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NATURAL ANTIOXIDANT : COENZYME Q_{10} (PERIO Q)™ IN MANAGEMENT OF CHRONIC PERIODONTITIS: A CLINICAL STUDY

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ABSTRACT:

Aim : The objective of this study was to test the efficacy of Coenzyme Q_{10} in the form of gel (Perio Q) in patients with Chronic Periodontitis.

Methods : A total of 24 sites with pocket depth ≥ 4 mm in chronic periodontitis patients were randomly divided in two groups. In the experimental group, 12 sites were treated with scaling and root planning (SRP) plus intra-pocket application of Perio Q gel, while the control sites were treated with SRP alone. Clinical parameters such as plaque index (PI), gingival index (GI), probing pocket depth (PPD), relative attachment level (RAL) were assessed at baseline, 15 days and 30 days .

Results:. The results showed significant reduction (P<0.05) in all the clinical parameters ie (PI), (GI),(PPD) and (RAL) for both the test and the control sites. On inter-group analysis, intra-pocket gel application in combination with SRP showed significantly more reduction for PI, GI, PPD and RAL in comparison to SRP alone.

Conclusion : Intra- pocket application of Perio Q gel along with SRP showed significant reduction in all the clinical parameters as compared to SRP alone. Hence, it confirmed the potential additive effect of Perio Q gel along with SRP.

Key words: Antioxidants, Chronic Periodontitis, Reactive oxygen species, Ubiquinone.

INTRODUCTION:

Periodontal disease is an infectious disease causing inflammation of supporting tissues of teeth such as gingiva, periodontal ligament, cementum and alveolar bone leading to tissue destruction and tooth loss. Various experiments and studies have proved that dental plaque is the primary etiologic factor in causing periodontal disease.[1] Other factors like host immune response and environmental factors like stress are involved in causing this disease. Oral microbial flora in health is loaded with gram positive organisms and in diseased conditions changes to anaerobic flora.[2]

Host immune cells like neutrophils (polymorphonuclear leukocytes) and

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monocytes are released to act against these microorganisms.[3] During phagocytosis, there is a non-mitochondrial O_2 consumption, which may be 10 or 20 times that of resting consumption and this ultimately ends in generation of 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.[4]

ROS were thought to be directly microbicidal but recent evidence indicates that their role is to establish an environment in the phagocytic vacuole suitable for killing and digestion by enzymes released into the vacuole from cytoplasmic granules.[5] The effects of ROS on proteins are protein folding or unfolding (which may or may not be reversible); protein fragmentation and polymerization reactions; protease degradation of the modified protein; formation of protein radicals and formation of protein-bound ROS.[6]

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. But when there is over production of free radicals like in diseased condition, anti-oxidants are unable to counteract the free radicals leading to tissue destruction.[7][8] When this tissue destruction happens in periodontal connective tissues, the attachment apparatus is weakened leading to mobility of teeth and finally tooth loss. Hence anti-oxidants are used as supplements to counteract the over production of free radicals in periodontal disease.[9] In quest for the search of an antioxidant therapy to be used as an adjunct scaling root planning in periodontally involved patients, focus has shifted to products like Coenzyme Q_{10} (Co Q $_{10}$), which is a compound found naturally in the energy-producing center of the cell known as the mitochondria.

Coenzyme Q10 was discovered by Fred Crane and his colleagues in 1957 in beef heart mitochondria at the University of Wisconsin.[10] 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.[11] Coenzyme Q_{10} is a substance of nutritional nature and is a vitamin on the basis of an updated definition of a vitamin by Folkers.[12] 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.[13] 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.[7] Crane 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.[10] 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}.[14] In such patients, oral dental treatment and oral hygiene could correct the plaque and calculus, but not that part of the deficiency of Coenzyme Q_{10} due to systemic cause. Therapy with Coenzyme Q_{10} can be included with the oral hygiene for an improved treatment of this type of periodontal disease. Many clinical trials with oral administration of Coenzyme Q_{10} to patients with periodontal disease have been conducted. The results have shown that oral administration of Coenzyme Q_{10} increases the concentration of Coenzyme Q_{10} in the diseased gingiva and effectively suppresses advanced periodontal inflammation.[15][16] Perio-Q gel (Coenzyme Q_{10} gel manufactured by PERIOQINC, Manchester, USA), supplied as a pack of gel, containes a mixture of Coenzyme Q_{10} and vegetable glycerin base in a ratio of 1:9. Studies have shown that Perio Q gel may possibly be effective as a topical agent and as an adjunct to scaling root planning in treatment for gingivitis and chronic periodontitis.

The aim of the study was to evaluate the efficacy of Coenzyme Q_{10} (Perio Q ™) as an adjunct to scaling and root planing in management of patients of chronic periodontitis.

MATERIAL AND METHODS:

A total number of 24 sites of patients of chronic periodontitis were selected from the OPD of Department of Periodontology and Oral Implantology, I.T.S Dental College, Muradnagar, Ghaziabad. The experimental procedures were undertaken with the understanding and written consent of the patient, following protocols reviewed and approved by the ethical committee of the institution.

A randomized, controlled clinical trial was conducted to compare the efficacy of scaling and root planing plus intra pocket application of Perio-Q gel (Fig 1) and scaling and root planing (SRP) alone ,in patients diagnosed with chronic periodontitis. Patients of both the sexes between 20 -50 years of age, diagnosed with chronic generalized periodontitis and periodontal pocket measuring 4-8 mm were included in the study. Subjects on antibiotics for last three months and who had undergone periodontal therapy in the past six months, patients with systemic diseases, smokers, and patients who were pregnant and lactating mothers were excluded from the study. Patients were informed about the treatment procedure and a written informed consent was taken.24 sites were randomly divided into the experimental and control groups. In the Experimental group , 12 sites were treated with scaling and root planing plus intra pocket application of 0.2 ml of Perio Q gel (Fig 2) and in the control group, 12 sites were treated by scaling and root

planing alone without intra pocket gel application. Periodontal scaling and root planing was done using ultrasonic scaler and intra sulcular application of 0.2 ml of Coenzyme Q_{10} (Perio Q™ gel, Hamilton, U.S.A) was done at the same visit .

Patients were evaluated after 15 and 30 days interval. The control sites were managed by scaling and root planing as a mono therapy, with no additional application of Coenzyme Q_{10} gel. They were also evaluated at the same intervals. Periodontal assessments were performed using the Plaque Index using (Turesky Gilmore Glickman modification of Quigley Hein Plaque Index, 1970)[17], Gingival Index (Loe & Silness, 1963)[18], Probing Depth and Relative Attachment Level were measured using UNC 15 probe and customised stents (Fig 3,4).

RESULTS:

SPSS (Statistical package of social science) version 18 was used. The Student's paired t-test was used to compare the data of test and control sites at baseline and at 30 days. For all the tests a p-value of 0.05 or less was considered for statistical significance.

All the clinical parameters ie plaque index, gingival index, pocket probing depth, relative attachment level showed significant improvement in both test and control groups. There was a significant reduction in plaque accumulation in both test sites (3.75 ± .39 to 2.62 ± .56) and control sites (3.70 ± .39 to 2.62 ± .56) from baseline to the end of 4 weeks. However, the mean reduction in plaque index was not significant between the two groups (Table 1, Figure 1). Groups showed significant reduction in gingival inflammation , pocket probing depth and relative clinical attachment level for both the test and the control sites at the end of 4 weeks (Table 1 , Figure 2, 3 ,4) . However the results showed more improvement for the test sites, thereby corroborating the added advantage of Coenzyme Q_{10} gel.

DISCUSSION:

The concept of antioxidant therapy in the treatment of numerous diseases including inflammatory periodontal disease exists in the literature. Because of its function, Coenzyme Q_{10} has received much research attention in a medical literature in the last several years. The mechanism of Coenzyme Q_{10} had not been known until Littaru and Kamamura reported its deficiency in patients with periodontal disease.[19] They did a series of trials on succinate dehydrogenase Coenzyme-Q_{10} reductase enzyme, which is found in Mitochondrial complex II of the cell. This was latter supported by the works Nakamura [20] and Matsumura.[21] Schmelzer studied the effect of Coenzyme Q_{10} on the NFkB1-dependent pro-inflammatory cytokine TNF-α and suggested that Coenzyme Q_{10} exerts anti-inflammatory properties via NFκB1-dependent gene expression.[22] Similarly, a split mouth trail conducted by Hanioka [7] demonstrated improved periodontal scores along with gingival scores when Coenzyme Q_{10} was applied topically alone or as an adjunct to scaling and root

planing. Clinical trials on human have revealed a relation between oral administration of Coenzyme Q_{10} and improved gingival health and immune response.

Our study showed reduction in all the clinical parameters including the gingival index, plaque index, pocket probing depth and relative attachment level in both the groups but the improvement in test group was much more significant than the control group. Similar results were reported by

Pal et al [23], who stated that Coenzyme Q_{10}, an antioxidant, effectively scavenges the reactive oxygen species thereby reducing periodontal collagen breakdown and hence inflammation. A study was conducted by Figuero [24] to evaluate potential oxidant/antioxidant interactions of nicotine with antioxidant Coenzyme Q_{10} in subjects with periodontitis suggesting that the catabolic effects of nicotine could be reversed by the addition of antioxidants such as Coenzyme Q_{10} and hence improved gingival health and immune response. In a clinical trial of Coenzyme Q_{10}, systemic administration on patients of AIDS related complex, T4/T8 ratio was increased, and they were symptom free for duration of four years. Also when Coenzyme Q_{10} was given to healthy individuals, a significant increase in T4/T8 ratio was observed.[25] The improved clinical parameters in our study could also possibly be credited by improvement in immunity in combating periodontal insult. This improvement in clinical indices indicate that Coenzyme Q_{10} when used with scaling root planing gave added advantage as compared to scaling root planing alone. Other than antioxidant action, it also has been shown in literature that it acts as an immune enhancer and also accelerates tissue healing. Further long term clinical studies of Perio-Q gel, with various doses and duration, need to be conducted to confirm its role in periodontal therapy.

CONCLUSION:

The concept of ROS-induced destruction has led to search for an appropriate complimentary antioxidant therapy in the treatment of numerous diseases including inflammatory periodontal diseases. As it is an antioxidant, there is a dearth of new information for Coenzyme Q_{10} in the treatment of periodontal conditions. On the basis of on new concepts of synergism with nutritional supplements and host response, Coenzyme Q_{10} may possibly be effective as a topical agent as an adjunct to scaling root planning in treatment for gingivitis and periodontitis. The results of the present study, confirmed the added and adjunctive advantage Coenzyme Q_{10} in such situations.

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TABLES:

Parameters		Test (Mean ± SD)	Control (Mean ± SD)	P value
PI	**Baseline**	3.708 ± .3965	3.750 ± .3989	0.800
	15 days	2.833 ± .3892	3.125 ± .2261	0.065
	30 days	2.625 ± .5691	2.750 ± .4523	0.557
GI	**Baseline**	1.850 ± .2276	1.933 ± .1614	0.312
	15 days	1.167 ± .2462	1.742 ± .2392	0.000
	30 days	.875 ± .4330	1.617 ± .3040	0.000
PD	**Baseline**	5.50 ± 5.52	5.58 ±.515	0.698
	15 days	3.75 ±.754	4.50 ±.674	0.018
	30 days	3.50 ±.522	4.25 ±.866	0.018
RAL	**Baseline**	9.50 ±1.087	9.42 ±.900	0.840
	15 days	7.70 ±.651	8.18 ±.996	0.040
	30 days	7.42 ±.515	7.88 ±1.138	0.031

Table 1 : Mean values of various clinical parameters (PI , GI, PPD, RAL) in control and test groups at baseline , 15 days and 30 days (p is significant at < 0.05)

FIGURES:

Figure 1 – Perio Q gel

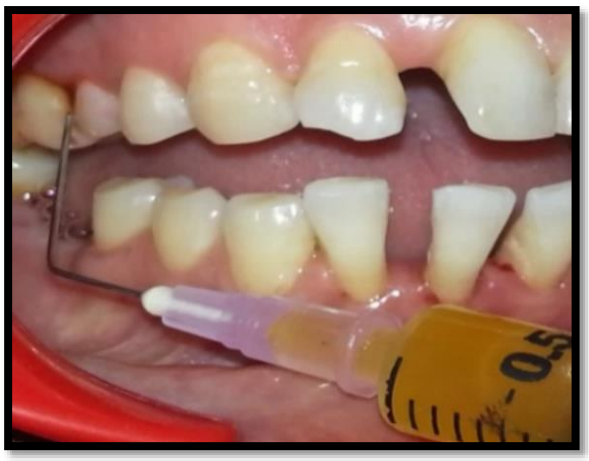
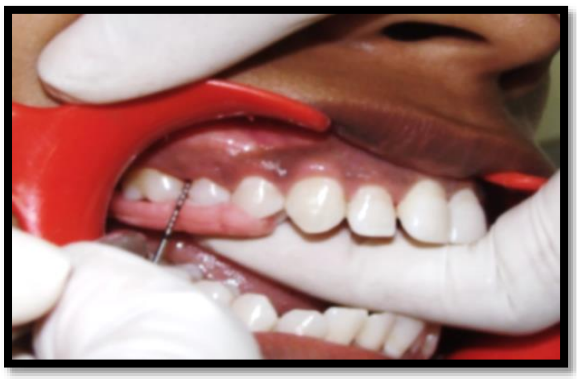
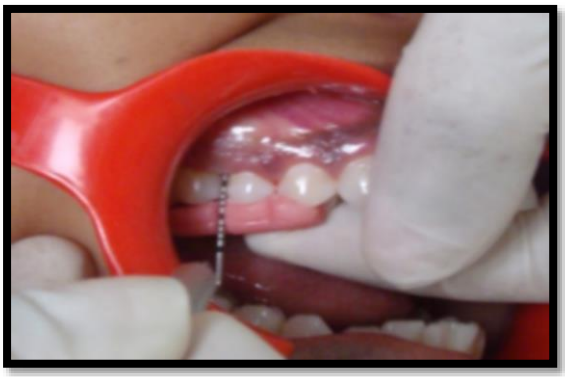


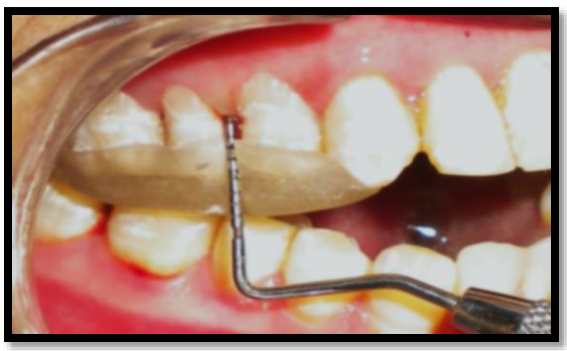
Figure 2: Intrapocket application of Perio Q gel

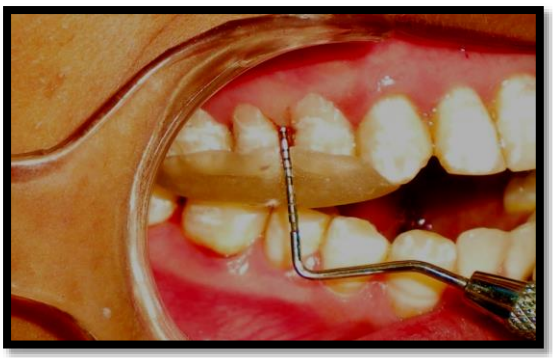




BASELINE 30 DAYS

Figure 3: Measurement of pocket probing depth (PPD) and relative attachment level (RAL) at baseline and 30 days using UNC 15 probe and customized stents for the test sites.

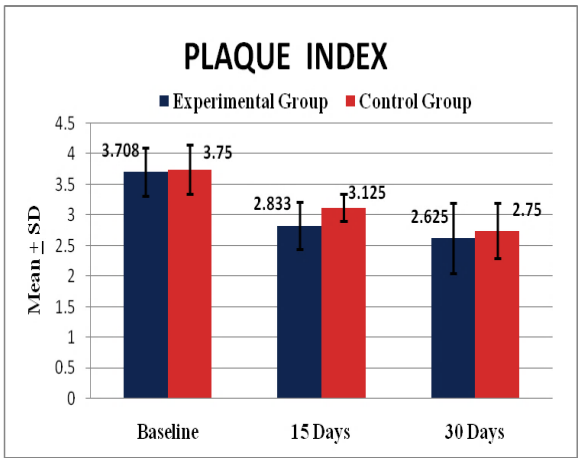




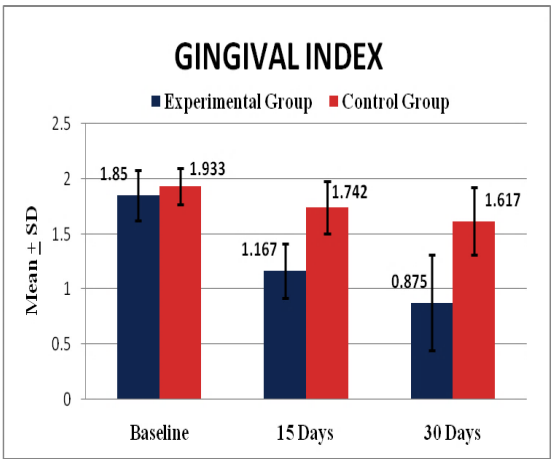
BASELINE 30 DAYS

Figure 4 : Measurement of pocket probing depth (PPD) and relative attachment level (RAL) at baseline and 30 days using UNC 15 probe and customized stents for the control sites

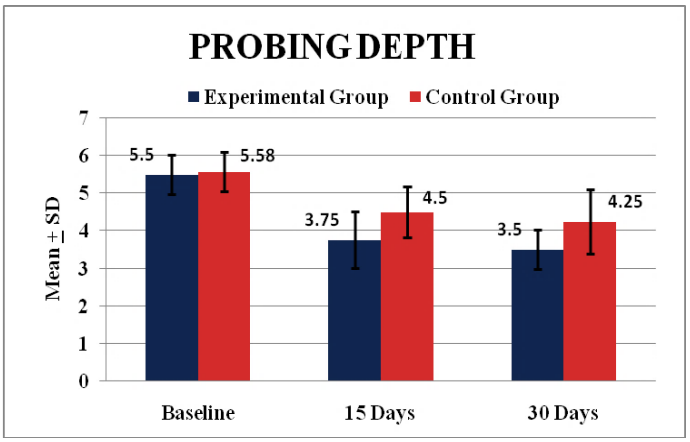
GRAPHS:



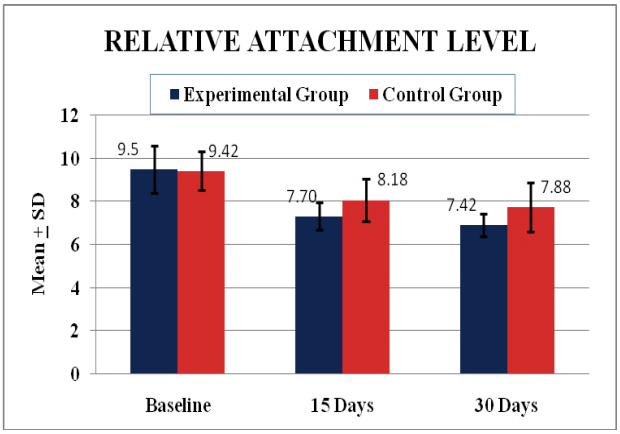
Graph 1 : Graph showing comparison of Plaque index (PI) in the test and the control groups at various time intervals



Graph 2 : Graph showing comparison of Gingival index (GI) in the test and the control groups at various time intervals.



Graph 3 : Graph showing comparison of pocket probiing depth (PPD) in the test and the control groups at various time intervals.



Graph 4 : Graph showing comparison of relaltive attachment level (RAL) in the test and the control groups at various time intervals.