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PHOTODYNAMIC THERAPY IN NON SURGICAL TREATMENT OF CHRONIC PERIODONTITIS-A SPLIT MOUTH STUDY

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Abstract: Chronic periodontitis is a multi-factorial disease due to its complex nature and association with periodontal pathogens. Attempts are made to prevent the progression of the disease at an earlier stage through non-surgical therapy. Many non-surgical modalities have evolved with time with varying degree of success. Hence; the present study was undertaken for assessing the efficacy of photodynamic therapy(PDT) as an adjunct to conventional scaling and root planing in the treatment of moderate chronic periodontitis. Twenty patients diagnosed as chronic periodontitis with recurring probing pocket depth of ≥5mm were included in the study.The study duration was 3 months. In this split mouth study design patients were subjected randomly to scaling and root planing (SRP)alone and in conjunction with diode laser and photosensitizer using Toluidine blue. Photodynamic therapy in conjunction with scaling and root planing was more effective in reducing sulcular bleeding scores, probing pocket depth and clinical attachment loss. Photodynamic therapy is an effective alternative to eradicate microorganisms in periodontal pocket and reducing the clinical parameters which are statistically significant.

Keywords: Diode laser, Moderate chronic periodontitis, Photodynamic therapy, Photosensitizer, Toluidine blue.

I. INTRODUCTION

The goal of periodontal therapy is to control the infection, regenerate the lost periodontal support, and maintain the periodontium in a disease free environment with the absence of destructive disease. Control of infection consists of removing all local and systemic factors which may be associated in the disease process.

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Periodontal therapy now is dynamic, including numerous modalities of treatment. Given the infectious nature of chronic periodontitis and the limited results that are sometimes achieved with conventional mechanical therapies, the use of antibiotics is warranted for certain forms of the disease.[1-3]

However, it is important to consider the potential benefits and adverse effects, including the development of resistant bacterial species. Keeping in mind the antimicrobial resistance, poor patient compliance, allergies and gastrointestinal problems, an effort is made to find an alternative to antimicrobial therapies. Among all the alternative treatment options to antimicrobial agents, antimicrobial photodynamic therapy (PDT) shows some promise. PDT has been successfully used to kill pathogens. It is based on the principle that a photosensitizer that binds to the target cells is activated by light of an appropriate wave length. By changing the energy status of the molecules in the photosensitizer, free radicals of singlet oxygen are formed, which are toxic to the cell by destroying the membrane, the mitochondria or the nuclei.[4, 5]

One of the greatest advantages of photodynamic therapy is the double selectivity obtained by targeting the photosensitizer, derived from its high affinity for microbial cells, and the light, implying that only the infected area is irradiated and consequently treated. Several kinds of photosensitizers may be associated with laser, but each will have application dependent on the absorption of the light and wavelength. For photodynamic therapy to be successful, it is essential to select an effective non-toxic photosensitizer, capable of high absorption in the light length used, to have great bactericidal effectiveness. The photosensitizer must also have the capacity to penetrate the membranes of the bacterial cells and only relatively hydrophobic compounds with low molecular weight succeed in diffusing through this membrane.It is safe for human tissue, as the photosensitizer typically shows a higher affinity against microbial cells.[6, 7] Toluidine blue was chosen as the photosensitizer as it had a high penetrating capacity in the membrane as it is cationic, hydrophilic and has a low molecular weight, easily passing through the channelled pore in high molecular weight substances.

Hence; the present study was undertaken for assessing the efficacy of photodynamic therapy (PDT) as an adjunct to conventional scaling and root planing in the treatment of moderate chronic periodontitis.

II. MATERIALS & METHODS

The study was conducted at Vinayaka Missions Sankarachariyar Dental College among the patients who attended the OPD of the Department of Periodontology. A total of 20 patients of both sexes who had a probing pocket depth of ≥5mm were recruited for the study.

INCLUSION CRITERIA

- Age 30-50 years
- Presence of at least 24 remaining teeth.
- History of chronic periodontitis.
- Residual PPD ≥with or without concomitant bleeding on probing.

EXCLUSION CRITERIA

- Patients with complicated medical history such as uncontrolled diabetes, bleeding disorder, osteoporosis and radiation therapy.
- Smokers
- Pregnant women and lactating mothers.
- Patients with use of systemic and local antibiotics in the last 6months.

Twenty pairs of contralateral maxillary/ mandibular teeth were included. Oral hygiene instructions and professional supragingival scaling was done 7-14days before the baseline examination. The study was done using a split mouth design. The study period was 3 months and patients clinical parameters such as the probing pocket depth (PPD), clinical attachment level(CAL), and sulcular bleeding index were recorded at baseline 0 day, 7days,1month and 3 months using a calibrated periodontal probe (Aesculap pressure sensitive probe, DB765R) with a point diameter of0.45mm and standardized to a probing force of 0.2N. On day 0 one tooth in each contra lateral pair was randomly treated, with sub gingival scaling and root planing (SRP) under local anesthesia using Gracey curettes, which served as the control group. The test group were treated with SRP followed by PDT using a diode laser and Toluidine blue as the photosensitizer.

The laser system included a diode laser with a wavelength of 810 nm and a power density of 2W and 200 microns optic fibre.Toluidine blue was used in the concentration of 1mg/ml (T 1961 ottochemie Laboratories). The photosensitizer was delivered to the bottom of the periodontal pocket using a disposable syringe and needle and applied in a coronal direction. After waiting for 3 minutes of action, the pocket was exposed to the laser light using a fiber optic application tip for 10 seconds per site in non-contact mode. The study was done by a single examiner to avoid bias as the treated sites were chosen randomly. All the results were recorded and analysed.

III. RESULTS

A total of 20 patients participated in the study. The study duration was 90 days. The patients were examined at baseline, 7 days, 30 days, and at 90 days. The various parameters namely the sulcular bleeding index, PPD and CAL were measured. The results were tabulated based on these three parameters which is represented in table 1 and 2. Significant results were obtained while comparing the Sulcular bleeding index in between the study group and the control group at 30 days and 90 days. However; while comparing the mean probing pocket depth in between the study group and the control group at different time intervals, non-significant results were obtained.

Table 1: Changes in the mean percentage of Sulcular Bleeding Index

Sulcular bleeding index	Baseline in %	7 days in %	30 days in %	90 days in %
Control	78.4	20	30	43.4
Test	75	13.4	0.00	0.00
p- value	0.283	0.5	<0.001*	<0.001*

Table 2: Probing pocket depth

Probing pocket depth	Baseline-7days		Baseline- 30days		Baseline-90days	
	Mean	SD	Mean	SD	Mean	SD
Control	1.58**	0.67	2.08**	0.90	2.00**	0.74
Test	1,25**	0.75	2.08**	1.08	2.58**	0.90
P	0.359		0.853		0.066	

IV. DISCUSSION

The mainstay of the non-surgical periodontal therapy remains the physical removal of sub gingival biofilm, which is often supplemented with a range of antimicrobial agents to the periodontal pocket. The specific organization of pathogenic periodontal bacteria in the biofilm affects their resistance to antibiotics. Bacteria within the biofilm may be up to 1000, times more resistant than those in planktonic form. Also systemic antibiotics reach the periodontal tissues by transduction across serum, then cross the crevicular and junctional epithelium to enter the gingival sulcus. By the time the systemic antibiotic reaches the gingival sulcus it no longer has an adequate concentration to achieve the desired antimicrobial effect. As a consequence, the host tissues cannot cope with the remaining microorganisms, resulting in the persistence of the inflammation of the soft tissues and producing a varying degrees of disease activities of the sub gingival pocket.[4- 6] Non surgical periodontal therapy is directed towards the removal of the antimicrobial biofilm from the root surfaces of periodontally diseased teeth. Thus the emerging need for alternative therapies led to newer studies.Employing PDT would serve an interesting discourse. Keeping in mind the antimicrobial resistance, John Toth acknowledged the photodynamic chemical effects and renamed the therapy as photodynamic therapy (PDT).[6]

PDT is widely used in periodontal therapy for pocket disinfection and studies for which have delivered promising results.[7] A major benefit of PDT is that the bactericidal effect is localized to areas that are treated with both photosensitizer and light, preventing disruption of the indigenous microflora at sites distal to the treated area.[8] Studies with PDT have shown reports of bacteria being killed or inactivated by various combinations of photosensitizer and light, reduction of pocket depth, improvement in bleeding and reduction in levels of interleukin (IL -1β), matrix metalloproteinase 8 and total bacterial flora,and eliminate inflammatory reactions in the gingiva with no detectable damage.[9]

After irradiation of lasers with a specific wavelength, (lasers)the photosensitizer at ground state is activated to a highly energized triple state. The longer lifetime of the triplet state enables the interaction of the exited

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photosensitizer with the surrounding molecules, and it is generally accepted that the generation of cytotoxic species produced during photodynamic therapy occurs in this state. The triplet -state photosensitizer follows two different pathways (TypeI and II) to react with biomolecules. Type I reactions involve electron transfer reactions between the exited state of the photosensitizer and an organic substrate molecule of the cells, which produces free radicals and radical ions which are highly reactive and interact with endogenous molecular oxygen to produce highly reactive oxygen species such as superoxide and hydroxyl radicals that are harmful to cell membrane integrity, causing irreparable biological damage.[10]

In the Type II reaction the triplet state photosensitizer reacts with oxygen to produce an electronically exited and highly reactive state of oxygen, (singlet oxygen) which can interact with a large number of biological substrates, inducing oxidative damage on the bacterial cell by damaging the cell membrane and the cell wall.[11] Thus the process of antimicrobial photodynamic therapy is generally mediated by a type II reaction, which is accepted as the major pathway of microbial cell damage.[12] The nonspecific mode of action of PDT expressing the generation of singlet oxygen means that the acquisition of bacterial resistance to these agents is unlikely. A study using a diode laser of proper power and wavelength and subjected to 60s of irradiation could be a useful adjunct along with mechanical debridement in the prevention of the recolonization of sub gingival lesions by pathogenic microorganisms there by effective in reducing the level of the clinical parameters observed at baseline and at the end of the study.[13]The most important characteristic is the wavelength of the diode laser used as the wavelength determines how the laser light will interact with the tissue (absorb in the appropriate tissue chromophores,penetration depth into the tissue etc).A comparative study was done on the effectiveness of a photo disinfection process along with diode laser to that of SRP alone in the non-surgical management of periodontal disease. Clinical assessments of bleeding on probing, PPD and CAL were made at baseline and at end of 12 weeks. SRP combined with photo disinfection showed significant improvements of the investigated parameters over use of SRP alone.[14]

A short term split mouth study done using antimicrobial photodynamic therapy as an adjunctive in the management of chronic periodontitis patients as the test group and SRP alone as the control group showed a relative reduction in PPD and CAL when compared with the baseline scores in test group than the control group.[15]

The results of the present study indicated a substantial reduction in the above said parameters when compared with the baseline scores. The results were found be in concurrence with the other studies.

Studies employing laser and toluidine blue showed that sensitization of periodontogenic bacteria was effective in killing bacteria in vivo and can be a useful means of eliminating periodontogenic bacteria from diseased sites that is evidenced by an improvement in the clinical parameters such as PPD and CAL [16]. It was observed that Toluidine blue used in conjunction with laser had a bactericidal effect and that older biofilms were less susceptible to photodynamic therapy.[17]

Comparison of photosensitization and SRP to that of SRP alone revealed that the clinical assessments of bleeding on probing, probing pocket depth and clinical attachment level from baseline to12 weeks showed SRP combined with photosensisation lead to significant improvements of the investigated parameters over use of SRP alone [18] . Similarly, contralateral examination of the parameters in the same patient showed that diode laser with

SRP presented long term positive results, while PDT showed a significant bacteria reduction during the entire observation period.[19] Similar results were obtained in the present study and is concurrent with the results of the earlier studies.

One-year study to document the possible added benefits of repeated adjunctive PDT to conventional treatment in residual pockets in periodontitis patients, bleeding on probing, PPD and CAL were assessed at 3 months following interventions. All the parameters showed a significant decline in the parameters compared to the control group.[20] Similarly a 3-month study using PDT also had a higher impact in test group and the values of PPD and CAL showed a greater reduction as compared to the control group.[21]

V. CONCLUSION

Photodynamic therapy can be used as an adjunct to mechanical debridement along with SRP for pocket disinfection that causes a reduction in microbial load in moderate chronic periodontitis. It can be used as an alternative antimicrobial therapy to antibiotics as PDT causes a reduction in sulcular bleeding scores, probing pocket depth and clinical attachment loss.

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