Desquamative effect of sodium lauryl sulfate on oral mucosa

A preliminary study

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Sodium lauryl sulfate (SLS) is the most commonly used detergent in dentifrices. The present study was concerned with the effect of SLS content of toothpastes on oral epithelial desquamation in an experimental model. Ten dental hygiene students participated in this double-blind cross-over study. Five dentifrices with different concentrations of SLS (ranging from 0.0% to 1.5%) were used in randomized order in the study. One centimeter of each test dentifrice was applied in a cap-splint, which covered both attached and non-attached oral mucosa of the upper jaw for 2 min twice daily. The test period for each experimental dentifrice was 4 days, followed by a 10-day rest period. The dentifrice without SLS did not result in any ontoward reaction, whereas the dentifrice containing 1.5% SLS provoked desquamation in 60% of the subjects. □ *Dentifrice; epithelial slough; sodium lauryl sulfate*

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Side effects on oral soft tissues have previously been reported as a result of using dentifrices (1–8).

Sodium lauryl sulfate (SLS) in concentrations from 0.5% to 2.0% has been used as a foaming agent in dentifrices since the mid-thirties (9). It is an anionic strong denaturing detergent with a hydrophobic organic 'tail' which exhibits a high affinity for protein molecules. Lauryl sulfate has the structural formula shown in Fig. 1. Some authors suggest that this detergent may be a causal agent for different oral ontoward reactions (1, 5, 7, 8).

Among reported side effects of SLS are oral epithelial sloughing, ulcerations and inflammation (1, 5, 7), increased permeability to non-electrolytes (6), widening of the stratum corneum due to separation and loss of surface epithelial layers (6), protein denaturation, and membrane expansion (10). Flores de Jacoby et al. (11) concluded in an exfoliative cytologic study that higher portions of anionic detergents in dentifrices are likely to break up the intercellular structure of the epithelium and thus provoke increased epithelial cell desquamation. Götze (12) found increased desquamation of the oral epithelium after application of a dentifrice containing 7.9% of an anionic detergent to attached gingiva of the mandibular anterior region for 30 sec. Götze did not include a detergent-free toothpaste in his study.

Rubright et al. (5) reported mucosal sloughing in a patient as a reaction to the

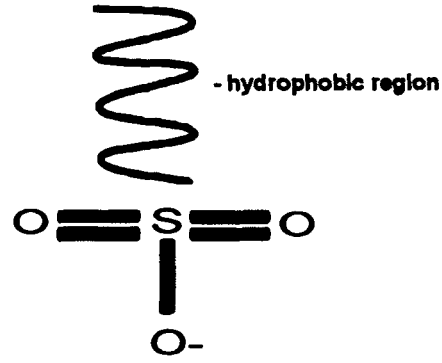

Fig. 1. The formula of the anion lauryl sulfate.

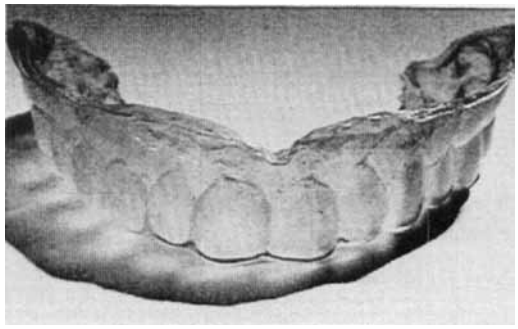

Fig. 2. Individually processed cap splint used for application of test dentifrices.

synthetic detergents SLS and sodium-*N*-lauryl sarcosinate, and sloughing was worsened by the patient's use of antisialic drugs.

Searls & Berg (7) showed an increase in epithelial cell count in whole saliva after brushing with an SLS-containing dentifrice for 1 week, compared with a control dentifrice used for the same time period.

With regard to the above-mentioned results, the aim of the present study was to investigate the desquamative oral mucosal effect on topical application of a test dentifrice with different concentrations of SLS compared with a placebo dentifrice to ascertain whether a dose-response effect was present.

Materials and methods

Ten female dental hygiene students between the ages of 20 and 31 years volunteered to participate in this double-blind clinical cross-over study.

Five dentifrices were used, and these varied from commercial dentifrices only in the different concentrations of SLS present (0.0%, 0.25%, 0.5%, 1.0%, and 1.5%). These dentifrices were manufactured by Unilever Research, Port Sunlight, UK, and each was given a code to ensure the double-blind design. A cap splint was made (Fig. 2), to apply the dentifrices on the mucosa, from 2-mm-thick bioplast plates on individual stone models in a vacuum processor and adjusted to cover attached and non-attached oral mucosa of the upper jaw. The palate was not included. Gjermo & Rølla (13) and Svatun (14) used the cap splint technique in plaque-inhibiting studies to eliminate the influence of toothbrushing, which could bias their results.

Plaque and calculus were removed at the start of the study, and the subjects told to brush only with water. After 1 week the mucosa was inspected and photographed. All oral brushing was then suspended. Every morning and evening for the next 4 days the cap splints, containing approximately 1 cm of the dentifrice to be tested, were placed in situ for 2 min twice daily. At the end of the 4-day period the mucosa was inspected for any signs of desquamation, and the most clinically evident reactions were photographed. At the same time 1 ml of whole saliva was collected from each subject by expectoration. The saliva samples were then evaluated for the presence of prominent (sheets consisting of at least 100 epithelial cells) visible membranous flakes. Light microscopy was used to examine these flakes together with flakes taken from desquamations of the oral mucosa. Symptoms such as pain and redness of the oral mucosa during the test period were recorded by the participants in a diary. The participants were permitted at least 1 week of brushing with water only between each of the five different test periods. All dentifrices were tested on all participants in a randomized order and in each experiment given the same pastes in accordance with the code on the tubes.

Results

A total of 17 desquamative reactions were observed in 7 subjects during this study, some reacting to more than 1 test dentifrice. Oral epithelial desquamation and presence of membranous flakes in saliva after 4 days of dentifrice testing is presented in Fig. 3. The desquamations were usually localized from the demarcation line between attached and non-attached mucosa to the vestibular sulcus and were only observed in areas that

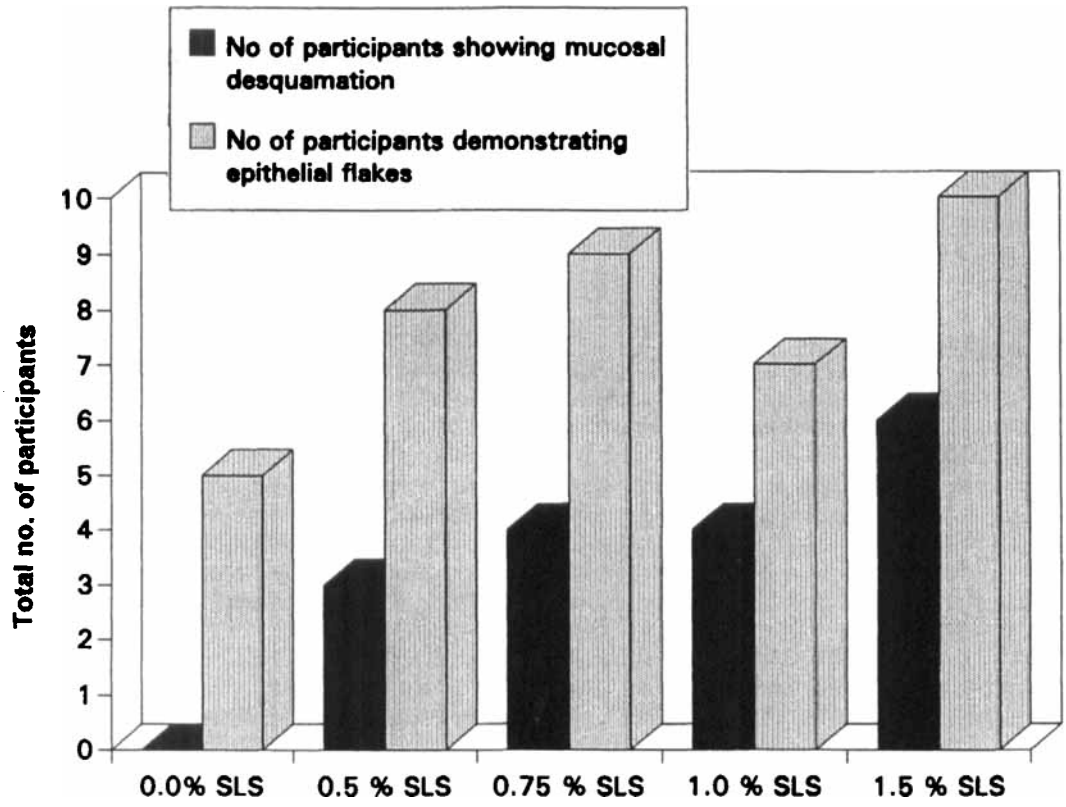

Fig. 3. The number of participants showing visible oral desquamation and epithelial flakes in saliva after exposure to toothpastes containing different concentrations of sodium lauryl sulfate.

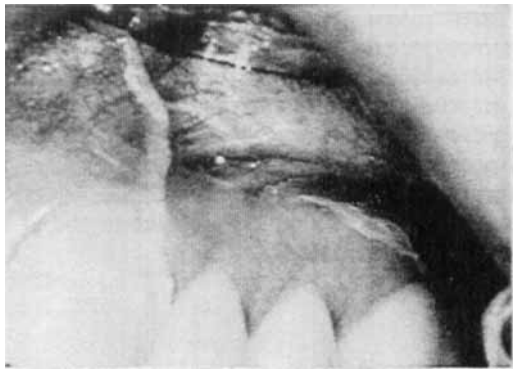

Fig. 4. Epithelial desquamation after the use of 1.5% sodium lauryl sulfate-containing dentifrice that had oral mucosal contact 2 min twice daily for 4 days.

had been covered by the cap splints. Visible membranous epithelial flakes at one or more sites were registered as desquamations. Absence of SLS did not result in any visible oral desquamation. With increasing concentration of SLS, the incidence of oral epithelial desquamation increased. 1.5% SLS gave most adverse effects, with six subjects showing marked desquamation, and all participants had prominent visible flakes in the saliva samples. Fig. 4 shows the buccolabial mucosa after 4 days' treatment with a dentifrice containing 1.5% SLS. 'Jelly'-like threads consisting of desquamated epithelial cells could be peeled off the mucosa for examination under the light microscope.

This showed clusters of epithelial cells. The participants registered the desquamations within 2 h after the cap splints were removed. The tongue or a finger could mechanically remove the desquamations. Pain was only associated with the most pronounced cases; three participants had burning and an increased sensation of warmth of the mucosa as the most outstanding symptoms.

Discussion

The present study suggests a relationship between different concentrations of sodium lauryl sulfate, the most commonly used detergent in dentifrices, and oral epithelial desquamation in healthy young women. In 1972 Stec (2) indicated a relationship between desquamation and use of dentifrices, after 109 of a total of 213 patients showed some desquamation on brushing with 1 of 16 different brands of commercially available dentifrices. However, the component of the dentifrice responsible for these observed desquamations was not identified. A dentifrice containing 7.9% of an anionic detergent in an exfoliative cytologic study by Flores de Jacoby et al. (11) resulted in breaking up of the intercellular structure of the oral epithelium and provoked increased epithelial cell desquamation. The detergent concentration of dentifrices today varies from 0.5% to 2.0%. In our study the detergent level was clinically relevant, since it was within this range. Götze (12) also reported increased desquamation of the oral epithelium after application of a dentifrice containing 7.9% of an anionic detergent compared with dentifrices with a lower detergent level. He did not include a detergent-free dentifrice. Rubright et al. (5) concluded in a 1978 case report study that a dentifrice containing 2% SLS caused sloughing of oral mucosa and that drugs with antisialic action aggravated this condition in a susceptible individual.

The present study demonstrated in 7 of 10 subjects 17 desquamative reactions to different concentrations of SLS. Three persons did not show desquamation during this study. 1.5% SLS, which is a commonly used level in commercial dentifrices, gave desquamation in 6 of 10 subjects, some being quite marked and unpleasant, all with visible epithelial flakes in the saliva samples. Kowitz et al. (3) confirmed in a study of 74 students utilizing 8 popular brands of commercially available dentifrices that the brushing technique is directly related to the frequency of irritation. It is therefore important to emphasize that the present experiments were executed without any brushing, to exclude mechanical distortion and irritation of the oral mucosa, which could bias the results. The dentifrices were in contact with the mucosa for 2 min, to imitate the usual brushing time. We are aware of the fact that occlusion with splints is far from the same as application at tooth-brushing. Nevertheless, an aspect of clinical relevance to this latter argument is that remaining dentifrice may after brushing and rinsing probably be in contact with oral mucosa if not adequately removed. Barkvoll et al. (15) showed a biologic effect of SLS in the oral cavity at least 2 h after application. Dentifrices without SLS resulted in no oral desquamations.

Searls & Berg (7) showed in 1986 increased epithelial sloughing after brushing with a dentifrice containing 2.4% sodium lauryl sulfate by collecting saliva samples and counting the number of sloughed epithelial cells in 1 ml of saliva. In our study SLS-containing dentifrices increased the number of saliva samples showing visible epithelial flakes.

To obtain more reproducible results, it may be necessary to increase the number of participants. It may also be of interest to investigate the effects of SLS on persons with decreased mucosal resistance—for example, in the elderly, persons using medications, or persons with chronic oral diseases, such as recurrent aphthous ulcers. The clinical relevance of SLS-containing dentifrices in connection with oral mucosal diseases has not yet been elucidated.

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