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Management of dry mouth: assessment of oral symptoms after use of a polysaccharide-based oral rinse

Joel B. Epstein, DMD, MSD, FRCD(C), FDS RCS(Ed), Diplomate ABOM,[a] Dana C. Villines, MA,[b] Mabi Singh, DMD MS,[c] and Athena Papas, DMD, PhD[c]

Objective. Salivary dysfunction is associated with a range of oral/dental issues, and management of oral symptoms may improve oral function and overall quality of life. The purpose of this pilot study was to evaluate oral symptoms and function in a xerostomic population after use of a proprietary topical for dry mouth, Moisyn (Synedgen Inc., Claremont, CA), which is a polysaccharide-based product.

Study Design. A pre- and post-test survey was completed by 57 patients with xerostomia. Patients rated their common oral symptoms, based on the Vanderbilt Head and Neck Symptom Survey, before and after 1-week use of Moisyn rinse and spray. Saliva production under resting and chewing stimulation was also assessed.

Results. Most patients reported relief from dry mouth symptoms and thick saliva (81.7% and 76.0%, respectively) for more than 30 minutes after product use. Statistically significant reductions were found in 15 of 33 oral symptoms. Symptom improvement ranged from 10.7% to 28.4% for thick saliva, 8.4% to 30.6% for pain, 5.5% to 30.4% for dry mouth, and 12% to 21.3% for taste/diet change. Whole unstimulated/resting saliva improved by 100%, and whole stimulated saliva improved by 23.8%.

Conclusions. These findings suggest that the product has utility in symptom control in patients with xerostomia and may lead to an increase in saliva production. (Oral Surg Oral Med Oral Pathol Oral Radiol 2016;■:1-8)

Salivary dysfunction is associated with a range of oral/dental issues that affect quality of life and nutritional status, including risk of dental demineralization and caries, tooth sensitivity, mucosal infection, mucosal trauma, taste reduction, dysphagia, dysphonia, and difficulty wearing removable dental appliances.[1-10] Progressive dental disease and oral infection resulting from hyposalivation may lead to regional and potentially systemic infection, oral pain, and dysphagia, affecting oral intake and negatively impacting systemic health. The subjective sensation of dry mouth (also referred to as *xerostomia*) is assessed by patient report.[8] Treatment of symptomatic dry mouth ranges from use of topical agents to medical and surgical approaches. Limited data are available to support the use of many available topical agents that are proposed to increase wetting and lubrication of the oral mucosa.[11]

Moisyn (Synedgen Inc., Claremont, CA), a proprietary topical dry mouth oral rinse, has been designed to improve dry mouth symptoms by aiding moistening and lubrication of the mouth and by managing sticky (viscous) secretions (mucus). The study product is a formulation of ingredients, including sorbitol, glycerol, a preservative and humectant (betaine), and a patented polysaccharide chitosan derivative that has been shown by laboratory testing of oral cell toxicity to be non-cytotoxic, mucoadhesive (data on file, Synedgen Inc., Claremont, CA) and not produce irritation, sensitization, or other oral adverse events.

The purpose of this preliminary, patient reported outcomes study was to evaluate oral symptoms and function in a xerostomic population before and after short-term, daily use of Moisyn. We hypothesized that Moisyn would produce a reduction in symptoms, based on a 10-point scale, after 1 week of use.

MATERIALS AND METHODS

This was an open-label study that had a within-patients design to evaluate changes in oral symptoms after use of a product developed to provide relief for symptoms of dry mouth. Patients were recruited from one private practice and one academic center (Los Angeles, CA, and Boston, MA) based on self-reported symptoms of *dry mouth* (a term used in this paper interchangeably with *xerostomia*), autoimmune disorders, and chronic

Statement of Clinical Relevance

Loss of saliva affects oral/oropharyngeal health and function. Management is directed at treatment for functional loss and stimulation of residual function, when possible. We evaluated a polysaccharide-based oral agent developed to improve symptoms, signs, and impact oral function in patients with dry mouth.

Synedgen Inc. provided funding for this research and contributed to the protocol development. Data were analyzed and the manuscript prepared independently by the authors.

[a]Cedars-Sinai Health System, Los Angeles, CA, USA.
[b]Advocate Health Care, Department of Research, Chicago, IL, USA.
[c]Tufts University School of Dental Medicine, Boston, MA, USA.

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use of xerostomia medications, or use following cancer therapy. Inclusion criteria were age 18 years or greater and reporting a score of 3 or higher on a scale of 0 to 10 in response to the statement "I have dry mouth," with 0 representing no dry mouth. To broaden generalizability to the population, exclusion criteria were not established. Internal review board approval was obtained from the Western institutional review board before study initiation (WIRB #1158744).

All patients in the study completed the study. Eligible patients (n = 57) were asked to undergo a visual examination of the oral cavity by the investigator under standard dental light, complete a pretest paper survey, and provide saliva samples during a scheduled clinic visit. After meeting the inclusion criteria and completing the pretest procedures, patients received a 7-day supply of the trial product. Patients were provided verbal and written instruction packet for study product use. The administration included an 8-ounce bottle of rinse of the trial product for twice-daily mouth rinsing and a 2-ounce bottle of spray of the trial product to be used as needed. Patients reported on their use of the product as instructed and were not asked to return unused product. Patients returned for the post-test procedures in which oral examination, written survey, and salivary flow measurement were repeated, along with data capture of adverse events and product use/preference.

Pre- and post-test surveys

The pretest survey included basic demographic questions, medical diagnoses, medications used (both prescription and over-the-counter), and oral products used before the clinical trial. Both the pretest and the post-test surveys included oral symptoms based on the Vanderbilt Head and Neck Symptom Survey, which has been previously validated for use in patients with head and neck cancer[7,12] and utilized in a previous product trial in patients with autoimmune-mediated xerostomia.[13] Symptoms queried included problems with dry mouth, saliva, and thick/sticky mucus; difficulty eating and swallowing; oral sores; difficulty speaking and sleeping; pain; problems with taste; oral complications; problems with mouth and throat lining; and oral care issues. Ratings ranged from 0, representing absence of the problem, up to 10, representing the most severe degree of the problem. The post-test survey contained questions about pretest symptoms and additional questions about product use, such as ease of use, duration of relief, and willingness to use the product again.

Saliva collection

Whole unstimulated/resting saliva (WRS) was collected at rest, after no oral intake (no smoking or eating) for 1 hour, by expectorating saliva for 3 minutes into a preweighed cup. Then, whole stimulated saliva (WSS) was collected while chewing unflavored vinyl or paraffin wax and expectorating saliva for 3 minutes into a preweighed cup. Patients were instructed not to speak or swallow during both collections. Each collection was weighed, and total WRS and total WSS were calculated.

Table I. Participants' characteristics, comorbidities, and current medications

Participant Variable	*Value*
Age, years, mean ± SD	55.1 ± 15.7
Number of comorbidities, mean ± SD	2.3 ± 2.3
Number of prescription medications, mean ± SD	3.3 ± 4.2
Number of over-the-counter medications, mean ± SD	1.3 ± 1.7
Gender (female), n (%)	33 (57.9)
Current smoker, n (%)	7 (12.3)
Past smoker, n (%)	12 (21.1)
Most frequently reported comorbidities, n (%)	
Allergies	16 (28.1)
Acid reflux	14 (22.8)
Hypertension	14 (22.8)
Most frequently reported medications, n (%)	
Cholesterol medication	21 (33.3)
Blood pressure medication	19 (29.8)
Antidepressant	11 (17.5)
Pain reliever	12 (17.5)

Sample size/power analysis and data analyses

The primary outcome of interest was reduction of symptoms of dry mouth at post-test. Similar research[13] has found mean pretest to post-test dry mouth reduction of 0.42 (standard deviation [SD] = 0.80). The corresponding effect size for the mean difference is Cohen's $d = 0.47$. A sample size estimate to achieve a power of 0.80 with $\alpha = 0.05$, two-tailed, determined that 60 patients are required to detect this difference in the proposed study.

Patient characteristics, comorbid conditions, medication use, and investigational product use are reported as means ± SD for continuous variables and as percentages for dichotomous variables. Change between pre- and post-test scores and WRS/WSS were analyzed by using dependent samples t tests with mean differences and their corresponding standard deviations presented. Percentage of change from pre- to post-test was computed on the basis of the means for each measurement. Analysis was performed by using SPSS, version 22 (SPSS Inc., Chicago, IL), and statistical significance was determined at $P < .05$.

RESULTS

Patient characteristics, comorbid conditions, and medication use

Patient characteristics, along with current comorbid conditions and medication use, are shown in Table I.

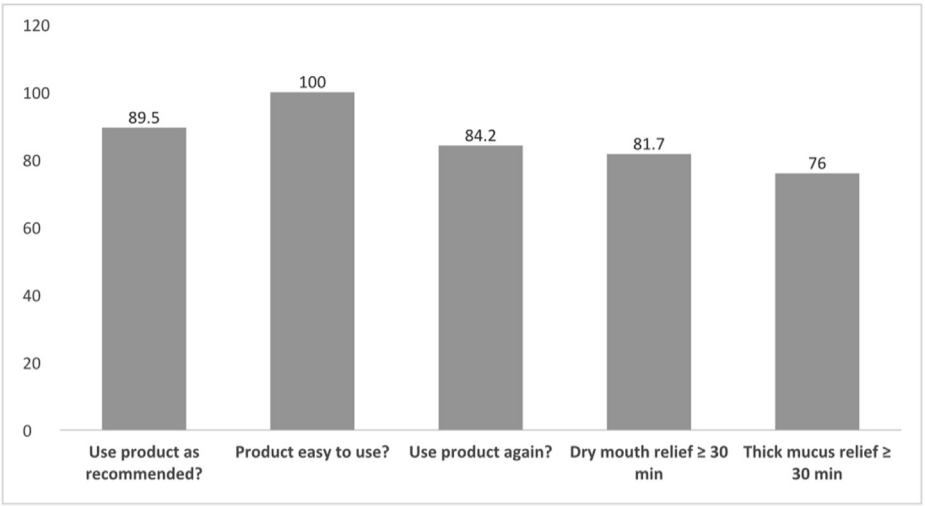

Fig. 1. Percentage of participants who responded 'yes' to product preference use and lasting relief.

The mean age of the sample was 55.1 ± 15.7, and 57.9% of the study participants were female. Smoking was reported by 12.3% of the patients. The mean number of oral care products used before the product trial was 3.3 ± 1.4 and the mean number of oral care products intended to treat xerostomia and other oral conditions was 1.0 ± 1.2 (data not shown). Oral care products included toothpaste, rinse, floss, spray, gum, lozenge, and gel, as well as an "other" category of oral products; oral care products intended to treat oral problems included a list of six lozenge, spray, and gel products that currently are commercially available.

The mean number of comorbid conditions reported by the patients was 2.3 ± 2.3 (see Table I). The three most frequently reported conditions were allergies (28.1%), acid reflux (22.8%), and hypertension (22.8%). The mean number of prescription medications reported was 3.3 ± 4.2. The most frequently reported medications used were cholesterol medications (33.3%), blood pressure medications (29.8%), and pain relievers and antidepressants (17.5% each). Use of xerostomia-inducing medications (blood pressure medications, pain relievers, and antidepressants) were reported by 54.1% of the sample.

Product use and product characteristics

The majority of the sample reported to have used the trial products as recommended in the instruction packet (89.5%). All the study patients (100%) rated the products as easy to use; and 84.2% reported they would use the products again (Figure 1). Patients were asked to report if they experienced specific side effects, and each of the following were experienced by 1.8% of patients (n = 1 for each): Dysgeusia, inflammation, and numbness of throat (data not shown). No patients reported oral bleeding or loss of taste. The majority of patients experienced relief of dry mouth symptoms and thick mucus for more than 30 minutes after product use (81.7% and 76%, respectively).

Properties of the products were rated on a scale of 0 to 10, (0 representing the poorest score and 10 the best, unless otherwise specified), as follows (Figure 2): Flavor (x = 7.8 ± 2.0), lubrication/mouth feel (x = 7.4 ± 2.0), texture (x = 7.8 ± 2.1), soothing relief (x = 6.7 ± 2.3), adequacy of mouth wetting (x = 6.8 ± 2.2), effectiveness on throat dryness (x = 6.4 ± 2.8), effectiveness at night for dry mouth (x = 6.1 ± 2.5) and thick mucus (x = 5.8 ± 3.0), and stinging or burning with use (0 represents none; x = 1.8 ± 2.8).

Pre- and post-test oral symptom and saliva changes

Patients reported multiple pre-and post-test oral symptoms on a scale of 0 to 10 (0 representing no problem with the symptom and 10 representing the most severe degree of the problem). Symptoms were grouped as problems with saliva, pain, dry mouth, and taste/diet changes, with statistically significant reductions in 15 of the 33 symptoms (Table II). At pretest, the highest rated symptoms involved problems with dry mouth (x = 7.2 ± 1.9). Data are not shown for the following symptoms: use of liquid supplements to maintain weight, trouble maintaining weight as a result of swallowing problems, trouble eating certain solid foods, great effort required to swallow as a result of dry mouth, teeth sensitive to hot/cold/sweet foods, trouble with dentures, burning sensation in the lining of the mouth and throat, lining of mouth and throat sensitive to dryness, and burning pain in the lining of the mouth and throat preventing brushing of

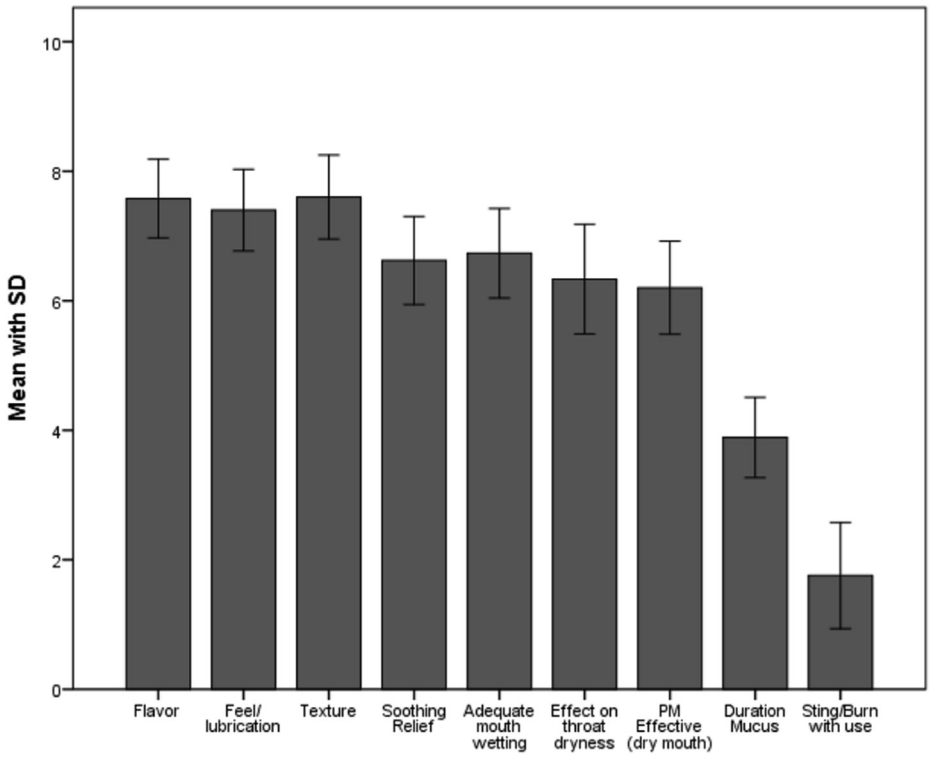

Fig. 2. Mean ratings of product properties. Scores are on a scale of 0 to 10 with 10 representing the highest preference, with the exception of "sting/burn with use" for which 10 represents the most severe degree of the problem.

teeth. Symptom reductions for these variables were not statistically significant; therefore, for the sake of brevity, there are not displayed.

Reported problems with thick saliva were moderate based on pretest reporting, and three of the five symptoms related to thick saliva had statistically significant reductions at post-test (see Table II). The largest symptom reductions in this grouping were those involving thick saliva affecting sleep (mean difference = 0.95 ± 2.81; $P = .02$) and thick saliva affecting diet choices (mean difference = 0.93 ± 2.53; $P = .01$). Thick saliva affecting reported ability to swallow also had a statistically significant reduction (mean difference = 0.71 ± 2.43; $P = .04$).

Overall, responses related to pain were fairly low at pretest, suggesting that in this patient population, dry mouth was not contributing greatly to oral pain. However, two of the six symptoms showed statistically significant reduction from pre- to post-test (see Table II): worst oral pain over the prior week (mean difference = 0.84 ± 2.12; $P = .01$) and pain causing difficulty sleeping (mean difference = 0.67 ± 1.95; $P = .01$).

Reduction in symptoms of xerostomia that specifically resulted from oral dryness is shown in Table II. Statistically significant reductions in symptoms were reported in five of the seven symptoms in this category. The symptom "food getting stuck in the throat because of mouth dryness" showed the largest reduction for this group (mean difference = 1.11 ± 2.21; $P < .01$) compared with "food getting stuck in the mouth because of mouth dryness" (mean difference = 0.64 ± 2.31; $P = .04$). Statistically significant symptom reduction also occurred in reported difficulty taking medications as a result of dry mouth (mean difference = 0.97 ± 2.09; $P < .01$) and in great effort required to swallow because of dry mouth (mean difference = 0.66 ± 2.14; $P = .03$). Problems with dry mouth making chewing and swallowing difficult (mean difference = 0.84 ± 2.58; $P = .02$) and problems with dry mouth affecting sleep (mean difference = 0.75 ± 2.78; $P = .05$) also had statistically significant reductions.

Product use resulted in a statistically significant reduction in four of the six symptoms of taste/diet changes (see Table II). Symptom reduction occurred for taste being altered or reduced (mean difference = 0.53 ± 1.58, $P = .02$) as well as for altering food choices (mean difference = 0.76 ± 1.90; $P < .01$) and less desire to eat because of taste changes (mean difference = 0.65 ± 1.72; $P = .01$). Similarly, decrease in the amount of food eaten because of taste change was reduced at post-test (mean difference = 0.53 ± 1.61; $P = .02$).

WRS and WSS values also were examined for pre- to post-test changes (see Table II). WRS showed a

Table II. Pre- and post- product use symptom relief and saliva measurements

	Pretest	*Post-test*	*Difference*	*Change %age (pre- to post-test)*	P *value*
Thick saliva					
Saliva thickness affects diet choices	3.27 ± 3.37	2.35 ± 3.01	0.93 ± 2.53	28.4%	.01
Saliva thickness affects sleep	3.44 ± 3.20	2.49 ± 2.64	0.95 ± 2.81	27.6%	.02
Saliva thickness affects ability to swallow	3.51 ± 3.13	2.80 ± 2.75	0.71 ± 2.43	20.2%	.04
Thick saliva (mucous or phlegm)	4.56 ± 3.29	4.07 ± 3.30	0.49 ± 2.48	10.7%	.15
Saliva thickness affects speech	3.16 ± 3.05	2.78 ± 2.93	0.38 ± 2.54	12.0%	.27
Pain					
Pain causes difficulty sleeping	2.19 ± 2.76	1.53 ± 2.65	0.67 ± 1.95	30.6%	.01
Worst mouth pain level over the last week	3.09 ± 3.40	2.25 ± 3.05	0.84 ± 2.12	27.1%	.01
Average Mouth pain level over the last week	2.61 ± 2.83	2.14 ± 2.83	0.46 ± 1.89	17.6%	.07
Mouth or throat pain causes difficulty swallowing	2.30 ± 2.88	2.09 ± 2.91	0.25 ± 1.93	10.9%	.34
Mouth or throat pain causes difficulty speaking	2.51 ± 2.77	2.26 ± 3.05	0.21 ± 1.91	8.4%	.41
Painful sores in mouth or throat	2.23 ± 3.05	2.02 ± 2.88	0.21 ± 2.16	9.4%	.46
Dry mouth					
Food gets stuck in throat because of mouth dryness	4.29 ± 3.13	3.18 ± 3.10	1.11 ± 2.21	25.9%	<.001
Hard to take medications because of dry mouth	3.19 ± 3.11	2.23 ± 3.00	0.97 ± 2.09	30.4%	.001
Problems with dry mouth make chewing/swallowing hard	5.36 ± 3.00	4.52 ± 2.94	0.84 ± 2.58	15.7%	.02
Great effort to swallow because of dry mouth	4.16 ± 3.04	3.50 ± 2.96	0.66 ± 2.14	15.9%	.03
Food gets stuck in mouth because of mouth dryness	4.64 ± 3.27	4.00 ± 3.23	0.64 ± 2.31	13.8%	.04
Problems with dry mouth affecting ability to sleep	4.88 ± 2.82	4.12 ± 3.04	0.75 ± 2.78	15.4%	.05
Problems with dry mouth affecting ability to talk	4.85 ± 2.79	4.35 ± 3.00	0.50 ± 2.35	10.3%	.12
Problems with dry mouth	7.21 ± 1.90	6.81 ± 2.39	0.40 ± 1.91	5.5%	.12
Taste/Diet changes					
Chosen foods to eat altered because of taste changes	3.56 ± 3.65	2.80 ± 3.42	0.76 ± 1.90	21.3%	.004
Less desire to eat because of taste change	3.44 ± 3.51	2.79 ± 3.33	0.65 ± 1.72	18.9%	.01
Taste is altered or reduced	4.42 ± 3.56	3.89 ± 3.52	0.53 ± 1.58	12.0%	.02
Decrease in food eaten because of taste changes	3.23 ± 3.61	2.70 ± 3.52	0.53 ± 1.61	16.4%	.02
Lining of mouth/throat is sensitive to spicy/hot/acidic foods	4.12 ± 4.01	3.61 ± 3.60	0.51 ± 2.12	12.4%	.08
Burning pain in the lining of mouth/throat changes food choices	2.67 ± 3.38	2.25 ± 3.25	0.42 ± 2.66	15.7%	.24
Saliva measurements (mg/min)					
Whole unstimulated/resting saliva	0.28 ± 0.36	0.44 ± 0.58	0.16 ± 0.33	100%	.001
Whole stimulated saliva	1.05 ± 0.95	1.30 ± 1.40	0.25 ± 1.21	23.8%	.13

Note: Scores are on a scale of 0 to 10, with 10 representing the most severe degree of the problem. Pretest, post-test, and difference scores are represented as mean ± standard deviation (SD). Positive mean differences and change %age represent an improvement in symptoms at post-test after using the investigational product(s).

statistically significant increase at post-test (mean difference = 0.16 mg/min ± 0.33; $P = .001$). Similarly, WSS showed an increase at post-test, but this was not statistically significant (mean difference = 0.25 mg/min ± 1.21; $P = .13$).

Saliva stratification between-group differences for symptom change

For a more thorough examination of specific patient subgroups with thick saliva problems, patients were stratified into two groups based on whether they reported "less severe" (0-4; n = 24) or "more severe" (5-10; n = 33) problems for "thick saliva" at pretest. Difference scores (i.e., pretest minus post-test) were calculated for the pre- to post-test symptom change. Only symptoms with a between-group differences 1-point or greater change are shown in Table III (more severe group − less severe group). All between-group comparisons with less than 1-point of change between groups were not statistically significant.

The more severe group and the less severe group had statistically significant differences with regard to the following symptoms: problems with dry mouth making chewing/swallowing hard, dry mouth affecting ability to sleep, problems with thick saliva, saliva thickness affecting sleep, saliva thickness affecting ability to swallow, saliva thickness affecting diet choices, food getting stuck in the throat because of mouth dryness, and great effort required to swallow because of dry mouth. For these symptoms, the less severe group's pre- to post-test changes were not modified greatly with the use of the product and varied from slightly worse to slightly better (difference score range: −0.54 to 0.33). In contrast, the more severe group experienced more changes in symptoms associated with thick saliva from pre- to post-test (see Table III; difference score range: 1.13-1.77, P value range: .002-.07).

DISCUSSION

A recent publication discussed development criteria for products and strategies for treatments for hyposalivation and xerostomia[14] to guide ongoing development of products for management. The present pilot study addresses many of the recommendations in the guideline paper for product development and clinical documentation of the effectiveness of products to treat dry mouth.

The study population included in this trial was a mixed population that met the entry criteria of self-reported dry mouth; of these patients, 73.8% had systemic conditions affecting saliva function, 54.1% were using xerostomia-inducing medication, and 11.5% were experiencing dry mouth after cancer therapy (some patients had more than one etiologic risk factor). Recruitment for this study did not target a specific patient population with conditions/causes leading to the dry mouth diagnosis. Instead, a broad range of self-reported medical conditions and medications associated with dry mouth and other oral side effects were captured in this study, suggesting that findings could be generalized to a larger population seeking relief from these symptoms.

In this within-subject preliminary study, we examined patient-reported changes in oral symptoms as well as patient product evaluation after a 7-day trial with Moisyn oral rinse and spray. Rinsing was performed in the morning and before bed, with the spray used during the day as needed. This twice-daily use is convenient, and overall, the patients reported favorable ratings of the product, with all of the patients reporting that the products were easy to use and 84.2% stating that they would use the product again. Product characteristics, including flavor, lubrication, texture, relief, mouth wetting, and effect on dry throat, were rated as good.

Symptom reduction was seen at a statistically significant level in about 45% of the oral symptoms surveyed in this study. Key symptoms that align with the product's intended outcomes showed statistically significant improvements. In this study, we found both positive symptom reductions and product preference, which may ultimately have had a cumulative impact on increased compliance. Although specific symptom reduction may be necessary for a patient to use the product as recommended, symptom relief alone may not be sufficient for compliance, and product preference may have a key role in compliance. The excellent compliance reported in this trial could have resulted from a combination of improved symptoms and factors reported as favorable product features (easy to use, taste, etc.).

Symptoms were grouped into four major categories in this study: thick saliva, pain, dry mouth, and taste/food changes. Symptoms improved in each category, but no single category showed statistical improvement in all symptoms. The improvements represented symptom decrease from pretest to post-test and ranged from 10.7% to 28.4% for thick saliva symptoms, 8.4% to 30.6% for pain symptoms, 5.5% to 30.4% for dry mouth symptoms, and 12% to 21.3% for taste/diet change symptoms.

Impairment in daily life related to thick saliva was affected by product use, although the product did not statistically reduce the reported thickness of saliva. The improvements included reductions in dietary restrictions as a result of thick saliva, thick saliva affecting the ability to sleep, and thick saliva affecting the ability to swallow food and medications. These scores represent reductions from pre- to post-test of 28.4%, 27.6%, and 20.2%, respectively (see Table II).

Table III. Between-group differences for selected change scores based on "thick saliva" stratification

	Less severe N = 24		*More severe N = 33*		
	Mean ± SD	*Change %age*	*Mean ± SD*	*Change %age*	P *value*
DIFF great effort to swallow because of dry mouth	−0.33 ± 2.22	−12%	1.41 ± 1.78	27.0%	.002
DIFF thick saliva (mucus or phlegm)	−0.54 ± 2.40	−22.5%	1.29 ± 2.27	18.3%	.005
DIFF saliva thickness is affecting ability to swallow	−0.21 ± 1.79	−14.4%	1.42 ± 2.64	27.8%	.009
DIFF saliva thickness is affecting my diet choices	0.04 ± 0.86	3.5%	1.61 ± 3.14	32.6%	.01
DIFF food gets stuck in throat because of mouth dryness	0.25 ± 1.89	9.2%	1.77 ± 2.23	32.1%	.01
DIFF problems with dry mouth make chewing/ swallowing hard	−0.04 ± 2.79	−9.0%	1.50 ± 2.23	24.8%	.03
DIFF problems with dry mouth affect ability to sleep	−0.25 ± 3.04	−6.3%	1.48 ± 2.36	26.8%	.03
DIFF food gets stuck in mouth because of dryness	0.00 ± 1.82	0%	1.13 ± 2.54	20.1%	.07
DIFF saliva thickness is affecting my sleep	0.33 ± 1.71	22%	1.42 ± 3.38	28.7%	.13

Note: Change scores represent pretest score minus post-test score, and stratification of "thick saliva" at pretest was defined as: Less severe = 0-4; more severe = 5-10. Difference scores (DIFF) are represented as mean ± standard deviation (SD). Positive mean differences and change %age represent an improvement in symptoms at post-test after using the investigational product(s).

Improved management of dysphagia may affect diet and potentially reduce the risk of aspiration, which may be impactful in general health outcomes. When stratified by thick saliva severity, some symptoms showed marked improvement for the more severe group (symptom $\geq$5) in comparison with the less severe group (see Table III), indicating that patients with more severe symptoms associated with increased saliva viscosity may benefit the most from product use. For example, the less severe group had little relief from dry mouth making chewing/ swallowing hard and food getting stuck in the mouth because of dryness (−0.9% and 0%, respectively), whereas the more severe group reported improvement by 24.6% and 20.2%, respectively. Similarly, food reported sticking in the throat as a result of dryness improved more than three times in the severe group (32.2%) than in the less severe group (9.2%).

Pain ratings were minimal before product use, and consequently minimal changes were seen in this category of symptoms. However, mouth pain affecting sleep and the worst oral pain experienced over the prior week were significantly less severe with use of the test product. Pain affecting sleep showed a 30.6% symptom reduction, and worst pain experienced showed a 27.1% reduction from pre- to post-test. Given that pain was not a complaint at the start of the trial, it makes sense that the broad symptom of "worst pain" and that affecting sleep might show some impact, but the specific symptoms relating to pain in daily life were hardly impacted as they were minimal even before product use.

Similar to the symptom of thick saliva, dry mouth associated issues showed statistically significant improvements, although the general symptom reported (i.e., dry mouth) did not show statistically significant improvement. A positive impact was observed in dysphagia, with improved swallowing associated with reductions in dry mouth affecting chewing/swallowing (15.7% reduction; see Table II), food getting stuck in the throat (25.9% reduction), difficulty swallowing medications (30.4% reduction), and dry mouth affecting sleep (15.4% reduction). To our knowledge, this is the first report of an oral product impacting swallowing (as self-reported by patients with dry mouth). Taste and diet changes also showed significant improvements. Restrictions in the amount and types of foods had statistically significant reductions after trial product use, whereas a decreased desire to eat before trial product use was reversed after product use. Symptom reductions from pre- to post-test for these were 16.4%, 21.3%, and 18.9%, respectively. These findings, taken together with those previously mentioned, indicate an improvement in daily activities that are of importance to overall health: sleeping and eating.

This study also included objective (saliva collection) as well as subjective (symptom self-report) measures. The trial product had a statistical impact on WRS but

not on WSS. WRS improved by 100%, and WSS improved by 23.8%. Increase in WRS is a positive finding, given the topical delivery of the product, and may relate to stimulation by the taste or texture of the product. The mechanism of action is not known, but if supported by continuing research, it represents an important finding in the management of patients with hyposalivation. Earlier studies of another mouth-wetting agent did not show change in saliva production.[5,15] Increase in saliva was reported in a trial of another oral rinse product.[16] The potential of Moisyn to allow release of resting saliva, in addition to the inherent surface wetting quality of the topical product, is of interest and may have a significant impact on quality of life and oral health.

The protocol of twice-daily rinsing and use of the oral spray as needed during the day led to high compliance with use of the product and was reported as an easy-to-follow protocol by patients. Relief of key symptoms observed included reduction in problems with sticky mucus and dry mouth and those that affect sleeping and eating. This study did not explore if increased frequency or duration of use of the oral rinse leads to increased duration of effect and effect size on dry mouth symptoms; consequently, a controlled study of longer duration of use is indicated, given the positive results of this short-term trial of Moisyn.

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Reprint requests:

Joel B. Epstein, DMD, MSD, FRCD(C), FDS RCS(Ed)
Diplomate ABOM
8500 Wilshire Blvd
Suite 800
Beverly Hills
CA 91012
USA
Joel_epstein@hotmail.com