

**Evaluation of effect of diode laser as an adjunct to scaling and root planing (SRP) in the management of chronic periodontitis- A clinical study**

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**Abstract**

**Aims and Objectives:** The purpose of this study was to evaluate & compare the effect of Diode Laser as an adjunct to Scaling and root planing (SRP), clinically, in the non – surgical management of chronic periodontitis patients.

**Materials and Methods:** A total of 30 patients with generalized chronic periodontitis with probing depth 5-7mm and clinical attachment loss  $\geq 3$ mm, with bleeding on probing were selected. Test group was treated with Sub gingival Scaling and root planing (SRP) followed by application of Laser and Control group with Sub gingival Scaling and root planing (SRP) alone. Clinical parameters including plaque index (PI), modified sulcular bleeding index (mSBI), Probing depth (PD), and clinical attachment level (CAL) were recorded at baseline, 6 weeks and 18 weeks.

**Results:** There were no statistically significant difference between two treatment groups in mSBI, PD and CAL but statistical significant difference in the mean values of PI at baseline between test group and control group. However, in intergroup comparison there was statistically significant difference between two treatment groups in mSBI, PD and CAL but no statistical significant difference in terms of PI between 6 weeks and 18 weeks.

**Conclusion:** Based on overall improvement in clinical parameters and superiority of laser application, with the specific settings used in this study, the application of diode laser as an adjunctive treatment with non-surgical therapy (SRP) show more effective clinical relevance and clinical benefit.

**Keywords:** Chronic Periodontitis, Diode Laser, Scaling and Root planing

**Introduction**

Chronic periodontitis is an inflammation of the supporting tissues of the teeth. It is characterized by loss of supporting periodontal attachment support and bone resorption, that ultimately leads to tooth mobility and loss.<sup>1</sup> For nonsurgical

management of chronic periodontitis, Scaling and root planing (SRP) remains the traditional approach of treatment.<sup>2,3</sup> In recent years, the use of laser irradiation has been expected to serve as an alternative or an adjunctive treatment to conventional, mechanical periodontal therapy. In search of more efficient and atraumatic technique which improves periodontal healing, minimal swelling and decreased post-surgical pain, the use of lasers for periodontal treatment has been proposed.<sup>4</sup> LASER, an acronym for “Light Amplification by Stimulated Emission of Radiation” is a device generating high intensity parallel beam of monochromatic electromagnetic radiation.<sup>5</sup>

Diode laser is a solid-state semiconductor laser with wavelength of about 800–980 nm that typically uses a combination of Gallium Arsenide, & other elements such as Aluminum & Indium to change electrical energy into light energy. Laser light at 500-750 nm is transmitted through water and poorly absorbed in hydroxyapatite but well absorbed by melanin, hemoglobin and other chromophores which are present in periodontally diseased tissue.<sup>6</sup> Diode laser is indicated for the treatment of soft tissues, but does not ablate calculus on the root surface; therefore it may be useful as an adjunct to SRP.<sup>7</sup> Gas and diode lasers are excellent for soft tissue ablation and haemostatic purposes, but often result in carbonization, thermal damage<sup>8,9</sup> and induced melting when utilized on root surface or alveolar bone, limiting their use to soft tissue procedures<sup>10</sup>. Secondary effects include increased lymphatic flow, microcirculation and stimulation of immune response, pain relief & promotion of wound healing.

In the present study, comparative therapies were conducted on patients with chronic periodontitis. The first therapy was the conventional SRP and the second was SRP with diode laser as adjunct. The study was done to compare the clinical results between the two modes of therapy on chronic periodontitis patients.

### **Materials and Methods**

The study was a randomized controlled clinical trial of split mouth design. It was conducted in the Outpatient department of Periodontics and Oral Implantology and an ethical clearance was obtained before conducting the study from the institutional ethical committee. The protocol was explained to the patients and subjects were requested to sign a consent form.

### **Inclusion criteria**

- Patients with good systemic health and moderate to severe periodontitis with at-least 10 teeth present.
- Age: 30-50 years
- All the teeth being considered for the study should be vital, single rooted, with contralateral tooth of the same arch present with probing pocket depth of atleast 5-7 mm and clinical attachment loss  $\geq$  3mm with sign of active disease i.e., Bleeding on probing present in both the groups.

### **Exclusion criteria**

- Patients who have undergone periodontal therapy during previous 6 months
- Patients on antibiotics or immunosuppressant medication six months prior to study.
- Chronic smokers, alcoholics, smokeless tobacco users.
- Subjects with acute illnesses/ acute intraoral lesions.
- Pregnant patients/lactating mothers.

### **Screening and Examinations**

A total of 50 patients were screened out of which 30 patients in the age group of 30-50 years (14 males, 16 females) were enrolled in the clinical trial. The subjects were subjected for an initial examination consisting of:

- a. Complete medical history
- b. Periodontal examination with following clinical parameters were assessed with UNC-15 Probe
  1. Plaque Index – (PI) -Silness & Loe1964
  2. Modified sulcular bleeding index (SBI) Mombelli 1987
  3. Probing pocket Depth (PPD)
  4. Clinical Attachment Loss (CAL)

At 14th day, after 6th weeks and after 18th weeks from baseline these parameters were reassessed.

### **Sampling**

The study sample included 30 patients (14 males, 16 females) in the age group of 30-50 years of age with generalized chronic periodontitis. Patients were randomly divided into 2 groups by a flip of a coin.

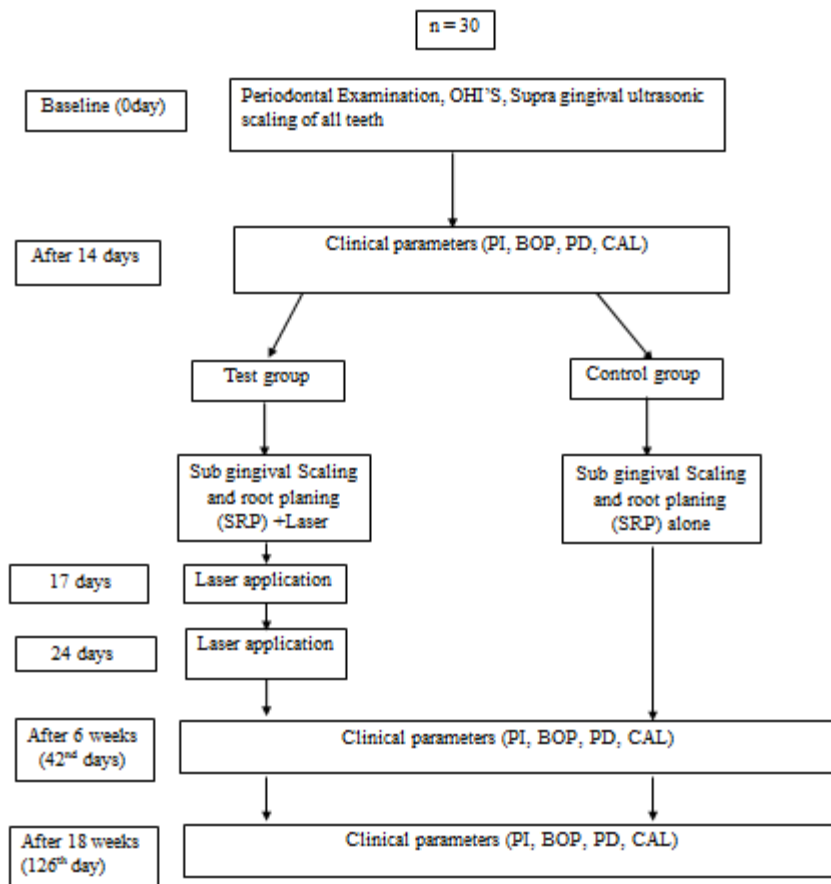
- Test group (G1): Scaling and root planing was performed followed by laser (SRP/L) application.
- Control group (G2): Scaling and root planing (SRP) was performed

### **Clinical Procedure**

Fourteen days before treatment, all patients received instructions for maintaining adequate plaque control, including Tooth brushing, Interdental cleaning with dental floss (Figure 1). Furthermore, supragingival scaling was performed on all the teeth with the help of ultrasonic scalers to facilitate probing. Test group was treated with Sub gingival Scaling and root planing (SRP) followed by application of Laser and Control group with Sub gingival Scaling and root planing (SRP) alone. The Laser therapy was performed on test group on 17th and 24th days from the baseline.

Out of sites with probing depth 5-7mm and clinical attachment loss  $\geq 3$ mm, with bleeding on probing positive, 2 sites with deepest probing depth were selected in test (Figure 2) and control group (Figure 3) each for evaluation. Thorough full supragingival and sub-gingival scaling was performed using ultrasonic and hand scalers. After SRP diode laser application was performed.

### **Study Design**



### Diode Laser Procedure

Diode laser application was done using a wavelength of 810 nm with power settings 0.8-1 watt with a thin fibre-optic. Pocket depth was measured clinically with a UNC-15 periodontal probe. The fiber-optic applicator was introduced in the periodontal pocket parallel to the long axis of the tooth, 1mm coronal to the base of the pocket. It was used in light contact and sweeping mode to cover soft tissue lining. The fiber tip was constantly cleaned with sterile damp gauze. Treatment time for each pocket was 20-30 sec amounting 1-2 min / tooth. (Figure 4)

After this, clinical parameters were recorded on the tooth with deepest probing depth in each control (Figure 5) and test quadrant (Figure 6) after 6th weeks (42nd days) and in each control (Figure 7) and test quadrant (Figure 8) after 18th weeks (126th days) from the baseline. Results obtained were subjected to statistical analysis.

### Statistical Analysis

For statistical analysis, **SPSS** (statistical package for social sciences) **version 21.0** and **Epi-info version 3.0** was used. From each parameter recorded at each periodontal site, means were calculated and used for further statistical analysis. The intra-group comparisons of PI, mSBI, PD, CAL scores were compared between Test group (G1) and Control group (G2) at various study interval using Mann-Whitney U test and Unpaired Student's t- test. The inter-group comparisons of PI, mSBI, PD, CAL scores were compared between Test group (G1) and Control group (G2) at various study interval using Wilcoxon sign-rank test and Friedman's test. Differences were considered as statistically significant when  $P < 0.05$ .

## Results

The study was conducted to evaluate the additional benefit of Diode laser, if any in the non-surgical treatment of deep Periodontal Pockets. Healing was uneventful in all cases and no adverse effects, such as discomfort, burning sensation, or pain related to Laser irradiation, were reported by any of the subjects.

The mean value with standard deviation at baseline is presented in Table I. The mean value with standard deviation at baseline, 6 weeks, 18 weeks are presented in Table II. Comparison of mean values of each parameter between the SRP and SRP + Diode Laser group at baseline was done using unpaired t-test. There was a statistically significant difference ( $p \leq 0.001$ ) in the mean values of PI at baseline between test group and control group. The mean value of PI was significantly more among control group ( $1.81 \pm 0.18$ ) than test group ( $1.64 \pm 0.18$ ). No statistically significant difference ( $p > 0.05$ ) was observed between two treatment groups in mSBI, PD and CAL at baseline.

The intergroup comparison was done using Wilcoxon Signed Rank Test in all clinical parameters i.e., PI, SBI, PD, CAL and it was found to be statistically significant difference in mean between the various time intervals from baseline to 6 weeks, baseline to 18 weeks and 6 weeks to 18 weeks.

## Discussion

Nonsurgical periodontal therapy remains the gold standard in maintaining chronic periodontal sites by reducing and shifting the microbial load to a more biological compatible microflora and this improves clinical parameters but these improvements are short lived due to repopulation of the biofilm matrix by periodontal pathogens which may result in inflammation and/or loss of attachment and alveolar bone. Therefore, Laser therapy has been proposed as an alternative or adjunctive treatment to conventional periodontal therapy. The bactericidal and detoxifying effects of the diode laser during non-surgical periodontal treatment have been documented.<sup>11,12</sup> The use of the laser as an adjunct to conventional SRP is based on the understanding that subgingival debridement and eradication of pathogenic microorganisms could provide new sites for attachment of connective tissue attachment. When used adjunctively with SRP, an 805-nm diode laser was shown to have an additive effect in reducing subgingival bacteria in periodontal pockets measuring  $\geq 4$  mm.<sup>13</sup> Therefore, the aim of the present study was to evaluate the effect of this treatment in patients with generalized chronic periodontitis.

In the present clinical trial, at the baseline examination, there was statistically significant difference in the mean values of PI at baseline between test group and control group but there was no statistically significant difference between two treatment groups in mSBI, PD and CAL. The presence of Bleeding on probing (BOP) signifies the recurrence or progression of disease while its absence signifies the maintenance of periodontal health.<sup>14</sup> In the present study the difference between Modified sulcular bleeding index in Test and Control group remain non-significant in baseline, 6 weeks and 18 weeks whereas the comparison of Modified sulcular bleeding index within the Test and Control group on baseline, 6 weeks and 18 weeks was highly significant. The intergroup comparison within Test and Control group from baseline to 6 weeks, 6 weeks to 18 weeks and baseline to 18 weeks was found to be highly significant. Bleeding on probing has reduced in both the groups at the end of 18 weeks. This can be attributed to scaling and root planing and improvement in clinical signs of inflammation. This difference can be attributed to the use of diode laser as an adjunct to scaling and root planing in Test group. The result of present study was consistent with the studies of Badersten et al

(1981)<sup>15</sup>, Claffey et al (1988)<sup>16</sup>, Walter Dukic et al (2013)<sup>13</sup>, Davoud Zare et al (2014)<sup>16</sup> which suggests the potential role of diode laser as a modulatory therapy during the inflammatory process. In contrast to the present study, Kreisler et al (2005)<sup>18</sup> and Kelbauskiene et al (2007)<sup>19</sup> didn't show any statistically significant differences between two groups of laser and conventional therapy.

Probing depth and Clinical Attachment Level have reduced in both the groups at the end of 18 weeks. Both Test group and control group sites responded favorably to treatment, additional application of diode laser in Test group sites did result in significant reduction in PPD. The result of present study was in agreement with the result of Aykol et al (2011)<sup>20</sup>, Micheli et al (2011)<sup>21</sup>, Qadri et al (2005)<sup>22</sup>, Crespi et al (2007)<sup>23</sup>, Reza Birang et al (2011)<sup>24</sup>

Plaque Index results showed that plaque was significantly more among control group at baseline in comparison to test group whereas there was no statistical difference at 6 weeks and 18 weeks. In Intergroup comparison, the mean PI reduced significantly from baseline to 6 weeks and 18 weeks intervals respectively. Whereas, the difference in mean PI values between 6 weeks and 18 weeks were found to be statistically non-significant. Increasing plaque score in control group at baseline can be attributed to the following reason that oral hygiene would have not been maintained by the patients during the phase of the treatment. Similar results were found in the study by Berakdar et al (2012)<sup>25</sup>, Qadri et al (2010)<sup>26</sup>, Raez et al (2013)<sup>27</sup>. Haffajee et al (1997)<sup>28</sup> found that SRP has 2 additional effects that influence the host-parasite equilibrium. The first would be to affect the local environment in which the pathogenic species reside. A decrease in inflammation, possibly accompanied by a decrease in pocket depth could markedly affect the milieu of the organism and alter its interaction with the host.

Aykol et al (2011)<sup>20</sup> and Ozcelik et al (2008)<sup>29</sup> reported the repeated application of low-level laser therapy 3 times during the period of 6 months to enhance early epithelization and wound healing by increasing the motility of human keratinocytes and promoting early epithelization, by increasing fibroblast proliferation and matrix synthesis and by enhancing neo-vascularization. Saglam et al (2014)<sup>30</sup> reported that Diode laser provided significant improvements in clinical parameters (PI, GI, BOP, PD, CAL) and MMP-8 was significantly impacted by the adjunctive laser treatment at first month providing an insight to how lasers can enhance the outcomes of the nonsurgical periodontal therapy

Diode lasers are smaller in size and less expensive than most dental lasers. Their hemostatic properties can reduce post-treatment bleeding. Other advantages of lasers include cell regeneration, collagen growth and mucosal tissue regeneration, along with an anti-inflammatory effect. Pesevska et al (2012)<sup>31</sup> reported that diode laser significantly reduced the level of tumor necrosis factor-alpha (TNF- $\alpha$ ) a pro-inflammatory cytokine, in gingival papillae of patients with chronic advanced periodontal disease. This study also demonstrated that more frequent use of the laser related to greater reduction in the levels of TNF-  $\alpha$ .

## **Conclusion**

In the present study, we found that additional irradiation with low-level laser therapy was better than scaling and root planing alone. Its effect was more on clinical parameter such as Probing depth and Bleeding on probing. Based on overall improvement in clinical parameters and superiority of laser application, with the specific settings used in this study, the application of diode laser as an adjunctive treatment with non-surgical therapy (SRP) show more effective clinical relevance or clinical benefit.

Within the limitations of the study, it may be concluded that low level laser therapy could be a beneficial adjunct to nonsurgical treatment of chronic periodontitis on a short-term basis. Longitudinal trials are needed to investigate whether clinical parameters can be improved in long term. Further clinical trials with additional microbiological analysis are needed to evaluate the effect of Diode Laser as an adjunct to Scaling and root planing (SRP) in the non – surgical treatment.

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**Legend Tables and Figures**

Table 1: Comparison of Mean and SD of all clinical Parameters at Baseline

Parameters	Groups	Baseline	P Value
Plaque Index (PI)	Control Group	1.81±0.18	0.000*
	Test Group	1.64±0.18	
modified sulcular bleeding index (mSBI)	Control Group	1.80±0.17	0.134**
	Test Group	1.89±0.22	
Probing depth (PD)	Control Group	5.43±0.63	0.704**
	Test Group	5.57±0.82	
clinical attachment level (CAL)	Control Group	7.07±0.69	0.148**
	Test Group	6.90±0.40	

\*p≤ 0.001- Significant

\*\*p> 0.05 – Non-Significant

Table 2: Comparison of Mean and SD of all clinical Parameters at Baseline, 6weeks, 18weeks

Parameters	Groups	Baseline	6 Weeks	18weeks	P Value
Plaque Index (PI)	Control Group	1.81±0.18	0.91±0.24	0.77±0.15	0.000***
	Test Group	1.64±0.18	0.91±0.22	0.81±0.16	
modified sulcular bleeding index (mSBI)	Control Group	1.80±0.17	0.91±0.28	0.82±0.20	0.134**
	Test Group	1.89±0.22	0.89±0.30	0.72±0.19	
Probing depth (PD)	Control Group	5.43±0.63	4.70±0.79	4.20±1.00	0.704**
	Test Group	5.57±0.82	4.40±0.97	3.53±0.68	
clinical attachment level (CAL)	Control Group	7.07±0.69	6.20±0.76	5.60±0.97	0.148**
	Test Group	6.90±0.40	5.83±0.59	4.97±0.96	

\*\*\* Very highly significant difference (p-value≤0.001)

\*\*Non-significant difference (p-value>0.05)



Figure 1: Baseline visit



Figure 2: Baseline Probing (Laser Site)



Figure 3: Baseline Probing (SRP Site)



Figure 4: Diode Laser application by Fibre optic tip



Figure 5: SRP site (After 6 weeks)



Figure 6: Laser site (After 6 weeks)