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COMPARATIVE EVALUATION OF INTRASULCULAR APPLICATION OF COMMERCIALLY AVAILABLE COENZYME Q_{10} GEL WITH SCALING AND ROOT PLANING IN THE TREATMENT OF CHRONIC PERIODONTITIS PATIENTS AS ASSESSED THROUGH AN ADVANCED DIAGNOSTIC AID, THE FLORIDA PROBE SYSTEM: A CLINICAL STUDY

KALE PP[1*], ANARTHE RY[2], MANI AM[3], BHANDARI S[4], JOTEPPA V[5], LAWANDE A[6], PENDYALA GS[7] AND KATHOLE V[8]

1: [*]Lecturer, Department of Periodontology, Pravara Rural Dental College and Hospital, Loni: 413736, Dist: Ahmednagar, State: Maharashtra, India

2: Professor, Department of Periodontology, Pravara Rural Dental College and Hospital, Loni: 413736, Dist: Ahmednagar, State: Maharashtra, India

3: Professor and Head, Department of Periodontology, Pravara Rural Dental College and Hospital, Loni: 413736, Dist: Ahmednagar, State: Maharashtra, India

4: Lecturer, Department of Periodontology, CSMSS dental College and Hospital, Aurangabad, State: Maharashtra, India

5: Lecturer, Department of Prosthodontics, Sarawati Dhanvantari Dental College and Hospital, Parbhani, Dist: Ahmednagar, State: Maharashtra, India

6: Lecturer, Department of Periodontology, Yashvant Chavhan Dental College and Hospital, Ahmednagar, State: Maharashtra, India

7: Reader, Department of Periodontology, Pravara Rural Dental College and Hospital, Loni: 413736, Dist: Ahmednagar, State: Maharashtra, India

8: Consulting Periodontist, Aurangabad, Maharashtra, India

***Corresponding Author: Dr. Preeti Prakash Kale: E Mail: preetikale20jan@gmail.com**

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ABSTRACT

Background: In periodontal disease variety of molecules are considered to mediate the inflammatory response including free radicals and reactive oxygen species (ROS). Periodontal pathogens can induce ROS overproduction and thus may cause collagen and periodontal cell breakdown. When ROS are scavenged by antioxidants, there can be a reduction of collagen degradation. Ubiquinone (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. **Aim**: To compare and evaluate intrasulcular application of commercially available Coenzyme Q_{10} gel with scaling and root planing in the treatment of Chronic Periodontitis patients as assessed through an advanced diagnostic aid, the Florida probe system. **Materials and Methods**: 30 Chronic Periodontitis patients with 30 sites have been selected and categorized randomly into 2 groups by lottery system for split mouth study with two parallel arms. Control sites were treated with scaling and root planing (n=30) and test sites were treated with scaling and root planing along with intrasulcular application of commercially available CoQ_{10} gel (n=30). Clinical parameters like plaque index, gingival index, bleeding on probing, periodontal probing depth, clinical attachment level was evaluated. **Results** were compared statistically using Students' paired T test, at baseline and after 1 month and 3month intervals. There was a statistically significant improvement in gingival index and reduction in probing depth in test sites seen at the end of 3-months. Sites with bleeding on probing were reduced more in the test group than in control. **Conclusion:** Coenzyme Q10 can be said to have a beneficial effect on periodontitis when used as an adjunct to scaling and root planing.

Keyword: Periodontal disease, Antioxidants, Coenzyme Q10, Local drug delivery, Periodontitis

1. INTRODUCTION

Periodontitis is an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession, or both **[1]**. The disease process is the result of a complex interplay between bacterial challenges and the response of the host **[2]**. Once immune and inflammatory processes are initiated, various inflammatory mediators such as matrix metalloproteinases (MMPs), cytokines and prostaglandins are released from leukocytes, fibroblasts or other tissue-derived cells into the area. Variety 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)

like superoxide anion radicals, hydrogen peroxide, hydroxyl radicals and hypochlorous acid. All these molecules are capable of damaging either cell membranes or associated bio-molecules. Periodontal pathogens can induce ROS overproduction and thus may cause collagen and periodontal tissue breakdown. When ROS are scavenged by antioxidants, there is a reduction of collagen degradation. The local drug delivery therapy to periodontal pockets has the potential to provide greater concentration directly to the infected area and reduce possible systemic side effect **[3]**.

CO-Q10 is one of the antioxidants which inhibits lipid and protein peroxidation and scavenges free radicals. It plays a crucial role in Adenosine Triphosphate (ATP) or biological energy production. The antioxidant material Coenzyme Q10 is a fat soluble quinone found in all cells in the body. Coenzyme Q10 (also known as ubiquinone) was discovered by Crane and his colleagues in 1957 in beef heart mitochondria **[4]**. 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 **[5]**. Florida probe: A periodontal probing system developed by Charles H. Gibbs which incorporates the advantages of constant probing force, precise electronic measurement to 0.1 mm and computer storage of the data. The system includes a probe handpiece, displacement transducer with digital readout, foot switch, computer interface and personal computer. A unique movable arm design enables the probe handpiece to maintain smooth operation and makes it easy to clean and sterilize. Electronic recording of the data (actuated by pressing a foot switch) eliminates errors which occur when probe tip markings are read visually and the data are called to an assistant. Computer storage and analysis of the data facilitates detecting changes in pocket depth and attachment level by rapidly comparing data recorded at different visits **[6]**. This study compares and evaluate intrasulcular application of commercially available coenzyme Q_{10} with scaling and root planing in the treatment of chronic periodontitis patients.

2. MATERIALS AND METHOD:

This was a randomized, controlled, clinical trial with a split mouth design. Target population was patients visiting the Department of Periodontology, Rural Dental College, Loni with Chronic Periodontitis between age range of 35-55 years with minimum of six permanent teeth in each quadrant. Ethical clearance was obtained from the Institutional ethical committee. (Registration no: PMIS/RDC/IEC-UG/2016/PG/18 dated on: 02/12/2016 Institute: Pravara institute of

Medical Sciences). Written and verbal consent was obtained from the sample recruited for the study.

Declaration of patient consent [The authors certify that they have obtained all appropriate patient consent **forms.** In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patient(s) understand that his/her/their name(s) and initials will not be published and due efforts will be made to conceal his/her/their identity**,** but anonymity cannot be guaranteed.]

Patient with any systemic disease, any apparent oral infection like herpes or candida, patients who received antibiotics, antioxidants and anti-inflammatory drugs in the past 6 months, patients who underwent any periodontal therapy in the past 6 months, pregnant and lactating females, present and former smokers (in any form of tobacco) were not included in the study.

30 Chronic Periodontitis patients 30 sites have been selected and categorized randomly into 2 groups by lottery system for split mouth study with two parallel arms.

At baseline, all the patients received full mouth scaling and root planing (SRP) both supragingivally and subgingivally according to individual needs.

Baseline probing depth records were obtained using Florida Probe **(Figure 1)**.

CONTROL SITE & TEST SITE

Figure 1: Assessment of Probing Depth By Florida Probe

Following SRP, the quadrants were randomly divided into 2 groups,

1. Control sites: The teeth in these quadrants were treated with SRP and vehicle in the form of sterile saline.

2. Test sites: were treated with scaling root planing with intrapocket application of Coenzyme Q10 gel. After completion of scaling and root planing, selected site was isolated with cotton rolls to prevent contamination from saliva. A 2ml disposable syringe equipped with a blunt 24-gauge needle, bent along its shank was used and 0.2ml of gel was delivered in pocket **(Figure 2)**.

TEST SITE

Figure 2: Co-Enzyme Q10 Gel Delivery Into Periodontal Pocket

After intrapocket gel application the area was protected with coe pack to retain material in the pocket as well as to prevent ingress of oral fluids.

The patients were permitted to perform normal oral hygiene procedures but not to use any mouth-rinse. Patients were instructed to report immediately if pain, swelling or any other complication occurs. Over the course of three months' investigation, the study subjects did not receive any professional prophylaxis, root planing or drug therapy. Patients were recalled after 1 month and 3 months for evaluation and all the clinical parameters were recorded**.** Statistical analysis was done by descriptive statistics as mean, SD and percentage etc.

3. RESULTS

Comparison of all parameters in Group I and Group II from Preoperative to 1 Month, Preoperative to 3 Month and 1 Month to 3 Month was done by applying Student's Paired 't' test at 5% (p, 0.05) and 1% (p, 0.01) level of significance.

3.1 PLAQUE INDEX (PI) - before scaling root planing in group I, group II was 2.05±0.53 and 2.05±0.53 respectively and after 1 month of scaling root planing (SRP) was 1.05±0.36 and 1.14±0.44 and after three months was 1.00±0.31 and 0.87±0.45 respectively. On intragroup analysis the mean PI scores of group I and group II before and after 1 and 3 months of scaling root planing showed highly significant difference **(Table 1)**.

3.2 GINGIVAL INDEX (GI) - before SRP in group I and group II 1.34 ± 0.41 and 1.34 ± 0.41 respectively and after 1 month of SRP was 0.51 ± 0.32 and 0.51 ± 0.32 and after 3 months' group I 0.48 ± 0.31 and Group II was 0.30 ± 0.16. On intragroup analysis the mean GI scores of group I and group II before and after, 1 and 3 months of SRP showed highly significant difference **(Table 2)**.

3.3 BLEEDING ON PROBING: In this present study the mean bleeding on probing (BOP) before SRP in group I and group II 1.00 ± 0.00 and 1.00 ± 0.00 respectively and after 1 month of SRP was 0.70 ± 0.46 and 0.37 ± 0.49 and after 3 months' group I 0.40 ± 0.49 and Group II was 0.13 ± 0.34. On intragroup analysis the mean GI scores of groups I and group II before and after, 1 and 3 months of SRP showed highly significant difference **(Table 3)**.

3.4 PROBING DEPTH (PD) - before SRP in group I and group II 5.50 ± 0.82 and 5.50 ± 0.82 respectively and after 1 month of SRP was 4.23 ± 0.87 and 4.50 ± 0.82 and after 3 months' group I 4.16 ± 0.87 and Group II was 3.50 ± 0.86. On intragroup analysis the mean BOP scores of group I and group II before and after, 1 and 3 months of SRP showed highly significant difference **(Table 4)**.

3.5 CLINICAL ATTACHMENT LEVEL(CAL) - before SRP in group I and group II 6.07 ± 0.87 and 6.07 ± 0.87 respectively and after 1 month of SRP was 4.83 ± 1.02 and 4.90 ± 0.66 and after 3

months' group I 4.90 ± 0.99 and Group II was 4.10 ± 0.71. On intragroup analysis the mean CAL scores of group I and group II before and after, 1 and 3 months of SRP showed highly significant difference **(Table 5)**.

Table 1: Plaque Index (Silness and Loe 1964)

Plaque Index	Preoperative	1 Month	3 Month
	Mean ± SD	Mean ± SD	Mean ± SD
Group I	2.05±0.53	1.05±0.36	1.00±0.31
Group II	2.05±0.53	1.14±0.44	0.87±0.45

Student's Paired 't' test at 5% (p, 0.05) and 1% (p, 0.01) level of significance.

Table 2: Gingival Index (Loe and Silness 1963)

Gingival Index	Preoperative	1 Month	3 Month
	Mean ± SD	Mean ± SD	Mean ± SD
Group I	1.34±0.41	0.51±0.32	0.48±0.31
Group II	1.34±0.41	0.51±0.32	0.30±0.16

Student's Paired 't' test at 5% (p, 0.05) and 1% (p, 0.01) level of significance.

Table 3: Gingival bleeding index (Ainamo and Bay 1975)

Gingival Bleeding Index	Preoperative	1 Month	3 Month
	Mean ± SD	Mean ± SD	Mean ± SD
Group I	1.00±0.00	0.70±0.46	0.40±0.49
Group II	1.00±0.00	0.37±0.49	0.13±0.34

Student's Paired 't' test at 5% (p, 0.05) and 1% (p, 0.01) level of significance

Table 4: Probing Depth

Probing Depth	Preoperative	1 Month	3 Month
	Mean ± SD	Mean ± SD	Mean ± SD
Group I	5.50±0.82	4.23±0.87	4.16±0.87
Group II	5.50±0.82	4.50±0.82	3.50±0.86

Student's Paired 't' test at 5% (p, 0.05) and 1% (p, 0.01) level of significance.

Table 5: Clinical Attachment Level

Clinical Attachment Level	Preoperative	1 Month	3 Month
	Mean ± SD	Mean ± SD	Mean ± SD
Group I	6.07±0.87	4.83±1.02	4.90±0.99
Group II	6.07±0.87	4.90±0.66	4.10±0.71

Student's Paired 't' test at 5% (p, 0.05) and 1% (p, 0.01) level of significance

4. DISCUSSION

Periodontitis is an inflammatory response caused by groups of specific microorganisms in which the structural support to the tooth is destroyed **[7, 8]**. The microflora of this plaque is extremely complex causing problems in establishing which organisms are responsible for tissue destruction associated with the disease. These bacteria cause the observed tissue destruction directly by toxic products and indirectly by activating host defense system which initiates gingival inflammation.

However, an event characteristic of mammalian inflammation, tissue infiltration by polymorphonuclear leukocytes and monocytes and subsequent phagocytosis features non-mitochondrial O_2 consumption, which may be 10 or 20 times that of resting consumption ultimately ends in generating free radicals (FRs) and reactive oxygen species (ROS),

such as superoxide anion radicals, hydrogen peroxide, hydroxyl radicals, and hypochlorous acid, all capable of damaging either cell membranes or associated biomolecules **[9]**. Antioxidant therapy is believed to be effective in periodontitis. Antioxidants are substances that scavenge these free radicals, the damaging compounds in the body that alter cell membranes, tamper with DNA, and even cause cell death. Normally present antioxidants include the lipid soluble antioxidants eg alpha-tocopherol and water-soluble antioxidants eg. Vitamin C, to counteract these free radicals. In quest for the search of an antioxidant therapy to be used as an adjunct to scaling and root planing in periodontally involved patients, focus has shifted to products like Coenzyme Q10 (COQ10), which is a compound found naturally in the energy producing center of the cell known as the mitochondria. Adequate amounts of COQ10 are necessary for cellular respiration and ATP production. COQ10 also functions as an intercellular antioxidant, and its presence was then demonstrated in all cell membranes and in blood, both in high- and in low-density lipoproteins, where it is endued with antioxidant properties **[10]**.

In our study mean Plaque index (PI) before scaling root planing in group I, group II was 2.05±0.53 and 2.05±0.53 respectively and after 1 month of scaling root planing (SRP) was 1.05±0.36 and 1.14±0.44 and after three months was 1.00±0.31 and 0.87±0.45 respectively. On comparison of percentage change of plaque index parameter from preoperative to 1-month group I showed 49.16% and group II showed 53.56% decrease. From preoperative to 3 months' group I showed 46.73% and Group II showed 40.39% decrease and from 1 month to 3 month group I showed 94.18% and group II 75.17% decrease. On intragroup analysis the mean PI scores of group I and group II before and after 1 and 3 months of scaling root planing showed highly significant difference.

In this present study the mean Gingival index (GI) before SRP in group I and group II 1.34 ± 0.41 and 1.34 ± 0.41 respectively and after 1 month of SRP was 0.51 ± 0.32 and 0.51 ± 0.32 and after 3 months' group I 0.48 ± 0.31 and Group II was 0.30 ± 0.16. On comparison of percentage change of gingival index parameter from preoperative to 1 month in group I showed 36.72% and group II showed 36.72% decrease. From preoperative to 3 months' group I showed 34.48% and Group II showed 21.04% decrease and from 1 month to 3-month group I showed 93.61% and group II 58.31% decrease. On intragroup analysis the mean GI scores of group I and group II

before and after, 1 and 3 months of SRP showed highly significant difference.

In this present study the mean bleeding on probing (BOP) before SRP in group I and group II 1.00 ± 0.00 and 1.00 ± 0.00 respectively and after 1 month of SRP was 0.70 ± 0.46 and 0.37 ± 0.49 and after 3 months' group I 0.40 ± 0.49 and Group II was 0.13 ± 0.34. On comparison of percentage change of gingival index parameter from preoperative to 1 month in group I showed 71.41% and group II showed 76.32% decrease. From preoperative to 3 months' group I showed 70.13% and Group II showed 58.13% decrease and from 1 month to 3-month group I showed 94.11% and group II 73.28% decrease. On intragroup analysis the mean GI scores of group I and group II before and after, 1 and 3 months of SRP showed highly significant difference.

In this present study the mean probing depth (PD) before SRP in group I and group II 5.50 ± 0.82 and 5.50 ± 0.82 respectively and after 1 month of SRP was 4.23 ± 0.87 and 4.50 ± 0.82 and after 3 months' group I 4.16 ± 0.87 and Group II was 3.50 ± 0.86. On comparison of percentage change of gingival index parameter from preoperative to 1 month in group I showed 69% and group II showed 36% decrease. From preoperative to 3 months' group I showed 39% and Group II showed 12% decrease and from 1 month to 3-month group I showed 56.44% and group II 34.76% decrease. On intragroup analysis the mean BOP scores of group I and group II before and after, 1 and 3 months of SRP showed highly significant difference. This study results were in accordance to split mouth study done by Unnati Pitale in 2012. There was improvement seen in terms of reduction in probing depth in millimeters from 3.28mm to 1.98mm for the test sites as compared to control sites where in the reduction was from 3.21 to 2.35 mm. The p value 0.002 was statistically significant at 2nd week for the test site.

In our present study the mean Clinical attachment level (CAL) before SRP in group I and group II 6.07 ± 0.87 and 6.07 ± 0.87 respectively and after 1 month of SRP was 4.83 ± 1.02 and 4.90 ± 0.66 and after 3 months' group I 4.90 ± 0.99 and Group II was 4.10 ± 0.71. On comparison of percentage change of gingival index parameter from preoperative to 1 month in group I showed 73.51% and group II showed 74.65% decrease. From preoperative to 3 months' group, I showed 74.65% and Group II showed 61.75% decrease and from 1 month to 3-month group I showed 96.61% and group II 78.77% decrease. On intragroup analysis the mean CAL scores of groups I and group II before and after, 1 and 3 months of SRP showed highly significant difference.

5. SUMMARY AND CONCLUSION

The purpose of this study was to evaluate the efficacy of intrasulcular application of commercially available Co-enzyme Q10 gel as an adjunct to scaling and root planing in improvement of clinical parameters in patients with chronic periodontitis as assessed with the use of an advanced diagnostic aid, the Florida probe system.

The study was conducted over a period of three months. Clinical parameters were recorded at baseline, 1 month and 3 months' post operatively. The following conclusions can be drawn from the study: Intrasulcular application of Co-enzyme Q10 gel as an adjunct to scaling and root planing, has a significantly better effect compared to scaling root planing alone in patients with chronic periodontitis. Significant reduction in plaque index, gingival index, bleeding on probing was noticed in the areas treated with scaling and root planing along with intrasulcular application on Co-enzyme Q10 gel, as compared to scaling and root planing alone. Adjunctive treatment with Co-enzyme Q10 gel provided a significant probing depth reduction compared to scaling and root planing. Local drug delivery with Co-enzyme Q10 gel along with scaling and root planing leads to significant gain in clinical attachment level at 1 and 3 months compared to SRP alone. Hence it confirmed the potential additive effect of Co-enzyme Q10 gel along with SRP.

6. FUTURE PROSPECTIVE FOR STUDY

1) Longitudinal studies with larger sample size should be carried out to know scrupulous relationship between COQ10 and chronic periodontal diseases. 2) Further long term randomized blinded clinical trials should be conducted for the outcomes of topical and systemic administration of COQ10 which are needed to affirm or refute the usefulness of COQ10 as the therapeutic agent for periodontitis.

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