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Immediate Effect of Xylitol Chewing Gum and Mouth Rinse on Salivary Levels of Mutans Streptococci in Adults with Systemic Sclerosis: A Pilot Study

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Abstract

Objective—To compare the immediate effect of xylitol chewing gum and xylitol mouth rinse on mutans streptococci (MS) levels in the saliva of adults with systemic sclerosis (SSc).

Methods—Thirteen female adults with SSc were assigned randomly to either the xylitol chewing gum or xylitol mouth rinse groups. Participants in the chewing gum group were given 2 pellets (2.12g) of commercial xylitol chewing gum to chew for 10 min; whereas participants in the mouth rinse group were given 10 ml (10% [w/v]) of xylitol solution to rinse orally for 2 min. MS samples were collected using *Dentocult*[®] *SM Strip mutans* before and after xylitol exposure.

Results—No significant difference in the change scores of MS levels between the two groups was observed at post xylitol exposure.

Conclusions—Mouth rinse may provide an alternative mode of xylitol delivery for this population.

Keywords

systemic sclerosis; xylitol; mutans streptococci

Introduction

Systemic sclerosis (SSc) belongs to a group of autoimmune connective tissue disorders, which are characterized by inflammation and excessive fibrosis of connective tissue [1]. SSc affects the oral and peri-oral tissues as well as skin and musculoskeletal tissue on the hands.

Conflicts of Interest: The authors declare that they have no conflict of interest.

Orofacial complications (microstomia and xerostomia), and manual dexterity impairments (loss of finger pad tissue, digital ulcers, and hand deformity) are two major clinical manifestations that may interfere with normal oral hygiene and contribute to increase risk of oral health problems in people with SSc [2,3]. Compared to sex-matched healthy controls, a higher proportion of people with SSc exhibited more dental caries experience, and periodontal disease [4,5]. With a high risk of dental disease in this population, plaque removal from tooth surfaces through regular oral self-care is essential.

Xylitol, a naturally occurring sugar alcohol sweetener, has been shown to decrease mutans streptococci (MS) levels, plaque formation, and the incidence of caries [6-10]. Although xylitol chewing gum has shown promise as an anticariogenic agent it may not be practical for people with SSc. A large proportion of people with SSc suffer from conditions such as osteolysis, temporomandibular disorders, and trigeminal neuropathy, which can lead to facial pain during prolonged repetitive movements such as chewing gum [4,5,11,12]. In this patient population, an aqueous form of xylitol, such as a mouth rinse, may be a useful alternative delivery system. In addition to reduced preparation costs, an oral xylitol solution that is expectorated may circumvent gastrointestinal complaints such as diarrhea in people who are less tolerant to high doses of xylitol [13]. The objective of this study is to compare the immediate effect of xylitol chewing gum and xylitol mouth rinse on MS levels in the saliva of adults with SSc.

Materials and Methods

Participants

A convenience sample of 13 adults with SSc was drawn from a pool of patients who had participated in the first author's oral health epidemiological study at the Medical University of South Carolina (MUSC). To be eligible for the study, adults had a diagnosis of SSc and their diagnosis fulfilled the American College of Rheumatology preliminary classification criteria for SSc [14], at least 20 natural teeth, and were older than 18 years of age. The exclusion criteria were localized scleroderma (e.g. morphea, linear scleroderma, and en coup de sabre), or complaint of jaw joint pain during chewing.

Procedures

One to two days before the study appointment, potential participants were contacted by phone and instructed to refrain from performing any oral self-care procedures or using chewing gum the morning before the appointment and to refrain from smoking, eating, or drinking (except water) two hours immediately prior to the appointment. The study was conducted in a research laboratory at MUSC. A written, informed consent was obtained from all participants before initiation of the study protocol. The protocol was approved by the Institutional Review Board at the MUSC. The study employed a randomized comparative trial design.

Treatment protocol and sample collection

At the research laboratory, participants were instructed to rinse their mouth with distilled water for 20 seconds, and then to swallow any excess saliva. As per the supplied manufacturer's protocol, a trained dental student (J.D.) pressed the rough surface of a *Dentocult® SM Strip mutans* (Orion Diagnostica) on the participant's tongue to collect MS, and removed the strip gently through the participant's closed lips. This served as the baseline data of the MS sample collection.

After baseline MS data collection, participants were assigned randomly to either the xylitol chewing gum or xylitol mouth rinse groups. Participants were given either 2 pellets of

commercial xylitol chewing gum (Epic, each pellet contained 1.06 g of xylitol) to chew for 10 min (chewing gum group) or 10 ml of xylitol solution (10 ml of water containing 1 g of dissolved xylitol, 10% [w/v], prepared by a pharmacist) to rinse mouth for 2 min (mouth rinse group). Lif Holgerson et al. [15] has shown that administration of 1.32 g of xylitol chewing gum for 5 min or 1.0 g of dissolved xylitol mouth rinse for 2 min produced a similar level of xylitol in the saliva at 8-16 min after intake. In addition, previous studies have demonstrated that MS growth is significantly inhibited at a xylitol concentration of 1.56%, while xylitol concentrations of 12.5% or higher were required to inhibit the growth of other oral streptococci such as *Streptococcus salivarius* and *Streptococcus sanguis* [16]. Therefore, the dosing schedule employed in this study was expected to inhibit the growth of MS when delivered and released within the oral cavity.

For participants in the chewing gum group, they were instructed to remove the gum from their mouth at the end of the 10 min. Whereas for participants in the mouth rinse group, they were instructed to expectorate the rinse at the end of the 2 min. The dental student then collected the second MS sample using *Dentocult*® *SM Strip mutans* as described above. The participant then waited for 25 min without consuming any food or liquid. During the waiting period, the participant completed a short oral health questionnaire and the dental student provided oral health information related to SSc to the participant. At the end of the 25 min, the dental student collected the third MS sample using the *Dentocult*® *SM Strip mutans*. Relevant oral health information of the participants was also obtained from the oral health epidemiological study.

For consistency, the same trained dental student, familiar with the procedure and the test kit, performed the testing and scoring of all MS samples. MS testing and scoring procedures were performed according to the manufacturer's instructions [17]. The density of MS growth was measured by colony forming unit (CFU) ml⁻¹ and the results were categorized using the *Dentocult*® *SM Strip mutans* scale provided by the manufacturer. Score 0 = <10⁴ CFU ml⁻¹; Score 1 = <10⁵ CFU ml⁻¹; Score 2 = 10⁵-10⁶ CFU ml⁻¹; Score 3 = >10⁶ CFU ml⁻¹. The dental student recorded the level of MS and then took images of all strips using a digital camera (Sony Cyber-shot DSC-W170 with 10.1 megapixels resolution). A microbiologist (C.W.), blinded to the participant's group assignment as well as the sequence of the strips, evaluated the strip images. An inter-rater agreement between the dental student and the microbiologist on evaluating the MS levels using Cohen's Kappa statistics was 0.87, which is considered to be excellent [18].

Results

All 13 participants were female of whom two were Black, and 11 were White. Two participants were diagnosed with diffuse cutaneous scleroderma, and 11 with limited cutaneous scleroderma. Their mean (±SD) age was 54.46±16.29 years old, ranging from 32 to 77 years old. The mean (±SD) years of diagnosis with SSc was 13.46±12.57 ranging from 1 to 41. All but one participant reported having symptoms of mouth dryness and gastroesophageal reflux. Characteristics of the 13 participants in each group are shown in Table 1.

We tested the hypotheses of whether there was significant difference in MS levels between the two groups (chewing gum and mouth rinse) on (a) change in score from baseline to post 10 min chewing xylitol gum / 2 min xylitol mouth rinsing, and (b) change in score from baseline to 25 min post xylitol exposure. We used nonparametric Mann-Whitney U test with exact p-values to test the hypotheses between groups. No significant difference in MS score between the two groups was observed in each time interval at the 5% level of significance. No adverse effects were reported at the end of the 25 min from either group.

Discussion

Based on the findings, it appears the effect of xylitol chewing gum on total MS levels in saliva does not differ from that of xylitol mouth rinse. These findings are consistent with the literature on no significant difference between xylitol chewing gum and xylitol mouth rinse for 3 months of daily exposure on MS levels [19]. The lack of significance observed in each time interval between the groups for the MS scores and no adverse effects were reported after xylitol exposure may indicate that the mouth rinse can be an alternative safe mode of xylitol exposure in the mouth cavity for adults with SSc [20]. Further study may increase the dosage as well as frequency and duration of xylitol mouth rinse exposure to determine the optimal regimen to inhibit the growth of MS in the oral cavity.

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References

1. Steen VD. Clinical manifestations of systemic sclerosis. *Semin Cutan Med Surg.* 1998; 17:48–54. [PubMed: 9512107]
2. Poole JL, Brewer C, Rossie K, Good CC, Conte C, Steen V. Factors related to oral hygiene in persons with scleroderma. *Int J Dent Hyg.* 2005; 3:13–7. [PubMed: 16451372]
3. Poole J, Conte C, Brewer C, Good CC, Perella D, Rossie KM, Steen V. Oral hygiene in scleroderma: The effectiveness of a multi-disciplinary intervention program. *Disabil Rehabil.* 2010; 32:379–84. [PubMed: 19852714]
4. Scardina GA, Messina P. Systemic sclerosis: description and diagnostic role of the oral phenomena. *Gen Dent.* 2004; 52:42–7. [PubMed: 15055670]
5. Wood RE, Lee P. Analysis of the oral manifestations of systemic sclerosis (scleroderma). *Oral Surg Oral Med Oral Pathol.* 1988; 65:172–8. [PubMed: 3422721]
6. Ly KA, Milgrom P, Roberts MC, Yamaguchi DK, Rothen M, Mueller G. Linear response of mutans streptococci to increasing frequency of xylitol chewing gum use: a randomized controlled trial [ISRCTN43479664]. *BMC Oral Health.* 2006; 6:6. [PubMed: 16556326]
7. Deshpande A, Jadad AR. The impact of polyol-containing chewing gums on dental caries: a systematic review of original randomized controlled trials and observational studies. *J Am Dent Assoc.* 2008; 139:1602–14. [PubMed: 19047666]
8. Makinen KK, Makinen PL, Pape HR Jr, Allen P, Bennett CA, Isokangas PJ, Isotupa KP. Stabilisation of rampant caries: polyol gums and arrest of dentine caries in two long-term cohort studies in young subjects. *Int Dent J.* 1995; 45:93–107. [PubMed: 7607749]
9. Simons D, Brailsford SR, Kidd EA, Beighton D. The effect of medicated chewing gums on oral health in frail older people: a 1-year clinical trial. *J Am Geriatr Soc.* 2002; 50:1348–53. [PubMed: 12164990]
10. Ly KA, Milgrom P, Rothen M. Xylitol, sweeteners, and dental caries. *Pediatr Dent.* 2006; 28:154–63. discussion 92–8. [PubMed: 16708791]
11. Farrell DA, Medsger TA Jr. Trigeminal neuropathy in progressive systemic sclerosis. *Am J Med.* 1982; 73:57–62. [PubMed: 7091174]
12. Rout PG, Hamburger J, Potts AJ. Orofacial radiological manifestations of systemic sclerosis. *Dentomaxillofac Radiol.* 1996; 25:193–6. [PubMed: 9084272]
13. Oku T, Nakamura S. Threshold for transitory diarrhea induced by ingestion of xylitol and lactitol in young male and female adults. *J Nutr Sci Vitaminol (Tokyo).* 2007; 53:13–20. [PubMed: 17484374]

14. Preliminary criteria for the classification of systemic sclerosis (scleroderma). Subcommittee for scleroderma criteria of the American Rheumatism Association Diagnostic and Therapeutic Criteria Committee. *Arthritis Rheum.* 1980; 23:581–90. [PubMed: 7378088]
15. Lif Holgerson P, Stecksén-Blicks C, Sjöström I, Öberg M, Twetman S. Xylitol concentration in saliva and dental plaque after use of various xylitol-containing products. *Caries Res.* 2006; 40:393–7. [PubMed: 16946607]
16. Sahni PS, Gillespie MJ, Botto RW, Otsuka AS. In vitro testing of xylitol as an anticariogenic agent. *Gen Dent.* 2002; 50:340–3. [PubMed: 12640850]
17. Jensen B, Bratthall D. A new method for the estimation of mutans streptococci in human saliva. *J Dent Res.* 1989; 68:468–71. [PubMed: 2921389]
18. Fleiss, JL. Statistical methods for rates and proportions. New York: John Wiley & Sons; 1981.
19. Hildebrandt G, Lee I, Hodges J. Oral mutans streptococci levels following use of a xylitol mouth rinse: a double-blind, randomized, controlled clinical trial. *Spec Care Dentist.* 2010; 30:53–8. [PubMed: 20415801]
20. Ship JA, McCutcheon JA, Spivakovsky S, Kerr AR. Safety and effectiveness of topical dry mouth products containing olive oil, betaine, and xylitol in reducing xerostomia for polypharmacy-induced dry mouth. *J Oral Rehabil.* 2007; 34:724–32. [PubMed: 17824884]

Table 1

Characteristics of the Participants and Changes in Salivary MS levels

Variable	Chewing Gum Group (n ₁ =6)	Mouth Rinse Group (n ₂ =7)	P value
Age - yr	51.00±16.05	57.43±17.15	0.53
SSc duration - yr	15.17±12.09	12.00±13.74	0.63
MS score [‡] at baseline	0.83±1.17	1.71±1.25	0.30
Type of SSc			
Diffuse cutaneous scleroderma	1	1	1.00
Limited cutaneous scleroderma	5	6	
Race			
Black	1	1	1.00
White	5	6	
Changes from Baseline (mean±SD)			
MS score [‡]			
10 min chewing gum/2 min mouth rinsing	0.67±0.82	0.00±0.82	0.18
25 min post xylitol exposure	0.33±1.03	-0.14±0.69	0.45

Note.

[‡]Score 0 = <10⁴ CFU ml⁻¹; Score 1 = <10⁵ CFU ml⁻¹; Score 2 = 10⁵-10⁶ CFU ml⁻¹; Score 3 = >10⁶ CFU ml⁻¹.