



## EVALUATION OF EFFICACY OF ANTIMICROBIAL PHOTODYNAMIC THERAPY AS AN ADJUNCT TO SCALING AND ROOT PLANING IN NON-SURGICAL PERIODONTAL THERAPY: A CLINICAL STUDY

### Periodontics

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### ABSTRACT

**Introduction:** Periodontitis is inflammation of periodontium that extends beyond the gingiva and produces destruction of the connective tissue attachment of the teeth. It is a complex interrelationship between infectious agents like bacteria and host factors. Aim: To evaluate the adjunctive effects of the photodynamic Therapy using indocyanine green dye to Scaling and Root planing as compared to the conventional mechanical debridement as assessed by clinical parameters in Non-Surgical Periodontal Therapy.

**Design:** 30 patients diagnosed as cases of generalized moderate to severe chronic periodontitis based on clinical evaluation were included in the study. The following clinical parameters were considered to compare both the treatment modalities at baseline and 6 weeks interval Plaque Index (PI), Gingival Index (GI), Sulcus bleeding index, Pocket probing depths (PPD) using UNC-15 probe (Hu-Friedy) and acrylic stent & Clinical attachment levels (CAL) using UNC-15 probe (Hu-Friedy) and acrylic stent.

**Results:** Significant difference was observed for each variable at both the time intervals (Baseline & 6 weeks) in control and experimental group when analyzed using paired t test. When mean difference (Baseline – 6 weeks) was compared significant difference was observed for all the variables.

**Conclusion:** Scaling and root planning and antimicrobial photodynamic therapy (SRP+APDT) (Experimental group) showed good results then control group i.e scaling and root planning alone (SRP). The present study showed that the addition of single episode of APDT with adjunct to SRP resulted in a significant improvement in terms of PI, GI, SBI, PPD reduction and CAL gain.

### KEYWORDS

Scaling, Root Planning, Antimicrobial Photodynamic Therapy.

### INTRODUCTION

Periodontitis is inflammation of periodontium that extends beyond the gingiva and produces destruction of the connective tissue attachment of the teeth. It is a complex interrelationships between infectious agents like bacteria and host factors. It is universally accepted that periodontitis is the result of mixed bacterial infections that require the participation of the members of the anaerobic micro biota inhabiting the sub-gingival region, resulting in the destruction of supporting structures of the teeth.<sup>2,3</sup>

Periodontal treatment is focused on prevention, arresting diseases progression, decreasing the diseases activity and elimination or control of etiologic agents. The course of treatment of systemic periodontal therapy is divided into three categories.<sup>4</sup>

- Non-surgical phase- aims at removal of supra and sub-gingival plaque and etiologic factors along with patient education,
- Surgical phase- surgical corrective measures are used if active pockets persist after non-surgical therapy,
- Maintenance phase- patients require constant plaque control and remotivation for a successful periodontal treatment.

Currently, the most widely accepted and effective treatment approach for periodontal disease is non-surgical periodontal therapy i. e. scaling and root planning (SRP), the mechanical removal of the bacterial biofilm and their toxins from the tooth surface, making it compatible for biologic reattachment.<sup>5,6</sup> mechanical debridement is performed using manual scalers and curettes or power driven instruments. The non-surgical therapy leads to resolution of inflammation, reduction in bacterial load and reduction in probing depth.<sup>6</sup> However, mechanical therapy alone may fail to eliminate periodontal pathogens located on the root surfaces,<sup>7</sup> in the deep periodontal pocket<sup>8</sup> and in areas that inaccessible to periodontal instruments, such as furcation areas, root depressions, concavities, grooves, and distal molar region.<sup>9</sup> This

predisposes the periodontal pockets to recolonize and the disease to relapse.

Recently, use of LASERS as an adjunctive or alternative to conventional mechanical therapy has been under investigation. 'LASER' is an acronym for Light Amplification by Stimulated Emission of Radiation. The physical principle of laser was developed from Einstein's theories in the early 1900s, and the first device was introduced in 1960 by Maiman.<sup>10</sup> Since then, lasers have been used in many different areas in medicine, surgery and in various specialities in dentistry including periodontics. One of the application of lasers in form of Low Level Laser Therapy is photodynamic therapy (PDT), also known as photo-radiation therapy, phototherapy or Photo-chemotherapy, which involves the use of a photoactive dye (photosensitizer) that is activated by exposure to light of specific wavelength in the presence of oxygen. Clinically this reaction is cytotoxic and vasculotoxic. Thus the purpose of this study is to evaluate the adjunctive effects of the photodynamic Therapy using indocyanine green dye to Scaling and Root planing as compared to the conventional mechanical debridement as assessed by clinical parameters in Non-Surgical Periodontal Therapy.

### MATERIALS AND METHODS

This study was a prospective randomized controlled clinical trial. 30 patients diagnosed as cases of generalized moderate to severe chronic periodontitis based on clinical evaluation that came to the department of Periodontology & Implantology, Dr. D.Y.Patil School of dentistry, Nerul, Navi Mumbai were included in the study. Patients were explained about the study and a written informed consent was obtained prior to the start of the study. The study protocol was reviewed and approved by the Institutional Review Board. Patients were selected based on the following inclusion and exclusion criteria's:

#### Inclusion criteria:

1. Patients from the age group of 25 to 55 years old diagnosed as cases

of generalized chronic periodontitis according to criteria by world workshop in periodontics 1999

- Subjects with more than 20 teeth present
- Patients with chronic periodontitis having at least 4 teeth with probing depth  $\geq 4\text{mm}$  (two teeth in contralateral quadrant)
- Subjects needed to be available for the duration of the study

#### EXCLUSION CRITERIA:

- Patients with smoking and/or tobacco chewing habit
- Pregnant or lactating women
- Patients having any systemic diseases
- Patients who have undergone periodontal therapy in last 6 months and received antibiotic therapy in the previous 3 months

The following clinical parameters were considered to compare both the treatment modalities at baseline and 6 weeks interval:

- Plaque Index (PI)
- Gingival Index (GI)
- Sulcus bleeding index
- Pocket probing depths (PPD) using UNC-15 probe (Hu-Friedy) and acrylic stent.
- Clinical attachment levels (CAL) using UNC-15 probe (Hu-Friedy) and acrylic stent.

On day 1, case history was recorded. Alginate impressions were made for the maxillary and mandibular arches. Custom acrylic stents were prepared. Baseline measurement of clinical parameters i.e. PPD and CAL were recorded with help of custom acrylic stents. All subjects were treated with SRP using hand instruments and sonic instrumentation followed by sub gingival scaling within 24 hours. Patients were immediately randomly distributed into the test and control group of 15 each. The test group received APDT in addition to SRP. Oral hygiene instructions not including the use of any antibacterial dentifrice or mouth wash were given to all 30 patients. Oral hygiene reinforcement was done at regular recall visits at intervals of 1, 2 and 4 weeks. At 6 week follow-up, the clinical parameters of test and control group were again recorded and compared with the baseline recordings.

#### Scaling and root planning (SRP) (Control group)

All subjects were treated within 24 hours with SRP using hand instruments and sonic instrumentation. Following sub-gingival instrumentation for test and control groups was performed until the operator believed that the root surfaces were adequately debrided and planed.

#### Antimicrobial Photo Dynamic Therapy application (APDT) (Experimental group)

After randomization in the test group, the photosensitizer liquid that is indocyanine green dye was applied with a blunt needle to the instrumented sites, starting from the apical end of the pocket and moving coronally to avoid entrapment of air bubbles. The photosensitizer was left in the place for 30 seconds. After which perio tip that was attached to the light guide was held approximately 1mm from the gingival surface. The depth of the pocket was illuminated for 30 seconds each. This procedure was repeated for all the teeth under consideration and for all the sites. 30 seconds later, all pockets were thoroughly rinsed with sterile saline to remove the excess photosensitizer.

#### STATISTICAL ANALYSIS

The responses were coded and entered in Microsoft excel and analyzed using IBM SPSS statistics 20.0 [IBM Corporation, Armonk, NY, USA]. Descriptive and inferential statistical analyses were carried out in the present study. Results on continuous measurements were presented on Mean  $\pm$  SD and results on categorical measurement were presented in number (%). Level of significance was fixed at  $p=0.05$  and any value less than or equal to 0.05 was considered to be statistically significant. Student t tests (two tailed, paired & unpaired) were used to find the significance of study parameters on continuous scale between two groups.

#### RESULTS

The study included 30 patients 14 male and 16 female patients with generalized chronic periodontitis within range of 25 to 55 years. Significant difference was observed for each variable at both the time intervals (Baseline & 6 weeks) in control and experimental group when analyzed using paired t test (Table 1 & 2). When mean difference (Baseline – 6 weeks) was compared significant difference was

observed for all the variables. Scaling and root planning and antimicrobial photodynamic therapy (SRP+APDT) (Experimental group) showed good results then control group i.e scaling and root planning alone (SRP) (Table 3).

**TABLE 1: Comparison Of Plaque Index, Gingival Index, Sulcus Bleeding Index, Probing Depth & Cal Values In Terms Of {mean (sd)} At Different Time Intervals In Control Group Using Paired T Test**

| Control group   | Baseline         | 6 weeks          | P value |
|-----------------|------------------|------------------|---------|
| Plaque index    | 1.22 $\pm$ 0.397 | 1.07 $\pm$ 0.292 | 0.009   |
| Gingival index  | 1.05 $\pm$ 0.336 | 0.98 $\pm$ 0.301 | 0.003   |
| Sulcus bleeding | 1.67 $\pm$ 0.724 | 1.00 $\pm$ 0.535 | <0.001  |
| Probing depth   | 5.40 $\pm$ 1.056 | 4.53 $\pm$ 1.125 | <0.001  |
| CAL             | 5.80 $\pm$ 0.862 | 4.93 $\pm$ 0.961 | <0.001  |

**TABLE 2: Comparison Of Plaque Index, Gingival Index, Sulcus Bleeding Index, Probing Depth & Cal Values In Terms Of {mean (sd)} At Different Time Intervals In Experimental Group Using Paired T Test**

| Experimental group | Baseline         | 6 weeks          | P value |
|--------------------|------------------|------------------|---------|
| Plaque index       | 1.27 $\pm$ 0.418 | 0.88 $\pm$ 0.197 | <0.001  |
| Gingival index     | 1.20 $\pm$ 0.424 | 0.96 $\pm$ 0.385 | <0.001  |
| Sulcus bleeding    | 1.87 $\pm$ 0.51  | 0.40 $\pm$ 0.50  | <0.001  |
| Probing depth      | 5.53 $\pm$ 0.91  | 4.13 $\pm$ 0.64  | <0.001  |
| CAL                | 6.33 $\pm$ 0.97  | 4.60 $\pm$ 0.50  | <0.001  |

**TABLE 3: Comparison Of The Mean Difference (baseline – 6 Weeks) Of Plaque Index, Gingival Index, Sulcus Bleeding Index, Probing Depth & Cal Values In Terms Of {mean (sd)} Among Both The Groups Using Unpaired T Test**

| Mean difference | Control group     | Experimental group | P value |
|-----------------|-------------------|--------------------|---------|
| Plaque index    | 0.159 $\pm$ 0.202 | 0.388 $\pm$ 0.288  | 0.018   |
| Gingival index  | 0.071 $\pm$ 0.078 | 0.246 $\pm$ 0.101  | <0.001  |
| Sulcus bleeding | 0.666 $\pm$ 0.487 | 1.466 $\pm$ 0.516  | <0.001  |
| Probing depth   | 0.866 $\pm$ 0.351 | 1.400 $\pm$ 0.632  | 0.008   |
| CAL             | 0.866 $\pm$ 0.351 | 1.733 $\pm$ 0.798  | <0.001  |

#### DISCUSSION

Mechanical debridement (scaling and root planing) is the gold standard of periodontal therapy because it is the form of nonsurgical treatment that actually removes the plaque biofilm, reduces the bacterial load. However it has its own limitations of reachability and ineffective antibacterial effect. Studies have shown that there is a decreasing efficiency in plaque removal with increasing pocket depth and this is associated with a corresponding decrease in treatment efficacy.<sup>11</sup> It is also not effective in the suppression of tissue-invasive organisms and this may be one of the reasons for failure of mechanical therapy in some pockets. Because of the lack of complete antibacterial effect, researches have always been on a hunt for a highly effective adjunctive therapy that would enhance the effects of scaling and root planing.

Recently, a new type of non-invasive phototherapy for bacterial elimination, called Photodynamic therapy has been introduced which uses low level laser light.<sup>13-15</sup>

Photodynamic therapy has been introduced as an alternative to regimes and the pioneering work of Professor Michael Wilson and colleagues at the Eastman dental institute, university college London, UK.<sup>12,16</sup> Photodynamic therapy has various advantages over antibiotic therapy like one of the greatest advantage of photodynamic therapy is the double selectivity<sup>17</sup> obtained by

- The photosensitizer because of its high affinity for microbial cells and,
- The light implying that only the infected area is irradiated and consequently treated.

The results are instantaneous while antibiotics take several days to act. The therapeutic window of antimicrobial photodynamic therapy is broader than other antimicrobial therapies because of high reactivity of ROS, secreted virulence factors can be also destroyed besides antimicrobial photodynamic therapy cannot easily induce the development of microbial resistance. The aim of the study was to evaluate the efficacy of PDT as an adjunct to nonsurgical periodontal therapy (SRP) in the treatment of chronic periodontitis patients

clinically. In this study, the group receiving APDT i.e indocyanine dye and scaling and root planning (test group) showed clinically and statistically significant improvement in all the clinical parameter from the baseline to the 6 weeks follow up then scaling and root planning alone (control group).

The results obtained for plaque index are in accordance with a study conducted by Sato et al<sup>17</sup>. In a study done by Cugini et al<sup>18</sup> plaque index were significantly reduced at 12 months ( $p < 0.05$ ) and a study done by Ravi Raj K et al (2016)<sup>19</sup> there was statistically significant reduction in PI value in both groups at 3 months visit. The results obtained for gingival index are in accordance with a study conducted by William Becker (1998)<sup>21</sup>. In a study done by Berakdar M. et al (2012)<sup>20</sup> there was a significant reduction after 3 months in plaque in comparison to baseline values. In a study done by Ravi Raj K et al (2016)<sup>19</sup> there was a significant reduction in GI scores in both the groups.

The results obtained for sulcus bleeding index were similar to a study conducted by Chetan et al 2015,<sup>22</sup> where the reduction in the mean bleeding scores was significant for both the groups with higher reduction in test group. The reduction in the pocket probing depth in the present study is in accordance with a study conducted by Andersen et al (2007),<sup>23</sup> where the sites treated with SRP alone demonstrated less reductions when compared to those treated with SRP + APDT. Similar results were obtained in a study conducted by Berakdar M. et al (2012)<sup>20</sup>, Cugini et al.<sup>18</sup> and Ravi Raj K et al (2016)<sup>19</sup>. The gain in the clinical attachment level in the present study is in accordance with a study conducted by Andersen et al (2007),<sup>23</sup> where the sites treated with SRP alone demonstrated less gains when compared to those treated with SRP + APDT. Similar results were obtained in a study conducted by Berakdar M. et al (2012)<sup>20</sup>, Cugini et al.<sup>18</sup> and Ravi Raj K et al (2016)<sup>19</sup>. The safety of topical oral antimicrobial photodynamic therapy using indocyanine green has been demonstrated in several studies.

## CONCLUSION

It may be concluded from the present study that the result of the test group were statistically significant as compared to the control group. As per the clinical and statistical data analysis, the test group proved to be more effective in PI, GI, SBI, PPD reduction and gain in clinical attachment level as compared to the control group. The component of photodynamic therapy (Indocyanine green dye) was well tolerated by patients. Thus it can be concluded that, within its limits, the present study showed that the addition of single episode of APDT with adjunct to SRP resulted in a significant improvement in terms of PI, GI, SBI, PPD reduction and CAL gain.

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