IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 25, Issue 6 Ser. 2 (June. 2026), PP 32-38
www.iosrjournals.org

Effect of Winkel Tongue Coating Index-Guided Tongue Cleaning and Oral Hygiene Instructions on Halitosis: A Prospective Clinical Study

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Abstract
Background:
Halitosis, commonly known as oral malodor, is a prevalent oral health condition with significant social and psychological consequences. The majority of halitosis cases originate from the oral cavity, with tongue coating recognized as one of the primary etiological factors due to its role as a reservoir for anaerobic microorganisms responsible for volatile sulfur compound production. Mechanical tongue cleaning has been recommended as an effective approach for reducing oral malodor; however, limited short-term clinical evidence exists regarding structured tongue cleaning guided by objective tongue coating assessment.
Aim:
To evaluate the effectiveness of Winkel Tongue Coating Index-guided tongue cleaning combined with oral hygiene instructions in reducing halitosis among adults.
Materials and Methods:
The present prospective clinical study was conducted among 64 participants aged 18–60 years presenting with complaints of halitosis and visible tongue coating. Baseline demographic details were recorded, and tongue coating was assessed using the Winkel Tongue Coating Index (WTCI), while halitosis was evaluated using the organoleptic scoring method. Participants received standardized tongue cleaning instructions using a tongue scraper along with routine oral hygiene instructions, including twice-daily tooth brushing and rinsing after meals. Follow-up assessment was performed after 6 days, during which WTCI and organoleptic scores were reassessed. Data were entered into Microsoft Excel and analyzed using SPSS software. Statistical analysis included paired t-test, Wilcoxon signedrank test, and chi-square test, with $p < 0.05$ considered statistically significant.
Results:
The study included participants with a mean age of 39.11 ± 9.39 years, comprising 54.7% males and 45.3% females. A statistically significant reduction in halitosis severity was observed following the intervention ($p < 0.001$). At baseline, 25% of participants exhibited severe malodor and 28.1% presented with strong malodor. Following intervention, severe malodor was completely eliminated (0%), while strong malodor reduced to 9.4%. Participants demonstrated a clear shift toward milder organoleptic categories, indicating significant clinical improvement.
Conclusion:
Winkel Tongue Coating Index-guided tongue cleaning combined with oral hygiene instruction is an effective short-term intervention for reducing halitosis. Structured tongue hygiene assessment and patient education may serve as practical and economical approaches for management of intraoral halitosis in routine dental practice.

Date of Submission: 28-05-2026 Date of Acceptance: 06-06-2026

I. Introduction

Halitosis, commonly referred to as oral malodor or bad breath, is a common oral health condition that significantly affects social interactions, self-esteem, and overall quality of life. It is often regarded as an

underestimated dental problem despite its considerable psychosocial impact. Epidemiological evidence suggests that halitosis affects a substantial proportion of the population worldwide. In a systematic review and meta-analysis, Silva et al. (2018) reported the estimated global prevalence of halitosis to be 31.8%, although variations were observed due to differences in diagnostic criteria and study populations [1]. Similarly, Rösing and Loesche (2011) reported prevalence ranging from 2.4% in severe clinically diagnosed halitosis to 42% in self-reported cases, demonstrating wide epidemiological variation [2]. A Swiss population-based study conducted by Bornstein et al. (2009) found clinically detectable halitosis in a notable proportion of adults and observed an association with increasing age and inadequate oral hygiene [3]. Du et al. (2019) reported a prevalence of 65.9% among Chinese subjects, with tongue coating and poor oral hygiene identified as major contributing factors, while Ueno et al. (2018) documented a prevalence of 44.9% in a Japanese population [4].

Although halitosis is often commonly attributed by the general public to gastrointestinal or systemic causes, scientific evidence indicates that nearly 85–90% of halitosis cases originate within the oral cavity, making it predominantly a dental concern [5]. Intraoral halitosis results primarily from microbial degradation of organic substrates present in the oral cavity, leading to the release of volatile sulfur compounds such as hydrogen sulfide, methyl mercaptan, and dimethyl sulfide, which are responsible for the unpleasant odor [5].

Among the various intraoral causes, tongue coating has consistently been identified as one of the most significant etiological factors. In a large clinical analysis of 2000 patients attending a specialized halitosis clinic, Quirynen et al. (2009) reported that tongue coating alone was responsible for 43% of halitosis cases, while tongue coating in combination with gingival or periodontal conditions contributed to an additional 18% [6]. The dorsal surface of the tongue, particularly its posterior region, provides a favorable environment for microbial colonization due to its papillary structure, reduced oxygen tension, and retention of desquamated epithelial cells, food debris, and salivary proteins. These factors facilitate bacterial metabolism and the production of malodor-causing compounds [7].

Accurate diagnosis of halitosis is essential for proper management. Several methods have been described, including gas chromatography, sulfide monitoring devices, microbiological testing, and organoleptic assessment. Among these, the organoleptic method remains the most clinically accepted gold standard because of its simplicity, practicality, and close resemblance to real-life odor perception [8]. Despite its subjective nature, it remains highly valuable in routine clinical settings where advanced instrumentation may not be available.

Assessment of tongue coating is equally important in identifying and monitoring intraoral halitosis. The Winkel Tongue Coating Index (WTCI) is a simple and validated clinical tool used to assess tongue coating by dividing the tongue dorsum into six sections and grading each according to coating severity [8]. This index allows objective clinical evaluation, facilitates monitoring of treatment progress, and improves patient awareness regarding tongue hygiene.

Mechanical tongue cleaning has been widely recommended as an effective intervention for reducing oral malodor. Seemann et al. (2001) demonstrated that tongue scraping significantly reduced volatile sulfur compound levels compared with conventional tooth brushing [9]. Similarly, a Cochrane review by Outhouse et al. (2006) concluded that tongue scraping may provide modest but beneficial reduction in halitosis compared to routine oral hygiene alone [10]. Since tongue coating serves as a major reservoir for anaerobic bacteria associated with halitosis, targeted tongue cleaning may provide an effective, simple, and economical management approach.

However, limited short-term clinical evidence exists regarding the effectiveness of structured tongue cleaning guided by objective tongue coating assessment indices such as WTCI. Therefore, the present study was undertaken to evaluate the effect of Winkel Tongue Coating Index-guided tongue cleaning along with oral hygiene instructions on halitosis.

II. Methodology

The present prospective clinical study was conducted to evaluate the effect of Winkel Tongue Coating Index (WTCI)-guided tongue cleaning along with oral hygiene instructions on halitosis among adults presenting with oral malodor. The study was carried out over a period of one week among participants reporting to the dental institution with complaints of bad breath and visible tongue coating.

A total of 64 participants were included in the study. Individuals aged between 18 and 60 years who complained of halitosis and demonstrated clinically visible tongue coating were considered eligible for participation. Participants who were unwilling to participate, had no visible tongue coating, or had conditions likely to interfere with halitosis assessment were excluded from the study.

At baseline, demographic details including age and gender were recorded. Clinical assessment of tongue coating was performed using the Winkel Tongue Coating Index, a validated index commonly used for assessment of tongue biofilm accumulation [10]. The dorsum of the tongue was divided into six sections, comprising three anterior and three posterior regions. Each section was scored based on the extent of coating,

where score 0 indicated absence of coating, score 1 indicated light coating, and score 2 indicated heavy coating, with a total possible score ranging from 0 to 12.

Halitosis assessment was performed using the organoleptic method, which remains the most widely accepted clinical method for breath odor evaluation [6]. Participants were instructed prior to examination, and breath odor was assessed using a standardized scoring scale ranging from 0 to 5, where 0 represented no detectable odor, 1 questionable odor, 2 slight malodor, 3 moderate malodor, 4 strong malodor, and 5 severe malodor.

Following baseline assessment, all participants received standardized demonstration of tongue cleaning using a tongue scraper. They were instructed to gently clean the tongue from posterior to anterior direction two to three times daily to ensure effective removal of tongue coating while avoiding trauma to the soft tissues. In addition, standardized oral hygiene instructions were provided, including twice-daily tooth brushing and rinsing after meals to maintain oral cleanliness and reduce microbial accumulation.

Participants were recalled after six days for follow-up clinical examination. During the followup visit, tongue coating was reassessed using the same WTCI criteria, and halitosis was reevaluated to assess changes following intervention. Participant compliance with tongue cleaning and oral hygiene instructions was also noted.

The collected data were entered into Microsoft Excel and statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software. Results were represented in the form of graphs and tables. Descriptive statistics were used to summarize demographic and clinical findings. Comparison between pre- and post-intervention continuous variables was performed using paired t-test, while categorical variable comparison was analyzed using chisquare test wherever appropriate. A p-value of less than 0.05 was considered statistically significant.

III. Results

Table 1 Mean Age and Gender Distribution of the Study Participants

		Mean	Standard Deviation
Age		39.11	9.39
		n	%
Gender	Male	35	54.7%
	Female	29	45.3%

The present study included a total of 64 participants with a mean age of **39.11 ± 9.39 years**, indicating that the study population predominantly consisted of middle-aged adults. The relatively moderate standard deviation suggests that the participants represented a fairly broad age range, reflecting variability in age distribution within the sample. In terms of gender distribution, **males constituted 54.7% (n=35)** of the study participants, while **females accounted for 45.3% (n=29)**.

Table 2 Mean Distribution and Comparison of the Pre and Post Wrinkle Score

		N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t	p Value
Wrinkle Score	Pre	64	5.2969	1.52939	.19117	1.65625	24.493	<0.001*
	Post	64	3.6406	1.47322	.18415			

*p <0.05, statistically significant (Paired t test)

The comparison of wrinkle scores before and after the intervention demonstrated a statistically significant reduction in wrinkle severity. The **mean pre-treatment wrinkle score was 5.2969 ± 1.52939**, whereas the **mean post-treatment wrinkle score decreased to 3.6406 ± 1.47322**. The observed **mean difference of 1.65625 units** indicates a clinically meaningful reduction in wrinkle score following the intervention. Statistical analysis using the **paired t-test** revealed a highly significant difference between pre- and post-treatment scores (**t = 24.493, p < 0.001**), indicating that the reduction in wrinkle score was not due to chance.

Table 3 Distribution and Pre and Post Comparison of the Organoleptic

	Organoleptic (pre)	Organoleptic (post)	z Value	p Value

	n	%	n	%		
Absence of Odor	0	0.0%	0	0.0%	-7.133	<0.001*
Questionable Odor	0	0.0%	13	20.3%		
Slight Malodor	11	17.2%	25	39.1%		
Moderate Malodor	19	29.7%	20	31.3%		
Strong Malodor	18	28.1%	6	9.4%		
Severe Malodor	16	25.0%	0	0.0%		
Total	64	100.0%	64	100.0%		
Chi Square	2.375a		12.875a			
p Value	3		0.005$			

$ - p<0.05, statistically significant (Chi Square test of Proportion), *p <0.05, statistically significant (Wilcoxon Signed Rankk test)

The assessment of organoleptic scores demonstrated a substantial improvement in odor status following the intervention. Prior to treatment, none of the participants exhibited **absence of odor or questionable odor**, indicating that all subjects had some degree of malodor. Specifically, **17.2% (n=11)** participants had **slight malodor**, **29.7% (n=19)** had **moderate malodor**, **28.1% (n=18)** had **strong malodor**, and **25.0% (n=16)** presented with **severe malodor**, highlighting a considerable baseline burden of oral malodor among participants.

Following the intervention, notable changes were observed in the distribution of organoleptic scores. The proportion of participants with **questionable odor increased to 20.3% (n=13)**, while the percentage with **slight malodor increased to 39.1% (n=25)**. Although **moderate malodor remained relatively stable (31.3%, n=20)**, there was a marked decline in the prevalence of **strong malodor from 28.1% to 9.4% (n=6)**. Importantly, **severe malodor was completely eliminated post-treatment (0.0%)**, indicating a substantial clinical improvement in odor severity.

The statistical significance of these changes was evaluated using the **Wilcoxon Signed Rank test**, which demonstrated a highly significant difference between pre- and posttreatment organoleptic scores (**$z = -7.133$, $p < 0.001$**). This finding confirms that the intervention produced a statistically significant improvement in oral malodor severity. Additionally, the **Chi-square test of proportion** showed a statistically significant difference in score distribution (**$\chi^2 = 12.875$, $p = 0.005$**), suggesting a meaningful shift from severe and strong malodor categories toward milder forms of odor after treatment. Collectively, these results indicate that the intervention was highly effective in improving organoleptic outcomes and reducing the severity of malodor among study participants.

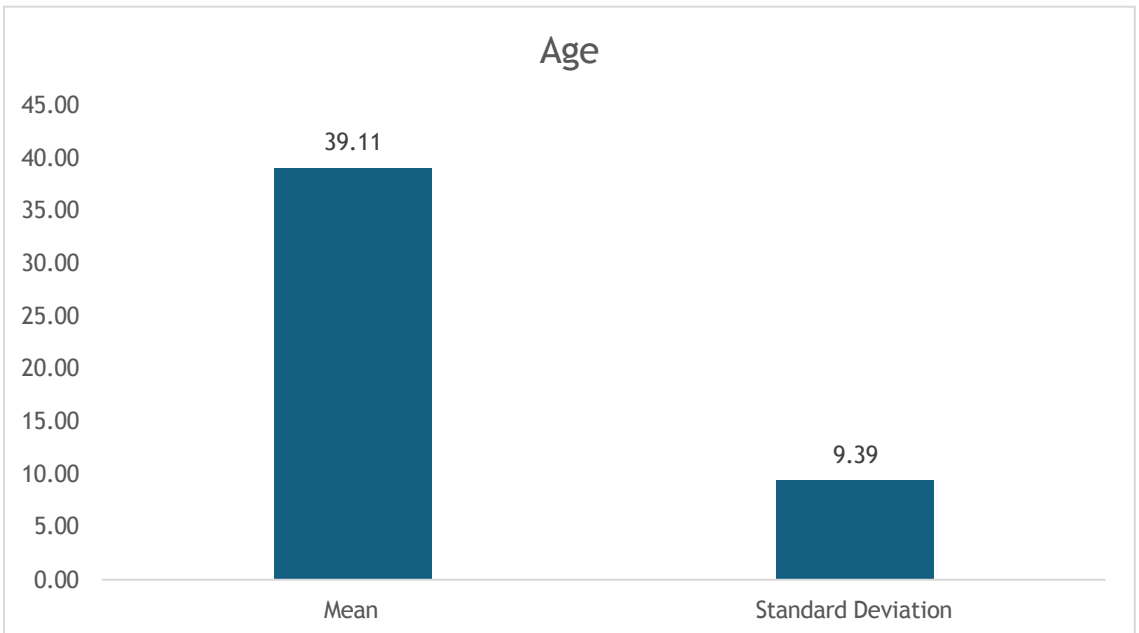

Fig. 1: Age distribution of study participants (values presented as mean ± standard deviation

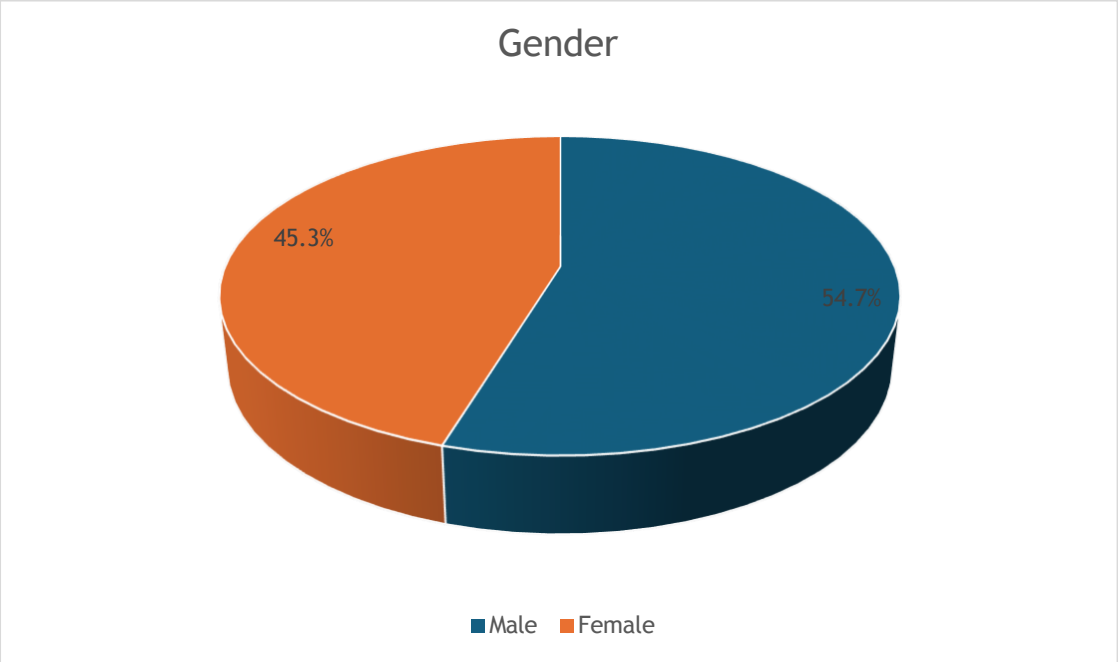

Fig. 2: Gender distribution of study participants showing 54.7% males and 45.3% females.

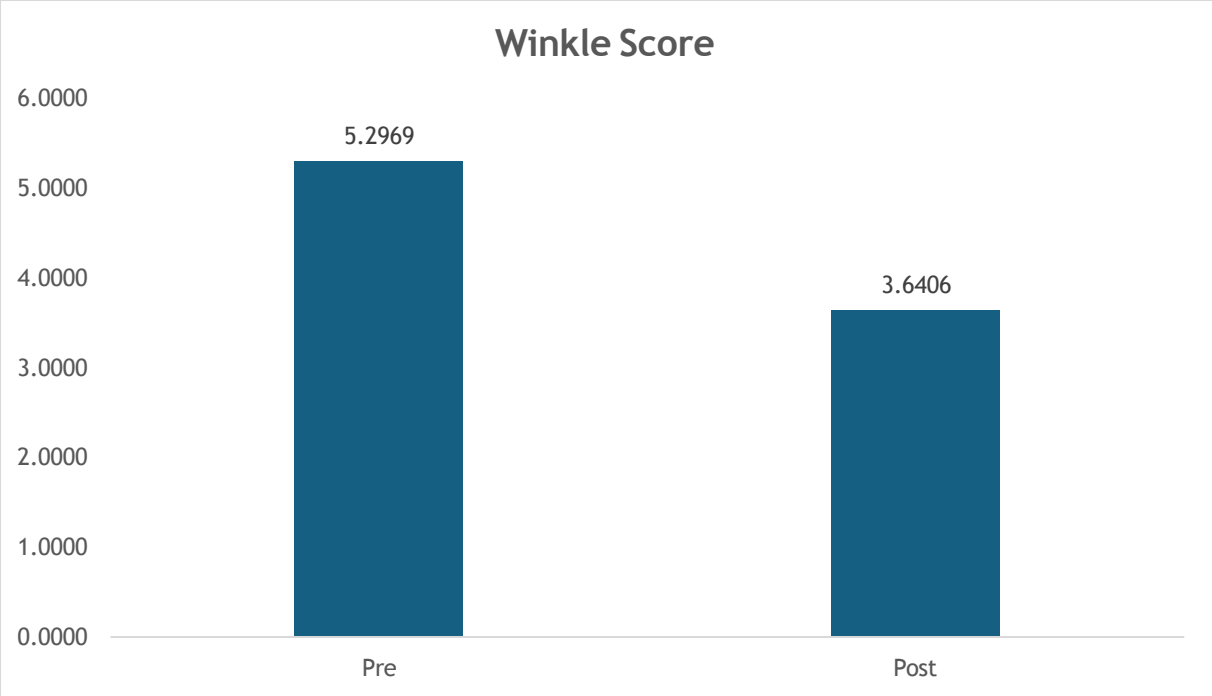

Fig. 3: Comparison of mean Winkle scores before and after intervention, showing a reduction from 5.30 to 3.64.

IV. Discussion

Halitosis is a frequently encountered oral health complaint that predominantly originates from intraoral causes, particularly tongue coating and inadequate oral hygiene. The dorsum of the tongue serves as an ideal reservoir for anaerobic microorganisms due to its papillary surface architecture, allowing retention of food debris, desquamated epithelial cells, and bacterial biofilm, all of which contribute to volatile sulfur compound production and subsequent oral malodor. Therefore, interventions targeting tongue biofilm removal remain clinically relevant in the management of intraoral halitosis.

The findings of the present study revealed a marked reduction in organoleptic malodor scores following the intervention. At baseline, 25% of participants presented with severe malodor and 28.1% exhibited strong malodor, indicating a substantial burden of oral malodor within the study population. Following WTCI-guided tongue cleaning and oral hygiene reinforcement, severe malodor was completely eliminated (0%), while the prevalence of strong malodor significantly reduced to 9.4%. Simultaneously, participants shifted toward milder categories of oral malodor, indicating clinically meaningful improvement in breath quality. Comparable findings were reported by AlSadhan et al. (2022), who observed approximately 35–50% improvement in clinical halitosis scores following mechanical tongue cleaning interventions, supporting the effectiveness of biofilm disruption in reducing oral malodor [11].

The improvement observed in the present study may be attributed to the combined effect of structured tongue cleaning and reinforcement of oral hygiene practices. Mechanical cleaning reduces microbial accumulation and removes proteinaceous substrates responsible for volatile sulfur compound generation. Bikov et al. (2023) reported that consistent tongue hygiene practices significantly improved intraoral halitosis outcomes through reduction in microbial colonization and oral malodor severity [12].

Tongue coating remains one of the most consistently identified etiological contributors to halitosis. Seerangaiyan et al. (2021) highlighted that the posterior dorsum of the tongue serves as the principal microbial niche for halitosis-associated anaerobic bacteria and reported that tongue coating contributes to nearly 40–50% of intraoral halitosis cases, emphasizing the importance of direct tongue biofilm control [13]. Similarly, Renvert et al. (2020) emphasized that approximately 90% of halitosis cases originate intraorally, further supporting the rationale behind the intervention used in the present study [14].

The use of the Winkel Tongue Coating Index in the present study provided a structured and clinically practical method for tongue coating assessment. Objective assessment tools improve consistency in clinical examination and facilitate patient motivation by making tongue hygiene visually understandable. This structured monitoring likely enhanced compliance and contributed positively to the favorable treatment outcomes observed.

Improvement in oral malodor may also be associated with reinforcement of oral hygiene practices provided during the intervention. Reduction in plaque accumulation and food debris decreases substrate availability for anaerobic bacterial metabolism. Porta et al. (2021) reported significant short-term improvement in halitosis outcomes when oral hygiene reinforcement was combined with tongue cleaning measures [15]. Similarly, Deutscher et al. (2019) demonstrated that professional plaque control and non-surgical periodontal therapy significantly improved oral halitosis in patients with periodontal disease, highlighting the importance of comprehensive oral hygiene measures in malodor control [18].

Mechanical tongue cleaning remains one of the most practical, economical, and accessible interventions for halitosis management. Motta et al. (2022) demonstrated clinically significant reduction in halitosis parameters following tongue cleaning interventions, reinforcing its effectiveness as a first-line treatment approach [16]. Likewise, Villa et al. (2014) reported associations between oral hygiene status, tongue coating, and halitosis prevalence, further supporting the role of routine tongue hygiene in preventing oral malodor [17].

Accurate diagnosis and classification remain essential in effective halitosis management. Aydin et al. (2014) proposed a revised classification system for halitosis to improve diagnostic clarity and guide appropriate management strategies [19]. In addition, Dadamio et al. (2021) emphasized that structured diagnostic and management protocols improve treatment outcomes in clinical practice, particularly in distinguishing genuine intraoral halitosis from other causes [20]. These findings support the clinical relevance of using standardized assessment approaches such as WTCI-guided intervention.

Certain limitations should be considered while interpreting the findings of the present study. The short duration of follow-up limits evaluation of long-term sustainability and participant compliance. Additionally, absence of instrumental volatile sulfur compound measurement restricts objective quantitative assessment of malodor reduction. The lack of a control group also limits direct comparison with conventional oral hygiene measures alone.

Despite these limitations, the findings of the present study demonstrate that WTCI-guided tongue cleaning combined with oral hygiene instruction is an effective short-term intervention for reducing halitosis. The results reinforce the importance of tongue hygiene assessment, patient education, and incorporation of structured tongue cleaning practices into routine preventive dental care for effective management of intraoral halitosis.

V. Conclusion

The present study demonstrated that Winkel Tongue Coating Index-guided tongue cleaning combined with oral hygiene instructions was effective in significantly reducing halitosis over a short-term period. A marked improvement in organoleptic malodor scores was observed following the intervention, with complete

elimination of severe malodor and a substantial reduction in strong malodor cases. These findings highlight the important role of tongue coating in the etiology of intraoral halitosis and reinforce the effectiveness of mechanical tongue cleaning as a simple, economical, and clinically practical intervention. Structured assessment using WTCI not only facilitated objective monitoring of tongue coating but also improved patient awareness and compliance with oral hygiene practices. Within the limitations of the study, WTCI-guided tongue cleaning may be considered an effective adjunctive approach for short-term management of intraoral halitosis and can be incorporated into routine preventive dental care.

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