

Comparative evaluation of co-enzyme Q10 and *Melaleuca alternifolia* as antioxidant gels in treatment of chronic periodontitis: A clinical study

CHETAN PURUSHOTTAM RAUT, KUNAL S. SETHI

Abstract

Background: Conventional nonsurgical periodontal therapy has been proven to be an effective treatment for patients with chronic periodontitis. Coenzyme Q10 and tea tree oil (TTO) are known to have potential therapeutic benefits in chronic periodontitis. **Aims:** The aim of the study is to compare the efficacy of Coenzyme Q10 (Perio Q[®]) and tea tree oil (*Melaleuca alternifolia*) gel as an adjunct to scaling and root planing in the treatment of chronic periodontitis. **Materials and Methods:** Patients were divided equally into three groups: Group I (Control group): those receiving placebo gel + SRP, Group II (Test group I): those receiving Perio Q[™] gel + SRP, and Group III (Test group II): those receiving tea tree oil gel + SRP. A total of 15 patients with 45 sites were enrolled in the study. Clinical parameters evaluated were plaque index (PI), gingival bleeding index (GI), probing pocket depth (PPD), and clinical attachment level (CAL). **Statistical Analysis Used:** Paired *t*-test was applied using SPSS software. **Results:** Mean PPD reduction for Group I, Group II, and Group III was 0.50 ± 0.2 , 2.95 ± 0.20 , and 2.09 ± 0.15 , respectively. Mean CAL reduction for Group I, Group II, and Group III was 0.45 ± 0.22 , 2.33 ± 0.04 , and 2.28 ± 0.09 , respectively. Changes in mean PI scores for Group I, Group II, and Group III were 0.67 ± 0.17 , 1.00 ± 0.11 , and 1.08 ± 0.05 and GBI scores were 0.92 ± 0.29 , 1.08 ± 0.13 , and 0.88 ± 0.28 , respectively. **Conclusions:** Coenzyme Q10 and tea tree oil gel proved to be effective in the treatment of chronic periodontitis.

Keywords: Coenzyme Q10, free radicals, periodontitis, reactive oxygen species, tea tree oil

Introduction

Periodontitis is an immuno-inflammatory disease process resulting from the interaction of a bacterial attack and host inflammatory response. This leads to the inflammation of the supporting tissues of the teeth further leading to tissue destruction and tooth loss. Varieties of molecules are considered to mediate the inflammatory response at one time or another. Among these are free radicals (FRs) and reactive oxygen species (ROS) known to cause destruction such as superoxide anion radicals, hydrogen peroxide, hydroxyl radicals, and hypochlorous acid. All these molecules are capable of damaging either cell membranes or associated biomolecules. Periodontal pathogens can induce ROS overproduction and thus may cause collagen and periodontal

cell breakdown. When ROS are scavenged by antioxidants, there is a reduction of collagen degradation.^[1] Hence, antioxidants are emerging as prophylactic and therapeutic agents. Antioxidants delivered by the diet,^[2] systemically,^[3] locally,^[4] and through a dentifrice^[5] have been shown to cause significant improvements in the measures of gingivitis, periodontitis, and oxidative injury.

Coenzyme Q10 (CoQ10) was discovered in beef heart mitochondria at the University of Wisconsin.^[6] CoQ10 is also known as ubiquinone because of its ubiquitous presence in nature and its Quinone structure (similar to that of Vitamin K).^[7] It is also called as “coenzyme” because of its unique ability to participate in chemical reactions but remain at steady-state levels in the cell and plays a central role in energy metabolism. It has a positive inotropic effect.^[8] The effects and mechanisms of action of CoQ10 include stabilization of calcium-dependent channels, inhibition of intracellular phospholipases, prostaglandin metabolism, FR scavenging, and direct membrane stabilization.^[9] Co-Q10 is also known to play a crucial role in the generation of adenosine triphosphate (ATP) and cellular respiration. It exists in two molecular forms, ubiquinone, the oxidized form,

Department of Periodontology, MGV's KBH Dental College and Hospital, Nashik, Maharashtra, India

Correspondence: Dr. Chetan Purushottam Raut, Department of Periodontology, MGV KBH Dental College and Hospital, Nashik - 422 003, Maharashtra, India. E-mail: craut96@gmail.com

Access this article online	
Quick Response Code:	Website: www.contempclindent.org
	DOI: 10.4103/0976-237X.188572

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How to cite this article: Raut CP, Sethi KS. Comparative evaluation of co-enzyme Q10 and *Melaleuca alternifolia* as antioxidant gels in treatment of chronic periodontitis: A clinical study. *Contemp Clin Dent* 2016;7:377-81.

and ubiquinol, the reduced form, which are the basis for its antioxidant properties.^[10] Co-Q10 functions as an intercellular antioxidant by acting as a primary scavenger of FRs and ROS. It serves as an endogenous antioxidant, and its increased concentration in the diseased gingiva effectively suppresses advanced periodontal inflammation.

Tea tree oil (TTO) is derived from the paper bark tea tree.^[11] TTO has a broad-spectrum antimicrobial, antifungal, antiviral, antioxidant, and anti-inflammatory effect. A few studies have shown the therapeutic effect of the local application of TTO on periodontal tissues.^[11]

Thus, the aim of the study was to compare and evaluate the efficacy of Coenzyme Q10 and TTO gel as an adjunct to SRP in the treatment of chronic periodontitis.

Materials and Methods

Fifteen patients (6 males, 9 females) were selected from the Outpatient Department of Periodontology. Ethical clearance was obtained from the Institutional Ethical Committee. Systemically healthy patients in the age group of 20–60 (37.4 ± 9.76) years of both the genders who were diagnosed with chronic periodontitis clinically and radiographically were included in the study.^[12,13]

Subjects included in the study were patients with untreated moderate to severe chronic periodontitis, sites with probing pocket depth (PPD) of >5 mm and clinical attachment loss >4 mm.

Subjects excluded from the study were patients with systemic disease that affects the periodontium, pregnant or lactating females, patients who received any anti-inflammatory drugs, antibiotics or vitamins within the previous 3 months, patients who were smokers (>10 cigarettes/day), had received scaling and root planing (SRP) or subgingival instrumentation <2 months before the baseline examination.^[14,15]

Materials

Perio Q[®] gel

Perio Q[®] gel (PerioQ Inc., Manchester, USA) is a mixture of CoQ10 in a vegetable oil base in a ratio of 1:9. It is supplied as a pack of gel and was stored at a temperature between 4°C and 8°C for maintaining its shelf-life.

Tea-tree oil gel preparation

Gel formulation was prepared from commercially available TTO (Allin Exporters, India). It was used as a locally delivered sustained release subgingival gel and was prepared as follows: To prepare the methyl cellulose gel, 7 g of methyl cellulose powder was dissolved in 100 ml boiled water. To make the TTO gel 5%, 5 ml of TTO was then mixed into the methylcellulose gel. The gel was sterilized in the autoclave at 110°C for 20 min.^[16]

Placebo gel

The placebo gel preparation was same as that of tea-tree oil gel preparation except for the addition of tea-tree oil. Placebo gel was used to reduce any bias related to patient acceptance.

Sites treated

A total number of 15 patients with 45 sites was included in the study. In each patient, three different sites were randomly divided by lottery method. Thus, a single patient was treated with all three treatment modalities to avoid any intersubject bias.

Treatment sites in patients were randomly divided into three groups.

- Group I (Control Group): SRP plus placebo gel
- Group II (Test Group 1): SRP plus Coenzyme Q10 gel delivery
- Group III (Test Group 2): SRP plus TTO gel delivery.

Clinical parameters

In total, 15 patients with 45 sites were enrolled in the study. Following clinical parameters were evaluated at baseline and 1 month follow-up.

Four clinical parameters evaluated were plaque index (PI),^[17] sulcus bleeding index, PPD^[18] and clinical attachment level.^[18]

Treatment procedure

At the baseline, SRP was performed in all the groups. In Group I, placebo gel was placed into periodontal pocket. In Group II, the Local application of Coenzyme Q10 gel was performed using special needles designed to deliver gel in the pocket. In Group III, local delivery of TTO gel was performed after SRP [Figures 1 and 2].

After application of gel periodontal pack placement was done to avoid flowing away of the gel and for its sustained release into the periodontal pocket. Patients were recalled after 7 days for removal of pack and 1 month for follow-up.

Statistical analysis

All the results were tabulated and statistically analyzed using Statistical Package for Social Science (SPSS Version 12, IBM



Figure 1: Coenzyme Q10 application

Inc, Chicago, IL, USA). $P < 0.05$ was defined as statistically significant.

Results

Probing pocket depth

Mean pocket depth at baseline and 1 month was found to be 5.10 ± 0.68 – 4.60 ± 0.47 , 5.69 ± 0.83 – 2.74 ± 0.63 , 5.60 ± 0.65 – 3.51 ± 0.50 in Group I, Group II, Group III, respectively.

In Group I, mean pocket depth changes at baseline and 1 month were nonsignificant. In Group II and Group III, the difference in mean pocket depth at baseline and 1 month was statistically significant [Table 1].

Clinical attachment level

Mean clinical attachment level changes at baseline and 1 month were found to be 5.22 ± 0.64 – 4.77 ± 0.42 , 5.94 ± 0.80 – 3.61 ± 0.84 , 6.05 ± 0.63 – 3.77 ± 0.54 in Group I, Group II, Group III, respectively.

In Group I, mean clinical attachment level changes at baseline and 1 month were nonsignificant. In Group II and Group III, mean clinical attachment level changes from baseline to 1 month were significant [Table 2].

Plaque index

Mean PI scores at baseline and 1 month were 1.75 ± 0.45 – 1.08 ± 0.28 , 1.66 ± 0.49 – 0.66 ± 0.38 , and 1.83 ± 0.38 – 0.75 ± 0.33 in Group I, Group II, and Group III, respectively. The changes in mean PI scores from baseline to 1 month follow-up were significant in all three groups [Table 3].

Gingival bleeding index

Mean gingival bleeding index scores changes from baseline to 1 month were 1.83 ± 0.57 – 0.91 ± 0.28 , 1.91 ± 0.51 – 0.83 ± 0.38 , 1.83 ± 0.38 – 0.95 ± 0.14 in Group I, Group II, Group III, respectively. Changes from



Figure 2: Tea tree oil gel Q10 application

baseline to 1 month follow-up were significant in all three groups (Group I, Group II, Group III) [Table 4].

Discussion

Antioxidant therapy is believed to be effective in periodontitis.^[19] However, studies exploring the role of antioxidants have shown mixed results.^[20-22] In this study, two antioxidant gels that are Coenzyme Q10 gel and TTO gel were used for the treatment of periodontitis. Coenzyme Q10 gel was available commercially (Perio Q[®]) and TTO gel was prepared using the protocols described previously. However, there are limited data regarding the comparison of Coenzyme Q10 and TTO gel as an antioxidant in the treatment of chronic periodontitis.

Table 1: Mean values of probing pocket depth at baseline and 1 month follow-up

Groups	Mean±SD		P
	Baseline	1 month	
I	5.10±0.68	4.60±0.47	>0.05
II	5.69±0.83	2.74±0.63	<0.05
III	5.60±0.65	3.51±0.50	<0.05

$P < 0.05$: Significant; $P > 0.05$: Nonsignificant. SD: Standard deviation

Table 2: Mean values of clinical attachment level at baseline and 1 month follow-up

Groups	Mean±SD		P
	Baseline	1 month	
I	5.22±0.64	4.77±0.42	>0.05
II	5.94±0.80	3.61±0.84	<0.05
III	6.05±0.63	3.77±0.54	<0.05

$P < 0.05$: Significant; $P > 0.05$: Nonsignificant. SD: Standard deviation

Table 3: Mean values of plaque index at baseline and 1 month follow-up

Groups	Mean±SD		P
	Baseline	1 month	
I	1.75±0.45	1.08±0.28	<0.05
II	1.66±0.49	0.66±0.38	<0.05
III	1.83±0.38	0.75±0.33	<0.05

$P < 0.05$: Significant; $P > 0.05$: Nonsignificant. SD: Standard deviation

Table 4: Mean values of gingival bleeding index at baseline and 1 month follow-up

Groups	Mean±SD		P
	Baseline	1 month	
I	1.83±0.57	0.91±0.28	<0.05
II	1.91±0.51	0.83±0.38	<0.05
III	1.83±0.38	0.95±0.14	<0.05

$P < 0.05$: Significant; $P > 0.05$: Nonsignificant. SD: Standard deviation

Healing and repair of periodontal tissue require efficient energy production, and the metabolic functions of the periodontal tissues depend on an adequate supply of CoQ10.^[6] Gingival biopsies revealed subnormal tissue level of CoQ10 in 60–96% patients with periodontal disease, indicating that periodontal disease is frequently associated with CoQ10 deficiency.^[6] Physiologically, CoQ10 plays four major roles. It has an essential role in mitochondrial energy (ATP) production through redox activity in the respiratory chain, transporting electrons between enzymes. Second, it plays a role in extramitochondrial redox activity in the cell membrane and endomembranes. CoQ10 also functions as an antioxidant, inhibiting lipid peroxidation, and scavenging FRs. Finally, it plays an important role in membrane stabilization and fluidity.^[7] The antioxidant nature of CoQ10 is derived from its energy carrier function. As an energy carrier, the CoQ10 molecule is continuously going through an oxidation–reduction cycle. CoQ10 inhibits lipid peroxidation by preventing the production of lipid peroxyl radicals. In addition, the reduced form of CoQ10 effectively regenerates Vitamin E from the α -tocopheroxyl radical. Furthermore, during oxidative stress, interaction of H₂O₂ with metal ions bound to DNA generates hydroxyl radicals and CoQ10 efficiently prevents the oxidation of bases, particularly in mitochondrial DNA.^[23]

Saxer *et al.* demonstrated that TTO (*Melaleuca alternifolia*) results in a reduction of inflammation due to the presence of 1,8-cineole and terpinen-4-ol.^[24] TTO also results in less plaque formation as reported by Takarada *et al.* who demonstrated that TTO could inhibit the adhesion of *Streptococcus mutans* and *Porphyromonas gingivalis*.^[25] These properties of TTO could account for the antiplaque and antigingivitis activities of the formulated gel. TTO is efficacious against oral bacteria, with antiseptic, fungicidal, and bactericidal effects due to its active ingredients.^[24]

Results showed that there was a statistically significant reduction in the mean PI and sulcular bleeding index scores during the study in all three groups as compared with baseline values, and there was no significant difference between the three groups during the study. The reduction in plaque scores could be due to the proper oral hygiene maintenance after SRP. This was in agreement with the clinical results reported by Arweiler *et al.* who described the efficacy of a TTO used as mouthwash on plaque formation. They found that the PI in the group treated by TTO mouthwash did not differ from placebo mouthwash on any day from the study periods.^[26] Furthermore, our results were in agreement with the other clinical results reported by Soukoulis and Hirsch, who performed a double-blind, longitudinal study to evaluate the effect of TTO gel (2.5%) applied to toothbrush twice daily. They found that TTO did not reduce plaque scores.^[11]

In this study, there was significant reduction in PPD and clinical attachment level in Group II (Coenzyme Q10) and Group III (TTO gel) scores as compared to Group I (SRP + placebo). The

results are consistent with the previous study done by Hans *et al.*, Chatterjee *et al.* regarding the use of Coenzyme Q10.^[6,27] The use of TTO also resulted improvement in all clinical parameters evaluated. The results using TTO gel are consistent with the previous study by Elgendy *et al.*^[15]

The results of the present study show that there was no significant difference between the two test groups. However, patients in Group III reported with slight change in taste after the application of TTO gel. No such change in taste was reported after the use of Coenzyme Q10 gel.

Thus, results of the present study brighten the futuristic aspect of using antioxidant gels as a local drug delivery system in subgingival sites. The limitation of the present clinical trial was the small sample size and the short duration for determining the efficacy of the experimental drug. Thus, further studies are recommended with larger sample size for the evaluation of the efficacy of this antioxidants in the form of gel in the treatment of chronic periodontitis. The concomitant biochemical and microbial analysis could also help in better interpretation of findings.

Conclusion

Within the limitations of the present study, coenzyme Q10, and TTO gel as an adjunct to SRP proved to be effective in the treatment of periodontitis. Furthermore, it emphasizes the potential therapeutic value of two agents as an antioxidant which can reduce inflammation and promote healing of periodontal tissues.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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