

Clinical and Microbiological Assessment of Using Ginger Extract Gel and Chlorhexidine Gel in Non-Surgical Treatment of Periodontitis

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ABSTRACT

Introduction: Periodontitis is considered as the 6th most common occurring disease. Scaling and root surface debridement is a non-surgical standard that reduces periodontal inflammation in response to biofilm removal. In recent years, natural products have become increasingly popular; Ginger is a natural plant and could be used in treating periodontal disease. **Aim:** To study the effect of Ginger gel in improving clinical parameters which is the clinical attachment level (CAL) and microbial count through blood agar. **Methodology:** Thirty-Six patients with stage II periodontitis will be selected from the out-patient clinic of Oral Medicine and Periodontology Department, Faculty of Dentistry, Suez Canal University. After that, they will be divided randomly into three equal groups. **Control group:** will receive scaling and root surface debridement only. **Group II:** will receive scaling and root planning and chlorhexidine gel adjunctive to non-surgical therapy. Lastly, **Group III** will receive Ginger gel in conjunction with non-surgical periodontal therapy. The clinical parameter, clinical attachment level (CAL) and the microbial count by blood agar will be assessed at baseline and 3 months.

Keywords: Periodontitis, Non-Surgical, Ginger Gel

INTRODUCTION

Periodontitis is a chronic inflammatory disease of tissues that support teeth caused by certain bacteria. Over time, it causes destruction to the periodontal ligament, cementum and bone. In chronic periodontal disease, biologically active components in bacterial plaque trigger an inflammatory response in the gingival soft tissues and periodontium [1]. The primary key of periodontal treatment is to remove periopathogenic bacteria, adjusting reversible risk factors and prevent re-colonization to avoid disease recurrence [2]. Antibiotics and other antimicrobial drugs are frequently used in clinical treatment as adjunctive to treat periodontitis [3]. Recently, natural remedies have drawn a lot of interest. Numerous studies have demonstrated the abundance of physiologically active substances found in herbal products, essential oils, and purified phytochemicals [4]. In developing nations, almost 80% of people still receive their medical treatment through traditional means. The use of traditional botanicals to treat periodontal diseases has been the subject of numerous reports [5]. Natural products, as one application of complementary and alternative medical therapies, provide a natural and cost-effective intervention to alter the course of many chronic diseases and may aid in regenerating various living tissues [6]. In this context, one of the natural products with a herbal origin is ginger (*Zingiber officinale*) [7]. Ginger, as a spicy flavor ingredient, possesses diverse chemical constituents, comprising raw fibers, organic acid, lipids, polysaccharides, terpenes, and phenolic compounds [8]. This plant has reflected its striking role in herbal medicine due to its wide pharmacological activities, like antioxidative, anti-inflammatory, anticancer, cardio-protective, antidiabetic, chemoprotective, and immune-protective functions [9]. Recently, it has been declared that ginger can be a potential candidate for periodontitis treatment [10].

Also found that using Ginger extracts in the lab had antimicrobial effects not only against bacteria that cause gingival disease (*Capnocytophaga gingivalis*, *Prevotella intermedia*, *Fusobacterium nucleatum*, and *Porphyromonas gingivalis*) [11], The various and wide-ranging impacts of Ginger on oral health have resulted in its application in treating periodontal diseases. Using Ginger extract for subgingival irrigation during periodontal therapy has demonstrated superior outcomes compared to root planing and scaling [12]. This study contributes to clearing the dilemma by studying the effect of Ginger Gel as an adjunctive to SRP on improving clinical parameters and reducing the Periodontopathogenic bacteria.

MATERIALS AND METHODS

Ginger was purchased from Local market in Egypt. Chitosan polymer was purchased from Al-Gomhoria® Company for chemicals, Egypt. The clinical outcomes are Clinical Attachment level at baseline and 3 months post treatment using a UNC-15 probe. Subgingival samples from the deepest periodontal pockets collected with complete aseptic precautions. Two sterile paper points were inserted to the bottom of the pocket for 20-30 seconds, transferred to sterile jar containing Tris- EDTA medium as anaerobic conservative medium. Samples were sent to the microbiology laboratory. The total microbial count per 1ml was determined by measurement of the number of colonies forming unit (CFU) on each plate. Only those organisms which failed to grow aerobically were taken as anaerobes. Identification of the microorganisms was based on typical colony morphology and Gram stain reaction. If no growth was obtained after 48-72 hours, re-incubation was done at faculty of pharmacy at Suez Canal University.

Preparation of Ginger Gel

A pack of 500 g of fresh powdered ginger will be purchased from the local market. It will be suspended in a sterile jar containing 1 liter of 70% ethanol. Then, it will be processed for cold maceration with continuous shaking at fixed intervals for 48 hours. Then, it will be subjected to a process of filtration by using sterile muslin cloth. The filtered resultant will be subjected to over steam bath apparatus for 5 days for ethanol content evaporation and dryness. While the Preparation of 10% of ethanolic ginger extract was done by 10 grams of 10% ethanolic ginger extract powder will be dissolved in 0.1 liter of an inert solvent (Dimethyl sulphoxide) to obtain the 10% concentration.⁽¹³⁾ The gel was manufactured at pharmaceutical department, faculty of pharmacy, Cairo University.

Sample Size Calculations

Current research was performed to evaluate the effect of ginger gel as local drug delivery in conjunction with non-surgical treatment of periodontitis. Accordingly, to assess and compare the difference between three groups (A, B, C) at two timepoints (T0, T1); repeated measures analysis of variance is proposed (ANOVA). A minimum total sample size of 30 samples will be sufficient to detect the effect size of 0.40 according to Cohen (1988), at a power ($1-\beta=0.95$) of 95% at a significance probability level of $p<0.05$, and a partial eta squared of 0.12. According to sample size calculations each treatment group (A, B, C), would be represented by 12 patients. Each treatment group at each timepoint (e.g., A1T0, A1T1). The sample size was calculated according to G*Power software version 3.1.9.6 (Cohen, 1988; Dupont, 1990; Lehr, 1992, Faul et al., 2007). Where, f : is the effect size; $\alpha=0.05$; Power= $1-\beta=0.95$

$$f = \frac{\sigma_{\mu}}{\sigma}$$

$$\sigma_{\mu}^2 = \frac{\sum_{i=1}^k n_j (\mu_i - \mu)^2}{N}$$

Patients Grouping

The study included thirty-six patients; they were given oral hygiene instructions including plaque control and were instructed not to use any sort of chemical plaque control. Group I included twelve patients that were treated with non-surgical therapy scaling and root planning only. Group II, included twelve patients with scaling and root planning and application of ready-made chlorhexidine gel, with the brand name EZ-Cure, Maramco® health care company, Egypt. In group III including twelve patients, after isolation, using a thin blunt plastic syringe injecting an amount of concentrated extract in the gel base, of concentration 10% W/V, and the ratio of Ginger to polymer is 1:1 [13]. Eventually, the clinical parameters were assessed for all groups immediately before the treatment, at baseline and after 3 months. Written informed consent approved by the university institution was obtained from participants who agreed to participate

(Ethical code - 591/2022). A full medical history of each patient was obtained.

Gingival Crevicular Fluid (GCF) Sampling

After recording the clinical parameters, the site was isolated with cotton rolls and the crevicular fluid was collected by paper point size (30) from the periodontal pocket and kept in place for thirty seconds. Then, samples were collected into a sterile plastic jar for microbial count.

Results

Statistical Analysis

Intragroup Comparisons

Paired t-test: This test was used to compare the mean values of variables (e.g., gingival index, pocket depth, clinical attachment level) within each group at baseline and after 3 months. It helped determine whether the interventions had a significant effect on these variables over time for each group.

Intergroup Comparisons

One-Way ANOVA: This test was used to compare the mean values of variables across the three groups (Control, Group II, and Group III) at each time point (baseline and 3 months). It helped identify whether there were significant differences between the groups for the measured variables. Tukey's post-hoc test: R After the One-Way ANOVA detected significant differences between groups, Tukey's post-hoc test was used to determine which specific groups differed from each other for the given variable.⁽¹⁴⁾

Microbial Evaluation

The study analyzed microbial data using various culture media (Blood Agar). One-Way ANOVA and Tukey's post-hoc tests were used to compare the microbial counts (log100 values) between the three groups at baseline and after 3 months for each culture medium. Paired t-tests were employed to assess intragroup changes in microbial counts from baseline to 3 months for each group and culture medium.

Clinical Evaluation

Effect on Clinical Attachment Level

This table presents intragroup comparisons of clinical attachment level (CAL) measurements for three groups over a 3-month period. All groups showed statistically significant improvements in CAL ($p < 0.05$). Group II started with the highest baseline CAL (3.84 mm) and showed the most substantial improvement (-1.54 mm), achieving a final CAL of 2.30 mm. The Control Group began with a CAL of 3.62 mm and improved by 0.75 mm. Group III had the lowest initial CAL (3.50 mm) and improved by 0.88 mm, reaching a lower final CAL of 2.62 mm.

Table 1: Intragroup Comparison between Different Time Intervals for Each Group on Clinical Attachment Level

TABLE 3: Intragroup Comparison Between Baseline and 3 months for each group for clinical attachment level						
	Intragroup				MD ± SD	P-value
	Clinical Attachment Level (M ± SD)					
	Baseline		3 months			
	M	SD	M	SD		
Group I (Control Group)	3.62	0.483	2.87	0.451	-0.75 ± 0.032	<0.0001*
Group II	3.84	0.328	2.30	0.197	-1.54 ± 0.131	<0.0001*
Group III	3.50	0.445	2.62	0.334	-0.88 ± 0.111	<0.0001*

M; Mean, SD; Standard Deviation, MD; Mean Difference, P; Probability Level

*, Significant Difference using Paired T-test

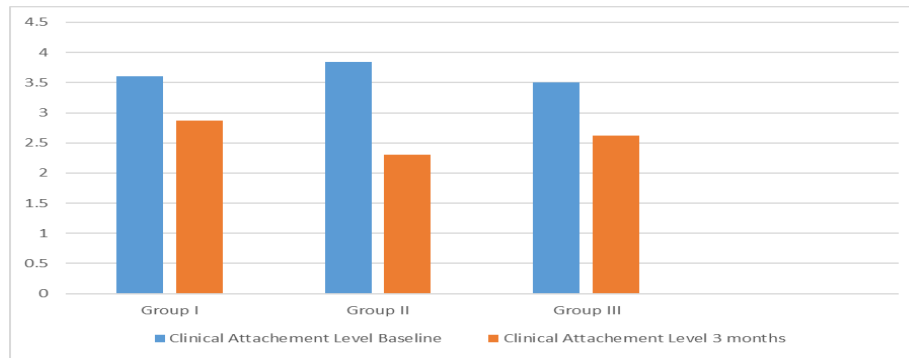


FIGURE 1: Bar Chart revealing Intragroup Comparison between Different Time Intervals for Each Group on Clinical Attachment Level

This table presents an intergroup comparison of clinical attachment level (CAL) measurements among three groups at baseline and after 3 months. At both time points, there were no statistically significant differences between the groups ($p < 0.0001$ at baseline, while a statistically significant difference $p = 0.0080$ at 3 months). At baseline, all three groups had no significantly different CAL values:

Group II had (3.84 mm), followed by the Control Group (3.62mm), and Group III had the lowest (3.50 mm).

After 3 months, all groups showed improvements. Group II achieved the best outcome with the lowest CAL (2.30 mm), which was significantly better than the other groups.

Table 2: Intergroup Comparison between Group I, Group II and Group III for Clinical Attachment Level Evaluation

Time	Intergroup						P-value
	Clinical Attachment Level (M ± SD)						
	Group I		Group II		Group III		
	M	SD	M	SD	M	SD	
Baseline	3.62 A	0.483	3.84 B	0.328	3.50 C	0.445	>0.05
3 months	2.87 A	0.451	2.30 A	0.197	2.62 B	0.334	
							0.0080*

M; Mean, SD; Standard Deviation, P; Probability Level

Same Letters in the same row indicated insignificant difference using Tukey's post hoc test for multiple comparisons

Different Letters in the same row indicated significant difference using Tukey's post hoc test for multiple comparisons

*, Significant Difference using One Way ANOVA test

Microbial Evaluation

This table compares blood agar (1/100) log₁₀ values among three groups at baseline and after 3 months. At baseline time point, there were no statistically significant differences between the groups (baseline $p = 0.9930$, 3 months $p < 0.05$). At baseline, all groups had similar values ranging from 2.922 to 3.000 log₁₀. After 3 months, all

groups showed reductions in their values, with Group II showing the largest decrease to 1.885 log₁₀, followed by Group III (2.541 log₁₀) and the Control Group (2.778 log₁₀). Intragroup comparisons revealed significant reductions for Group II and Group III ($p < 0.0001$), while the Control Group showed no significant change ($p = 1.0000$).

Table 3: Comparison between Different Groups regarding Blood Agar (1/100) log₁₀

Time	Blood Agar (1/100) log ₁₀ (M ± SD)						P-Value (One Way ANOVA)
	Group I (Control Group)		Group II		Group III		
	M	SD	M	SD	M	SD	
Baseline	3.000 A	0.500	2.922 A	0.04992	2.934 A	0.03036	0.9930 (NS)
3 Months	2.778 A	0.778	1.885 A	0.2283	2.541 A	0.1198	
P-Value (Paired T-Test)	1.0000 (NS)		<0.0001*		<0.0001*		0.3824*

M; Mean, SD; Standard Deviation, P; Probability Level

Same Letters in the same row indicated insignificant difference using Tukey's post hoc test for multiple comparisons

NS; Insignificant Difference using One Way ANOVA

*, Significant Difference using One Way ANOVA and Paired t-test

Discussion

Periodontitis is a factorial multi-inflammatory disease of the tissue of infectious origin that, if improperly treated, can destroy the periodontal tissue and ultimately tooth loss. Recent research shows that oral health and disease are characterized by complex microbiological interactions between bacterial origins and environmental influences, systemic factors, host genetic factors, drug treatments, and the host immune system [14]. Mechanical cleaning is the biofilm and reducing the bacteria. However, mechanical instrumentation may sometimes be insufficient to control the disease due to tissue-invasive pathogens or other tooth-related anatomic factors [15]. Various non-chemical alternative products, such as

lasers, topical and systemic antibiotics like azithromycin, and chemicals such as hyaluronic acid, antiseptics, and anti-inflammatory agents with positive effects on the immune system, are reported to be beneficial. Due to the fewer side effects of medicinal herbs such as green tea, Cordia Verbenaceae (a native plant of the Brazilian coasts), Mikania levigate, and aloe vera and Ginger [16]. The active component of Ginger is Zingiber officinale Roscoe has been used extensively in medicine for many years, with antibacterial, antiviral, antifungal, antitumor, and immunomodulatory effects [17]. The present study was designed as a controlled clinical trial to study the effect of Ginger gel as an adjunctive to non-surgical treatment on improving clinical parameters and reducing the bacterial count in stage II grade B periodontitis. Patients with stage II periodontitis were

particularly selected because such cases are usually responsive to non-surgical periodontal therapy [18]. The participants were divided into three groups. Group I was treated with SRP only, group II was treated with SRP combined with local delivery of Chlorhexidine gel, and group III which was treated with Ginger extract gel. The primary clinical outcome measures were changed in clinical attachment level. Whereas, the secondary outcome, the microbial count was obtained through a gingival crevicular fluid (GCF) sample. The present study showed a statistically significant difference in the three groups at 3 months in the clinical parameter compared to the baseline, the group II showed the best outcomes, with significant difference in relation to the other two groups. This could be attributed to the substantivity property of chlorhexidine gel, specifically when it is used in concentration of 0.2%, as being bactericidal [19]. Regarding the microbial count, this study showed that microbial count in blood agar scores was improved in all of them. These results were in parallel Sneha M et al. 2024 about clinical attachment loss which used different herbal medications. The study showed a similar reduction of these parameters (CAL) in groups. This indicates that periodontal healing occurred in all subjects, thus showing periodontal therapy had

improved periodontal health after scaling and root planing. The present results were parallel to the study by Zahratul U A et al. 2023 where non-surgical periodontal therapy and using of ginger gel in periodontal pockets showed clinically significant reduction in microbial count as being antimicrobial agent as it effectively inhibited the growth of various types of bacteria by reducing ergosterol synthesis in the cell wall and affecting membrane integrity. However, clinically significant improvements were seen in all groups regarding clinical parameter which was the clinical attachment level. While microbiologically, based on the present study findings, group II and group III gel showed clinically significant microbial count reduction in blood agar culture media, while non clinically significance difference in group I [20].

Conclusion

In this study, it was concluded that Subgingival Ginger gel delivery is considerable and the group that received Ginger gel exhibited favorable clinical and microbial results than the group I, with the best results attributed to group II.

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