Influence of Copper Tongue Scraper and Toothbrush on Morning Halitosis in Dentistry Students: A Brief Clinical Study

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Abstract: The objective was to evaluate the influence of two tongue cleaning methods (copper tongue scraper and toothbrush) on morning halitosis in dental students. Thirteen dental students were included. After training, the first participant took the halimeter home and used it for 6 days. On the first three days, halitosis was measured immediately after the participant woke up in the morning. The night before each of these first three days, before going to sleep, the participant cleaned their mouth with dental floss and a soft-bristled toothbrush. The individual's same soft-bristled toothbrush was also used to brush his tongue. Only one halitosis measurement was taken per day and the value was recorded each day (toothbrush group). On the fourth, fifth and sixth day, the same process was carried out, but the night before measuring halitosis, a copper tongue scraper was used to clean the participants' tongue. Only one halitosis measurement was taken per day and the value was recorded each day (tongue scraper group). Subsequently, for each participant, the highest halitosis value of the first three days (toothbrush group) was chosen, as well as the highest halitosis value of the last three days (tongue scraper group). The Wilcoxon test was used to compare the two groups ($P<0.05$). The halitosis value (median) in the toothbrush group was significantly higher than that in the tongue scraper group. Only the tongue scraper group showed a clinically acceptable halitosis value (imperceptible odour). Therefore, the copper tongue scraper is more recommended for cleaning the tongue.

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Introduction

In most patients, the origin of bad breath (also known as "halitosis") is related to the oral cavity due to materia alba, caries, tongue coating, dry mouth, poorly adapted dentures, or periodontal or systemic diseases (Pedrazzi et al., 2004; Acar et al., 2019; Souza et al., 2023). Among these factors, tongue coating is the main source of bad odour (Bosy et al., 1994; Seemann et al., 2001; Van Tornout et al., 2013), being formed by fungi, viruses, protozoa, bacteria, blood metabolites, desquamated epithelial cells, different kinds of food remnants, and leukocytes coming from periodontal pockets (Casemiro et al., 2008; Van Tornout et al., 2013; Jiang et al., 2023). The anaerobic bacteria present in the tongue coating are also responsible for the release of volatile sulfur compounds (VSCs), which cause bad breath, due to the degradation of organic substrates (Scully and Greenman, 2000; Seemann et al., 2001; Casemiro et al., 2008; Van Tornout et al., 2013; Jiang et al., 2023). Therefore, it is very important to remove tongue coating daily, as it is a normal phenomenon that occurs in individuals with and without periodontal disease (Van Tornout et al., 2013).

VSCs produced by microorganisms include hydrogen sulfide (H_2S), dimethyl sulfide: $(CH_3)_2S$, dimethyl disulfide ($C_2H_6S_2$), and methyl mercaptan (methanethiol, CH_3SH) (Seemann et al., 2001, Casemiro et al., 2008; Acar et al., 2019; Jiang et al., 2023). In addition to VSCs causing bad breath, which creates problems for interpersonal relationships and the psychological health of individuals (Lee et al., 2021), VSCs are toxic to periodontal tissues, which means that these compounds may play a role in the development of gingivitis and periodontitis (Ratcliff and Johnson, 1999; Seemann et al., 2001).

Saliva contains many antimicrobial agents such as lysozyme, lactoferrin and lactoperoxidase that protect teeth and oral mucosa against pathogenic microorganisms (Thie et al., 2002). During sleep, salivation is reduced, which consequently contributes to an increase in the number of microorganisms in the oral cavity, resulting in an increased risk of caries and bad breath (Marsh et al., 2016; Vila et al., 2019; Sotozono et al., 2021). Therefore, it is accepted that the mouth is cleaned before sleeping to help control microbial growth during the night, preventing oral diseases (Sotozono et al., 2021).

Regardless of brushing force, using a soft or medium toothbrush results in comparable teeth cleaning effectiveness (Tanner et al., 2023). However, toothbrushes with soft bristles are the most recommended for cleaning teeth, as they help prevent damage to the gum tissue (Romitti et al., 2022). Because of this, it is common for patients to brush their teeth and tongue with a soft-bristled brush (Pedrazzi et al., 2004; Casemiro et al., 2008), although they can also use a scraper to clean their tongue (Seemann et al., 2001; Pedrazzi et al., 2004; Casemiro et al., 2008; Acar et al., 2019).

In 2025, a search on PubMed using the keywords "dentistry students and tongue scraper" or "tongue scraper and toothbrush" or "tongue scraper and toothbrush and halitosis" found no articles comparing tongue brushing with tongue scraping (using a copper tongue scraper), based on halitosis assessed by a halimeter, in dental students. Therefore, the objective of this study was to evaluate the influence of two tongue cleaning methods (copper tongue scraper and toothbrush) on morning halitosis in dental students.

Material and Methods

Ethics committee

This study was approved by the Ethics Committee for Human Research (No. 81690324.1.0000.5420) of the Araçatuba Dental School, São Paulo State University Júlio de Mesquita Filho (UNESP-FOA) and followed the recommendations of the Declaration of Helsinki (World Medical Association, 2013). All participants signed the free and informed consent form.

Thirteen (Pedrazzi et al., 2004) undergraduate dentistry students (UNESP-FOA) were included in this study according to the inclusion and exclusion criteria. All students included received a free copper tongue scraper (Yogateria, Ayurveda, Brazil).

Inclusion criteria

- Students in the 3rd or 4th year of the Dentistry course at the UNESP-FOA aged between 20 and 25 years old.
- Individuals classified as ASA (American Society of Anesthesiologists) I (Mayhew et al., 2019).
- Good oral health.
- Complete dentition and no malocclusion.
- Healthy sleep with 7 to 9 hours of sleep per night, as recommended by the National Sleep Foundation for young adults ages 18 to 25 (Hirshkowitz et al., 2015; Do, 2020).
- Those who clean their teeth with dental floss and a soft-bristled toothbrush and clean their tongue only with the soft bristles of the toothbrush.
- Those with toothbrushes in good condition.
- No previous orthodontic treatment, or orthodontic treatment completed at least 5 years ago and no use of permanent or removable retainers (Acar et al., 2019; Banjar et al., 2022).

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Exclusion criteria

- Wearers of dental or maxillofacial prostheses (Casemiro et al., 2008; Acar et al., 2019; Souza et al., 2023).
- Pericoronitis, caries, gingivitis or periodontitis (Pedrazzi et al., 2004; Jiang et al., 2023).
- Those who already use tongue scrapers daily.
- Whitening treatment in progress or completed in less than 3 months.
- Fissured tongue.
- Smokers (Pedrazzi et al., 2004; Casemiro et al., 2008; Acar et al., 2019; Jiang et al., 2023).
- Pregnancy or lactation (Acar et al., 2019).
- Abusive consumption of alcoholic beverages (Acar et al., 2019; Jiang et al., 2023).
- Use of illicit drugs (Antoniazzi et al., 2017).
- Cancer (before, during and after cancer treatment) (Casemiro et al., 2008; Shen et al., 2024).
- Stomach or respiratory problems (Pedrazzi et al., 2004; Casemiro et al., 2008; Kinberg et al., 2010).
- Use of medications that reduce salivation such as fluoxetine (Casemiro et al., 2008; Miranda-Rius et al., 2015; Acar et al., 2019).
- Those who wear mouthguards while sleeping (D'Ercole et al., 2014).
- Antibiotics and mouthwashes used in the 3 months prior to sampling (Seemann et al., 2001; Casemiro et al., 2008; Acar et al., 2019).
- Oral surgery less than 6 months ago.

Halitosis test

Halitosis was measured using a portable halimeter (HC-312F Tanita Portable Fitscan Breath Checker, Tanita, USA) (Souza et al., 2023). This device assessed the quality of the volunteer's breathing using a semiconductor gas sensor that can measure the quantity of VSCs emitted by bacteria (Souza et al., 2023). The volunteers were instructed to blow into the device according to the manufacturer's recommendations. After the volunteer blew into the device, which should be 1 cm away from their mouth, the halimeter display showed the level of halitosis (0: no odour; 1: little odour; 2: moderate odour; 3: heavy odour; 4: strong odour; or 5: intense odour) (Souza et al., 2023).

Data collect

All participants used the same halimeter, therefore, before each of them used the device, the researcher (C.L.d.M.M.N.) trained the individual on how to use the halimeter. Students were instructed not to consume alcoholic beverages or use mouthwash on the days of halitosis measurement. The researcher also instructed each participant to use the same toothpaste (Creme Dental Máxima Proteção Anticáries – Colgate, Brazil) during data collection days.

After training, the first participant took the halimeter home and used it for 6 days. On the first three days, halitosis was measured immediately after the participant woke up in the morning. The night before each of these first three days, before going to sleep, the participant cleaned their mouth with dental floss and a soft-bristled toothbrush. The individual's same soft-bristled toothbrush was also used to brush his or her tongue. Each participant was instructed to clean their tongue only with the toothbrush bristles, that is, they should not use the tongue scraper found on the back of the head of some toothbrushes (standardization of cleaning). Only one halitosis measurement was taken per day and the value was recorded each day (toothbrush group). On the fourth, fifth and sixth day, the same process was carried out, but the night before measuring halitosis, a copper tongue scraper (Yogateria, Ayurveda, Brazil) was used to clean the participant's tongue, instead of a toothbrush. Only one halitosis measurement was taken per day and the value was recorded each day (tongue scraper group). The volunteer then returned the halimeter to the examiner, who passed it to the second volunteer to perform the same protocol described above. This process was repeated until all thirteen volunteers had collected their halitosis data.

After six days, each participant collected 6 halitosis measurements. Subsequently, for each participant, the highest halitosis value of the first three days (toothbrush group) was chosen, as well as the highest halitosis value of the last three days (tongue scraper group).

Perception of tongue cleanliness

At the end of each participant's halitosis measurements, the operator asked the following question: "Between the toothbrush and the copper tongue scraper, which method generated the greatest perception of cleanliness for your tongue?"

Statistical analysis

Statistical analysis was conducted using the Jamovi software (Version 2.2.5.0, Jamovi Project, Australia). The Wilcoxon test was used to compare the two groups (toothbrush group and tongue scraper group) based on halitosis values ($P<0.05$).

Results

Ten women and three men with an average age of 22 years participated in this study. Table 1 shows that the halitosis value (median) in the toothbrush group

Table 1: Comparison of halitosis values between the two groups

Groups	Halitosis value (median)	P-value
Toothbrush group	3	0.003*
Tongue scraper group	1	

Wilcoxon test (P<0.05); *represents a statistically significant difference

was significantly higher than that in the tongue scraper group.

The average halitosis value in the toothbrush group was approximately 3, while in the tongue scraper group it was approximately 1.

All participants reported that the greatest perception of cleanliness for their tongue was achieved with the copper tongue scraper.

Discussion

The halitosis value (median) in the toothbrush group was significantly higher than that in the tongue scraper group (Table 1). This theoretically happened for two reasons: 1) the metal scraper has greater resistance to bending than the soft bristles of a toothbrush, which prevented its metal arms from bending during tongue scraping. This factor, combined with the pointed surface of the metal scraper that came into contact with the tongue during cleaning, may have facilitated the application of the pressure necessary to remove the tongue coating. In this way, the copper tongue scraper generated enough friction with the tongue to completely remove the tongue coating, contributing to the reduction of microbial proliferation during sleep, which consequently reduced the release of VSCs. On the other hand, in the toothbrush group, the soft bristles of the toothbrush certainly did not generate enough friction with the tongue to completely remove the tongue coating, contributing to greater microbial proliferation during sleep that resulted in greater VSCs release (compared to the tongue scraper group); and 2) the copper tongue scraper may have cleaned a larger area of the tongue with each scraping action than the toothbrush bristles with each brushing action (Seemann et al., 2001). This may have made cleaning the tongue with the copper scraper easier, faster and more efficient, which may have prevented hygiene failures.

Clinically, halitosis values from 0 to 1 are clinically acceptable (imperceptible odour), while those from 2 to 5 are considered unacceptable (perceptible odour) (Souza et al., 2023). The toothbrush group showed a clinically unacceptable halitosis value (i.e., median: 3), while the tongue scraper group showed a clinically acceptable value (i.e., median: 1) (Table 1). Furthermore, when obtaining the mean values of both groups, the same result was observed. Therefore, the copper tongue scraper was more efficient in reducing morning halitosis, which makes it the most clinically recommended method for cleaning the tongue.

Based on the level of halitosis measured by a halimeter, few studies have compared tongue brushing with tongue scraping (Seemann et al., 2001; Pedrazzi et al., 2004). Despite different methodologies, Seemann et al. (2001) and Pedrazzi et al. (2004) corroborate this study. Seemann et al. (2001) observed that the tongue scraper showed a significant reduction in halitosis compared to the toothbrush. Pedrazzi et al. (2004) noted that the plastic tongue scraper showed a 75% reduction in VSCs, while the toothbrush only achieved a 45% reduction in VSCs.

All participants (100%) reported that the greatest perception of cleanliness for their tongue was achieved with the copper tongue scraper. Dental schools should more strongly encourage the use of a copper tongue scraper as part of the daily oral hygiene of their dental students and patients. Thus, after students become dentists, they will recommend this method to their patients.

A limitation of this study is the absence of a group using a plastic tongue scraper.

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