

## EFFICACY OF PHOTODYNAMIC THERAPY AS AN ADJUNCT TO NON – SURGICAL PERIODONTAL THERAPY IN TYPE-2 DIABETES MELLITUS PATIENT

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### Abstract

**Background:** To Evaluate the additional benefit of Antimicrobial Photodynamic therapy, if any in the glycemic control of type 2 diabetes mellitus chronic periodontitis patients .

**Methods:** Fifty diabetic patients with chronic periodontitis were taken for the study who met the inclusion criteria of clinical attachment loss  $\geq 3$  to 5 mm at  $\geq 30\%$  of sites and bleeding on probing present in two different quadrants . After SRP ( Scaling and root planing ) , one quadrant was selected for aPDT while other served as a control group. Clinical parameters i.e. Plaque index, Probing depth ,Relative attachment level and HbA1c were measured at baseline, 1 week , 1month and 3 months.

**Results:** Statistically significant differences in the mean probing depth, Relative attachment level, plaque deposit, and HbA1c were found between baseline and 12 weeks post-treatment for both groups. No significant differences in glucose levels were detected among the two groups in 1 week . Reduction in the mean HbA1c level after treatment was observed in both groups in 1 month and 3 months .

**Conclusion:** Antimicrobial Photodynamic Therapy when used in addition to scaling and root planing yields significant improvement of mean probing depth , Plaque deposit ,Relative attachment levels, periodontal status and reduction of HbA1c levels in treatment of diabetic patients with periodontitis when comparing the test group to the control group.

**Keywords:** photodynamic therapy , scaling and root planing, glycated haemoglobin ,Randomized controlled trial

### Introduction

Periodontitis is especially established through a bacterial biofilm; however, systemic diseases can affect the disease course, influencing the capacity of the periodontal tissues to react to the attack or modulate this action, thus increasing both the risk of disease development and the disease severity.<sup>1</sup>

Chronic periodontal conditions, almost like the other infections, are caused by Gram negative bacteria, and that they not only tend to exacerbate insulin resistance within the body but also aggravate the systemic inflammatory condition in patients with diabetes.<sup>2</sup> The dysregulated secretion of inflammatory cytokines in periodontitis causes their entry into the bloodstream, thereby affecting distant sites (tissues and organs). This prolonged hyperglycemic state caused by periodontal inflammation is understood to further worsen the glycemic status and to market the associated complications of diabetes in these patients. Periodontal therapy also has an impact on glycosylated hemoglobin (HbA1c) levels within the blood, thus improving the metabolic control of the patient.<sup>3</sup>

Diabetes mellitus is a leading systemic risk factor for periodontitis, which may be defined as heterogeneous

syndrome with impaired glucose tolerance (IGT) and impaired lipid and carbohydrate metabolism and many studies have been conducted to elucidate its mechanism of action on the periodontium and vice versa. Diabetes, also seems to influence the severity of periodontitis, demonstrating the existence of a bidirectional relationship between these pathologies.<sup>4,5</sup> Both type 1 DM and type 2 DM affect the 2 major periodontal diseases, gingivitis and periodontitis.<sup>6</sup>

Several epidemiological studies confirm a link between type 2 diabetes mellitus and periodontitis, with the risk of periodontitis 3-4 times higher in diabetic patients compared with normoglycemic patients.<sup>6</sup> It has been reported that individuals with type 2 diabetes mellitus are 2.8 times more likely to have at least 5 mm clinical attachment loss and 3.4 times more likely to have at least 25% radiographic bone loss, with a 4-fold higher risk of severe alveolar bone loss.<sup>7</sup>

Few of the studies evaluated the impact of non-surgical periodontal therapy (NSPT) with scaling and root planing (SRP) on the glycemic control of diabetic patients and found evidence of metabolic improvement in these patients. Although SRP is taken into account the gold

standard for the treatment of periodontitis, SRP is usually unable to completely eliminate the periodontal infection and associated inflammation, especially in individuals with systemic involvement and individuals susceptible to more severe cases of periodontitis, like diabetic patients.

New alternatives are tested to potentiate the effect of periodontal therapy, like antimicrobial photodynamic therapy (aPDT), which aims to inactivate microorganisms related to the pathological conditions of the periodontium. This therapy consists of the irradiation of infected areas by a low-level laser after staining with a selected photosensitizer. In the presence of oxygen, photochemical reactions occur and can cause the formation of reactive oxygen species that are toxic to the microorganisms, thus enabling a discount in their pathological action or maybe their elimination through different mechanisms. The present study was aimed to evaluate the effect of periodontal therapy on periodontal status and glycemic control of patients with type 2 diabetes mellitus and affected by chronic periodontitis.

### Methodology

**Study design:** This split mouth single blinded, randomized controlled clinical trial was approved by the Ethical Committee of Dental Institute, Modinagar. This trial involved 50 adult diabetic patients of either sex who met the inclusion criteria. The patients were selected from the Outpatient Department of Periodontology and Implantology at Dental College, Modinagar

### Inclusion criteria:

- 1- Male and Female in the age range 45 to 65 years ;
- 2- Confirmed diagnosis of type 2 diabetes;
- 3- Generalized moderate to severe chronic periodontitis;  $\geq 20$  remaining teeth and
- 4- The presence of clinical attachment loss  $\geq 3$  to 5 mm at  $\geq 30\%$  of sites was used to define generalized moderate to severe Chronic periodontitis .

### Exclusion criteria :

- 1- Pregnant women;
- 2- Patients with major diabetic complications ;and
- 3- Patients who had received periodontal treatment or antibiotic therapy 6 months before the study.

**Clinical Examination:** Patients who fulfilled the inclusion criteria, were explained the treatment methods, risks and benefits. 50 patients signed the informed consent form following which detailed history and examination was carried out and recorded. The following clinical parameters were recorded at 4 sites altogether teeth using mouth mirror, explorer and calibrated periodontal probe (UNC-15, Hu-Friedy, Chicago, IL). (1) Plaque Index (PI)- Sillness and Loe -1964 2. Pocket probing Depth (PD) 3. Relative Attachment Level (RAL) 4. HbA1c

Sites with maximum RAL was included from each patient and equally divided into control and test sites was allotted for clinical evaluation. Both the sites received SRP while the test sites additionally received photodynamic therapy. and acrylic stents were fabricated for the measurement of PD and RAL. The measurements of PD and RAL were repeated for the selected sites after placing the acrylic stents. A vertical groove was made within the stent at the location like the deepest PD to breed the position and angulation of probe at subsequent visits

**Test Site (Group A):** Received Photodynamic therapy by means of 0.01% of methylene blue and irradiation by diode laser after scaling and Root Planing.

**Control Site (Group B):** Received scaling and Root Planing

SRP was performed using ultrasonic and hand instruments in one to four sessions lasting 60 to 90 minutes each and was conducted within 7 days under local anesthesia wherever needed. Photodynamic Therapy (PDT) was performed employing a formulation consisting of 0.01% methylene blue because the active ingredient and irradiated non-thermal diode laser.

After SRP, haemostatis was achieved and photodynamic therapy was performed as per following steps:

- ✓ Methylene blue was supplied by the manufacturer during a prefilled syringe irrigator containing 0.6 ml or 2.0 ml solution. Briefly, the blunt-end irrigator tip attached to the prefilled syringe and introduced into the pocket, and therefore the photosensitizing solution was slowly instilled over 5 to 10 seconds.
- ✓ The light-diffusing tip of the non-thermal diode laser was placed into the irrigated periodontal pocket, and therefore the solution was illuminated for 60 seconds. Any residual photosensitizer was then removed using water irrigation or suction.

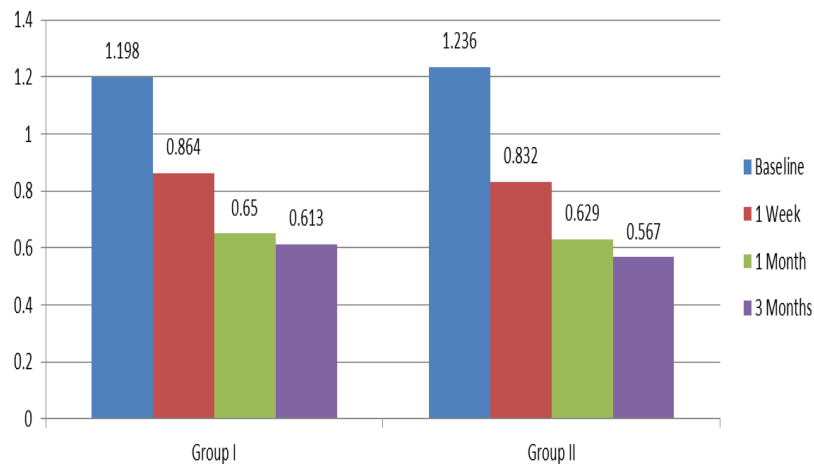
Soft tissue diode laser unit with fiberoptic cable- 200 $\mu$ m diameter fiber was used as a light source with a 970 $\pm$ 15 nm wavelength at 0.5 W in a pulsed mode to activate photosensitizer molecules. Patients have been recalled for follow up and clinical parameters were recorded again at 1 week , 1 month and three months after the primary application of aPDT .

**Statsical analysis :** Data for this study was analyzed using the SPSS statistical software 22.0 Version. The descriptive statistics included mean, standard deviation .The intragroup comparison for the different time intervals was done using paired t test and Repeated Measures ANOVA to find the difference amid the individual time intervals The level of the significance for the present study was fixed at 5%.Intergroup comparison for the difference of mean scores amid two independent groups was done using the unpaired/independent t test.

## Results

In this split mouth single blinded, randomized controlled clinical trial, it was seen that healing was unremarkable and no adverse effects, such as discomfort, burning sensation, or pain related to the laser irradiation, were reported by any of the subjects. Mean values of clinical parameters and difference at 1 week, 1 month and 3 months interval were recorded.

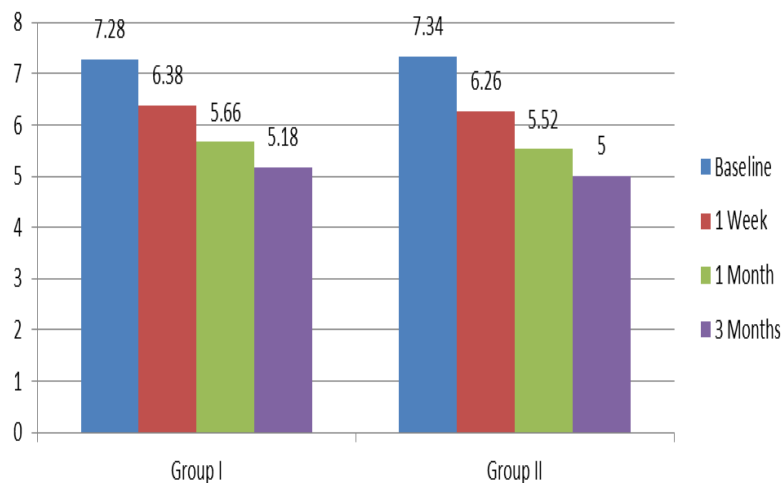
**Plaque index :** Mean PI reduction in group I was from  $1.198 \pm 0.428$  to  $0.613 \pm 0.266$  after 3 months. Mean PI reduction in group II was from  $1.236 \pm 0.404$  to  $0.567 \pm 0.194$  after 3 months. Result implies that Plaque index improves equally in both treatment groups at significant level



**Graph 1: Intragroup comparison of plaque index between two groups at different time intervals**

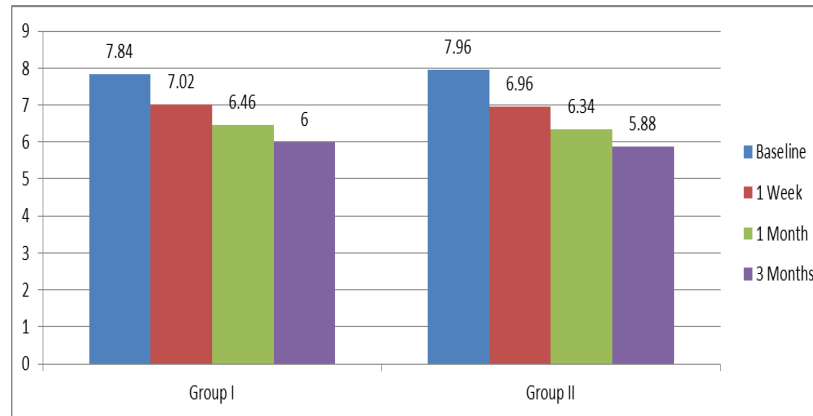
**Probing depth :** Mean PD reduction in group 1 was from  $7.28 \pm 1.12$  to  $5.18 \pm 0.87$  after 3 months. Mean PD reduction in group II was from  $7.34 \pm 1.58$  to  $5.00 \pm 1.29$  after 3 months.

This Result suggests that although the Probing depth decreased significantly in both treatment groups compared to baseline, a mixture of SRP and aPDT was simpler in reduction of probing depth at 1 week, 1 month and 3 months after treatment.



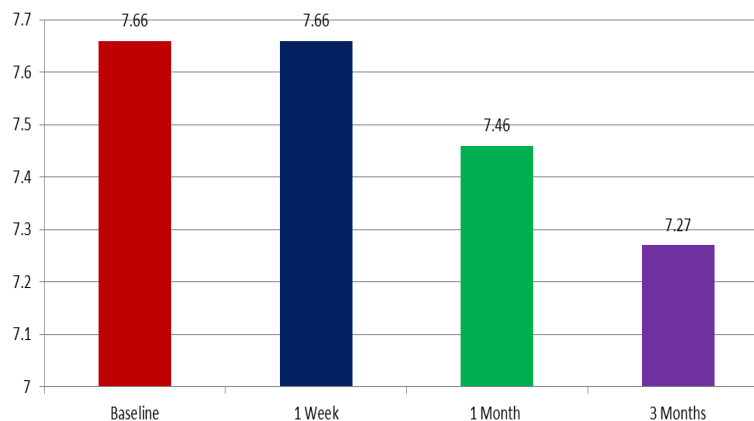
**Graph 2: Intragroup comparison of Probing depth between Two Groups At Different Time Intervals**

**Relative attachment level -** Mean RAL was  $7.84 \pm 1.64$  at baseline, and  $6.00 \pm 1.456$  at 3 months in group I. The mean RAL was  $7.96 \pm 1.81$  at baseline, and  $5.88 \pm 1.586$  at 3 months in group II. Results indicates that Relative Attachment Level (RAL) improved significantly in both treatment groups.



**Graph 3: Intragroup Comparison of Relative attachment level between Two Groups at Different time intervals**

**HbA1c :** Reduction in HbA1c levels was seen in 1 month ( $7.46 \pm 0.381$ ) and 3 month ( $7.27 \pm 0.361$ ) from baseline ( $7.66 \pm 0.388$ ). No significant change was observed in 1 week ( $7.66 \pm 0.388$ ).



**Graph 4 Comparison of Mean Values HbA1c Levels At Baseline , 1week , 1 Month And 3 Months**

## Discussion

According to the American Diabetes Association, levels of hemoglobin A1c (HbA1c) should be lower than 7% in order to prevent most diabetes complications, except for cardiovascular disease. Well-controlled diabetic patients are considered to be those with fasting glucose of up to 110 mg/dL, and, more importantly, with HbA1c values of up to 7%. Herein, uncontrolled diabetes will be referred to as fasting glucose over 110 mg/dL and HbA1c over 7%.<sup>8</sup>

Nonsurgical periodontal therapy has shown to be effective and predictable treatment approach.

Plaque index improved equally at all sites from baseline to month, which supports the decision for using a split mouth design. In this study there was a statistically significant mean reduction in the plaque index score of Group I & Group II was observed at 1 week, 1 & 3 months, which was in accordance of the findings of the studies by Lui J, Corbet EF *et al.* 2011<sup>9</sup> & Bernd W. Sigusch *et al.* 2010<sup>10</sup>

Periodontal pocket is considered as pathognomonic sign of periodontal disease. In this study there was a statistically highly significant mean reduction in the probing pocket depth of Group I & in Group II was observed, which was in accordance of the findings of the study done by Polansky R *et al.* 2009,<sup>11</sup> Nicos Christodoulides 2008<sup>12</sup> & Rafael R. de Oliveira *et al.* 2007<sup>13</sup>

In this study, gain in attachment was seen at 1 week, 1 month and 3 months in both the groups. Gain in RAL was in accordance with a study by Lin hua Ge *et al* 2011,<sup>14</sup> Polansky R *et al* 2009,<sup>11</sup> and Campos *et al* 2013<sup>15</sup>.

On contrary, Andersen R *et al.* 2007<sup>16</sup> evaluated the clinical effects of a-PDT as an adjunct to SRP over a 12-week period in 33 subjects randomly allocated to receive treatment with either PDT alone or a combination of SRP and a-PDT, or SRP also. CAL, PD and bleeding on probing (BoP) were clinically assessed at 3, 6 and 12 weeks after treatment. The addition of a-PDT to SRP was seen to have

resulted in a statistically significant improvement in CAL and PD at the 12-week follow-up.

In this study, reduction in HbA1c levels was seen in 1 month and 3 months. No significant change was observed in 1 week. Reduction in HbA1c was in accordance with the study by Khaw KT, Wareham N 2004<sup>17</sup>, T. Kocher et al 2019<sup>18</sup> where both groups showed reduction in HbA1c levels. Our study is in accordance with L. Hyman et al 2013<sup>20</sup> observed statistically significant reduction of HbA1c in 3 months.

On contrary, Steven P. Engebretson et al 2013<sup>21</sup> evaluated if nonsurgical periodontal treatment reduces levels of glycated hemoglobin (HbA1c) in persons with type 2 diabetes and moderate to advanced chronic periodontitis. Participants had type 2 diabetes, were taking stable doses of medications, had HbA1c levels between 7% and less than 9%, and untreated chronic periodontitis. At 6 months, mean HbA1c levels in the periodontal therapy group increased 0.17% (SD, 1.0), compared with 0.11% (SD, 1.0) in the control group.

Nonsurgical periodontal therapy did not improve glycemic control in patients with type 2 diabetes and moderate to advanced chronic periodontitis. These findings do not support the use of nonsurgical periodontal treatment in patients with diabetes for the purpose of lowering levels of HbA1c.

#### Limitations & Recommendation

- ✓ Large sample size
- ✓ Though laser power is very low, but irradiation of patients' eye must be avoided and excessive retention of PS (photosensitizer) may effect periodontal tissue attachment during wound healing
- ✓ Longer follow up time interval is required to assess long term effectiveness of PDT as an adjunct to non-surgical periodontal therapy in the treatment of chronic periodontitis patients, hence further studies are needed using larger sample.

#### Conclusion

It is tempting to hypothesize a link between glycemic changes and periodontal therapy. Result indicates that Plaque Index improves equally in both treatment groups. The Probing depth decreased significantly in both treatment groups compared to baseline, a combination of SRP and PDT was more effective in reduction of probing depth after treatment. Relative Attachment Level (RAL) improved significantly in both groups. The glycated haemoglobin (HbA1c) level reduction was seen in 1 month and 3 months. No significant difference was observed after 1 week. The overall observations of the present study were encouraging & showed promising results in significant reduction of clinical parameters.

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