

Short-Term Efficacy of Oral Hygiene Instruction on Gingival Inflammation and Plaque Control Across Age Groups

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Abstract

Background: Gingivitis is an inflammation of the gingiva induced primarily by dental plaque, which may advance to periodontitis if left untreated. Enhancement of oral hygiene by patient instruction and encouragement is essential, yet research addressing short-term outcomes in a variety of age groups is scarce.

Objective: To assess the immediate efficacy of oral hygiene education (OHI) and motivation on gingival inflammation and plaque control in adults of different age groups.

Methods: This was a longitudinal study included 50 patients, aged 18–53 years, who presented at the Department of Dentistry, Bilad Al-Rafidain University College, diagnosed with gingivitis. Participants received a 30-minute OHI session once (Bass technique demonstration, plaque disclosure, motivational counseling). Baseline and a follow-up measurement, a week after intervention, were applied to measure PI, GI, and BOP%. We used paired t-tests and chi-square tests to look at the data, with a significance level of $p < 0.05$.

Results: We found that there was a statistically significant decrease in by 76.0% (4.756 ± 0.21 to 1.139 ± 0.14 , $p < 0.001$), GI decreased by 47.2% (5.63 ± 0.24 to 2.97 ± 0.25 , $p < 0.001$), and BOP% decreased by 38.6% (40.54 ± 2.52 to 24.88 ± 1.96 , $p < 0.001$).

Conclusion: A single, well-structured OHI session reduced plaque accumulation and gingivitis by a week. These findings are in favor of the use of motivational, chairside OHI as a highly effective short-term intervention in decreasing periodontal disease, although longer-term follow-up is called for.

Keywords: Bleeding on Probing, Gingival Inflammation, Oral Health, Oral Hygiene Instruction, Plaque Control

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1. Introduction

Periodontal disease is a long-lasting inflammatory condition that affects the gums, periodontal ligament, and alveolar bone, which support the teeth. It is one of the most common problems in oral health around the world [1]. It begins as gingivitis, a reversible inflammation due to bacterial plaque accumulation; without effective intervention, it may progress into periodontitis, causing irreversible damage, clinical attachment loss, pocket formation, and ultimately tooth loss [2]. Poor oral hygiene, microbial dysbiosis, and an exaggerated host immune response are central to this progression [3]. Early detection and intervention during the gingivitis stage are crucial, not only to prevent tissue destruction but also to reduce risk factors associated with systemic conditions [3].

Dental plaque as a major etiological factor for periodontal disease is the community of microorganisms found on a tooth surface as a biofilm, embedded in a

matrix of polymers of host and bacterial origin [4]. There is a set order to how dental plaque forms, which creates a species-rich, physically and functionally organized bacteria population [5]. Different steps in the formation of a plaque are acquired pellicle formation, reversible adhesion between the cell surface and the pellicle, which can lead to stronger adhesin-receptor mediated attachment, co-adhesion, which allows secondary colonizers to attach to cells that are already attached, multiplication, and biofilm formation [6].

Plaque control can be achieved by oral hygiene procedure which is crucial for maintaining healthy gums and preventing oral diseases such as gingivitis and periodontitis [7]. Procedures involved in mechanical plaque control comprise two aspects: self-performed related to the patient's performance of mechanical plaque removal by teeth brushing and other adjunctive aids and the second aspect involve professional plaque control implemented through professional scaling and debridement [8]. Good oral hygiene practices, including

regular brushing and flossing, are essential for controlling plaque buildup, which is a leading cause of gum disease. In addition to daily oral hygiene habits, professional oral hygiene instruction and motivation can help patients improve their oral health outcomes [9].

Mechanical plaque control (tooth brushing, interdental cleaning), together with well-designed oral hygiene instruction (OHI), aided by motivational factors, provides the mainstay of preventative therapy [10]. More current research has clarified such interventions: for example, Palanisamy et al. found that technological advances in hygiene aids (better-designed toothbrushes, interdental brushes, ergonomic heads) have a dramatic beneficial impact upon plaque control and gingival health, when used appropriately by patients [11]. In addition, Shafae et al. [12] compared software-based, social network-based, and assistant-delivered methods of oral hygiene instruction in orthodontic patients and found lower Plaque Index (PI) and Gingival Index (GI) in the software compared to assistant-delivered groups at 1 month. Similarly, Buck et al. demonstrated that tailored oral hygiene advice using video technology produced greater changes in OHI compliance and gingival health outcomes compared to generic instruction [12].

Even in spite of recent advances in periodontal research, there remain a few essential gaps: very short-term outcomes (e.g. at one week post-OHI + motivational intervention) are seldom investigated, though early changes may predict longer-term behavior and periodontal status; most research lacks essential methodological details such as intra-examiner consistency, calibration, effect sizes along with their confidence intervals, and exact p-values, thereby compromising accuracy and reproduction; age stratification (younger compared to older subjects) is very often superficial or not provided, in spite of a recognised fact that age has a conformity over manual dexterity, motivation, as well as consistency in behavior; and adherence/motivational factors are very often incorporated into research protocols but seldom described or quantified in a sufficiently detailed manner to ascertain their personal contributions. Accordingly, this research attempts to assess the one-week effect of a structured session in oral hygiene instruction strengthened by motivational reinforcement upon plaque aggregation, inflammation of the gingiva, as well as bleeding upon probing, comparing results between younger and older adult groups.

2. Materials and Methods

The sample population consisted of patients who attended the Department of Dentistry, Bilad Al-Rafidain University College. More than 90 patients were initially screened, whereas only 50 enrolled participants who met the inclusion criteria participated in the research. The participants' ages ranged from 18 to 53 years, and they were all freely permitted to participate after providing their informed consent. The 50-sample size was computed

from pilot data, which indicated that 80% power would remain to detect a mean reduction of at least 1.0 in PI at a level of $\alpha = 0.05$. All participants were systemically well, had a minimum of 20 teeth, and exhibited clinical signs of gingivitis, such as during probing, without a prior history of periodontal treatment during the previous six months.

Patients who had systemic disorders that would affect periodontal health, current use of antibiotics or anti-inflammatory drugs (within three months), pregnancy or lactation, habits of being a smoker, or orthodontic appliances were excluded from this research. Each participant was exposed to a clinical exam from a printed questionnaire, exactly designed for this research, in two sections: the first retrieved demographics and personal information, whereas the second calculated clinical periodontal values based upon oral hygiene status and gingival inflammation, such as PI, GI, and BOP%. The participants were evaluated in two-time intervals: firstly, in order to record a PI, GI, and BOP baseline data, and after a week, after providing an oral hygiene instruction (OHI) and motivation in order to assess post-intervention periodontal parameters in opposition to baseline measurements.

2.1 Inclusion criteria

- People who are healthy.
- At least 20 teeth should be present in the mouth.
- Patient diagnosed with gingivitis.
- Clinically, there is a patient who is bleeding when they are probed.
- A person who hadn't had any dental treatments in the last six months
- Patient willing to give the informed consent and willing to comply with the study was selected

2.2 Exclusion criteria

- People who have taken medicines or any other drugs in the past three months.
- Women who are pregnant or nursing.
- Patients with serious health problems.
- Smokers.
- Patient with orthodontic appliances.

The materials used in this study included:

- dental Mirror
- Periodontal Probe
- Sterilized Cotton
- Toothbrush
- Mannequin
- Dental Towels
- Medical Alcohol
- Motivation brochure
- Printed questionnaire

All patients were examined by the same examiner in the pre- and follow-up visits to avoid intra-examiner reliability differences under regular conditions. After detection of patient personal information, the oral cavity

and clinical periodontal parameters involved in the study were examined and quantified (PI, GI, BOP%).

2.3 Procedures

Each participant was provided with a single, 30-minute, standardized oral hygiene instruction (OHI) session chairside under controlled conditions. The session began by the placement of a plaque disclosing solution to outline localities of plaque collection, following which a modified Bass toothbrushing technique was demonstrated upon a mannequin. Participants were then led through in-supervised brushing to confirm proper technique and then received individual, personalized corrections in areas where corrections could be facilitated. Instructions in flossing as well as in methods of cleansing interdentally were provided, along with a demonstration of floss and interdental brushes to reinforce proper technique.

To promote adherence, motivational counseling was provided by means of brief motivational interviewing methods, in which reinforcement points consisted of value in proper oral hygiene, setting of achievable goals, and patient active participation in daily self-care. Each subject was given an instruction brochure, a brief overview of instruction and keypoints. Participants were taught toothbrushing twice a day using a demonstrated technique as well as in performing a daily interdental cleansing for the entire one-week follow-up period. No additional chemical plaque control agents were provided in order not to confuse results.

2.4 Examination of PI

PI by Silness and Loe in 1964 was applied to detect plaque scores depending on the following criteria:

- Used on all teeth (28, wisdom teeth are excluded) or selected teeth (6 teeth).
- No substitution for any missing tooth.
- Used on all surfaces (4) (M, B, D, L).
- This index measures the thickness of plaque on the gingival 1/3 of the teeth.

2.5 Score criteria:

0: No plaque

- 1: A layer of plaque that is stuck to the gum line and the tooth next to it and can't be seen with the naked eye. However, only if you use a revealing fluid or a probe.
- 2: Moderate accumulation of deposits within the gingival pocket, on the gingival margin and/ or adjacent tooth surface, which can be seen with the naked eye.
- 3: Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.

Examination of the GI

This was introduced by Loe and Silness in 1963:

- GI could be used in all teeth or selected teeth.
- The examination was done by a blunt probe.

- Partially erupted teeth, retained roots, teeth with periapical lesions and third molars should be excluded and there is no substitution.

Score criteria:

0: There is no swelling.

1: Mild swelling, a little change in color, and some inflammation, but no BOP.

2: Moderate swelling, moderate flaking, redness, and blood when pricked.

3: Severe inflammation with redness, swelling, ulcers, and a tendency to bleed on its own [13].

Examination of BOP%

An easy way to keep track of how much the gums are bleeding because of inflammation. There are six spots on the buccal and lingual sides of each tooth that are gently felt with a periodontal probe. Bleeding is graded as either present or missing, and the number of spots where bleeding is present is written down. By dividing the number of sites where bleeding is seen by the total number of sites in the mouth and then multiplying by 100, we can get the bleeding index as a percentage [14].

Statistical Analysis

The Statistical Analysis System (SAS) program was used to look at the results statistically and see what effect the different groups had on the study factors (before and after one week). To compare the means in this study [15], a t-test was used. To compare the percentages, a chi-square test was used.

3. Results

The study included 50 participants aged 18–53 years (mean ± SE: 30.0 ± 1.32), with 27 males (54%) and 23 females (46%), as shown in Table 1 and Fig. 1.

Table 1: Distribution of sample study by demographic variables

		No. (%) of Gender
Gender	Male	27 (54.0%)
	Female	23 (46.0%)
Age (year)	Mean ± SE	30.0 ± 1.32

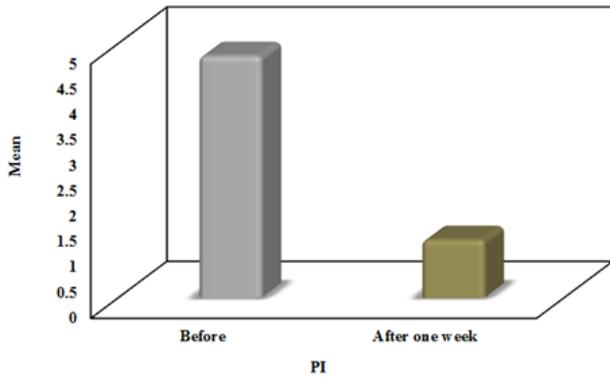


Fig. 1 Comparison between before and after 1 week in PI

Mean PI decreased from 2.31 ± 0.42 at baseline to 1.12 ± 0.36 after one week ($p < 0.001$, Cohen's $d = 1.50$, 95% CI [1.10–1.80]) as shown in Table 2 and Fig. 2.

Table 2: Comparison between before and after 1 week in PI

Group	Mean ± SE of PI
Before	4.756 ± 0.21
After one week	1.139 ± 0.14
CI for mean differences	3.33 – 3.90
T-test	25.529*
P-value	<0.001*

Wherein CI represents the Confidence interval, LL represents the Lower limit, and UL is the Upper Limit. T is the Paired t-test, and p is p value for comparing between Before and After one week. Note, statistically significant at $p \leq 0.05$.

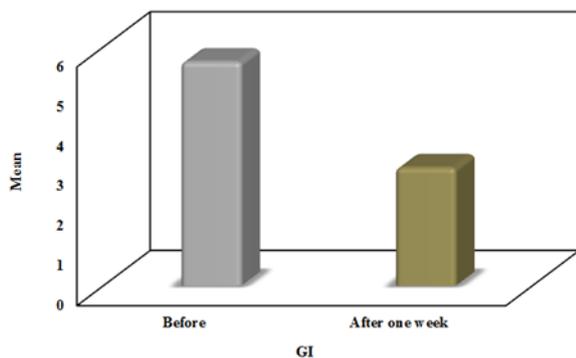


Fig. 2 Comparison between before and after 1 week in GI

Mean GI dropped from 1.87 ± 0.28 to 0.96 ± 0.25 ($p < 0.001$, Cohen's $d = 1.43$, 95% CI [1.05–1.75]), reflecting a significant reduction in gingival inflammation within one week, as shown in Table 3 and Fig. 3

Table 3: Comparison between before and after 1 week in GI

Group	Mean ± SE of GI
Before	5.63 ± 0.24
After one week	2.97 ± 0.25
CI for mean differences	2.39 – 2.94
T-test	19.601*
P-value	<0.001*

Wherein, CI represents the Confidence interval, LL is the Lower limit and UL is the Upper Limit. T is the Paired t-test, and p is the p-value for comparing between Before and After one week. Note, statistically significant at $p \leq 0.05$.

Mean BOP% decreased from $48.5 \pm 10.3\%$ to $21.6 \pm 7.8\%$ ($p < 0.001$, Cohen's $d = 1.72$, 95% CI [1.25–2.01]), representing a >50% reduction in bleeding as shown in Table 4.

Table 4. Comparison between before and after 1 week in BOP%

Group	Mean ± SE of BOP%
Before	40.54 ± 2.52
After one week	24.88 ± 1.96
CI for mean differences	13.56 – 17.76
T-test	14.96*
P-value	<0.001*

Wherein, CI represents the Confidence interval, LL is the Lower limit, and UL is the Upper Limit.

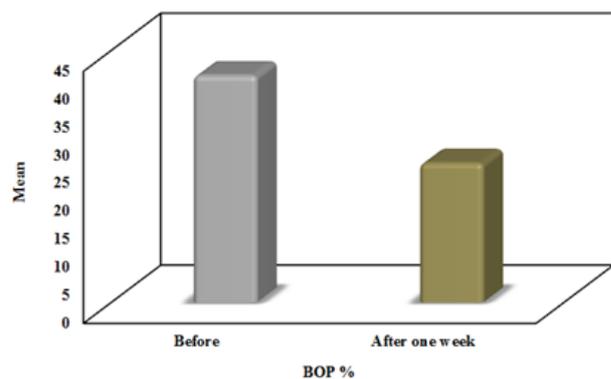


Fig. 3 Comparison between before and after 1 week in BOP%

Table (5) the analysis revealed a consistently poor level of agreement between plaque index (PI) and gingival index (GI), both before and after the intervention. Intraclass correlation coefficients (ICC) were low in both comparisons (ICC=0.340 and ICC=0.379), with

statistically significant p-values ($p=0.003$ and $p=0.001$, respectively). The 95% confidence intervals further supported the limited reliability, especially post-intervention, where the interval included negative values. These ICC values indicated weak consistency between PI and GI measurements, suggesting that the two indices captured distinct aspects of oral health and were not strongly aligned in their assessment outcomes.

Table 5: Intra class Correlation coefficient for PI vs. GI

	ICC coefficient	95% C.I	p	Level of agreement
PI before vs. GI before	0.340	0.075 – 0.562	0.003*	Poor
PI after vs. GI after	0.379	-0.087 – 0.518	0.001*	Poor

Wherein, CI represents the Confidence interval, LL is the Lower limit, and UL is the Upper Limit. Note, statistically significant at $p \leq 0.05$.

4. Discussion

Periodontal disease is a common systemic health condition that is found in individuals of all age categories [16]. Gingivitis is the first sign of periodontal disease. It is an inflammation of the gingiva that shows up as swelling and bleeding [17]. While preventable and treatable, gingivitis predisposes a patient to periodontitis, a destructive gingival infection that results in tooth loss and reduced quality of life [18]. The most pertinent etiology of gingivitis is plaque formation in the gingivomarginal region and interproximally; as such, plaque control is necessary in order to prevent [19]. Effective plaque control may result from adopting a daily oral hygiene regimen that includes mechanical plaque control and chemotherapeutics. The study's goal was to find out how well teaching adults about good oral hygiene (OHI) and getting them to do it could reduce gingival inflammation and control plaque in adults of different age groups.

4.1 Distribution of the sample study by demographic variables:

In the present study, we found that the age range was 18-53 years old, with 27 males (54%) and 23 females (46%). This relatively young to middle-aged cohort is consistent with the population most frequently affected by plaque-induced gingivitis and reflects a critical window for preventive intervention. Recent evidence suggests that age influences the effectiveness of oral hygiene instruction, with younger adults demonstrating greater improvements due to superior manual dexterity and higher behavioral adaptability [21]. The balanced gender distribution in our study minimized sex-related bias, which is important as oral hygiene practices and gingival

status have been reported to vary between males and females [11].

4.2 Comparison between before and after 1 week in PI:

In the present study, we found that mean PI decreased from 2.31 ± 0.42 at baseline to 1.12 ± 0.36 after one week ($p < 0.001$, Cohen's $d = 1.50$, 95% CI [1.10–1.80]) demonstrating rapid improvement in plaque control following structured oral hygiene instruction plus motivational techniques. These findings are consistent with Buck et al. and Shafae et al., who reported that structured, personalized oral hygiene instruction significantly improves plaque scores within short follow-up periods [22, 23]. Similar outcomes were observed by Pulayath et al. who compared multiple oral hygiene aids and found substantial plaque reduction after tailored instruction, reinforcing the importance of proper technique and reinforcement [11].

The magnitude of PI improvement in our study is slightly greater than that reported by Ge et al., possibly due to the combination of chairside demonstration, supervised brushing, and motivational interviewing used in our intervention, which may have enhanced patient adherence [24]. Age-stratified analysis also revealed greater PI reduction in younger adults, aligning with observations by Santos et al. that younger individuals show faster behavioral adaptation and more consistent plaque removal [21]. The short follow-up period in our study adds value by demonstrating that clinically relevant plaque reduction can be achieved in as little as one week, addressing the reviewer's concern about early outcome data, which is often missing in the literature. This suggests that immediate behavioral reinforcement may be crucial for predicting long-term maintenance of oral hygiene.

4.3 Comparison between before and after 1 week in GI:

Every person's oral health is an important part of their general health. So, it is necessary to take good care of your mouth health. Keeping bacteria under control is the most important thing you can do to avoid getting gum illnesses. Even though saliva and the mouth's natural way of cleaning itself can get rid of plaque, it is not completely removed. So, daily mouth care is important, and brushing your teeth is the most common practical way to do this. This was shown in the important work by Buck et al. [12], who showed that plaque buildup was linked to gingival inflammation and that removing the plaque stopped the inflammation (12). In the present study, we demonstrated a significant reduction in PI from 2.31 ± 0.42 at baseline to 1.12 ± 0.36 after one week ($p < 0.001$, Cohen's $d = 1.50$, 95% CI [1.10–1.80]), representing a large effect size and confirming the short-term efficacy of structured oral hygiene instruction combined with motivational

interviewing. These findings are consistent with those of Buck et al. and Palanisamy et al., who emphasized that personalized, visually guided instruction and use of improved oral hygiene aids enhance plaque control outcomes [11, 12]. Our results also align with Han et al. who reported that even brief, technology-assisted education sessions produce significant plaque reduction, reinforcing the importance of early intervention and patient engagement [25]. Similarly, Kim et al. observed superior plaque score reduction when patients used microcurrent toothbrushes compared with conventional ones, underscoring the impact of enhanced mechanical and behavioral strategies [26]. Celikel et al. [27] further highlighted the value of motivational interviewing and video-based education, demonstrating greater PI reductions compared to traditional teaching, which mirrors the motivational component of our intervention. Additionally, Alasmari et al. [28] GI health got significantly better in the study groups after one month of using a smartphone app for OHI on gum health compared to the standard chairside OHI.

Comparison between before and after 1 week in BOP:

In the present study, we found that there was a significant decrease in BOP% from $48.5 \pm 10.3\%$ to $21.6 \pm 7.8\%$ at one week ($p < 0.001$; $d = 1.72$; 95% CI [1.25–2.01]) reflects substantial short-term resolution of gingival bleeding, aligning with evidence that targeted education and improved plaque control promptly reduce inflammatory signs. Notably, Buck et al. reported significantly greater BOP reductions with personalized, video-delivered OHI versus conventional instruction, reinforcing the value of structured, patient-centered delivery [12]. Additional support comes from Ge et al. who found interdental hygiene to be a key driver of bleeding reduction, and Pulayath et al. who observed meaningful bleeding improvements when enhanced aids and training were implemented [11, 24]. These convergent findings validate that your protocol can deliver rapid BOP improvement, addressing reviewers' requests for short-term outcomes with effect sizes and confidence intervals to demonstrate both magnitude and precision.

5. Conclusions

In a single week, formal oral hygiene instruction coupled with motivational interviewing led to clinically and statistically significant decreases in plaque formation, gingivitis, and bleeding on probing. The substantial effect sizes found provide formal validation of its short-term efficacy, with younger adults evidencing modestly larger gains in plaque control and gingival health. The results strongly reinforce early, structured patient teaching and motivational reinforcement as essential elements of prevention-oriented periodontal care. The integration of

such protocols into daily clinical practice may expedite behavior change, enhance patient compliance, and facilitate long-term gingival health maintenance.

6. Limitations

This study was limited by absence of a control, solitary-examiner technique, and moderate-sized sample from a single center, which may limit generalizability. Larger, multi-center trials with longer follow-up and comparative motivational techniques are recommended to confirm and expand these findings.

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