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Clinical evaluation of topical application of perio-Q gel (Coenzyme Q_{10}) in chronic periodontitis patients

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Abstract

Background and Objectives:

Coenzyme Q_{10} is a well studied antioxidant in medical literature, but studies regarding its efficacy in periodontal diseases are few. Hence, the aim of this study was to test the efficacy of coenzyme Q_{10} in the form of gel (Perio-Q) in patients with chronic gingivitis and periodontitis.

Materials and Methods:

A total of 12 patients were enrolled. A split mouth design was used for topical (extrasulcular) application, intra-pocket application alone, intra-pocket application combined with scaling and root planing (SRP) and SRP only in each quadrant, respectively. Clinical parameters such as plaque index, gingival index, gingival bleeding index, probing pocket depth, clinical attachment level were assessed at baseline, 3rd week, and 6th week. The results were subjected to statistical analysis, which were expressed as mean±SD and proportions as percentages. Intra group comparisons were made by paired t-test and one way analysis of variance (ANOVA) for inter-group comparisons. Categorical data was analyzed by Fisher's exact test.

Results:

The results showed on intra-group analysis significant reduction (P<0.01) of clinical parameters (plaque index (PI), gingival index (GI), gingival bleeding index (GBI), periodontal probing pocket depth (PPD), and clinical attachment level (CAL)) in all four treatment groups, whereas on inter-group analysis, intra-pocket gel application in combination with SRP showed significant reduction (P<0.05) for PI, GI, GBI, and CAL in comparison to intra-pocket gel alone.

Interpretation and Conclusion:

In the present study, in chronic periodontitis patients, sub-gingival mechanical debridement only and with Perio-Q gel showed almost similar clinical results without any statistically significant differences. Hence, it confirmed the primary role of basic mechanical approaches in periodontal therapy and did not provide enough clinical support for the superiority of adjunctive use of Perio-Q gel. However, it appears that Perio-Q gel in this study may have a potential additive effect. Further, long term clinical studies of Perio-Q gel with various doses and duration need to be conducted.

Keywords: Antioxidants, chronic periodontitis, coenzyme Q_{10}, gingivitis, reactive oxygen species, topical application

INTRODUCTION

Inflammation represents the response of the organism to a noxious stimulus, whether mechanical, chemical, or infectious. It

is a localized protective response elicited by injury or destruction of tissues which serves to destroy, dilute, or wall off both the injurious agent and the injured tissue. Whether acute or chronic, inflammation is dependent upon regulated humoral and cellular responses, and the molecules considered to mediate inflammation at one time or another are legion.[1] However, an event characteristic of mammalian inflammation, tissue infiltration by polymorphonuclear leukocytes and monocytes, and subsequent phagocytosis features non-mitochondrial 02 consumption, which may be 10 or 20 times that of resting consumption ultimately ends in generating free radicals (FR) and reactive oxygen species (ROS) like superoxide anion radicals, hydrogen peroxide, hydroxyl radicals, and hypochlorous acid, all capable of damaging either cell membranes or associated biomolecules.[1] Coenzyme Q_{10} was discovered by Fred Crane and his colleagues in 1957 in beef heart mitochondria.[2] It was first isolated from the mitochondria of bovine hearts in 1957 at the University of Wisconsin. Identification of the chemical structure and synthesis was completed by 1958. Because of its ubiquitous presence in nature and its quinone structure (similar to that of vitamin K), Coenzyme Q_{10} is also known as ubiquinone.[3] CoQ_{10} is a substance of nutritional nature and is a vitamin on the basis of an updated definition of a vitamin by Folkers.[4] It has an extraordinarily long isoprenoid side chain in the 6-position of its 2,3-dimethoxy-5-methyl benzoquinone structure, which is widely distributed in the tissues of the human body.[5] It exists naturally in the mitochondria of all cells in the human body, and has indispensable functions in the bioenergetics of human tissues, including the gingiva.[6] Crane[2] has concisely summarized the currently recognized functions of CoQ_{10} as: needed for energy conversion (ATP production), an essential antioxidant, regenerates other antioxidants, stimulates cell growth, and inhibits cell death.

A deficiency of Coenzyme Q_{10} at its enzyme sites in gingival tissue may exist independently of and/or because of periodontal disease. If a deficiency of coenzyme Q_{10} existed in gingival tissue for nutritional causes and independently of periodontal disease, then the advent of periodontal disease could enhance the gingival deficiency of coenzyme Q_{10}.[7] In such patients, oral dental treatment and oral hygiene could correct the plaque and calculus, but not that part of the deficiency of CoQ_{10} due to systemic cause; therapy with CoQ_{10} can be included with the oral hygiene for an improved treatment of this type of periodontal disease.[7]

Gingival biopsies from patients with inflamed periodontal tissues showed a deficiency of CoQ_{10}, in contrast to patients with normal periodontal tissues.[8] Many clinical trials with oral administration of CoQ_{10} to patients with periodontal disease have been conducted. The results have shown that oral administration of CoQ_{10} increases the concentration of CoQ_{10} in the diseased gingiva and effectively suppresses advanced periodontal inflammation.[9–11]

Thus, we speculate that a concentration of CoQ_{10} applied to the periodontal pocket may improve periodontal inflammation. Topical application is a convenient method in the dental clinical setting. Therefore, to evaluate the benefits of topical application of CoQ_{10} (Perio Q gel [Figure 1]) to periodontal pockets in patients with chronic periodontitis, a clinical trial was conducted.

MATERIALS AND METHODS

This was a randomized, controlled, single-blinded clinical trial with a split-mouth design, intended for comparison of four treatment modalities: Topical (extrasulcular) Perio-Q gel [Figure 2] alone, Intrapocket Perio-Q gel [Figure 3] alone, Scaling and root planing plus intrapocket Perio-Q gel (Coenzyme Q_{10}) and Scaling and root planing (SRP) only in patients diagnosed with chronic periodontitis. The trial was undertaken in Department of Periodontics, College of Dental Sciences, Davangere, Karnataka. Both sexes belonging to age group of 22 – 55 years were included in the study. Informed consent was taken from all the patients and the ethical clearance was obtained from the ethical committee of College of Dental Sciences, Davangere, Karnataka.

Inclusion criteria included patients who were diagnosed with chronic generalized periodontitis (AAP-1999) [Figures 4a and 4b] and patients selected should have periodontal pocket measuring 4-8 mm in different quadrants of the mouth on clinical examination with radiographic evidence of bone loss. Exclusion criteria included those subjects who were taking antibiotics in last three months, patients who had undergone periodontal therapy for past six months, patients with systemic diseases and smokers, and patients who were pregnant and lactating mothers.

A total number of 12 patients with a minimum of 4 sites/ quadrant in each patient participated in the study. In each patient, four quadrants were randomly assigned as follows.

Experimental group I

- These sites were treated with topical application of Perio-Q gel alone without SRP.

Experimental group II

- These sites were treated with intrapocket application of Perio-Q gel alone without SRP.

Experimental group III

- These sites were treated with SRP along with intrapocket application of Perio-Q gel.

Control group C

- These sites were treated by SRP alone without Perio-Q gel application.

Periodontal examinations were performed before and after three and six weeks after the beginning of the experiment. Periodontal assessments were performed using the plaque index (PI; Silness and Loe 1964) [Figure 5a and b], gingival bleeding index (GBI; Ainamo and Bay, 1975), and gingival index (GI; Loe and Silness, 1963) [Figure 6a and b]. Periodontal probing pocket depth (PPD) and clinical attachment level (CAL) [Figure 7a and b] were measured using William's graduated probe graded to the nearest 0.5 mm.

On the first day, recording of the clinical parameters for all four quadrants was done. The second day collection of microbiological samples from each quadrant i.e. deepest site from each quadrant was selected for microbiological analysis and SRP were performed in control group C and in experimental group III, using hand instruments and ultrasonic scalers. The third day constituted of application of the gel as per the treatment groups, experimental group I, experimental group II, and experimental group III.

Perio-Q gel (Coenzyme Q_{10} gel manufactured by PERIOQ INC, Manchester, USA), supplied as a pack of gel, contained a mixture of coenzyme Q_{10} and vegetable glycerin base in a ratio of 1:9. The gel should preferably be used within 48 months from the date of manufacture and stored in a dry area away from sources of light and heat. It does not have to be stored in the refrigerator. However, when kept in the refrigerator at a temperature between 4-80C, its shelf-life would be maintained.

Topical application was used with the tip of the applicator completely soaked in gel and applied to the assigned quadrant (experimental group I). Intrapocket application was done by Max-i-Probe (Dentsply, USA) irrigation needles were modified to deliver the gel intrapocket (group II and III). The periodontal pocket was dried with paper points before sub gingival administration of Perio-Q. Subgingival administration was accomplished by inserting the syringe to the base of the periodontal pocket first and then placing the gel while working the way up, until the gingival margin.

All the clinical parameters were recorded after three and six weeks after treatment. Data obtained after treatment was compared with the initial values. Results were expressed as mean±SD and proportions as percentages. Intragroup comparisons were made by paired t-test and one way analysis of variance (ANOVA) for intergroup comparisons. Categorical data was analyzed by Fisher's Exact Test.

For all the tests a *P*-value of 0.05 or less was considered for statistical significance.

RESULTS

On comparing mean plaque index, gingival index, gingival bleeding index, probing pocket depth, clinical attachment level among all four groups at 3^{rd} and 6^{th} week showed statistically significant results ($P<0.01$) [Tables 1–5]. On intergroup comparison of PI, statistically significant result was found between groups' I-III and II-III at difference 0-3^{rd} week and 0-6^{th} week, whereas III-C showed statistically significant result only between 0-3^{rd} week [Table 6]. Gingival index and gingival bleeding index showed statistically significant result between II-III groups at both 0-3^{rd} week and 0-6^{th} week [Table 7]. GBI also showed significant result between III-C at 0-6^{th} week [Table 8]. PPD showed significant result between only I-III groups at 0-6^{th} week [Table 9], whereas gain in CAL was significant between I-III, I-C, II-III and II-C at 0-6^{th} week [Table 10].

DISCUSSION

The concept of antioxidant therapy in the treatment of numerous diseases including inflammatory periodontal disease exists in the literature. Because of its function, CoQ_{10} has received much research attention in a medical literature in the last several years. However, there is a dearth of new information regarding CoQ_{10} in the treatment of periodontal conditions. Hence, based on new concepts of synergism with nutritional supplements and host response, we designed a randomized controlled, single-blinded clinical trial with a split-mouth design, intended for comparison of four treatment modalities: Topical Perio-Q gel (CoQ_{10}) alone, Intrapocket Perio-Q gel (CoQ_{10}) alone, Scaling and root planing plus intrapocket Perio-Q gel (CoQ_{10}), and Scaling and root planing (SRP) only in patients diagnosed with chronic periodontitis.

There were certain problems encountered during our study which included difficulty in intrapocket placement of the gel due

to unfavorable thixotropic properties of the gel, although the pocket was filled up from its base to the coronal aspect; thoroughness remained a question. Substantivity of the gel used was not known; thus bioavailability of CoQ_{10} cannot be commented upon. It was neither a sustained release nor a controlled release formulation; therefore, it may have had a short wash out period even though post gel application instructions were given.

During the study, four patients gave highly positive statements in aspect of subjective feeling of improvement of periodontium condition, which additionally confirmed the effectiveness of applied supporting therapy. No adverse reactions were reported in the study.

Topical (extrasulcular) application of gel alone (experimental group I) resulted in significant reduction ($P<0.01$) of plaque index, gingival index, and gingival bleeding index during first three weeks and at six weeks. Results were similar to Matthews-Brzozowska *et al*. 2007 suggesting that the gel could be a treatment option for gingivitis cases and also is a convenient method for patients for home use. On intragroup comparison, SRP only and SRP with gel had shown similar clinical results, which was not statistically significant, but in comparison with combination of gel and SRP, group III has proved to be better. Thus, in this study, improvement in chronic periodonttis patients occurred mainly along with a combination of gel and conventional nonsurgical periodontal therapy.

CONCLUSION

Intra-pocket application of the Perio-Q gel as a sole treatment in this study had reduced the various clinical parameters, but intra-pocket application of Perio-Q gel with mechanical debridement further improved the clinical parameters. In chronic periodontitis patients, sub-gingival mechanical debridement only and with Perio-Q gel showed almost similar clinical results without any statistically significant differences. The result of the present study evaluated on a short term basis confirmed the primary role of basic mechanical approaches in periodontal therapy and did not provide enough clinical support for the superiority of adjunctive use of Perio-Q gel. However, it appears that Perio-Q gel in this study may have a potential additive effect. This study necessitates further studies with other antioxidant agents for designing a strategy for the use in clinical practice. Further long term clinical studies of Perio-Q gel, with various doses and duration, need to be conducted.

Footnotes

Source of Support: Nil

Conflict of Interest: None declared

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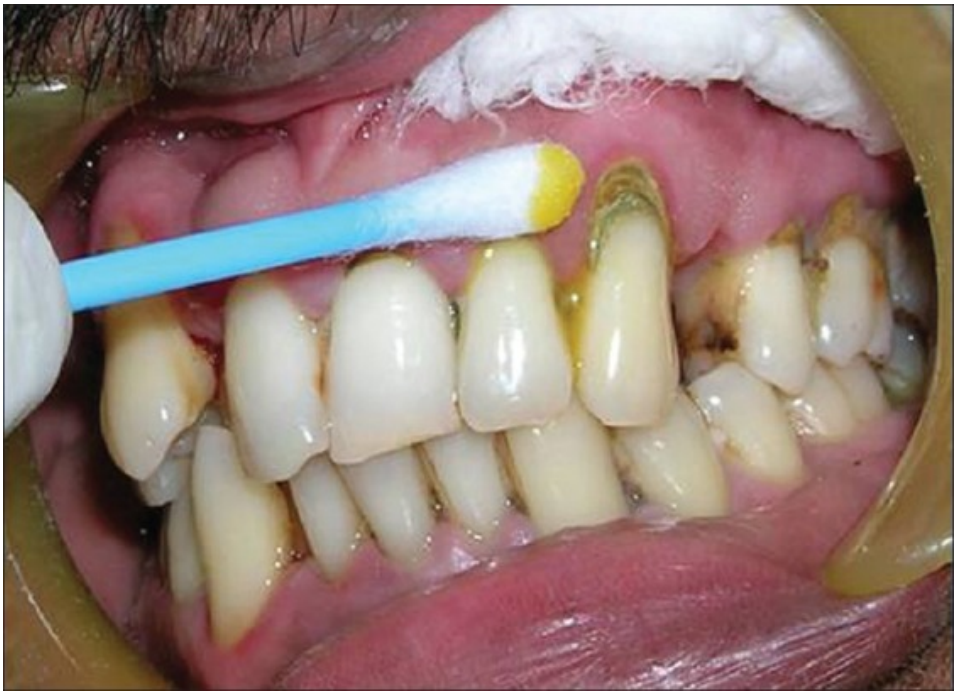
Figures and Tables

Figure 1

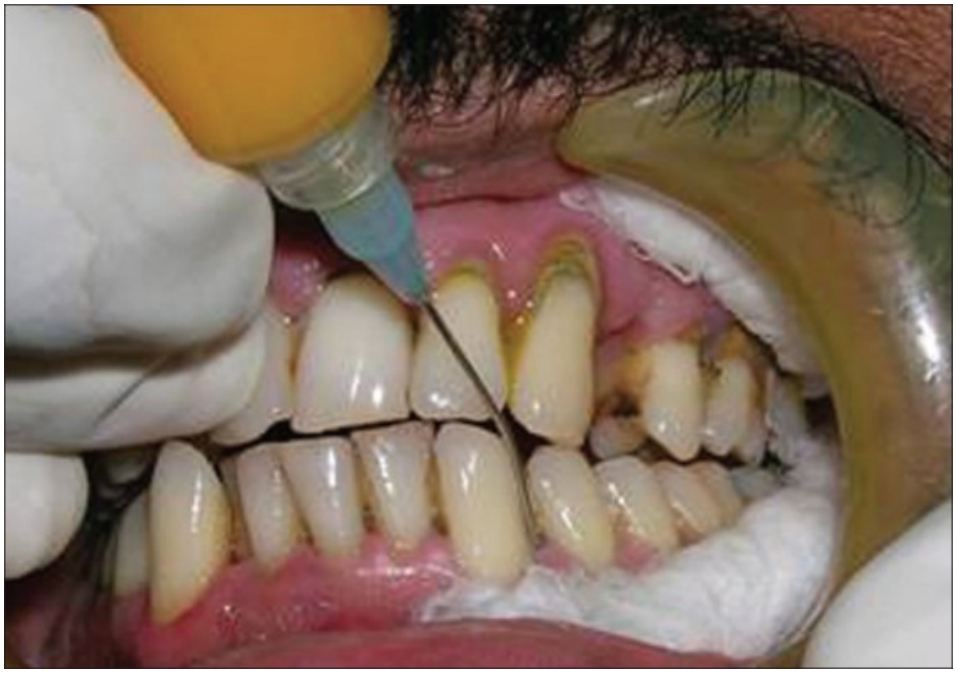
Perio Q gel

Figure 2



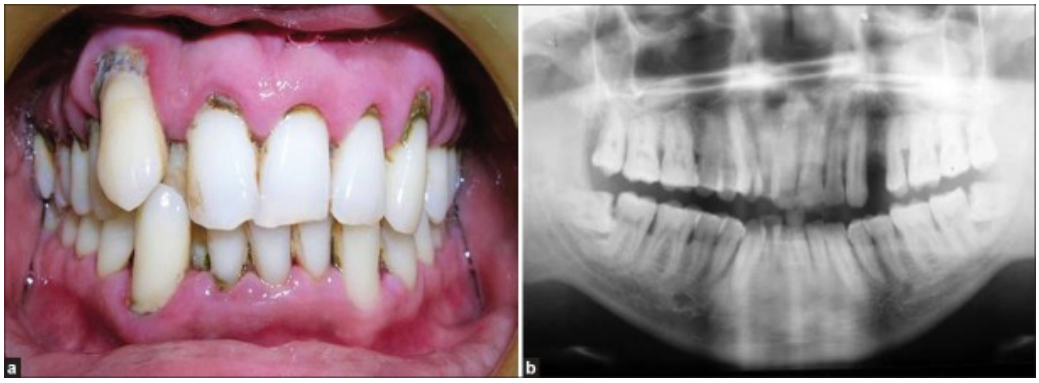
Topical application of Perio Q gel

Figure 3



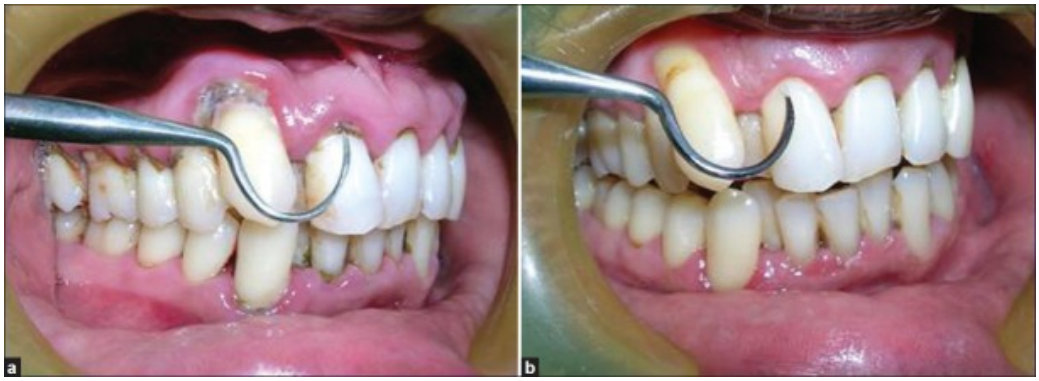
Intra pocket application of Perio Q gel

Figure 4



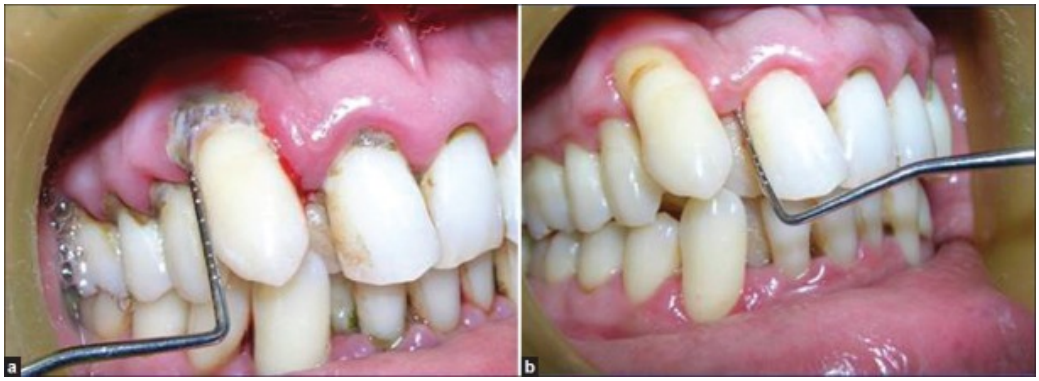
(a) Chronic peridontitis - Clinical; (b) Chronic peridontitis - OPG

Figure 5



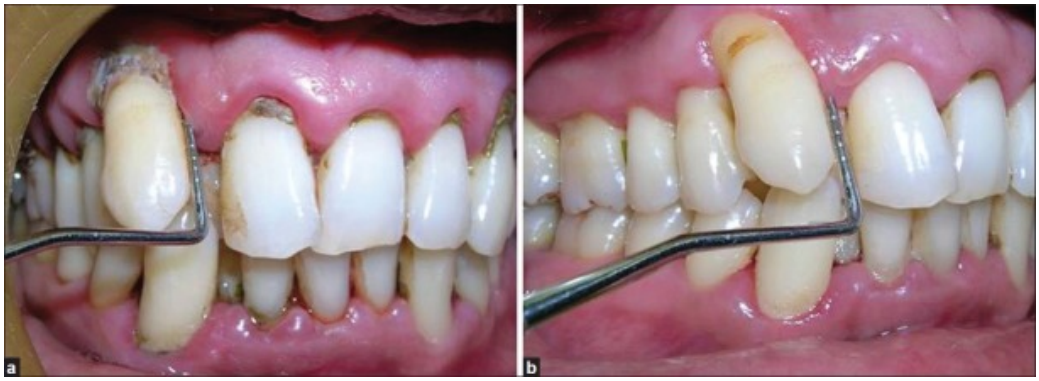
(a) Plaque index at 0 day; (b) Plaque index at 6 weeks

Figure 6



(a) Gingival bleeding and gingival index at 0 day; (b) Gingival bleeding and gingival index at 6 weeks

Figure 7



(a) PPD and CAL at 0 day; (b) PPD and CAL at 6 weeks

Table 1

Intra-group comparison of plaque index values

Groups	'0' day	3rd week	Diff. (0-3)	6th week	Diff. (0-6)
			T		T
			P		P
Experimental group I	2.43±0.43	1.76±0.40	0.67±0.35	1.42±0.48	1.01±0.44
			6.71		7.91
			<0.01		<0.01
Experimental group II	2.41±0.32	1.93±0.17	0.48±0.29	1.54±0.23	0.88±0.41
			5.67		7.35
			<0.01		<0.01
Experimental group III	2.53±0.23	1.26±0.19	1.28±0.34	1.00±0.16	1.54±0.31
			13.0		17.12
			<0.01		<0.01
Control group C	2.32±0.39	1.49±0.46	0.83±0.36	1.07±0.28	1.24±0.25
			8.04		17.2
			<0.01		<0.01
ANOVA			F 12.2		F 8.34
			P<0.01		*P*<0.01

T – Unpaired *t*-test; *P*<0.05, *P*<0.01 Significant one way ANOVA; $F = \frac{\text{Between group variance}}{\text{Within group variance}}$

Table 2

Intra-group comparison of gingival index values

Groups	'0' day	3rd week	Diff. (0-3)	6th week	Diff. (0-6)
			T		T
			P		P
Experimental group I	1.75±0.28	1.32±0.24	0.42±0.16	1.19±0.21	0.56±0.17
			9.44		11.2
			<0.01		<0.01
Experimental group II	1.78±0.75	1.39±0.31	0.39±0.25	1.24±0.29	0.55±0.24
			5.45		7.92
			<0.01		<0.01
Experimental group III	1.87±0.16	1.27±0.20	0.60±0.12	1.13±0.17	0.74±0.13
			17.1		19.1
			<0.01		<0.01
Control group C	1.72±0.18	1.23±0.26	0.48±0.36	1.07±0.22	0.65±0.20
			7.90		11.1
			<0.01		<0.01
ANOVA			F 2.70		F 2.73
			P=0.01		*P*=0.05

T – Unpaired *t*-test; $P<0.05$, $P<0.01$ Significant one way ANOVA; $F = \frac{\text{Between group variance}}{\text{Within group variance}}$

Table 3

Intra-group comparison of gingival bleeding index values

Groups	'0' day	3rd week	Diff. (0-3) T P	6th week	Diff. (0-6) T P
Experimental group I	81.9±18.6	38.4±11.6	43.5±9.6 15.7 <0.01	26±13	55.3±13.1 14.6 <0.01
Experimental group II	82.3±13.6	41.7±22.3	40.6±19.8 7.1 <0.01	29.3±19.1	52.9±14.6 12.5 <0.01
Experimental group III	87.3±16.0	29.3±16.2	58.1±15.4 13.10 <0.01	18.4±10.1	68.9±14.2 16.9 <0.01
Control group C	70.4±21.4	29.1±8.6	41.3±18.2 7.89 <0.01	20.1±10.5	50.3±21.3 8.19 <0.01
ANOVA			F 3.10 *P*<0.05		F 3.17 *P*<0.05

T – Unpaired *t*-test; *P*<0.05, *P*<0.01 Significant one way ANOVA; $F = \frac{\text{Between group variance}}{\text{Within group variance}}$

Table 4

Intra-group comparison of probing pocket depth values

Groups	'0' day	6th week	Diff. (0-6) T P
Experimental group I	4.65±0.25	3.99±0.40	0.66±0.22 10.51 <0.01
Experimental group II	5.09±0.43	4.35±0.38	0.75±0.37 7.05 <0.01
Experimental group III	4.97±0.23	3.83±0.67	1.14±0.57 6.88 <0.01
Control group C	4.75±0.34	3.73±0.53	1.02±0.36 9.78 <0.01
ANOVA			F 3.77 *P*<0.05

NS – Not significant; S – Significant

Table 5

Intra-group comparison of clinical attachment level values

Groups	'0' day	6th week	Diff. (0-6) T P
Experimental group I	1.84±0.42	1.72±0.41	0.12±0.001 3.94 <0.01
Experimental group II	2.17±0.41	1.99±0.43	0.18±0.002 8.15 <0.01
Experimental group III	2.25±0.48	1.92±0.52	0.33±0.04 6.28 <0.01
Control group C	2.08±0.32	1.70±0.41	0.38±0.15 8.97 <0.01
ANOVA			F 10.2 *P*<0.01

NS – Not significant; S – Significant

Table 6

Inter-group comparison of plaque index values

	Groups	Diff. 0-3rd week	Diff. 0-6th week
Difference between groups (*P* values)	I – II	0.51, NS	0.79, NS
	I – III	<0.01, S	<0.01, S
	I – C	0.66, NS	0.41, NS
	II – III	<0.01, S	<0.01, S
	II – C	0.07, NS	0.08, NS
	III – C	<0.05, S	0.22, NS

NS – Not significant; S – Significant

Table 7

Inter-group comparison of gingival index values

	Groups	Diff. 0-3rd week	Diff. 0-6th week
Difference between groups (*P* values)	I – II	0.98, NS	0.99, NS
	I – III	0.13, NS	0.10, NS
	I – C	0.86, NS	0.66, NS
	II – III	=0.05, S	=0.05, S
	II – C	0.64, NS	0.58, NS
	III – C	0.48, NS	0.62, NS

NS – Not significant; S – Significant

Table 8

Inter-group comparison of gingival bleeding index values

	Groups	Diff. 0-3rd week	Diff. 0-6th week
Difference between groups (*P* values)	I – II	0.97, NS	0.98, NS
	I – III	0.14, NS	0.18, NS
	I – C	0.99, NS	0.87, NS
	II – III	<0.05, S	0.08, NS
	II – C	0.99, NS	0.97, NS
	III – C	0.07, NS	<0.05, S

NS – Not significant; S – Significant

Table 9

Inter-group comparison of probing pocket depth values

	Groups	Diff. 0-6th week
Difference between groups (*P* values)	I – II	0.96, NS
	I – III	<0.05, S
	I – C	0.14, NS
	II – III	0.09, NS
	II – C	0.34, NS
	III – C	0.90, NS

NS – Not significant; S – Significant

Table 10

Inter-group comparison of clinical attachment level values

	Groups	Diff. 0-6th week
Difference between groups (*P* values)	I – II	0.63, NS
	I – III	<0.01, S
	I – C	<0.01, S
	II – III	<0.05, S
	II – C	<0.01, S
	III – C	0.78, NS

NS – Not significant; *t*=Unpaired *t*-test *P*<0.05; Significant