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Evaluation of Safe Tongue Cleaning Methods in Elderly Individuals Using Microbleeding as an Indicator

Yoko Tada, Wataru Fujii, Junichi Karaki, Jumpei Kubota, Yasuaki Kakinoki

Division of Dysphagia Rehabilitation, Department of Oral Function Reconstruction, School of Dentistry, Faculty of Dentistry, Kyushu Dental University, Kitakyushu, Japan
Email: r07sakakibara@fa.kyu-dent.ac.jp

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Abstract

Objectives: This study aimed to evaluate the safety of different tongue cleaning devices and scraping frequencies in elderly individuals requiring nursing care, using microbleeding of the tongue mucosa as an objective indicator. Associations with oral and systemic conditions were also examined. **Subjects and Methods:** Thirty elderly residents (mean age 89.4 ± 7.9 years) underwent tongue cleaning under six conditions: toothbrush (3 and 10 strokes), tongue brush (10 and 30 strokes), and sponge brush (10 and 30 strokes), with pressure standardized at 100 g. Microbleeding was assessed using a urine test strip method. Clinical variables included Geriatric Nutritional Risk Index (GNRI), tongue coating index (TCI), oral dryness (clinical criteria and moisture meter), and number of present teeth. **Results:** Microbleeding occurred under all conditions and increased significantly with greater numbers of strokes for toothbrush and tongue brush use. At 10 strokes, the toothbrush induced significantly more microbleeding than the tongue brush and sponge brush. At 30 strokes, the tongue brush caused significantly more microbleeding than the sponge brush. The sponge brush demonstrated the lowest incidence overall. Lower TCI values were significantly associated with microbleeding in sponge brush groups. Moderate to severe oral dryness (clinical criteria) and fewer present teeth were also associated with higher microbleeding incidence. No significant associations were found with medical history, medication use, or GNRI. **Conclusions:** Tongue cleaning safety in elderly individuals depends on both device type and stroke frequency. Sponge brushes appear less invasive, and individualized approaches considering tongue coating, oral dryness, and dentition are essential for safe practice.

Keywords

Tongue Cleaning, Microbleeding, Tongue Coating Index (TCI)

1. Introduction

A healthy tongue surface is covered with fine lingual papillae and has a pale appearance, and may sometimes be coated with varying degrees of tongue coating. Tongue coating is formed by accumulation of desquamated epithelial cells derived from filiform papillae, food debris, saliva, microorganisms, leukocytes, and other substances [1]. Additionally, it has been reported to be associated with gastrointestinal conditions, including those noted in endoscopic gastric findings [2] and radiographic gastric findings [3], as well as pancreatic exocrine function [4], while its thickness has been found to correlate with subjective gastrointestinal symptoms such as non-ulcer dyspepsia [5]. When a gastrointestinal disorder is present, filiform papillae tend to elongate and the tongue coating becomes thicker, while in contrast, atrophic changes of the gastric mucosa are associated with shortening of filiform papillae and thinning of tongue coating [6]. Thus, filiform papillae length is considered to be closely related to the condition of the upper gastrointestinal tract, with elongated papillae facilitating the adhesion of food debris and microorganisms [6]. Tongue coating has long been regarded as a reservoir of oral microorganisms [7] and its removal recommended [8].

When providing oral care for elderly individuals who require nursing care, it is important to clean not only their teeth but also the oral mucosa, including the tongue and buccal mucosa [9]-[11]. There are various tools available for tongue cleaning, including toothbrushes and sponge brushes, as well as tongue brushes of different shapes (e.g., spatula-type and brush-type) [12]. Scraping instruments used for tongue cleaning include tongue brushes, soft-bristled toothbrushes, sponge brushes, suction-type tongue cleaning devices, gauze, sonic toothbrushes, sponge brushes with irrigation function, and tooth surface cleaning devices. However, recommended scraping pressures vary widely, with 50 g [13], approximately 50 - 60 g [14], 50 - 80 g [15], and 100 - 150 g [16] [17], reported [18]. Although various tools used to evaluate the effectiveness of tongue coating removal according to brush morphology are available and instructions are included to avoid excessive force, the optimal pressure in grams remains unclear [19]. Some studies have specified rationale for tool selection, such as using a sponge brush with irrigation to soften and rinse away tongue coating [13], or employing a soft manual toothbrush to compare cleaning efficacy and assess mucosal irritation relative to tooth-cleaning devices [15]. However, the evaluations performed in those studies were primarily based on visual inspection or subjective assessment by the users, with no objective evaluations performed.

During tongue cleaning, microbleeding has been observed after three strokes with a toothbrush applied at 100 g of pressure [20], whereas another study found no microbleeding of the tongue mucosa with fewer than 30 strokes using a tongue brush at 100 - 150 g of pressure [16]. Unfortunately, the ages of the participants in those studies were not presented.

The present study was performed to evaluate the effects of tongue cleaning devices and number of scraping strokes during tongue cleaning in elderly individuals. Furthermore, appropriate tongue cleaning methods based on the condition of the tongue mucosa were also examined, with microbleeding used as an indicator of safety. Differences according to cleaning devices and number of strokes were assessed, as well as associations with oral findings and general health status.

2. Methods

2.1. Participants

The study population consisted of elderly individuals residing in a nursing home between December 2024 and August 2025. The sample size of 30 participants was determined by recruiting individuals who were super-elderly, had relatively high care needs, and were in the older age group, and by referencing previous studies investigating tongue cleaning methods (typically 20 - 40 participants). In addition, because each participant underwent all six cleaning conditions (within-subject design), the statistical efficiency for detecting differences in microbleeding incidence between devices and stroke numbers was increased.

Exclusion criteria included the presence of mucosal diseases such as oral lichen planus or oral candidiasis, history of Sjögren's syndrome or head and neck radiotherapy that could cause oral dryness, inability to cooperate with oral hygiene management due to dementia or other conditions, and current smoker.

2.2. Materials

DENT.EX Systema Genki f (Lion Dental Products Co., Tokyo, Japan) toothbrushes were used. The bristle material was saturated polyester resin and classified as medium hardness. The tongue brush employed was a Dental Pro® Tongue Brush (Dental Pro Co., Osaka, Japan), with nylon bristles classified as soft. As for the sponge brush, that was a Mouth Pure® Oral Care Sponge, size S (Kawamoto Corporation, Osaka, Japan), made of urethane. Uropaper® III H urine test strips (Eiken Chemical Co., Tokyo, Japan) were used for detection of microbleeding. Microbleeding was assessed using commercially available urine occult blood test strips. The test kit used for detecting microbleeding in the oral cavity is currently difficult to obtain; therefore, urine occult blood test strips were used as an alternative method. The urine test strips demonstrated high sensitivity for detecting trace amounts of blood, and occasionally showed a faint reaction even before tongue cleaning. Consequently, microbleeding was evaluated based on the color change of the test strips before and after cleaning.

2.3. Measurement Procedures

Measurements were performed after 90 minutes of fasting, to allow for salivary pH to return to baseline [21]. Immediately after mouth opening, the examiner wiped the tongue three times using a sponge brush, with the collected material then suspended in 1 mL of water and used as the baseline specimen. A urine test strip was then immersed into the specimen and the resulting color tone used as the reference.

Next, while maintaining mouth opening, the tongue mucosa was scraped a predetermined number of times using either a toothbrush, tongue brush, or sponge brush at a site different from the area previously wiped with the sponge brush. The tongue mucosa was then wiped three times using a new sponge brush for collection, suspended in 1 mL of water, and used as the recovery specimen. A test strip was subsequently immersed in the recovery specimen, and the color tone was compared with the reference to determine the presence or absence of microbleeding. Following the manufacturer's instructions, the test strip was read 30 seconds after sample application and evaluated using the kit's included 5-level standard color chart. To establish individual baseline values, samples immediately after opening the mouth were tested with test papers. The color of these test papers became the baseline value for each subject. Under each experimental condition, specimens were collected and examined using the same procedure. "Positive" microbleeding was defined as an increase in grade on the color chart compared to the baseline value.

All color evaluations were conducted by a single trained inspector. Evaluations were not blinded with respect to cleaning equipment or number of strokes. To ensure consistency, standardized color charts were used for all evaluations.

For all scraping and collection procedures, wiping was performed from the posterior toward the tip. It was confirmed in advance that the series of collection procedures used with the sponge brush did not induce new microbleeding. Additionally, testing performed prior to the examinations confirmed that no color change occurred when the test strip was applied directly to the sponge brush used for wiping, while immersion of the test strip in the 1 mL water suspension resulted in a color change.

The following six experimental conditions were used: toothbrush, 3 strokes (TB3); toothbrush, 10 strokes (TB10); tongue brush, 10 strokes (TongueB10); tongue brush, 30 strokes (TongueB30); sponge brush, 10 strokes (S10); and sponge brush, 30 strokes (S30). These conditions were performed in a fixed sequence. To minimize potential carryover effects, evaluations under each condition were conducted at least two days apart [22] [23]. This interval was set based on prior reports indicating that the tongue surface and tongue coating return to baseline values within several days after tongue cleaning. All evaluations were performed after confirming that the tongue coating had sufficiently reformed. Before use, each brush was moistened with water and excess moisture was removed with a paper towel.

Previous studies have noted that the mean applied pressure during tongue cleaning was 95.0 ± 40.8 g in individuals with cleaning habits and 90.9 ± 66.2 g in those without such habits [20], and that no microbleeding occurred with tongue brushing at 100 - 150 g [16]. Therefore, scraping pressure for the present participants was standardized at 100 g for all conditions. Sufficient practice was conducted to ensure consistent application of 100 g of pressure before the examined measurements and a brushing force measurement device was used (Sanei ME Co., Kanagawa, Japan). All measurements and specimen collections were performed by the same examiner. Based on previous studies suggesting that up to 30 strokes are appropriate for tongue cleaning [16], the maximum number of strokes was set at 30.

2.4. Investigation of Factors Associated with Microbleeding

Participant medical-related characteristics were collected from medical records and included age, sex, height, weight, medical history, medications, level of nursing care required, route of nutritional intake, and serum albumin levels. Nutritional status was evaluated using the Geriatric Nutritional Risk Index (GNRI) [24]. Oral assessments included number of present teeth, clinical diagnostic criteria for oral dryness [25], oral moisture levels [26] measured using a Mucus® oral moisture meter (Life Co., Saitama, Japan), and tongue coating index [27]. Subjective pain during tongue scraping was evaluated using the Visual Analog Scale (VAS).

Statistical analyses were performed using IBM SPSS Statistics, version 28.0 (IBM Corp., Armonk, NY, USA), with a t-test and Fisher's exact test used as appropriate, and statistical significance defined as $p < 0.05$.

This study was approved by the Research Ethics Committee of Kyushu Dental University (Approval No. 22-26). Written informed consent was obtained from each participant after explanation of the study using a consent form.

3. Results

3.1. Participants

The participants included 30 elderly individuals, aged 65 - 101 years, who required nursing care (6 males and 24 females; mean age 89.4 ± 7.9 years) (**Table 1**). As for long-term care level, no participants required Support Level 1 or 2, two required Care Level 1, three required Care Level 2, nine required Care Level 3, eight required Care Level 4, and eight required Care Level 5. The mean care level value was 3.57 (**Table 2**). All participants routinely received oral nutritional intake. Pain during tongue scraping was assessed and all were VAS 0, thus no participant experienced pain.

Serum albumin data were available for 27 of the participants. Nutritional status assessed using the GNRI showed no nutritional risk in five, mild risk in nine, moderate risk in seven, and severe risk in six (**Table 3**). Regarding medical history, hypertension was the most common cardiovascular condition (n = 27), followed by fractures/joint disorders (n = 24) and gastrointestinal disorders (n = 23) (**Table 4**). The mean number of prescribed medications, excluding eye drops and topical agents, was 8.5 ± 3.6 per participant, with cardiovascular medications the most frequently noted (n = 26) (**Table 5**).

Table 1. Participant characteristics (n = 30).

Age, years	Total, n (%)	Male, n (%)	Female, n (%)
≤69	1 (3.3)	1 (3.3)	0 (0.0)
70 - 79	2 (6.7)	0 (0.0)	2 (6.7)
80 - 89	9 (30.0)	3 (10.0)	6 (20.0)
90 - 99	17 (56.7)	2 (6.7)	15 (50.0)
≥100	1 (3.3)	0 (0.0)	1 (3.3)

Table 2. Long-term support and care level (n = 30).

Support 1	Support 2	Care 1	Care 2	Care 3	Care 4	Care 5
0	0	2	3	9	8	8

Table 3. Nutritional risk according to GNRI (n = 27).

No risk	Mild	Moderate	Severe
5	9	7	6

GNRI formula: GNRI = (14.89 × serum albumin [g/dL]) + (41.7 × current body weight [kg] / ideal body weight [kg]). Classification: No nutritional risk: >98; Mild risk: 92 to <98; Moderate risk: 82 to <92; Severe risk: <82.

Table 4. Medical history (n = 30).

Condition	Number	TB3	TB10	TongueB10	TongueB30	S10	S30
Cardiovascular disease							
Hypertension	27	0.548	0.279	0.166	1.000	1.000	1.000
Heart disease	15	0.711	1.000	0.242	0.465	1.000	1.000
Other	3						
Fracture/joint disease	24	1.000	0.466	0.417	0.722	1.000	1.000
Gastrointestinal disorder	23	1.000	0.372	1.000	0.392	1.000	0.548
Cerebrovascular disease	14	0.465	1.000	0.698	1.000	0.492	1.000
Dyslipidemia	13	0.465	0.454	0.407	0.264	1.000	0.613
Urological disease	13	1.000	0.672	0.391	0.678	1.000	0.550
Dementia	13	0.711	0.708	0.698	0.711	1.000	1.000
Osteoporosis	11	1.000	0.466	1.000	0.266	1.000	0.611
Diabetes mellitus	9	0.418	0.687	1.000	0.704	1.000	0.287
Neurological disease	8	0.364	0.129	0.102	0.066	1.000	0.538
Respiratory disease	4	1.000	1.000	0.284	0.632	0.253	0.454
Hepatic disease	3	1.000	1.000	0.545	0.548	1.000	1.000
Cataract and glaucoma	6	0.632	0.611	0.284	0.632	1.000	0.075
Other	13						

Fisher's exact test. Among cardiovascular diseases, hypertension was the most prevalent, observed in 27 participants. No significant association was found between medical history and number of participants with microbleeding.

Table 5. Medications (n = 30).

Type	Number	TB3	TB10	TongueB10	TongueB30	S10	S30
Cardiovascular agents	26	1.000	1.000	0.284	0.632	1.000	1.000
Laxatives	22	0.678	0.417	0.643	0.678	0.469	1.000
Antithrombotic agents	19	0.442	0.696	0.672	0.712	1.000	0.611
Gastrointestinal medications	18	0.458	0.712	1.000	1.000	1.000	0.632
Lipid-lowering agents	12	0.260	0.266	0.099	0.136	0.503	0.130
Sleep/sedative agents	12	0.458	0.712	0.678	0.709	1.000	0.632
Osteoporosis agents	8	0.419	0.672	1.000	0.678	0.469	1.000
Analgesic agents	7	0.669	1.000	1.000	0.084	0.418	1.000
Oral antidiabetic agents	6	0.660	0.641	1.000	1.000	1.000	0.557
Antidementia agents	6	0.660	0.372	0.645	1.000	1.000	1.000
Antiallergic agents	5	1.000	0.327	1.000	0.622	0.310	0.538
Respiratory agents	2	1.000	0.520	0.064	0.503	1.000	0.253
Antiparkinsonian agents	2	1.000	0.520	0.469	0.503	1.000	1.000
Respiratory agents	1	0.400	1.000	0.267	1.000	0.067	0.133
Antidepressant agents	1	0.503	0.126	1.000	1.000	1.000	1.000
Eye drops	4	0.632	0.611	1.000	1.000	1.000	0.454
Transdermal agents	2	1.000	0.520	0.469	0.503	0.131	0.253
Other (ear drops, Kampo medicines, topical agents, etc.)	49						

The mean number of medications was 8.5 ± 3.6. Cardiovascular agents were the most frequently prescribed medications, used by 26 participants. No significant association was observed between medication use and number of participants with microbleeding.

3.2. Microbleeding Observed with Scraping Method

In the TB3 group, microbleeding was observed in 12 participants (40.0%), whereas that was observed in 19 (63.3%) in TB10, a significant difference. Microbleeding was observed in eight participants (26.7%) in TongueB10 and in 18 (60.0%) in TongueB30, again a significant difference. In contrast, microbleeding was not significantly different between the S10 and S30 groups, as that was observed in two (6.7%), and four (13.3%) participants, respectively.

Comparisons of the 10-stroke groups showed that TB10 had a significantly higher number of participants with microbleeding than TongueB10 and S10. Although TongueB10 showed a tendency toward greater microbleeding than S10, the difference was not statistically significant. As for the 30-stroke groups, TongueB30 showed a significantly higher number of participants with microbleeding as compared with S30. These results are shown in Table 6.

We performed a generalized linear mixed model with a logit link function, incorporating device type, stroke count, and their interaction as fixed effects, and participant ID as a random effect. The analysis revealed significant main effects for both device type ($p < 0.001$) and stroke count ($p < 0.001$), while the interaction was not significant ($p = 0.126$). These results are shown in Table 7.

Table 6. Microbleeding by scraping method (n = 30).

Method	Microbleeding, n (%)	
	(+)	(−)
TB3	12 (40.0)	18 (60.0)
TB10	19 (63.3)	11 (36.7)
TongueB10	8 (26.7)	22 (73.3)
TongueB30	18 (60.0)	12 (40.0)
S10	2 (6.7)	28 (93.3)
S30	4 (13.3)	26 (86.7)

*p < 0.05, McNemar's test; **p < 0.01, Fisher's exact test; In a comparison between TB3 and TB10, the number of participants with microbleeding was significantly higher in TB10. In a comparison between TongueB10 and TongueB30, the number of participants with microbleeding was significantly higher in TongueB30. A comparison of the 10-stroke groups showed that TB10 had a significantly greater number of participants with microbleeding than TongueB10 and S10. A comparison of the 30-stroke groups showed that TongueB30 had a significantly greater number of participants with microbleeding than S30.

Table 7. Factors associated with the absence of minor bleeding during tongue mucosa scraping (Generalized Linear Mixed Model).

Independent Variables	Coefficient (*B*)	Odds Ratio (*OR*)	95% CI	p-value
Device				
Tongue brush (Ref.)	—	1.00 (Ref.)	—	—
Sponge brush	2.27	9.68	2.98 - 31.40	**p < 0.001**
Toothbrush	-1.78	0.17	0.05 - 0.55	**p = 0.003**
Stroke Count				
30 strokes (Ref.)	—	1.00 (Ref.)	—	—
3 strokes	2.76	15.74	2.98 - 83.14	**p = 0.001**
10 strokes	1.62	5.06	1.56 - 16.42	**p = 0.007**

OR > 1 indicates a higher likelihood of "no bleeding"; Interaction between device and stroke count was not significant (p = 0.126). Generalized Linear Mixed Model (Binomial distribution, Logit link function). Device and stroke count were included as fixed effects. Participant ID was included as a random effect. *p < 0.05.

3.3. Factors Associated with Microbleeding

3.3.1. Medical History and Medications

No significant associations between medical history or medication use with the number of participants with microbleeding were observed (Table 4, Table 5).

3.3.2. Nutritional Status

Assessments of nutritional status performed with the GNRI showed no significant differences in number of participants with microbleeding between the no/mild risk group and moderate/severe risk group (Table 8).

Table 8. GNRI (n = 27).

Method	No/Mild (n = 14)		Moderate/Severe (n = 13)		P
	Microbleeding, n (%)		Microbleeding, n (%)		
	(+)	(−)	(+)	(−)	
TB3	4 (14.8)	10 (37.1)	8 (29.6)	5 (18.5)	0.322
TB10	8 (29.6)	6 (22.2)	11 (40.8)	2 (7.4)	0.561
TongueB10	5 (18.5)	9 (33.3)	3 (11.1)	10 (37.1)	0.700
TongueB30	8 (29.6)	6 (22.2)	10 (37.1)	3 (11.1)	0.763
S10	1 (3.7)	13 (48.2)	1 (3.7)	12 (44.4)	1.000
S30	3 (11.1)	11 (40.8)	1 (3.7)	12 (44.4)	0.606

Fisher's exact test. GNRI: Geriatric Nutritional Risk Index. No significant differences in number of participants with microbleeding were observed between the no/mild risk and moderate/severe risk groups for any of the scraping methods.

3.3.3. Tongue Coating

Tongue coating was evaluated using the Tongue Coating Index (TCI), and the median values in the S10 and S30 groups were significantly lower in participants with (8.33%) as compared to those without microbleeding (61.1%) (**Table 9**; **Figure 1**, **Figure 2**). There were no significant differences in TCI observed among the TB3, TB10, TongueB10, and TongueB30 groups.

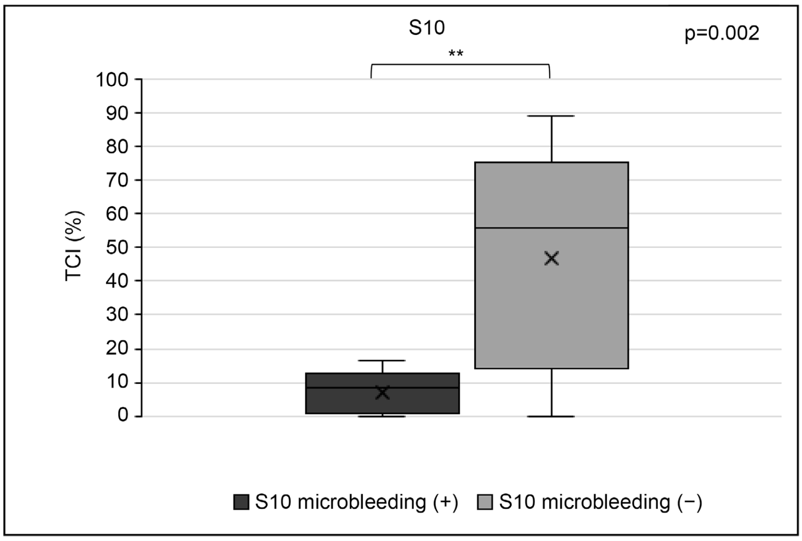
3.3.4. Oral Moisture

When oral moisture was assessed using the clinical diagnostic criteria for oral dryness, the number of participants in the S10 and S30 groups with microbleeding by the scraping method differed significantly, with the moderate/severe dryness group showing a significantly higher incidence as compared to the normal/mild group (**Table 10**). In contrast, when assessing oral mucosal moisture levels using an oral moisture meter and number of microbleeds associated with each scraping method, no significant differences were observed (**Table 11**).

Table 9. TCI (n = 30).

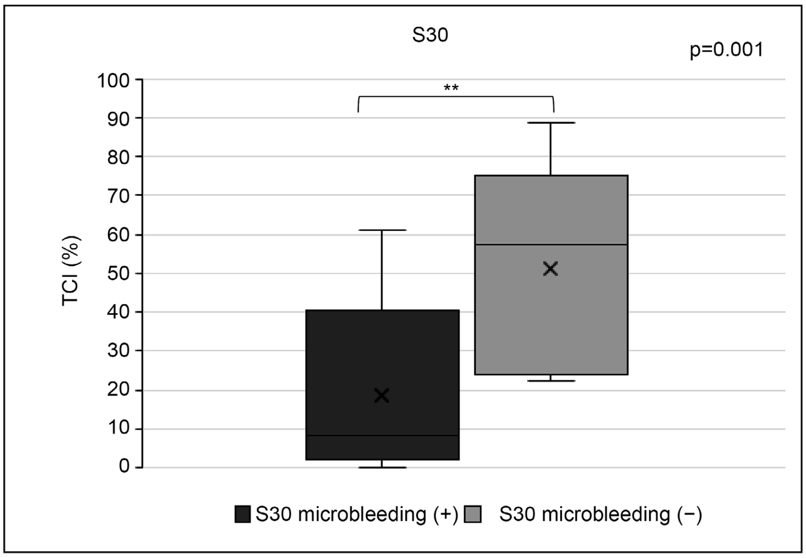
Method	Microbleeding (+)					Microbleeding (−)					P
		TCI (%)					TCI (%)				
	n	Mean	Median	Min	Max	n	Mean	Median	Min	Max	
TB3	12	52.78	55.56	0	88.89	18	52.16	58.33	0	72.22	0.949
TB10	19	53.22	61.11	0	88.89	11	51.01	55.56	22.22	66.67	0.801
TongueB10	8	48.61	61.11	0	88.89	22	53.79	55.56	22.22	83.33	0.713
TongueB30	18	51.54	58.33	0	88.89	12	53.70	58.33	22.22	72.22	0.802
S10	2	8.33	8.33	0	16.67	28	55.56	61.11	0	88.89	**0.002****
S30	4	19.44	8.33	0	61.11	26	57.48	61.11	22.22	88.89	**0.001****

t-test. **$p < 0.01$. In the S10 and S30 groups, TCI values were significantly lower in participants with microbleeding.



t-test, **p < 0.01. In the S10 group, TCI was significantly lower in participants with microbleeding.

Figure 1. Relationship between TCI and microbleeding in S10 group.



t-test, **p < 0.01. In the S30 group, TCI was significantly lower in participants with microbleeding.

Figure 2. Relationship between TCI and microbleeding in S30 group.

Table 10. Oral dryness (n = 30).

Method	Normal/Mild (n = 25)		Mod/Sev (n = 5)		P
	Microbleeding, n (%)		Microbleeding, n (%)		
	(+)	(−)	(+)	(−)	
TB3	8 (26.7)	17 (56.6)	4 (13.3)	1 (3.4)	0.128
TB10	14 (46.7)	11 (36.6)	5 (16.7)	0 (0.0)	0.129
TongueB10	4 (13.3)	21 (70.0)	4 (13.3)	1 (3.4)	**0.011***

Continued

TongueB30	13 (43.3)	12 (40.0)	5 (16.7)	0 (0.0)	0.066
S10	0 (0.0)	25 (83.4)	2 (6.6)	3 (10.0)	**0.023***
S30	1 (3.4)	24 (80.0)	3 (10.0)	2 (6.6)	**0.009****

Fisher's exact test. *p < 0.05, **p < 0.01. Clinical diagnostic criteria: Grade 0 (normal): No oral dryness or increased salivary viscosity. Grade 1 (mild): Increased salivary viscosity and slightly reduced salivary volume; saliva appears stringy. Grade 2 (moderate): Markedly reduced salivary volume; fine bubbles observed. Grade 3 (severe): No saliva visible on tongue mucosal surface. In the TongueB10, S10, and S30 groups, the number of participants with microbleeding was significantly higher in the moderate/severe group as compared with the normal/mild group.

Table 11. Oral mucosal moisture (n = 30).

Method	Normal (n = 19)/Borderline (n = 9)		Dry (n = 2)		P
	Microbleeding, n (%)		Microbleeding, n (%)		
	(+)	(−)	(+)	(−)	
TB3	10 (33.4)	18 (60.0)	2 (6.6)	0 (0.0)	0.152
TB10	17 (56.7)	11 (36.7)	2 (6.6)	0 (0.0)	0.520
TongueB10	6 (20.0)	22 (73.4)	2 (6.6)	0 (0.0)	0.064
TongueB30	16 (53.4)	12 (40.0)	2 (6.6)	0 (0.0)	0.503
S10	1 (3.3)	27 (90.0)	1 (3.3)	1 (3.3)	0.131
S30	3 (10.0)	25 (83.4)	1 (3.3)	1 (3.3)	0.253

Fisher's exact test. Classification criteria: Normal: ≥29.6; Borderline: 28.0 - 29.5; Dry: ≤27.9; No significant differences in number of participants with microbleeding were observed among the scraping methods according to oral mucosal moisture level.

3.3.5. Number of Present Teeth

In the TB3 group, participants with fewer present teeth had significantly higher rates of microbleeding. Additionally, participants in the TongueB30 and S10 groups with fewer present teeth also showed significantly higher rates of microbleeding (Table 12). Five of the participants had 20 or more present teeth and none of those exhibited microbleeding under the TB3, TongueB10, TongueB30, S10, or S30 conditions.

Table 12. Present teeth (n = 30).

Method	0 - 10 (n = 18)		11 - 20 (n = 7)		≥21 (n = 5)		P
	Microbleeding, n (%)		Microbleeding, n (%)		Microbleeding, n (%)		
	(+)	(−)	(+)	(−)	(+)	(−)	
TB3	10 (33.4)	8 (26.6)	2 (6.6)	5 (16.7)	0 (0.0)	5 (16.7)	**0.039***
TB10	13 (43.4)	5 (16.7)	4 (13.3)	3 (10.0)	2 (6.6)	3 (10.0)	0.167
TongueB10	7 (23.3)	11 (36.7)	1 (3.3)	6 (20.0)	0 (0.0)	5 (16.7)	0.132
TongueB30	15 (50.0)	3 (10.0)	3 (10.0)	4 (13.3)	0 (0.0)	5 (16.7)	**0.000****
S10	2 (6.6)	16 (53.4)	0 (0.0)	7 (23.3)	0 (0.0)	5 (16.7)	**0.000****
S30	3 (10.0)	15 (50.0)	1 (3.3)	6 (20.0)	0 (0.0)	5 (16.7)	0.137

t-test. *p < 0.05, **p < 0.01. In the TB3, TongueB30, and S10 groups, participants with fewer present teeth showed a significantly higher incidence of microbleeding.

4. Discussion

This study was conducted to evaluate microbleeding of the tongue mucosa during tongue cleaning and also determine its associations with cleaning device, number of scraping strokes, medical history and medication use, nutritional status, tongue coating, oral moisture, and number of present teeth. Microbleeding was observed under all six experimental conditions. With use of 10 strokes, TB10 showed the highest number of participants with microbleeding, followed by TongueB10 and S10, while with 30 strokes, TongueB30 showed greater microbleeding than S30. Regardless of the cleaning device used, an increase in the number of scraping strokes led to a higher incidence of microbleeding. However, because the sponge brush was made of a flexible material, the applied pressure was likely dispersed rather than concentrated at a single point, resulting in lower invasiveness and fewer cases of microbleeding. These findings suggest that use of a sponge brush provides safer cleaning of the tongue mucosa as compared with a toothbrush or tongue brush. Although previous reports have indicated that fewer than 30 strokes with a tongue brush generally does not induce microbleeding [16], that was observed in 60% of the present participants in the TongueB30 group. This finding suggests that microbleeding may occur in elderly individuals even with 30 or fewer strokes, therefore, it may be beneficial to determine the number of strokes with consideration for individual characteristics.

No significant interaction was observed between the type of device and the number of strokes ($p = 0.126$), suggesting that the increase in bleeding risk associated with higher stroke counts is a consistent trend across all tested devices.

No associations were found between medical history or medication use and microbleeding. Oral mucosal lesions are frequently observed in individuals who are elderly [28], and have been reported to be associated with systemic diseases and medication use. However, all of the participants in this study were elderly with underlying medical conditions and taking various medications; therefore, the influence of medical history or medication use may not have been detectable.

There were also no associations observed between GNRI findings and the number of participants with microbleeding across the scraping methods employed. Micronutrient deficiencies, such as vitamin B12 deficiency (Hunter's glossitis) and iron deficiency anemia-related glossitis, have been reported to affect the tongue mucosa [29]. The GNRI is a systemic nutritional index calculated based on serum albumin, height, and weight, and does not necessarily reflect specific micronutrient deficiencies. Therefore, chronic nutritional deficiency-related mucosal changes may not have been reflected in the GNRI values obtained, which may explain the lack of association with microbleeding.

Regarding tongue coating, TCI values were significantly lower in participants in the S10 and S30 groups with microbleeding. A value of ≥50% is considered to be indicative of poor oral hygiene and tongue coating thickness reflects the number of anaerobic bacteria, thus lower TCI values are generally regarded as favorable. However, approximately half of elderly individuals exhibit atrophy of lingual papillae [30], and a reduction in tongue coating may reflect papillary atrophy or shortening of the filiform papillae [31]. Filiform papillae are comprised of keratinized tissue and contribute to protection against mechanical stimulation. Therefore, a low TCI value may indicate reduced resistance to mechanical stimulation. Lower TCI values were observed in the present participants with microbleeding, thus more gentle tongue cleaning may be required when TCI is low.

Using clinical diagnostic criteria for oral dryness, participants with moderate to severe dryness in the S10 and S30 groups were found to have significantly more microbleeding. In contrast, no association was found between mucosal moisture level measured with an oral moisture meter and microbleeding. This discrepancy may be explained by differences in measurement principles, as clinical diagnostic criteria were used to assess saliva distribution on the tongue surface and oral moisture meter was employed to measure submucosal moisture content. It is thus suggested that surface moisture may play a protective role against mechanical stimulation.

Participants with fewer present teeth had significantly more microbleeding under several scraping conditions. In contrast, participants with 21 or more present teeth showed no microbleeding under any of the conditions except TB10. It is possible that in individuals with many present teeth, the tongue mucosa is regularly exposed to mechanical stimulation through contact with the hard tooth surfaces, thereby increasing resistance to scraping-induced mechanical stress.

The urine test strip method used in this study has not been widely validated for detecting microbleeding in the oral cavity. Therefore, the results should be interpreted together with clinical observations. Further studies are required to evaluate the sensitivity and specificity of this method in the oral environment.

In this study, safety was evaluated based on the occurrence of microbleeding, which was used as an indicator of mucosal injury caused by mechanical tongue cleaning. The tongue mucosa, particularly in older adults, can be vulnerable to mechanical stimulation, and excessive cleaning may lead to mucosal damage. However, the present study focused primarily on safety and did not directly evaluate cleaning efficacy, such as the removal of tongue coating or reduction of bacterial load.

This study has several limitations. It was a cross-sectional study conducted at only two facilities and the number of participants was relatively few (n=30), which may limit generalizability and introduce potential bias. Only three stroke conditions (3, 10, and 30 strokes) were evaluated and other possible related settings were not examined. All participants were elderly with underlying diseases and diverse medication use, thus the study population may have been predisposed to increased susceptibility of the tongue mucosa to mechanical stimulation. In addition, micronutrient deficiency related to glossitis was not evaluated. Finally, denture use varied among the participants, including some with unilateral denture use and/or inconsistent wearing times, and the potential influence of denture status on tongue mucosal condition was not assessed. Future studies with larger sample sizes and expanded experimental conditions are needed.

5. Conclusion

To ensure safe tongue cleaning in elderly individuals, the present findings indicate that it is important to appropriately select both the cleaning device and number of scraping strokes according to the condition of the tongue mucosa.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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