

Effects of carboxymethylcellulose (CMC)-based artificial saliva in patients with xerostomia

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Abstract. The purpose of this study was to investigate the effects of carboxymethylcellulose (CMC)-based artificial saliva according to residual secretory potency, assessed by the salivary flow rate in patients with dry mouth. Fifty patients (6 men and 44 women, 57.8 ± 13.2 year of age) with a chief complaint of dry mouth were asked a standardized series of questions regarding dry mouth-related symptoms and behaviors. Whole salivary flow rates were measured under unstimulated and stimulated conditions. After using CMC-based artificial saliva for 2 weeks, each patient completed the same questionnaire. Use of the artificial saliva decreased the severity of ‘oral dryness at night or on awakening’, ‘oral dryness at other times of the day’, and ‘the effect of oral dryness on daily life’ ($P < 0.05$). Patients with an undetectable flow rate of stimulated whole saliva responded better on ‘oral dryness during eating’ compared with the other patients ($P < 0.05$). The use of CMC-based artificial saliva also improved dry mouth-related behaviors, especially ‘awakening from sleep at night because of oral dryness’. In conclusion, CMC-based artificial saliva demonstrated moderate effects in reducing dry mouth-related symptoms and behaviors with more significant effects appearing in patients whose residual secretory potency was severely compromised.

Keywords: dry mouth; artificial saliva; carboxymethylcellulose (CMC).

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Xerostomia is the subjective complaint of oral dryness and may have many causes, including medication, Sjögren’s syndrome, head and neck radiotherapy, uncontrolled diabetes mellitus and psychological factors^{12,14,24}. Dry mouth is more common in the elderly, with a prevalence of 12–40%^{6,11}; the range is the

result of different criteria being used for xerostomia in different age groups.

Patients with xerostomia may have difficulty speaking, eating and swallowing. Some patients complain of halitosis, a chronic burning sensation, taste disturbance and intolerance to spicy food. Decreased salivary production can lead

to oral mucosal infection with *Candida*, and increases the risk of dental caries and the severity of periodontal disease, which worsens nutritional problems. Patients with dentures may have retention problems, soreness and ulcers^{4,12,24}. Inadequate saliva production can significantly diminish quality of life^{7,18,23}.

To relieve problems related to xerostomia, most patients use saliva stimulants and/or saliva substitutes. When some residual salivary flow remains, saliva stimulants such as pharmaceutical sialogogues, sugarless candies and chewing gum can be used to restore saliva production. If stimulation of salivary secretion using saliva stimulants is ineffective, symptomatic treatment with saliva substitutes may be helpful^{3,12,13,19}. Among saliva substitutes, mouth-rinse solutions containing sodium carboxymethylcellulose (CMC) or animal mucins have been used and evaluated extensively^{2,10,20–23}.

Questionnaires are an effective method for determining subjective measures of dry mouth and for assessing the effects of treatments in patients with dry mouth. Many previous reports have studied the effects of artificial saliva using questionnaires in patients with dry mouth, but some did not ask for enough information to assess dry mouth effectively^{1,2,22,23}. Some of these studies used yes/no binary questions or questions based on discrete scales^{2,10,16,21–23}. Regarding the efficacy of artificial saliva, previous reports have shown a significant reduction in dry mouth-related complaints in patients suffering from severe xerostomia^{8,13}. Information on the effectiveness of artificial saliva, according to the residual secretory potency of the salivary glands, assessed by both the stimulated and unstimulated flow rates, is sparse.

The purpose of the present study was to assess the short-term effects of CMC-based artificial saliva in patients with dry mouth using a comprehensive questionnaire. The effectiveness of CMC-based artificial saliva according to the residual secretory potency of the salivary glands was evaluated.

Materials and methods

Subjects

Fifty patients (6 males and 44 females, mean age 57.8 ± 13.2 years) who came to

the Department of Oral Medicine at Seoul National University Dental Hospital complaining chiefly of oral dryness participated in this study. Twenty-four patients (48%) were currently taking medications affecting salivary gland function. Seven (14%) had Sjögren's syndrome and 4 (8%) were being followed up to determine if they had Sjögren's syndrome associated with rheumatology problems. Two (4%) patients had recently received radiation, 4 (8%) had diabetes mellitus, and 13 (26%) had xerostomia of unknown etiology. The research protocol was approved by the institutional review board of the University Hospital (#CRI 05021).

Questionnaire

On the initial visit to the clinic, each patient was asked a standardized series of questions concerning dry mouth (Table 1). Some of these questions were modeled on those of Fox et al.⁴, such as oral dryness at night or on awakening (Dry-PM), at other times of the day (Dry-day), and during eating (Dry-eat), difficulty in swallowing foods (Dif-swal), amount of saliva in usual, everyday life (Am-sal), taking water to bed (H₂O-bed), sipping liquids to aid in swallowing dry foods (Sip-liq), and using candy or chewing gum to aid oral dryness (Gum-candy). Questions regarding the effect of oral dryness on daily life (Eff-life) and awakening from sleep at night because of oral dryness (Night-awake) were also asked.

The patients were instructed to use about 2 ml of the CMC-based artificial saliva (0.65% CMC, 1.0% glycerin and 0.05% methyl parahydroxybenzoate in distilled water) as frequently as desired throughout the day and/or night for 2 weeks. The patients then completed the same questionnaire.

Questions regarding Dry-PM, Dry-day, Dry-eat, Dif-swal, Am-sal, and Eff-life were evaluated using a 10 cm visual ana-

log scale (VAS). Night-awake, H₂O-bed, Sip-liq and Gum-candy were evaluated using a categorical scale.

Measurement of stimulated and unstimulated whole salivary flow rates

Patients abstained from smoking, eating or drinking for 1 h before the measurement of salivary flow rate. Unstimulated whole saliva (UWS) was collected for 10 min by spitting. The flow rate of stimulated whole saliva (SWS), which was stimulated by chewing 1 g of gum base, was measured for 5 min. The flow rate of whole saliva was expressed in ml/min.

Statistical analysis

The Wilcoxon signed rank test was used to evaluate changes in subjective symptoms after the use of CMC-based artificial saliva. The Mann-Whitney U-test was used to evaluate the differences in effects of CMC-based artificial saliva on the degree of dry mouth determined by the patients' salivary flow rates.

Results

Salivary flow rates

The mean flow rate of UWS was 0.06 ± 0.05 ml/min (men 0.07 ± 0.05 ml/min; women 0.05 ± 0.05 ml/min) and the mean flow rate of SWS was 0.34 ± 0.36 ml/min (men 0.38 ± 0.46 ml/min; women 0.34 ± 0.35 ml/min). The flow rate of SWS could not be measured in two female subjects wearing dentures because the chewing substance stuck to the dentures.

Changes in dry mouth-related symptoms after using artificial saliva

Among the dry mouth-related symptoms, there were statistically significant differences in Dry-PM, Dry-day and Eff-life following the use of artificial saliva ($P < 0.05$) (Table 2). When the patients

Table 1. Questionnaire on dry mouth

Question	Answer
• Oral dryness at night or on awakening (Dry-PM)	VAS (Visual Analog Scale)
• Oral dryness at other times of the day (Dry-day)	
• Oral dryness during eating (Dry-eat)	
• Difficulty in swallowing foods (Dif-swal)	
• Amount of saliva in usual, everyday life (Am-sal)	
• Effect of oral dryness on daily life (Eff-life)	
• Awakening from sleeping at night because of oral dryness (Night-awake)	
• Taking water to bed (H ₂ O-bed)	
• Sipping liquids to aid in swallowing dry foods (Sip-liq)	
• Using candy or chewing gum to aid oral dryness (Gum-candy)	
	(1) Never (2) 1–2/week (3) 3–4/week (4) 5–6/week (5) Everyday (1) Never (2) Occasionally (3) Frequently (4) Always

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