www.daiichius.com	(800) 374-5589
Pilocarpine Ophthalmic Solution 15 ml (4% solution — 40mg/ml) q.s. to 600 ml (1 mg/ml) 5 ml/tid — (approx. $0.16/5 ml)	Available from local pharmacies	
Biotene® Oralbalance® moisturizing gel Biotene® Mouthwash Alcohol-free, antibacterial, pH -5.0, no fluoride, can be swallowed to sooth the esophagus. Biotene® Dry mouth toothpaste Biotene® Antibacterial Chewing Gum	Laclede Research Laboratories Gardena, CA www.laclede.com	(800) 922-5856
Biotene Care Pak® Convenient travel size, about $7.00 Includes: Toothpaste .75 oz (1500 ppm Fl) Chewing Gum 2 pcs, Mouthwash 2fl. oz blt Oralbalance Moisturizing Gel .5 oz	also available online at www.dentaldepot.com ($4.77)	
Biotene Denture Grip® moisturizing gel, pH 5.7 enzymes, Aloe Vera, Hydrogenated Starch Hydrolysate (Hydroxyethylcellulose) 2.4 oz tube — About $7.00 at Walgreens, Eckerd, Revco	also available online at www.dentaldepot.com ($4.86)	
Revive® Remineralizing Gel 4.3 oz bottle, $CaPO_4$ saturated solution with 0.05% NaF, pH 6.4 Pharmacies or dental offices only. 24 bottles for approx. $ 68.00 plus shipping	Dental Resources Inc. Delano,MN www.dentalresourcesinc.com	(800) 328-1276
15 mL plastic centrifuge tubes	Corning Incorporated One Riverfront Plaza Corning NY, 14831-0001 www.corning.com	(607) 974-9000
Mouthguard Sheets 5" X 5" X 0.15" Ethylene Vinyl Acetate	Ultradent Products Inc. South Jordan, UT www.ultradent.com	(800) 552-5512

PRODUCTS FOR USE IN TREATING PATIENTS WITH XEROSTOMIA

IX. ANTIFUNGAL PRODUCTS

GENERIC	PROPRIETARY	DIRECTIONS
Clotrimazole cream	Lotrimin®, Mycelex® (1%)	Apply to affected area qid
Clotrimazole oral troches	Mycelex® Troches 10 mg	Dissolve intra-orally 5 times/day x 14 days
Fluconazole tablets*	Diflucan® (50,100,150,200 mg tabs 10, 40 mg/ml suspension)	6 mg/kg up to 200mg loading dose then 3 – 6mg/kg up to100 – 200 mg q d
Ketoconazole tablets**	Nizoral® 200 mg	200 – 400 mg q d
Ketoconazole cream	Nizoral® 2%	Apply to affected area qid
Miconazole cream, powder	Monistat® 2%	Apply to affected area qid
Nystatin cream, ointment, powder	Mycostatin® 100,000 units/cc 100,000 units/gram	Apply to affected area tid, qid
Nystatin solution 50% sucrose	Mycostatin® 100,000 units/ml	4 – 6 ml swish x 2 min and swallow qid
Nystatin pastilles	Mycostatin® 200,000 units	Dissolve 1 – 2 intra-orally 4 – 5 times per day for 14 days.

* Caution with drug interactions when using the azoles. Check drug reference.
** Not recommended because of the high sucrose content and need to use at least 4X day