

Comparative Effect of Chlorhexidine and Anti-Calculus Mouthrinse on Dental Plaque, Gingival Inflammation and Calculus Formation on Plaque Induced Gingivitis Patients

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ABSTRACT

Background: Chlorhexidine (CHX) is considered as a gold standard of antimicrobial rinses. Various anti-calculus mouthrinse are available in the market However, little is known of its effectiveness. **Aim:** The aim of this study was to evaluate the clinical changes after the usage of anti-calculus mouthrinse and 0.12% CHX. **Subjects and Methods:** In a randomized clinical trial, 30 patients with dental plaque-induced gingivitis were assigned to two groups i.e. Experiment Group A (Anti-calculus mouthrinse) and Control Group B (0.12% Chlorhexidine mouthrinse). Gingival index, plaque index, calculus index and salivary concentration scores were recorded at baseline and six months along with the feedback questionnaire. **Results:** Intragroup comparison in both groups showed that all the clinical parameters scores were statistically significant after six months as compared to baseline. Intergroup comparison showed that Anti-calculus mouthrinse statistically showed more significant reduction in all the clinical parameters scores from base line to six months. **Conclusion:** Anti-calculus mouthrinse significantly reduced the clinical symptoms of plaque-induced gingivitis compared to 0.12% CHX with no adverse effects.

Key words: Anti-calculus mouthrinse, 0.12% Chlorhexidine mouthrinse, Dental plaque, Gingivitis, Inflammation, Oral Hygiene, Anti-Calculus, Chlorhexidine.

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INTRODUCTION

Dental plaque is an example of microbial biofilm with a complex microbial composition containing as many as 500 different species of bacteria that have been identified from the oral cavity. The community adheres tightly to the acquired salivary pellicle and is thought to develop by the coordinated and successive colonization of different microbial species. Oral microbial biofilms are three-dimensional structured bacterial communities attached to a solid surface like the enamel of the teeth, the surface of the root or dental implants and are embedded in an exopolysaccharide matrix.¹ The pathogenicity of the dental plaque biofilm is enhanced by the fact that in biofilm form, the component bacteria have increased resistance to antibiotics and other chemotherapeutic agents and are less able to be phagocytized by host inflammatory cells. Therefore, control of the dental plaque biofilm is a major objective of dental professionals and critical to the maintenance of optimal oral health.² Gingivitis is manifested by red, swollen gums and bleeding that may occur with tooth brushing and can advance to periodontitis if left untreated. The widely known periodontal pathogens present in plaque are as follows: *Porphyromonas gingivalis* (*P. gingivalis*), *Prevotella intermedia* (*P. intermedia*), *Treponema denticola* (*T. denticola*), *Tannerella forsythia* (*T. forsythia*),

Campylobacter rectus (*C. rectus*), *Selenomonas spp.*, *Agregatibacter actinomycetemcomitans* (*A. actinomycetemcomitans*), *Eubacterium timidum* and *Fusobacterium nucleatum* (*F. nucleatum*). Over time, the plaque biofilm can spread and grow below the gum line (subgingival area), and toxins produced by bacteria in the plaque biofilm can irritate the gums. These toxins stimulate a chronic inflammatory response in which the body, in essence, turns on itself, and supporting tissues and bone are broken down and destroyed. In this process, gums separate from the teeth, forming infectious periodontal pockets (spaces between the teeth and gums). Gingivitis is reversible, although if left untreated, it can progress to periodontitis.³ In recent years, the concept of focal infection has changed and now mostly relies on the correlation between chronic periodontitis and systemic diseases. The mechanisms by which periodontal infections may influence systemic health have been described as follows: Oral-hematogenous spread of periodontal pathogens and direct effects to target organs, transtracheal spread of periodontal pathogens and direct effects to target organs and oral-hematogenous spread of cytokines and antibodies with effects at distant organs.⁴ Although dental biofilm cannot be completely eradicated, its pathogenicity can be lessened

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through enhancing oral hygiene methods. The aim of this study was to evaluate and compare the clinical and salivary concentration changes after six month usage of anti-calculus and 0.12% chlorhexidine mouthrinse. The other objective of this study was to get the feedback from the subjects for both the products in this study regarding their acceptability for longer compliance.

MATERIAL AND METHODOLOGY

This randomized controlled clinical trial was carried out in Faculty of Odonto-Stomatology, University of Medicine and Pharmacy, Ho Chi Minh City, Vietnam. The study population consisted of 30 individuals, who were systemically healthy, between 20 and 50 years of age and with moderate to severe plaque-induced gingivitis were enrolled in the study. They were equally distributed in the test ($n = 15$) and the control group ($n = 15$) with the study flow chart as mentioned in Figure 1. Participants were excluded from the study if they suffered from non-plaque induced gingivitis or periodontitis, history of antibiotic use and use of any form of anti-calculus products in the last 90 days, need for antibiotic premedication, patients using mouth rinse within the last 3 months, pregnant women, habit of smoking or any form of smokeless tobacco and with systemic diseases. Patients were selected on the basis of inclusion and exclusion criteria and were randomly assigned using a coin toss to two groups as illustrated in Table 1. The examiner and participants were blinded to product allocation. The clinical examinations recorded were gingival index, plaque index and calculus index. Along with that salivary concentration of Calcium and Magnesium was also assessed at base level to 6 Months. Patients were recalled at weekly interval to check for the oral hygiene and the oral hygiene was reinforced in noncompliant patients. All the subjects were also provided with a fixed set of feedback questionnaire during their clinical visit at 2, 4 and 6 Month to understand their challenges regarding compliance for the both the products. The response from the subjects recorded under both the groups in a coded manner and their feedback was revealed to the clinician only after the study was completed.

OBSERVATION AND RESULTS

All the clinical and salivary concentration parameters were recorded at base level, 2 Months, 4 Months and 6 Months of time period. Data were statistically analyzed. Between groups statistical comparison of all the parameters is done using independent sample *t*-test after confirming the underlying normality assumption. Within group statistical comparison of all the parameters is done using paired sample *t*-test after confirming the underlying normality assumption of differences. $P < 0.05$ is considered to be statistically significant.

All recorded parameter (Clinical and Salivary) scores of post-treatment were statistically significant. Within group comparison of pre-treatment and post-treatment scores was done of all the parameters in both test and control group as illustrated in Table 2. When between group comparisons was done; Group A (Test group: Anti-calculus mouthrinse, Periogen) results were statistically significant as compared to Group B (Control group: 0.12% Chlorhexidine mouthrinse, Kin) at sixth month observation.

DISCUSSION

Bacterial plaque is one of the major etiologic agents involved in the initiation and progression of periodontal disease. The role of microorganisms in the onset of gingivitis and evolution of periodontitis increased dramatically following the recognition of bacterial plaque as the major cause of chronic gingivitis. The association of organisms with periodontal disease has been established long ago. Based on the strong associa-

tion between certain microorganisms and periodontal diseases, there has been an increasing interest in the use of antimicrobial agents in their management.⁵ Periogen mouthrinse with key ingredients of Tetrapotassium Pyrophosphate (TKPP), Sodium Tripolyphosphate (STPP), Sodium Bicarbonate, Sodium Fluoride and Citric Acid seems to be potential oral rinse for suppressing the mineralization of dental plaque when used on regular basis as an adjunct to tooth brushing.⁶

The purpose of this study was to determine the comparative effects of anti-calculus mouthrinse to 0.12% CHX on gingival health and plaque accumulation over time. In this study, there was a statistically significant reduction in the proportion of gingival index scores, plaque index scores, calculus index scores and salivary concentrations in anti-calculus mouthrinse (as compared to the 0.12% CHX group. The result of this study showed that there was 47 % more amount of new calculus deposit and 10% more new plaque formation in control group (Chlorhexidine) as compared to experimental group (Anti-calculus). The greater reduction in plaque and calculus index in experiment group thus resulted 19.82% more reduction in gingival inflammation as compared to control group. Similarly the salivary concentration of Calcium was 57.58% and Magnesium was 59.34% much higher in control group than experiment group over a period of six month of observations. These results correlate with previously done studies that clearly marked the significance of anti-calculus mouthrinse for total oral hygiene with no adverse effects as compared to CHX.

Saini R.^{7,8} observed similar efficacy of anti-calculus mouthrinse over six month study in gingivitis patients when compared with placebo. Study confirmed that anti-calculus mouthrinse was 45% more effective to prevent calculus build up than tooth brushing alone. Tham T.⁹ performed BANA (Benzoyl-DLArginine Naphthylamide) chair side periodontal test to detect presence of oral bacteria in plaque. The study concluded that Periogen mouthrinse is significantly better in reducing periodontal disease as compared to just using water flosser alone after using for 3 Months. Kokovic A *et al*¹⁰ study the effects of anti-calculus mouthrinse on dental implants. The study concluded that calculus dissolution based Periogen mouthrinse provided clinically significant reduction in calculus formation in subjects with zirconium dioxide and titanium dental implants when used twice daily for 6 months as an adjunct to tooth brushing. S. Cantore *et al*¹¹ in a 3 day plaque accumulation model study indicated that anti-calculus mouthrinse (Periogen) has equivalent plaque inhibitory action to chlorhexidine. Regina TC *et al*¹² conducted a histopathological study in moderate gingivitis patients concluded that Periogen mouthrinse significantly proved to switch the Maturation Index and will promote wound healing. Optimal oral hygiene is the fundamental key for complete oral health. This study was designed to understand the significance of new anti-calculus mouthrinse (Periogen) for plaque control and salivary concentration when compared with 0.12% CHX. As the study was a concurrent parallel design, so to know more suitable results crossover study for a longer duration of time period should be considered for further studies.

The other leg of this study was to accurately analyze the product feedback compliance for both the groups (Chlorhexidine and Anti-calculus) for their short and long term usage. The feedback response along with questionnaire is listed in Table 3. By applying Z test of difference between

Table 1: Patient Grouping.

Group	Protocol
Group A (Test Group): Periogen*	Conventional Oral Hygiene & Anti-Calculus Oral Rinse
Group B (Control Group): KIN™	Conventional Oral Hygiene & 0.12% Chlorhexidine Oral Rinse

Table 2: Results of Recorded Parameters.

Variables	T0	p ¹	T1	p ²	T2	p ³	T3	p ⁴
Plaque Index								
Group A	1.00±0.09	0.107	1.08±0.12	0.811	1.09±0.12	0.01**	1.17±0.12	0.003
Group B	0.99±0.12	<0.001**	1.22±0.07	0.208	1.24±0.06	0.014**	1.26±0.06	<0.001**
p*	0.79		0.001**		<0.001**		0.018**	
Gingival Index								
Group A	1.27±0.32	0.022**	0.92±0.30	0.012**	0.95±0.27	0.935	0.95±0.19	0.013**
Group B	1.30±0.22	0.015**	1.05±0.38	0.005**	1.23±0.21	0.832	1.23±1.13	0.286
p*	0.741		0.312		0.004**		0.001**	
Calculus Index								
Group A	0	-	0.11±0.11	0.014**	0.19±0.12	0.199	0.23±0.09	0.002**
Group B	0	-	0.20±0.11	<0.001**	0.44±0.20	<0.001	0.72±0.24	<0.001**
p*	0	-	0.065**		0.001**		<0.001**	
Calcium Concentration								
Group A	1.38±0.21	0.001**	1.35±0.20	0.001**	1.20±0.18	0.001**	1.01±0.17	<0.001**
Group B	1.30±0.20	0.807	1.31±0.15	0.017**	1.39±0.24	0.002**	1.70±0.35	<0.001**
p*	0.286		0.579		0.02**		0.001**	
Magnesium Concentration								
Group A	0.28±0.05	0.024	0.25±0.03	<0.001**	0.24±0.04	<0.001**	0.20±0.05	<0.001**
Group B	0.26±0.04	0.163	0.24±0.05	0.220	0.27±0.04	<0.001**	0.34±0.03	<0.001**
p*	0.278		0.597		0.021**		<0.001**	

Group A: Test Group, Group B: Control Group, T0: Baseline; T1: After 2 months; T2: After 4 months; T3: After 6 months, ¹Between T0 and T1; ²Between T1 and T2; ³Between T2 and T3; ⁴Between T3 and T1; *Between Experimental and control groups, ** Significant

Table 3: Feedback From Subjects After 2, 4 and 6 Months.

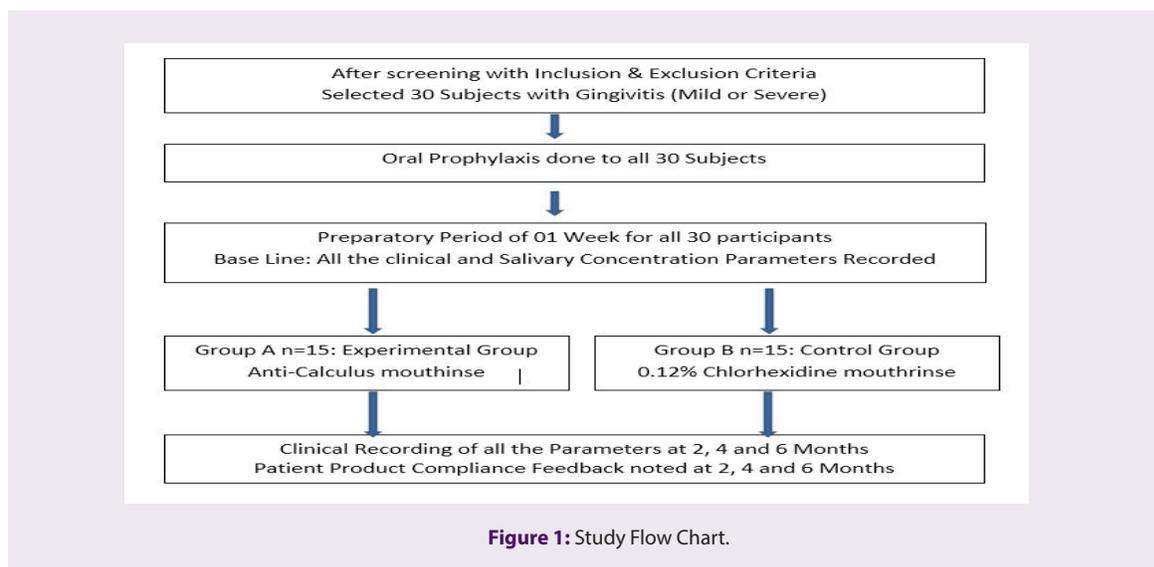
	Experimental group (n=15)			Control group (n=15)		
	2 month	4 months	6 months	2 month	4 months	6 months
Do you feel any burning sensation after use	0	0	0	0	3	4
Do you feel any strong taste effects	0	0	0	3	3	3
Do you feel challenging of its application	2	2	2	0	0	0
Do you feel any adverse effects	0	0	0	1	1	2
Do you see some color changes of your teeth	0	0	0	0	1	2
Do you want to use regularly	14	14	14	14	14	12

two sample proportions there is a significant difference between proportions of burning sensation after use, strong taste effects, challenging of its compliance, adverse effects, some color changes of teeth and regular use after 6 months when experimental group compared with control group as illustrated in Table 4. 26.7% of the subjects reported with burning sensation and 20% reported with strong taste effects after 6 months of continuous use of 0.12% CHX mouthrinse. 13.3% of subjects reported

adverse effects and color changes on their teeth with six month of continuous usage of 0.12% CHX mouthrinse. In contrast to that subjects under anti-calculus rinse reported with no noticeable side effects from the subjects under the study after six months of regular compliance. 13.3% of the subjects under experiment group (Anti-calculus) reported with challenge for its application as compared to control group. The possible reason would be as the anti-calculus agent (Periogen) used in this

Table 4: Statistic Comparative Analysis after 6 Month.

	Experimental group n (%)		Control group n (%)		Z test value p value
	Yes	No	Yes	No	
Do you feel any burning sensation after use	0 (0)	15 (100)	4 (26.7)	11 (73.3)	3.31 p=0.0023, significant
Do you feel any strong taste effects	0 (0)	15 (100)	3 (20)	12 (80)	2.74 p=0.0461, significant
Do you feel challenging of its application	2 (13.3)	13(86.7)	0 (0)	15 (100)	2.14 p=0.0311, significant
Do you feel any adverse effects	0 (0)	15 (100)	2 (13.3)	13 (86.7)	2.14 p=0.0311, significant
Do you see some color changes of your teeth	0 (0)	15 (100)	2 (13.3)	13 (86.7)	2.14 p=0.0311, significant
Do you want to use regularly	14 (93.3)	1 (6.7)	12 (80)	3 (20)	1.56 p=0.0311, significant



study is powdered concentrate and the subjects had to mix in the water for making the solution for oral rinsing. In this study 20% of the subjects reported their disinclination for continuation usage of CHX oral rinse as compared to anti-calculus rinse the reluctance is only 6.7%. This reluctance in the experimental group is due to daily efforts for creating liquid solution from powdered concentrate to use as mouthrinse. However, 93.3% of subjects still showed their strong affinity towards using the anti-calculus product considering its long term benefits as compared to adverse effects associated with CHX. Chlorhexidine leads to clinical side effects with long term usage; reported many times previously in the clinical studies and literature.^{13,14}

CONCLUSION

Mechanical plaque control is the gold standard for prevention of oral disease but it requires immense patient co-operation and motivation; therefore chemical plaque control agents acts as a useful adjunct to achieve the targets. The anti-calculus mouthrinse i.e. Periogen effectively reduced

the clinical symptoms of plaque-induced gingivitis, and had a statistically significant effect on the reduction of clinical and salivary concentration parameters when compared to 0.12% Chlorhexidine.

CONFLICT OF INTEREST

None

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None

ABBREVIATION USED

None

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