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Comparative Evaluation of Phase I Therapy with and Without Adjunctive Photodynamic Therapy in the Treatment of Chronic Periodontitis – A Clinical Study

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Abstract: ***Background:*** *The emergence of Photodynamic therapy (PDT) in recent years as a non-invasive treatment modalityfor managing infectious diseases especially Periodontitis has gained interest. PDT is an oxygen-dependent photochemical reaction that generates cytotoxic reactive oxygen metabolites.*
Aims: *The main aim of this study was to compare and evaluate the efficacy of Photodynamic therapy as an adjunct to Phase I therapy in treating Chronic Periodontitis.*
Methods and Material: *It is a single centred randomized controlled trial, a total number of 5 patients were enrolled in a split mouth design into two groups as Group I (control group) SRP only and Group II (Test group) SRP with adjunctive PDT using 1% methylene blue as photosensitizing agent. Clinical parameter such as Probing depth (PD) and Clinical attachment level (CAL) were measured at baseline and after 45 days.*
Statistical analysis used: *WilcoxonSigned Ranks Test and Mann-Whitney Test.*
Results: *The mean PD (mm) reduction from baseline (4.42 ±0.41) to 45 days (3.49 ± 0.39) in group I and in group II baseline (4.38 ±0.6) to 45 days (3.31 ±0.51) was statistically significant. The mean CAL (mm) gain from baseline (4.87 ±0.36) to 45 days (3.79 ±.29) in group I and in group II at baseline (4.74 ±0.69) to 45 days (3.68 ± 0.60) was also statistically significant. The inter-group comparison of post-operative PD and CAL values at 45 days was not significant statistically.*
Conclusions: *The results obtained suggest adjunctive PDT is beneficial in reducing PD and CAL gain, further investigations with more sample size are recommended to support the study results.*
Key-words: *Photodynamic therapy (PDT), Subgingival Scaling and Root planing (SRP), Methylene blue, Generalized Chronic Periodontitis.*

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I. Introduction

Periodontitis is an inflammatory disease of multi-factorial origin that is said to be associated with loss of supporting structures around the teeth.[1] The therapeutic measures to manage such diseases are conventional non-surgical periodontal therapy that includes mechanical supra and subgingival tooth debridement and instruction in self- administered Oral health care measures.[2]

The recognition of specific microorganisms as an etiologic agent for periodontal diseases stimulated the development of new tools to reduce the supra and subgingival microbial load. Certainly some patients do not respond well to conventional non-surgical periodontal therapy alone, in such cases the use of antibiotic as an adjunct to mechanical therapy works favourably. These antibiotics are administered either through local or systemic route. No single therapeutic regimen has shown to have significant clinical benefits yet. The development of resistant strains to dental plaque microorganisms and their adverse side effects limits the use of multiple systemic antibiotics. In order to combat such threats various novel clinical approaches have been practiced in the treatment of Periodontitis. The other alternative for mechanical periodontal therapy is the use of laser because of its ablation, hemostatic and bactericidal action.[2]

Recently photodynamic therapy has emerged as an adjunct to non-surgical periodontal therapy as a result of the pioneering work of Prof. Michael Wilson and colegues at the Eastern Dental Institute, University College London.[3] In photodynamic therapy the laser light is used to activate the photosensitizer dye as it was found to suppress the anaerobic bacteria in the periodontal pocket. The commonly used photosensitizers are

Methylene blue, Toluidine blue O, Malachite green etc. Many periodontal pathogenic bacteria are found to be susceptible to low-power lasers in the presence of these dyes. Adjunctive antimicrobial photodynamic therapy (aPDT) utilizes these light activated photosensitizers that are selectively incorporated by most bacteria and absorbs a low-power laser light with an appropriate wavelength to induce singlet oxygen and free radicals which offend the microorganisms.[4] The aim of this present study is to compare the efficacy of photodynamic therapy with conventional non-surgical periodontal therapy in treating chronic periodontitis patients.

II. Subjects and Methods

This study was a split mouth controlled clinical trial performed at single centre to evaluate the efficacy of photodynamic therapy in the treatment of chronic Periodontitis. The study was performed after obtaining ethical clearance of the institute research committee. Patients reporting to APDCH, Department of Periodontics diagnosed with chronic periodontitis were included in the study. The study commenced with the treatment of Chronic Periodontitis patients with treatment plan of SRP for control sites and SRP with adjuvant PDT for study sites and was completed within 3 months.

INCLUSION CRITERIA:

Systemically healthy subjects in the age group between 35 to 45 years

Patients diagnosed with Chronic Periodontitis having PD/CAL ≥5 mm in more than 30% of total sites.

EXCLUSION CRITERIA:

1. Patients having systemic diseases
2. Individuals allergic to photo sensitizers
3. Smokers, pregnant and lactating mothers
4. History of any anitibiotic therapy or periodontal treatment during 3 months period before the examination.

A simple randomized double blind approach was employed to assign patients in a split-mouth design to one of the following treatment plan.

GROUP I (Control sites):

Control group: 5 patients, total No. Of quadrants =10 (SRP only)

GROUP II (Test sites):

Test group: 5 patients, total No. Of quadrants =10 (SRP along with Photodynamic therapy using 1% methylene blue solution as photosensitizer)The pre-operative probing pocket depth and clinical attachment level was measured using UNC-15 graduated periodontal probe. All measurements were examined by one efficient examiner.

SRP AND ADJUNCTIVE PHOTODYNAMIC THERAPY:

Study patients were treated by the following methods.

1. One stage full mouth scaling and root planing was performed and routine OHI was given.
2. Patients were recalled on the next day for photodynamic therapy in selected 2 quadrants.
3. After 24 hours group II (test sites) subjects were given a second appointment for Photodynamic therapy. Protective eye wear were provided for both patients and operator. 1% methylene blue solution was used as a photosensitizer which was injected inside the deep pocket areas and left for about 2 minutes. The dye was activated for 30 to 45 seconds per site using Diode laser at an average power of 1.0 w with 400 μmfiber optic tip and the wavelength was 980 nm. The fibre tip was introduced into the pocket with a gentle to and fro motion starting coronally and moving towards the bottom of the pocket. Oral hygiene instructions were given to the patients and asked to report after 45 days.

Statistical analysis:

The obtained data was entered in Microsoft excel and the results were analysed using SPSS software (statistical package for social science version 22.0). The intra group comparison of pre-op and post-op Probing depth and Clinical attachment level values in Group I and Group II were done using Wilcoxon Signed Rank Test.

The inter group comparison of post op probing depth and clinical attachment level values between Group I and Group II were done using Mann-Whitney U Test.

III. Results

A total number of 5 Chronic Periodontitis patients (total number of 20 quadrants) with age group of 35 to 45 years were enrolled in this study. 10 quadrants (I and IV quadrant) were assigned for SRP and 10 quadrants (II and III quadrant) were assigned for SRP along with Photodynamic therapy. All 5 patients completed the study without any pain, discomfort or post-op complications.

TABLE 1: The mean Probing Depth (mm) reduction from baseline (4.42 ±0.41) to 45 days (3.49 ± 0.39) in group I and in group II baseline (4.38 ±0.6) to 45 days (3.31 ±0.51) was statistically significant.
TABLE 2: The mean CAL (mm) gain from baseline (4.87 ±0.36) to 45 days (3.79 ±.29) in group I and in group II at baseline (4.74 ±0.69) to 45 days (3.68 ± 0.60) was also statistically significant.
Inter-group comparison of post-operative probing depth:
Post-operative comparison of PD and CAL among intergroup at 45 days was not statistically significant with *pvalue* of 0.353 and 0.796 respectively.

IV. Discussion

Treatment of periodontitis with conventional therapy has always been a challenge because of inability to achieve complete removal of bacteria and its toxins from the root surface. Many adjuvant therapies have been used in clinical trials and photodynamic therapies appears promising amidst of all. [5] The main advantages of this novel technique are its rapid and painless application of light; it does not alter the taste, it is not phototoxic to human cells, it provides dual benefit in terms of clinical and microbiological results with less impact on natural microbiota[6]

Randomized controlled clinical trial by Malgikar*et al.,* suggested that an additional application of PDT was a beneficial adjunct to non-surgical therapy in treating chronic periodontitis patients in terms of clinical parameters as compared to scaling and root planing alone[5]. The use of photodynamic light source ranging from 380 to 520 nm was able to achieve a threefold decrease in the growth of *P.gingivalis and Prevotella*species.[7]

PDT seems to be the most efficient option for treatment of localized and superficial infections in the oral cavity such as mucosal, endodontic infections, periodontal diseases, Peri-implantitis etc[8]

Initial phase of periodontal therapy includes mechanical debridement of diseased root surface by scaling and root planing using either manual or power driven instruments, however the complete elimination of bacterial deposits and their noxious products within the periodontal pocket is only partially achieved by conventional mechanical therapy. Adjunctive use of photodynamic therapy in treating periodontitis results in effective removal of bacterial deposits because of the release of free radicals that are formed during therapy that might have a toxic effect on the bacteria.

In this present study both the control group (SRP treated sites) and the test group (PDT treated sites) resulted in significant reduction of mean Probing depth and mean Clinical attachment level scores after therapy suggesting that this novel photodynamic therapy is equally effective to conventional therapy in controlling periodontitis since the use of photosensitizers like methylene blue reported to be beneficial in killing the influenza virus, *H.pylori,* and *C.albicans.*Methylene blue is also said to be a redox indicatorthat appears blue in an oxidizing environment and becomes colourless upon reduction. It's an effective photosensitizing agent used for inactivation of both gram positive and gram negative periodontopathic bacteria. Antimicrobial photodynamic therapy not only has bactericidal effect but also lead to the detoxification of endotoxins such as lipopolysaccharides. [8] In vitro study indicated that PDT is efficient in killing bacteria that are organised in biofilm. [9]

So the beneficial effects of antimicrobial photodynamic therapy can be utilised in treating periodontal disease. Thus, suggesting further studies with more sample size to investigate the potential effects of PDT in Periodontitis.

V. Conclusion

Within the limitations of this present study, it can be concluded that the adjunctive use of PDT could also be beneficial in terms of reduction of PD and CAL scores equal to that of Non-surgical therapy alone. Further investigations with more sample size should be performed to avail the superior benefits of PDT in routine clinical practise.

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Nil

Conflicts of interest:
There are no conflicts of interest

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TABLES:

TABLE 1: PROBING DEPTH

PROBING DEPTH	N	GROUP I (SRP)CONTROL GROUP			GROUP II (SRP + PDT)TEST GROUP		
PRE-OP PROBING DEPTH VALUE At Baseline	10	MEAN (mm) 4.4237	SD ±.41089	*P. VALUE* 0.004*	MEAN(mm) 4.3890	SD ±.61289	*P. VALUE* 0.005*
POST-OP PROBING DEPTH VALUE After 45 days:	10	3.4957	±.39519		3.3140	±.51438	

Group I: Statistically significant difference was found between pre-op and post-op Probing depth values in SRP treated sites with a *P. VALUE* .004*
Group II: Statistically significant difference was found between pre-op and post-op probing depth values in PDT treated sites with a *p.value*.005*

TABLE 2: CLINICAL ATTACHMENT LEVEL

CLINICAL ATTACHMENT LEVEL	N	GROUP I (SRP)CONTROL GROUP			GROUP II (SRP + PDT)TEST GROUP		
PRE-OP CLINICAL ATTACHMENT LEVEL VALUE At Baseline	10	MEAN (mm) 4.8742	SD ±.36267	*P. VALUE* .005*	MEAN (mm) 4.7440	SD ±.68880	*P. VALUE* .005*
POST-OP CLINICAL ATTACHMENT LEVEL VALUE After 45 days	10	3.7986	±.29399		3.6830	±.60588	

Group I: Statistically significant difference was found between the pre-op and post-op clinical attachment levels in SRP treated sites with a *P.VALUE* .005*
Group II: Statistically significant difference was found between the pre-op clinical attachment levels n PDT treated sites with a *p.value*.005*

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