Rate of reformation of tongue coatings in young adults

F Chérel
A Mobilia
T Lundgren
J Stephens
R Kiger
M Riggs
J Egelberg

Authors' affiliations:
Fabrice Chérel, formerly Department of Periodontology, School of Dentistry, Loma Linda University, Loma Linda, CA, USA; presently private practice, Paris, France
Adrian Mobilia, *Joni Stephens*, *Robert Kiger*, Department of Periodontology, School of Dentistry, Loma Linda University, Loma Linda, CA, USA
Tord Lundgren, *Jan Egelberg*, formerly School of Dentistry, Loma Linda University, Loma Linda, CA, USA; presently Department of Periodontology, College of Dentistry, University of Florida, Gainesville, FL, USA
Matt Riggs, Department of Psychology, California State University, San Bernardino, CA, USA

Correspondence to:
Tord Lundgren
Department of Periodontology
College of Dentistry
University of Florida
PO Box 100434
Gainesville, FL 32610
USA
Tel.: +1 352 273 7881
Fax: +1 352 392 5899
E-mail: tlundgren@dental.ufl.edu

Dates:
Accepted 22 January 2008

To cite this article:
Int J Dent Hygiene **6**, 2008; 371–375
Chérel F, Mobilia A, Lundgren T, Stephens J, Kiger R, Riggs M, Egelberg J. Rate of reformation of tongue coatings in young adults.

Abstract: *Background:* Reviewing the literature, no study on the rate of regrowth of tongue coatings after tongue cleaning was found. Therefore, the purpose of this study in young adults was to study the rate of reformation of tongue coatings after mechanical removal. *Material and Methods:* Thirty-five dental students participated in the present study. Following preparatory study instructions, baseline examinations were carried out followed by 3 days of observation. At baseline, tongue coating scores (prescraping) were obtained followed by tongue scrapings and determination of the wet weights of the coatings. A second tongue coating score was then obtained within 5 min of the first score (immediate post-scraping). The subjects returned for repeated tongue coating scores after 1 and 2 days and for final examination after 3 days, which included both tongue coating scores (prescraping and immediate post-scraping) and determination of the wet weights of the coatings. *Results:* Prior to scraping the tongue at day 0 (baseline), mean tongue coating amounted to a surface extension of 33% of the entire dorsum of the tongue. Scraping the tongue reduced the score to 9%. On average, tongue coating scores had returned to baseline levels on day 2. The mean wet weights of tongue scrapings at days 0 and 3 were similar and amounted to 0.09 ± 0.07 and 0.09 ± 0.06 g, respectively. *Conclusion:* If tongue cleaning is to be recommended, the results of this study in dental students indicate that tongue cleaning should be performed on a daily basis.

Key words: reformation rate; tongue coating

Introduction

It is well established that the dorsum of the tongue harbours great numbers of micro-organisms (1, 2). It has been suggested that these bacteria may constitute a potential reservoir of micro-organisms contributing to plaque formation and thus possibly play a role in the development of dental diseases. For example, Almas *et al.* (3), instructing adult patients to use a tongue scraper twice daily for 7 days, observed reductions of salivary counts of *Streptococci mutans* and Lactobacilli. Faveri *et al.* (2) studied the microbiota of the dorsum of the tongue in dental students and observed that discontinuation of tongue brushing resulted in an increase in several putative periodontal pathogens amongst the tongue microbiota.

Micro-organisms harboured in tongue coatings may also contribute to oral malodor. It has been established that several of these bacteria have the capacity to produce odorous, volatile sulphur compounds through putrefaction of sulphur-containing proteins, peptides and amino acids (4–6).

The circumstances above most likely explain why cleaning the tongue using a toothbrush or a tongue scraper is often recommended as part of regular oral hygiene, aiming at reducing the degree of tongue coating and the amount of micro-organisms harboured in these coatings (7–9). Although tooth-brushing is typically recommended to be performed twice daily, tongue cleaning recommendations seem to be more uncertain (7). Reviewing the literature, we were unable to find any study on the rate of reformation of tongue coatings after tongue cleaning. Such information would seem to be of interest and might have an impact on tongue cleaning recommendations. Thus, the present study was designed to investigate the rate of reformation of tongue coatings after mechanical removal using a tongue coating index for evaluation.

Materials and Methods

Subjects

The second year dental students at the School of Dentistry, Loma Linda University were asked to volunteer for a screening examination for this study. All 92 students in the class were examined. Subjects showing a tongue coating index of ≥20% of the entire surface of the tongue (see below) were invited to participate in the study. Thirty-five subjects met this inclusion criterion, 15 females and 20 males; mean age, 26 years; range, 23–37 years. No qualifying subject had to be excluded because of systemic antibiotic intake, presence of respiratory infection, periodontitis or pericoronitis. Assuming a correlation between repeated measures of $r = 0.5$, 35 subjects provided a power level of 0.82 for two-tailed tests of repeated measures mean differences. Approval for the study was granted from the Institutional Review Board of Loma Linda University based upon the World Medical Association Declaration of Helsinki. Qualifying individuals volunteering to participate were given verbal and written information about the study and asked to read and sign an informed consent.

Procedures

Pilot studies in 12 periodontal residents and faculty indicated that a 4-day experimental period would be sufficient to allow reformation of tongue coatings after mechanical removal. Therefore, examinations were carried out during 4 days (Monday through Thursday) before lunch between 12:00–13:00 h with groups of 9–14 subjects per session. The subjects were instructed to abstain from tongue cleaning, use of mouthwash and antimicrobial dentifrice starting 3 days prior to the study and to continue to abstain from these procedures throughout the duration of the study. On each day of examination, the students were instructed to eat a regular breakfast and to abstain from further eating prior to the examination and limit drinking of water.

Measurements

Extent of tongue coating

This was scored using a Winkel tongue coating index (10) as modified by Lundgren *et al.* (11). The subjects were asked to protrude their tongue as far as possible. The tip of the tongue was grasped using a $2'' \times 2''$ gauze to enable the examiner to use a gentle pull to make it easier for the subjects to keep their tongues protruded during the examination. Saliva on the dorsum of the tongue was removed by blotting the surface with absorbent paper for 5 s (Gel Blot Paper; Schleicher & Schuell, Keene, NH, USA). The dorsum of the tongue was divided into three parts: a posterior, a middle and an anterior part. Ink marks were placed on the tongue surface at two locations, indicating the anterior-posterior width of each third (Color Transfer Applicator; Great Plains Dental Products, Kingman, KS, USA). For each third, presence of tongue coating thick enough to provide a layer concealing the pink colour of the tongue was estimated to the nearest 5%. The percentage scores for each third were added and divided by three to provide the tongue coating value for the entire tongue dorsum.

Wet weight of tongue coatings

Following removal of saliva by blotting the tongue dorsum with absorbent paper as described above, a disposable plastic spatula was used to scrape and collect the tongue coating. Repeated scraping movements in different directions (back, forth, sideways) were continued until no more coating could be dislodged. The scrapings were collected at intervals on a $2'' \times 2''$ gauze. The wet weight of the collected tongue coating was measured to nearest 0.01 g by subtracting the prescraping from the post-scraping weight of the gauze (XS-410; Denver Instrument Company, Denver, CO, USA).

At baseline, tongue coating scores (prescraping) were obtained by one calibrated examiner (examiner 1: author F.C.). This was followed by tongue scrapings by another examiner (examiner 2: author A.M.) to clean the tongue and to determine the wet weights of the coatings. A second tongue coating score was then obtained within 5 min of the first score by examiner 1 (immediate post-scraping). The subjects returned for repeated tongue coating scores after 1 and 2 days and for final examination after 3 days by examiner 1. The examiner did not have access to previous scores at the repeated recordings. At the final examination, both tongue coating scores (prescraping and immediate post-scraping) and measurements of the wet weights of the coatings (examiner 2) were performed.

Reproducibility of tongue coating scores

Prior to start of this study and following calibration exercises, the interexaminer reproducibility of tongue coating scores was evaluated in 25 adult patients. Scores were independently obtained by the examiner of the present study (author F.C.) and by another examiner previously evaluated for interexaminer reproducibility (author A.M.) in the study by Lundgren *et al.* (11). Similar to previous results (11), interexaminer reproducibility as determined from Pearson's coefficient of correlation was $r = 0.9$.

Data analyses

Descriptive statistics coupled with use of repeated measures ANOVA were used to analyse the data for tongue coating scores throughout the study. Given the significance of the omnibus F tests, *post hoc* analyses within these ANOVAs were conducted using Fisher's Least Significant Difference procedure. The wet weights of tongue coatings at days 0 and 3 were compared using Student's t-test for paired samples. Relationships between tongue coating scores and wet weights of tongue coatings were evaluated using Pearson's coefficients of correlation.

Results

The extents of tongue coating for the posterior 1/3, middle 1/3 and the entire dorsum of the tongue throughout the study are presented in Fig. 1. At day 0, mean tongue coating scores prior to scraping the tongue were 66% for the posterior 1/3, 33% for the middle 1/3, 0.3% for the anterior 1/3 and 33% for the entire dorsum of the tongue. Scraping the tongue reduced the tongue coating scores by 70–80%. On average, tongue coating scores for the posterior 1/3, middle 1/3 and the entire dorsum of the tongue had returned to baseline levels on day 2.

The statistical analyses of the tongue coating scores showed significant differences comparing day 0 prescraping to day 0 post-scraping and also comparing day 0 prescraping to day 1. These differences were observed for the posterior 1/3, middle 1/3 as well as the entire dorsum of the tongue. There were no differences comparing day 0 prescraping to day 2 and day 3 for any of these three areas of the tongue.

Although mean tongue coating scores for the entire group of subjects showed clear patterns, analyses on an individual level disclosed quite some variation. Reviewing the scores for the entire dorsum of the tongue and allowing a deviation of 10%, 15 subjects reached baseline levels after 1 day, 13 subjects after 2 days, 6 subjects after 3 days and 1 subject did not reach baseline levels.

On average, the wet weights of tongue scrapings (means ± SD) at days 0 and 3 were similar and amounted to 0.09 ± 0.07 and 0.09 ± 0.06 g, respectively. Statistically significant coefficients of correlation were observed between the tongue coating scores for the entire tongue and wet weight of tongue coatings. For day 0 and day 3, the coefficient amounted to 0.51 ($P < 0.01$) and 0.45 ($P < 0.01$), respectively.

Discussion

In the present study in dental students with obvious tongue coating following abstention of tongue cleaning for 3 days it was observed that tongue coating scores on average had returned to baseline levels 2 days following baseline mechanical removal.

Reviewing the literature, we were unable to find any study on the rate of reformation of tongue coatings after mechanical removal. This was unexpected, considering the common

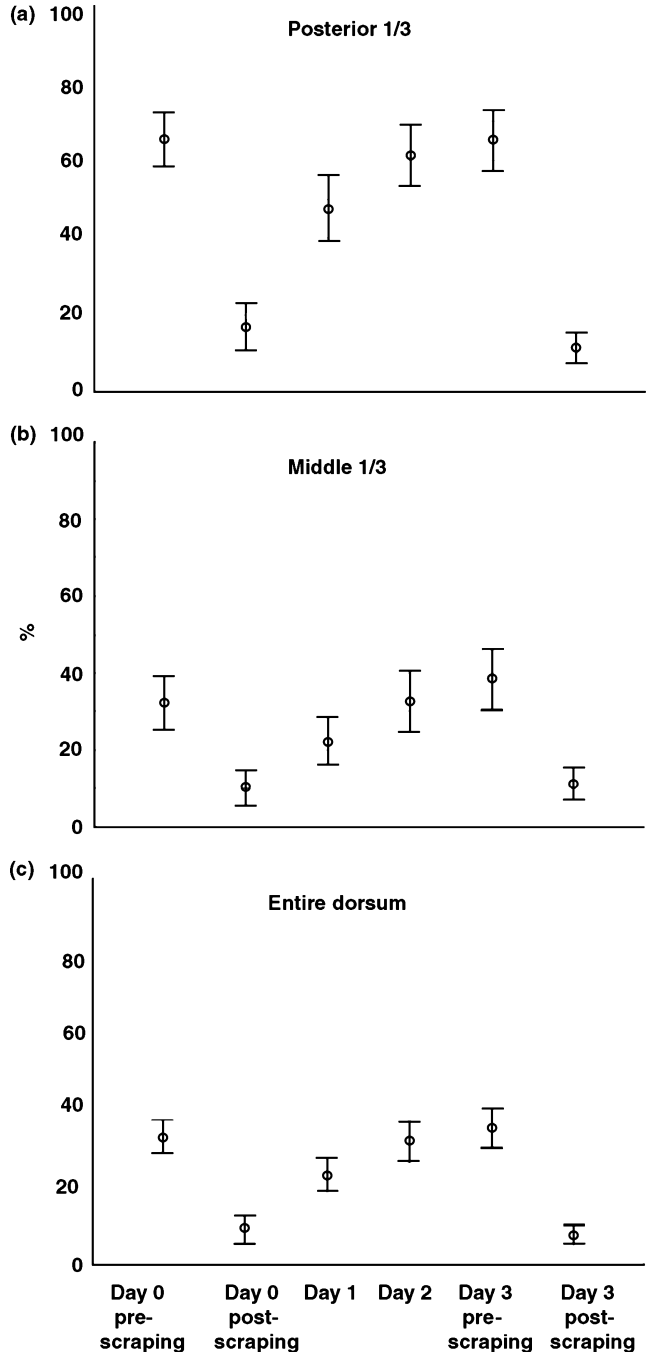

Fig. 1. Mean tongue coating scores (95% confidence interval) for posterior 1/3 (a), middle 1/3 (b) and the entire dorsum of the tongue (c) at day 0 prescraping, day 0 post-scraping, day 1, day 2, day 3 prescraping and day 3 post-scraping.

recommendation of tongue cleaning as part of regular oral hygiene (7–9). To ascertain that the subjects of the present study would have sufficient amounts of tongue coating, only subjects showing a tongue coating score in a screening examination of ≥20% of the entire surface of the tongue were included.

The scoring of tongue coatings throughout the present study and the baseline tongue cleaning were performed during the lunch hour. The subjects were allowed to eat a regular breakfast in the morning. This may have reduced the amount of tongue coating observed during lunch hour and thus affected the scores throughout the course of the study. If so, this design could be considered a limitation of this study. On the other hand, the design might also have been advantageous, as individuals more prone to formation of tongue coatings might have been included.

Scraping the tongue resulted in reductions of the tongue coating scores amounting to 70–80%. Considering the efforts to remove all tongue coating, larger reductions might have been expected. This, less than expected reduction, may relate to the nature of the tongue coating index. Tongue coating thick enough to provide a layer concealing the pink colour of the tongue is recorded. Most likely, keratinization of the tongue papillae may often be heavy enough to conceal the pink colour of the tongue and thus be difficult to separate from true tongue coating and be given positive tongue coating scores. The fact that 10–11% of the easily accessible middle 1/3 of the tongue surface showed tongue coating after tongue scraping would seem to support this concept. Thus, the tongue coating index seems to include a systematic error because of frequent occurrence of keratinization. This is supported by the fairly modest coefficients of correlation between tongue coating scores and wet weights of tongue coatings at days 0 and 3 ($r = 0.51$ and 0.45, respectively). Nevertheless, this should not invalidate the findings of the present study as the degree of keratinization is most likely a consistent feature within each individual. In fact, this was substantiated by examination of individual tongue coating scores after scrapings on days 0 and 3. For the vast majority of subjects, post-scraping scores were similar on day 0 and day 3.

Tongue brushing on a regular basis for the purpose of removing or reducing the tongue coatings on the dorsum of the tongue has been found to be beneficial in individuals with oral malodor [see review by Danser *et al.* (5) 2003]. Studies investigating tongue brushing for the purpose of reducing formation of dental plaque show conflicting results (12–15). Other studies on tongue cleaning, observing a reduction of the degree of tongue coating, have found minor or no decrease in the bacterial load of the dorsum of the tongue (16, 17). Nevertheless, if tongue cleaning is to be recommended to decrease the amount of coating on the accessible parts of the tongue, the results of this study in dental students indicate that tongue cleaning should be performed on a daily basis.

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