



## CLINICAL EFFECTIVENESS OF INTRASULCULAR APPLICATION OF COENZYME Q10 AS AN ADJUNCT TO SCALING AND ROOT PLANING

### Periodontology

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### ABSTRACT

**Aim:** The aim of the present study was to assess the efficacy of administering intrapocket Coenzyme Q10 as an adjunct to SRP in the treatment of chronic periodontitis.

**Materials and methods:** A total number of 10 patients (4 male and 6 female) in the age group of 20 - 55 years who were diagnosed with chronic periodontitis. The selected subjects were treated in two different quadrants randomly. Group I (Control quadrants): those receiving only SRP, Group II (Test quadrants): those receiving Perio QTM gel + SRP. Clinical parameters evaluated were plaque index (PI), gingival bleeding index (GI and probing pocket depth (PPD), were measured at baseline, 3<sup>rd</sup> week and 6<sup>th</sup> weeks.

**Results:** In this study there was significant decrease in the probing depth, plaque index, gingival index and gingival bleeding index in Groups II (test quadrant) as compared with Group I (control quadrant), study in all two groups as compared with baseline values, and there was significant difference between the two groups during the study. The *P*-value, 0.001, was statistically significant at the 3<sup>rd</sup> week for the test groups. There is no difference in the results after a period of 6 weeks in both test and control quadrant.

**Conclusion:** This study showed significant reduction of all clinical parameters when Intrapocket Coenzyme Q10 is used as an adjunct to scaling and root planing than scaling and root planing alone. Therefore, CoQ10 along with scaling and root planing can prevent periodontitis by reducing gingival inflammation.

### KEYWORDS

Antioxidants, coenzyme Q10, chronic periodontitis, inflammation, reactive oxygen species.

### INTRODUCTION:

Periodontitis, a local chronic inflammation in the supporting tissues of the teeth leading to progressive loss of the periodontal ligament and bone, is believed to result from disruption of the homeostatic balance between periodontopathic bacteria and the host response to this microorganisms.<sup>1</sup>

The inflammatory and immune responses to the bacteria and viruses that colonize the periodontal and associated tissues involve the systemic circulation and ultimately the peripheral systems of the body. This creates a complex bi-directional series of host-microbial interactions involving cellular and humoral factors and networks of cytokines, chemokines and growth factors.<sup>2</sup> However the majority of periodontal tissue destruction is caused by an exaggerated host response to those organisms and their products.<sup>3</sup>

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. In normal physiology, there is a dynamic equilibrium between ROS activity and antioxidant defense capacity and when that equilibrium shifts in favour of ROS, either by reduction in anti-oxidant defenses or an increase in ROS production or activity, oxidative stress results. This imbalance between the ROS-AO has been implicated as one of the progressive or pathogenic factors for periodontal disease.<sup>4</sup> Usually, the oxidative damage is perfectly controlled by the anti-oxidant defense mechanisms of the surrounding tissues but plaque microorganisms promoting periodontitis can

unbalance this equilibrium. A massive neutrophil migration to the gingiva and gingival fluid leads to abnormal spreading of FRs/ROS produced. Consequently, this led to a search for appropriate "antioxidant therapy" in inflammatory periodontal disease.<sup>5</sup>

Coenzyme Q10 (CoQ10) was discovered in beef heart mitochondria at the University of Wisconsin. CoQ10 is also known as ubiquinone because of its ubiquitous presence in nature and its Quinone structure (similar to that of Vitamin K).<sup>7</sup> 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.<sup>8</sup> CoQ10 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, and ubiquinol, the reduced form, which are the basis for its antioxidant properties.<sup>9</sup> Co-Q10 functions as an intercellular antioxidant by acting as a primary scavenger of FRs and ROS.

Healing and repair of periodontal tissue requires efficient energy production. The metabolic functions depend on an adequate supply of CoQ10. CoQ10 deficiency has been reported in gingival tissue of patients with periodontal disease. CoQ<sub>10</sub> deficiency is frequently associated with periodontal diseases and its administration to periodontal tissues may control advanced periodontitis.<sup>10</sup>

It prevents the generation of free radicals. Topical administration to the gingiva as a sole treatment may decrease GCF flow and probing depths and improve clinical gingival attachment. CoQ<sub>10</sub> topical application

has been beneficial for patients at risk of periodontal diseases.<sup>11</sup> Thus; an attempt has been made through this study to evaluate the efficacy of administrating intrapocket Coenzyme Q10 as an adjunct to SRP in the treatment of chronic periodontitis.

**MATERIALS AND METHODS**

A total number of 10 patients (4 male and 6 female) in the age group of 20 - 55 years who were diagnosed with chronic periodontitis who are visiting to the outpatient Department of Periodontology of Sri Rajiv Gandhi College of Dental Sciences & Hospital, R.T. Nagar, Bangalore were considered for the study. Ethical clearance was obtained from the institutional ethical committee. The nature of the study was informed to all the patients and written consent was obtained.

Inclusion criteria included patients who were diagnosed with chronic generalized periodontitis (AAP-1999) Inclusion criteria for this randomized, controlled, double-masked study were as follows: 1) Patient suffering from chronic periodontitis and having pocket depth  $\geq 5$ mm in more than 30 sites. 2) Radiographic evidence of bone loss. 3) Patient age group of 20-55 yrs. 4) Patient who are willing to consent for the study. Subjects with significant systemic disease, smokers, apparent oral infection like herpes or candida and pregnant or lactating women were excluded. Individuals with a history of periodontal treatment or antibiotic usage in the previous 6 months also were excluded from the study.

Perio Q gel (Perio QTM) is a mixture of CoQ10 in a vegetable oil base in ratio of 1:9 and is supplied as a pack of gel, and was stored at a temperature between 4 and 8°C to maintain its shelf-life.

Cast models of the selected patients were poured. Occlusal stents were made to compare the pre-surgical and post-surgical measurements. A groove on occlusal stents was made corresponding to the area of highest PD with a tapering low-speed bur. These grooves help in maintaining the same position and angulations during measurement recording. Using the groove as a guide, the periodontal probe was inserted into the pocket and clinical measurements were obtained at the baseline, after 3 weeks, and 6 weeks.

The selected treatment sites were randomly divided into two groups by simple randomization technique of rolling the dice. Clinical parameters were recorded for all the subjects.

**Groups I:** (Control Quadrant) consisted of site in which scaling and root planing alone was performed.

**Groups II:** (Test Quadrant) consisted of contralateral side of the same subject in which scaling and root planning was performed followed by intrapocket Perio Q gel application.

All the clinical parameters, i.e. plaque index,<sup>12</sup> gingival index,<sup>13</sup> modified sulcular bleeding index<sup>14</sup> and probing pocket depth were recorded at baseline and at the 3rd week and 6th week after treatment.

Experimental sites received Perio Q gel in Groups II, and in Groups I no drug was placed in following SRP. The gels were placed in the pockets using a wide gauge needle which was inserted till the base of the pocket. It was made sure that the gel slightly overflowed during placement from the pocket. The experimental sites were covered by coepack. Eating, spitting and drinking were restricted for 1 h after application. Patients were recalled at the 3rd and 6th weeks after treatment to record all the clinical parameters.



**Fig.1 Preoperative test quadrant**



**Fig.2 Preoperative control quadrant**



**Fig.3 Stent**



**Fig.4 Intrasulcular application of Perio Q gel**



**Fig.5 Probing pocket depth in test quadrant**

**Fig.6 Probing pocket depth in control quadrant**

**Statistical Analysis**

All the results clinical parameters were recorded after three and six weeks after treatment and statistically analyzed. Results were expressed as mean  $\pm$ SD and proportions as percentages. One way analysis of variance (ANOVA) was used for Intra-group comparisons. Also, in order to check the accuracy of the study, its p-value (as per Pearson's correlation method) was calculated for all data namely PD, GI, PI and BI. The p-value of the study was found to be less than 0.05, confirming the accuracy of all data collected.

**RESULTS**

The study duration was of 6 weeks during which the values of PD, GI, PI and BI were recorded for both test and control groups over 3 intervals of baseline time, 3 weeks' time and 6 weeks' time respectively.

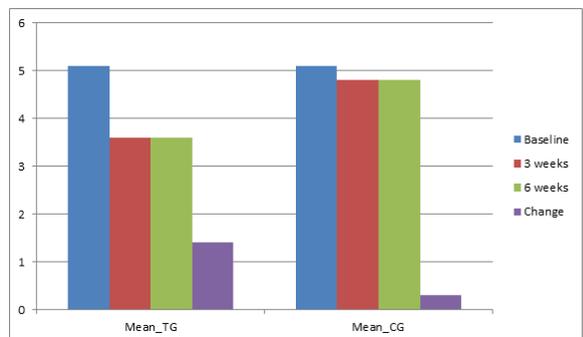
**Probing Depth:**

The mean probing depth values of the control & test quadrant at the baseline were recorded to be 5.1 $\pm$ 0.3162. The mean value after the 3-week period shows as 4.8 $\pm$ 0.4216 for the control quadrant and 3.6 $\pm$ 0.5164 for the test quadrant. There is no difference in the results after a period of 6 weeks, which suggests that the maximum result which could be achieved with traditional treatment as well as with the use of Perio Q gel, was obtained during the 3rd week itself. The intergroup comparison showed statistically significant improvement in the test group as compared to control group. (p<0.0001) as shown in Table 1 and figure 7.

**Table 1.**

	Baseline Mean $\pm$ SD	3 weeks Mean $\pm$ SD	6 weeks Mean $\pm$ SD	Change Mean $\pm$ SD	F ratio value	P value
Control quadrant	5.1 $\pm$ 0.3162	4.8 $\pm$ 0.4216	4.8 $\pm$ 0.4216	0.3 $\pm$ 0.483	308.322 58	P<0.000 1
Test quadrant	5.1 $\pm$ 0.3162	3.6 $\pm$ 0.5164	3.6 $\pm$ 0.5164	1.4 $\pm$ 0.5164	103.222 22	P<0.000 1

Below is the comparison between mean values at each interval of time for test quadrant & control quadrant : **Figure 7**



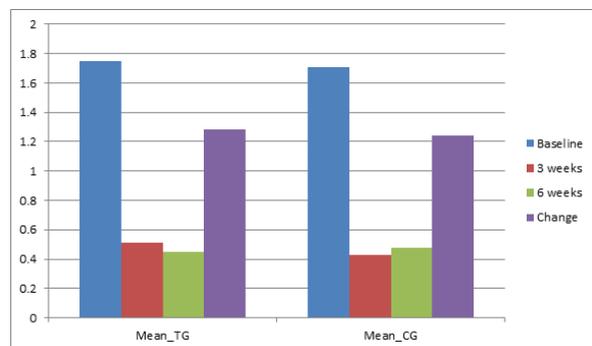
**Gingival Index:**

The mean gingival index measurements taken at baseline for control and test quadrant are 1.71 $\pm$ 0.4954 and 1.75 $\pm$ 0.4223 respectively, with marginal change in their value. Over initial 3 weeks of time, the mean value of GI in control quadrant has changed from 1.71 $\pm$ 0.4954 to 0.43 $\pm$ 0.3234 while it changed to 0.51 $\pm$ 0.3143 in test quadrant. However, the mean value of the same has marginally increased from 0.43 $\pm$ 0.3234 to 0.48 $\pm$ 0.319 from 3rd week of the study to 6th week in control quadrant. This wasn't the case in test quadrant as the mean GI value further reduced to 0.45 $\pm$ 0.2759 in 6th week. The intergroup comparison showed statistically significant improvement in the test group as compared to control group (p<0.0001) as shown in table 3 and figure 8.

**Table 2**

	Baseline Mean ± SD	3 weeks Mean ± SD	6 weeks Mean ± SD	Change Mean ± SD	F ratio value	P value
Control quadrant	1.71± 0.4954	0.43 ± 0.3234	0.48 ± 0.319	1.28 ± 0.3327	F= 27.86172	P <0.0001*
Test quadrant	1.75 ± 0.4223	0.51 ± 0.3143	0.45 ± 0.2759	1.24 ± 0.2011	F= 39.35902	P<0.0001*

Below is the comparison between mean values at each interval of time for test quadrant & control quadrant: **Figure 8**



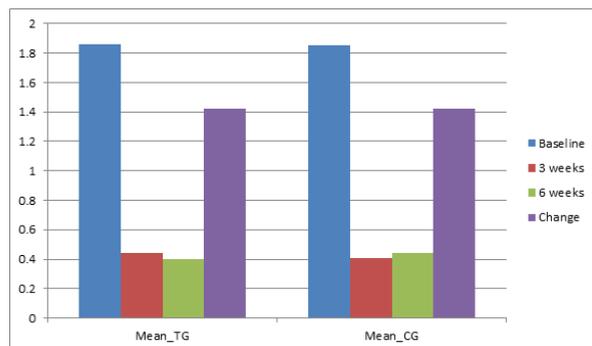
**Plaque Index:**

Plaque Index readings of control & test quadrant at baseline are read as 1.86±0.4169 and 1.85±0.3866 respectively. The post-treatment mean PI values of the same 3 weeks after, show as 0.41±0.3315 and 0.44±0.3204, which is a significant improvement. Similar to the GI values in the 6<sup>th</sup> week, the plaque index readings taken 6 weeks after were recorded to be 0.44±0.3134 and 0.4±0.2789 for control & test quadrant, with the control quadrant mean PI increasing in the 6<sup>th</sup> week. The intergroup comparison showed statistically significant improvement in the test group as compared to control group (p<0.0001) as shown in table 3 and figure 9.

	Baseline Mean ± SD	3 weeks Mean ± SD	6 weeks Mean ± SD	Change Mean ± SD	F ratio value	P value
Control Group	1.85± 0.3866	0.41 ± 0.3315	0.44 ± 0.3134	1.42 ± 0.1814	F= 53.17018	P <0.0001*
Test Group	1.86 ± 0.4169	0.44 ± 0.3204	0.4 ± 0.2789	1.42 ± 0.1687	F= 55.26132	P<0.0001*

**Table 3**

Below is the comparison between mean values at each interval of time for test quadrant & control quadrant: **Figure 9**



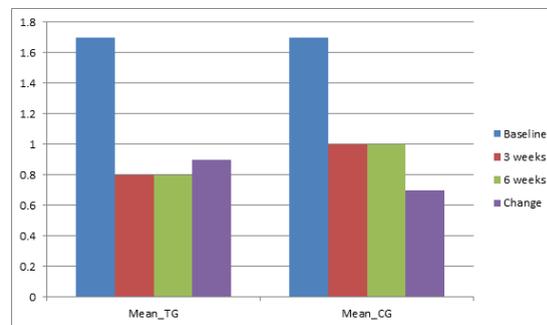
**Bleeding Index:**

The mean bleeding index of the control & test quadrants measured to be 1.7±0.483 at the baseline. After 3 weeks, the mean BI of control quadrant reduced to 1±0 while that of test quadrant reduced to 0.8±0.4216. These values remained the same in the 6<sup>th</sup> week as that of 3rd week of study as shown in table 4 and figure 10. The intergroup comparison showed statistically significant improvement in the test group as compared to control group (p<0.0002)

**Table 4**

	Baseline Mean ± SD	3 weeks Mean ± SD	6 weeks Mean ± SD	Change Mean ± SD	F ratio value	P value
Control Group	1.7 ± 0.483	1 ± 0	1 ± 0	0.7 ± 0.483	F= 15.42857	P<0.0001*
Test Group	1.7 ± 0.483	0.8 ± 0.4216	0.8 ± 0.4216	0.9 ± 0.5676	F = 8.34146	P<0.0002*

Below is the comparison between mean values at each interval of time for test quadrant & control quadrant: **Figure 10**



**DISCUSSION:**

Patients with periodontal disease display increased PMN number and activity, resulting in high degree of ROS release, culminating in heightened oxidative stress in gingival tissue, periodontal ligaments, and alveolar bone.<sup>15</sup> While most ROS have extremely short half-lives, they can cause substantial tissue damage by initiating free radical chain reactions. Therefore the body contains a number of protective antioxidant mechanisms, whose specific role is to remove harmful oxidants (ROS) as soon as they form or to repair damage caused by ROS in vivo. Antioxidants are defined as “those substances which when present at low concentrations, compared to an oxidisable substrate, will significantly delay or inhibit oxidation of that substrate.”<sup>16</sup>

Cells require adequate levels of Antioxidants in order to prevent tissue damage caused by excessive production of reactive oxygen species (ROS). This has been shown that additional intake of high grade antioxidants can reduce periodontal pocket depths as much as 3 times compared to scaling and root planing alone.<sup>17</sup> Due to possible health benefits of antioxidants against periodontitis, increased intake of such nutrients have been recommended.

Ubiquinol (reduced form coenzyme Q10) serves as an endogenous antioxidant which increases the concentration of CoQ10 in the diseased gingiva and effectively suppresses advanced periodontal inflammation.

The antioxidant nature of CoQ10 derives from its energy carrier function. As an energy carrier, the CoQ10 molecule is continuously going through an oxidation-reduction cycle. As it accepts electrons, it becomes reduced. As it gives up electrons, it becomes oxidized. In its reduced form, the CoQ10 molecule holds electrons rather loosely, so this CoQ molecule will quite easily give up one or both electrons and, thus, act as an antioxidant. CoQ10 inhibits lipid peroxidation by preventing the production of lipid peroxyl radicals.<sup>19</sup>

In this study there was significant decrease in the probing depth, plaque index, gingival index and gingival bleeding index in Groups II(test quadrant) as compared with Group I(control quadrant), study in all two groups as compared with baseline values, and there was significant difference between the two groups during the study. The P-value, 0.001, was statistically significant at the 3<sup>rd</sup> week for the test quadrant. There is no difference in the results after a period of 6 weeks in both test and control quadrant for all the parameters, which suggests that the maximum result which could be achieved with traditional treatment was obtained during the 3<sup>rd</sup> week itself.

This was in agreement with the clinical results reported by Hanset *et al.*,<sup>6</sup> who described the efficacy of coenzyme Q10 in the form of gel (Perio-Q) on reduction of pocket depth and plaque formation. They found that the 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.

Furthermore, our results were in agreement with the other clinical results reported by Chatterjee *et al.*,<sup>20</sup> who performed a split mouth randomized controlled trial to evaluate the anti-gingivitis effect of Co-Q10 on plaque induced gingivitis. They found that there was remarkable reduction in gingival, bleeding, and plaque scores were recorded at the sites where Co-Q10 was applied.

However, Wilkinson *et al.*, also reported that eight patients under routine care for periodontitis, when received oral treatment with a form of CoQ showed significant reduction in pocket depth.<sup>21</sup>

A study conducted by Hanioka *et al.*, suggested that the oxygen supply for inflamed gingiva may be increased<sup>22</sup>. Evaluation of the effect of CoQ10 on the oxidative metabolism in gingiva of periodontitis patients using reflectance spectrophotometry suggested that the administration of CoQ10 improves oxygen utilization in the gingival tissue<sup>23</sup>.

Coenzyme Q10 with vitamin E has a beneficial effect on the periodontal tissue which was shown by study conducted by Matthews *et al.* in 2007.<sup>24</sup>

Clinical trials showed a positive relation between Co-Q10 administration and improved periodontal health and immuner response.<sup>7</sup> Thus in this study there is improvement in chronic periodontitis patients occurred mainly when SRP was combined with perioQ gel. The limitation of the present clinical trial was the small sample size and the substantivity of the gel for determining the efficacy of the experimental drug. No adverse reactions were reported. Thus, further studies are recommended with larger sample size and biochemical and microbial analysis for the evaluation of the efficacy of these antioxidants in the form of gel in the treatment of chronic periodontitis.

## Conclusion

This short term study with small sample size showed significant reduction of all clinical parameters when Intrapocket Coenzyme Q10 are used as an adjunct to scaling and root planing than scaling and root planing alone. However, it appears that Perio-Q gel in this study may have a potential additive effect. Therefore, CoQ10 along with scaling and root planing can prevent periodontitis by reducing gingival inflammation. Thus, further studies are recommended with larger sample size and biochemical and microbial analysis for the evaluation of the efficacy of these antioxidants in the form of gel in the treatment of chronic periodontitis.

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