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# COMPARATIVE EVALUATION OF THE EFFICACY OF DIODE LASER APPLICATION WITH SCALING AND ROOT PLANING & SCALING AND ROOT PLANING ALONE FOR THE TREATMENT OF PERIODONTAL POCKETS IN CHRONIC PERIODONTITIS PATIENTS- A CLINICO-MICROBIAL STUDY.

Dental Science

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## ABSTRACT

**Objectives:** The aim of the present study was to evaluate the effect of diode laser therapy on periodontal pockets with regards to its bactericidal abilities and to assess the improvement in periodontal health. **Materials and Methods:** This split mouth study included 30 sites from 15 patients, randomly designated to receive one of the treatment procedures. Group-A subjects (control) received scaling and root planing followed by normal saline irrigation. Group-B subjects received scaling and root planing along with diode laser application. The patients were followed up for a period of 90 days. The clinical parameters evaluated include, bleeding on probing, clinical attachment level and probing pocket depth. The sub-gingival plaque samples were collected for microbiological evaluation. **Results:** The results showed that there was a significant reduction in bleeding on probing and probing pocket depth along with gain in attachment levels in the test group. The results of the test group also revealed a significant bacterial reduction. **Conclusion:** Within the limits of the study our results indicate that the diode laser can constitute an excellent adjunctive device to the conventional method of scaling and root Planing by exhibiting the anti-bacterial property of laser light.

## KEYWORDS

Aggregatibacter actinomycetemcomitans, diode laser, periodontal pocket, root planing, scaling.

## INTRODUCTION

The prime goal of periodontal therapy is to reduce or eliminate the subgingival microorganisms associated with periodontal disease, regenerate the lost tissues and to maintain periodontal health. Scaling and root planing (SRP) is considered as gold standard to attain and maintain periodontal health by elimination of bacterial plaque. Although mechanical treatment significantly decreases the prevalence and levels of subgingival microorganisms, it does not necessarily eliminate all pathogens. Limited access to deep pockets cause incomplete removal of bacterial deposits and leads to the presence of persistentperiodontopathogens.[1]

Successful periodontal treatment is dependent on the arrest of tissue destruction, elimination or control of etiological agents together with a microbial shift towards one typically present in health.[2,3] The elimination of the pathogenic subgingival microbiota may be achieved by non-surgical scaling and root planing.[4,5,6] However, mechanical therapy alone, may fail to eliminate the pathogenic bacteria because of their location within the gingival and dental tissues or in the deeper depths inaccessible to periodontal instruments.[7,8] These limitations and the improved biological understanding of periodontal diseases together with the emerging evidence of bacterial specificity have led to a move in emphasis from a pure mechanical approach to other methods which include the use of adjunctive antimicrobial measures by which bacterial count drops.

The success of periodontal therapy greatly depends on an efficient bacterial reduction. The conventional treatment of the periodontal diseases include the removal of supra and subgingival calculus and root planing.The use of lasers has been investigated in periodontal therapy for subgingival curettage, gingivectomy, frenectomy, ablation of granulation tissue during flap surgery, maintenance of implants and management of peri-implantitis.The antimicrobial efficiency of diode laser light has been proved in a number of studies.[9,10]The diode laser has become an important tool in the dental armamentarium due to its exceptional ease of use and affordability.[11]Lasers have been found to be very effective for their bactericidal action on periodontal pathogens which makes the adjunctive use of antibiotics unnecessary.[12]

The aim of the study was to investigate the effects of diode laser therapy in periodontal pockets with regard to its action on specific bacteria such as Aggregatibacter actinomycetemcomitans (A.a), Porphyromonas gingivalis (P.g), Prevotella intermedia (P.i) and to assess the improvement in the periodontal health following diode laser application.

## MATERIALS AND METHODS

This randomized controlled split mouth study was conducted in the Department of Periodontics and Implantology, Coorg Institute of Dental Sciences, Virajpet, Kodagu, Karnataka, India, after the study protocol was reviewed and approved by the Institutional Review Board (IRB). The nature and purpose of the study and the treatment protocol was explained to all the subjects included and a written consent was obtained before commencing the treatment for the study.

The study group comprised of 15 healthy subjects (7 males and 8 females) with the age ranging from 35-55 years with chronic periodontitis. Each quadrant of the subject was randomly assigned to one of the following groups: Group-A (control group) treated by scaling and root planing followed by irrigation with normal saline and Group-B (test group) treated with scaling and root planing followed by irradiation of the pocket wall using the diode laser optic fiber.

Systemically healthy subjects having a probing pocket depth of 4-6 millimetre (mm) in single rooted teeth (at least one in each quadrant), who followed the instructions and maintained good oral hygiene were included in the study. Subjects with underlying systemic disease, who were on antibiotics/any other medication or received periodontal treatment within 6 months preceding the study, pregnant and lactating women, smokers and alcoholics were excluded from this study.The clinical parameters assessed were:Bleeding on Probing (BOP) [13], Probing Pocket Depth (PPD) and Clinical Attachment Level (CAL).

All the measurements were made using a calibrated manual probe (UNC-15 probe) and rounded off to the nearest millimeter. Clinical parameters were recorded at baseline and 90 days post operatively. Customized acrylic stents were used to standardize the measurements of the clinical parameters.

### Study design

Baseline evaluation of clinical parameters, supra-gingival scaling and sub-gingival plaque sample collection was done in the first visit. In the second visit (7th day from baseline) the patient underwent scaling and root planing (if required) & irrigation with normal saline in the control site (Group-A), and scaling and root planing (if required) along with laser irradiation of the periodontal pocket on the test site (Group-B).

In the test group the pocket wall irradiation was done using an 810nm diode laser (AMD Picasso® DENTSPLY India Pvt. Ltd.) equipped with a thin flexible optic fiber(400µm) at a power setting of 0.7 Watts in a contact continuous wave mode. The optic fiber was introduced into the periodontal pocket with the laser beam directed towards the soft tissue wall of the pocket and moved in an apico-coronal direction, with a sweeping motion. The optic fiber was withdrawn by 1mm from the base of the pocket before laser application.The depth of the periodontal pocket in millimeters corresponded to the exposure time in seconds.The third and fourth appointments were scheduled at 30 and 60 days respectively from the baseline and consisted of irrigation of the periodontal pocket with normal saline for control site and application of diode laser in the periodontal pocket for test site. During application,

protective eye glasses were worn both by the operator and the patient.In the fifth appointment, at 90 days from the baseline, clinical parameters were recorded followed by microbiological sampling.

A three months study design was chosen, as it corresponds to the typical recall interval for patients after periodontal treatment.[14]Clinical measurements and treatment was performed by a single examiner.

**Microbiological Procedures**

The subgingival samples for microbiological evaluation were collected using a sterile gracey curette and placed in the transport medium (RTF). The transport medium was first vortexed and then inoculated in the culture medium according to the requirement in enriched and selective medium.

**Culturing of Aggregatibacter actinomycetemcomitans(A.a)**

The samples were placed on dentaid agar for isolation of A.a. The inoculated plates were then incubated at 370C in 5-10% $CO_2$ jar for 48-72 hours as it is a facultative anaerobe which requires $CO_2$ for growth. A.a was identified as translucent white colonies.

**Culturing of Porphyromonas gingivalis (P.g) and Prevotella intermedia (P.i)**

For isolation of P.g and P.i,the samples were placed on blood agar and brucella agar. The inoculated plates were then incubated at 370°C for 3-4 days in anaerobic jar. After inoculation, the crystal violet with erythromycin plates were checked for growth of P.g and P.i which were identified as black pigmented colonies.

**Statistical analysis**

Data was analyzed using statistical software SPSS (Statistical Package for Social Science) Version 17.0 and Microsoft Excel. Mean values and standard deviation for clinical parameters and microbial evaluation were calculated. For comparison between the groups, paired t-test was used. Values of $P<0.05$ were accepted as statistically significant.

## RESULTS

The mean and standard deviation of PPD in the control group was 5.93±0.258 and 3.47±0.743 at baseline and 90 days postoperative respectively (Table-1). When compared between baseline and 90 days post operative the mean difference was 2.467 which was found to be statistically significant with P value 0.000 (Table-1). Similarly in the test group the mean and standard deviation at baseline was 5.80±0.414 which reduced to 2.87±0.64 at 90 days post-operative (Table-1). When intra group comparison was done in the test group the difference was found to be 2.933, which is statistically significant with P value 0.000 (Table-2). When inter group comparison was done with independent sample t- test at 90 days post therapy, the test group showed more significant reduction in PPD with P value 0.025 (Table-3).

The mean and standard deviation of BOP in the control group was 4.13±0.64 and 2.67±0.48 at baseline and 90 days post-operative respectively (Table-1). When compared between baseline and 90 days post operative the mean difference was 1.46 which is statistically significant with P value 0.000 (Table-1). Similarly in the test group the mean and standard deviation of BOP at baseline was 4.13±0.64 which reduced to 1.67±0.61 at 90 days post-operative (Table-1). When intra group comparison of clinical parameters was done in the test group, the difference was found to be 2.46, which is statistically significant with P value 0.000 (Table-1).When inter group comparison was done with independent sample t- test at 90 days post therapy, the test group showed highly significant reduction in BOP with P value 0.002 (Table-3).

The mean and standard deviation of CAL in the control group was 6.33±0.48 and 3.60±0.828 at baseline and 90 days post operative respectively (Table-1).When compared between baseline and 90 days post operative the mean difference was 2.733 which was found to be statistically significant with P value 0.000 (Table-1)Similarly the mean and standard deviation of CAL in the test group was 6.00±0.655 and 2.87=0.64 at baseline and 90 days post-operative respectively(Table-1). When intra group comparison was done in the test group, the difference was found to be 3.13, which is statistically significant with P value 0.000 (Table-2). When inter group comparison was done with independent sample t- test at 90 days post therapy, the test group showed a significant gain in CAL with P value 0.011 (Table-3).

The mean and standard deviation CFU/ml of A.a in the control group was 106.67±20.23 at baseline which reduced to 52.33±16.13 at 90 days post-operative (Table-4). When intra group comparison was done between baseline and 90 days post operative, the difference in reduction was found to be 54.33 which is statistically significant with P value 0.034(Table-5). Similarly the mean and standard deviation CFU/ml of A.a in the test group at baseline was 115.33±22.318, 90 days post operative which reduced to 14.67±8.701 with a difference of 101.33 which is statistically significant with P value 0.001 (Table-4).

The mean and standard deviation CFU/ml of P.g in the control group was 96.33±33.67 at baseline which reduced to 45.33±22.55 at 90 days, post operative (Table-4). When intra group comparison was done, the difference in reduction was 51.00 which is statistically significant with P value 0.028(Table-5). Similarly the mean and standard deviation CFU/ml of P.g in the test group at baseline was 99.33±40.65 which reduced to 14.67±11.412 at 90 days post operative with a difference of 84.66 which is statistically significant with P value 0.004 (Table-4).

The mean and standard deviation CFU/ml of P.i in the control group was 74.00±19.567 at baseline which reduced to 29.00±10.889 at 90 days post operative (Table-4). When intra group comparison was done, the difference in reduction was 45.00 which is statistically not significant with P value 0.081 (Table-5). Similarly the mean and standard deviation CFU/ml of P.i at baseline in the test group was 77.00±25.05 which reduced to 9.33±5.300 at 90 days post operative with a difference of 67.66 which is statistically significant with P value 0.011 (Table-4). Inter group comparison showed a significant reduction of A.a, P.g and P.i in the test group.

**Table – 1: The mean and standard deviation of clinical parameters in control and test groups**

| Groups | Mean | n | Standard Deviation | Standard Error Mean |
|---|---|---|---|---|
| BOP at baseline(control) | 4.13 | 15 | 0.640 | 0.165 |
| BOP after 90DAYS(control) | 2.67 | 15 | 0.488 | 0.126 |
| BOP at baseline(test) | 4.13 | 15 | 0.640 | 0.165 |
| BOP after 90 Days(test) | 1.67 | 15 | 0.617 | 0.159 |
| CAL at baseline(control) | 6.33 | 15 | 0.488 | 0.126 |
| CAL after 90days(control) | 3.60 | 15 | 0.828 | 0.214 |
| CAL at baseline(test) | 6.00 | 15 | 0.655 | 0.169 |
| CAL after 90 Days(test) | 2.87 | 15 | 0.640 | 0.165 |
| PPD at baseline(control) | 5.93 | 15 | 0.258 | 0.067 |
| PPD after 90days(control) | 3.47 | 15 | 0.743 | 0.192 |
| PPD at baseline(test) | 5.80 | 15 | 0.414 | 0.107 |
| PPD after 90 Days(test) | 2.87 | 15 | 0.640 | 0.165 |

**Table – 2: Intra-group comparison of clinical parameters in controls and test**

| | Mean Difference | t-value | Degree of freedom | P-value |
|---|---|---|---|---|
| BOP(control) | 1.467 | 8.876 | 14 | 0.000 H.S |
| BOP(test) | 2.467 | 9.646 | 14 | 0.000 H.S. |
| CAL(control) | 2.733 | 11.979 | 14 | 0.000 H.S |
| CAL(test) | 3.133 | 13.256 | 14 | 0.000 H.S. |
| PPD(control) | 2.467 | 11.457 | 14 | 0.000 H.S |
| PPD(test) | 2.933 | 16.144 | 14 | 0.000 H.S. |

H.S. – Statistically highly significant

**Table – 3: Independent sample t-test for Inter group comparison of Clinical parameters recorded after 90 days.**

| Clinical Parameters | t-value | Degree of freedom | P value |
|---|---|---|---|
| BOP AFTER 90DAYS | 4.922 | 28 | 0.002 H.Sig |
| CAL AFTER 90DAYS | 2.714 | 28 | 0.011 Sig. |
| PPD AFTER 90DAYS | 2.398 | 28 | 0.025 Sig. |

Sig: statistically significant, N.S: statistically not significant. H.S.-highly significant.

**Table – 4: Mean and standard deviation of A.a, P.g and P.i in control and test groups.**

| Groups | n | Mean | Standard Deviation | Standard Error Mean |
|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Group A (control) | Pre Op-A.a | 15 | 106.67 | 20.237 | 5.225 |
| | Post op A.a | 15 | 52.33 | 16.132 | 4.165 |
| | Pre op P.g | 15 | 96.33 | 33.672 | 8.694 |
| | Post op P.g | 15 | 45.33 | 22.557 | 5.824 |
| | Pre op P.i | 15 | 74.00 | 19.567 | 5.052 |
| | Post op P.i | 15 | 29.00 | 10.889 | 2.812 |
| Group B (test) | Pre op-A.a | 15 | 115.33 | 22.318 | 5.762 |
| | Post op A.a | 15 | 14.00 | 8.701 | 2.247 |
| | Pre op P.g | 15 | 99.33 | 40.658 | 10.498 |
| | Post op P.g | 15 | 14.67 | 11.412 | 2.947 |
| | Pre op P.i | 15 | 77.00 | 25.057 | 6.470 |
| | Post op P.i | 15 | 9.33 | 5.300 | 1.369 |

**Table – 5: Intra-group comparison of A.a, P.g, and P.i using paired t-test.**

| | | Mean Difference | t-value | Degree of Freedom | p-value |
|---|---|---|---|---|---|
| Group A (control) | Pre op A.a Post op A.a | 54.333 | 11.432 | 14 | 0.034 Sig. |
| Group B (test) | Pre op A.a Post op A.a | 101.333 | 16.656 | 14 | 0.001 H.S. |
| Group A (control) | Pre op P.g Post op P.g | 51.000 | 7.680 | 14 | 0.028 Sig. |
| Group (test) | Pre op P.g Post op P.g | 84.667 | 9.190 | 14 | 0.004 H.S. |
| Group A (control) | Pre op P.i Post op P.i | 45.000 | 10.945 | 14 | 0.081 N.S. |
| Group B (test) | Pre op P.i Post op P.i | 67.667 | 11.482 | 14 | 0.011 H.S. |

Sig: statistically significant, N.S: statistically not significant. H.S.- highly significant

## DISCUSSION

An essential component of periodontal therapy is to eliminate or control periodontal pathogens. Traditionally this has been accomplished through mechanical methods i.e. scaling and root planing. In some instances SRP is not effective in removing subgingival biofilms especially in difficult to reach areas such as deep periodontal pockets. Conventional methods for the treatment of periodontal disease are not completely effective in eliminating all types of bacteria. Although systemic and local administration of antibiotics into periodontal pockets is occasionally effective for disinfection, the frequent usage of antibiotics bears the potential risk of producing various resistant microorganisms. These limitations have led to a shift in emphasis from a purely mechanical approach to the use of novel technical modalities having additional bactericidal effects, such as lasers.[15]

The effectiveness of scaling and root planing in the treatment of periodontal disease in order to reduce bacterial plaque on the root surface is universally accepted.[16]

The photo-physical characteristics of lasers, laser irradiation exhibits strong ablation, hemostasis, detoxification and bactericidal effects on the human body. These effects could be beneficial during periodontal treatment, especially for the fine cutting of soft tissue as well as in the debridement of diseased tissues. Thus, in periodontal therapy, laser treatment may serve as an alternative or adjunctive therapy to mechanical approaches.[15]

The present clinical trial shows that the adjunctive use of diode laser with nonsurgical periodontal therapy in patients with chronic periodontitis did enhance the response of clinical parameters such as bleeding on probing, probing depth and clinical attachment level as measured 90 days after treatment.

Bleeding on probing is the initial sign of gingival inflammation. Reduction in bleeding on probing is an indicator of reduced gingival inflammation. In the present study, bleeding on probing reduced in both the groups at the end of three months, however the experimental group showed more reduction compared to control group. Reduced bleeding on probing can be attributed to scaling and root planing and patient education and motivation in both the groups, however greater reduction in the experimental group can be attributed to the use of diode laser as an adjunct to scaling and root planing. Our findings are in accordance with Badersten et al[17] and Claffey et al[18]who suggested the potential role of diode laser as a modulatory therapy in the treatment of periodontal disease.

Increased probing depth and loss of clinical attachment are pathognomic for periodontitis and hence, pocket probing is a crucial and mandatory procedure in diagnosing periodontitis and evaluating the success of periodontal therapy. Probing pocket depth is still the most important clinical parameter for periodontal diagnosis (Lang & Brägger).[11]

In the present study a significant reduction in probing pocket depth was found in both the groups at 90 days post operative. However the test group showed more significant reduction in probing pocket depth compared to the control group with a P value 0.000. The intergroup probing depth values showed a statistical difference between the groups at 90 days post operative with a P value of 0.025. Our results are in accordance with findings of Mortiz et al 1998[16] who found significant reduction in BOP and PPD values in the laser treated sites than sites treated with scaling and root planing with normal saline irrigation alone.

Though CAL gain was achieved in both the groups, the test group showed a significant gain in CAL with a P value of 0.011, when inter group comparison was done. Our results are in accordance with those of Kiesler et al 2005[19] who found a greater reduction in probing depth and increase of attachment gain with the adjunctive application of laser compared to SRP alone.

The World Workshop in Periodontology[20] designatedAggregatibacter actinomycetemcomitans, Porphyromonasgingivalis, Tannerella forsythia, and Prevotella intermedia as periodontal pathogens. In assessing the potential anti-microbial effects of low power laser irradiation, a number of investigations have been done till date. With respect to the bacterial reduction in periodontal pockets is concerned, the diode laser is expected to have a distinguishing thermal effect on bacteria that is basically limited to the root surface. The thermal effect of the laser beam depends on the absorption of radiation by tissue and subsequent transformation of laser energy into heat. The amount of energy absorbed depends on the type of tissue irradiated and the wavelength of the laser.[9]Laser light not only eliminates bacteria but also inactivates bacterial toxins diffused within the root cementum.[21]

In the present study it was found that there was a highly significant reduction in A.a, P.g., and P.i after 90 days post therapy. This could be attributed to the bactericidal effects of diode laser as an adjunct to SRP as from studies conducted by Moritz et al.[22]

Also, there was highly significant reduction in A.a, P.g, and P.i with P value 0.001, 0.004 and 0.011 respectively in the test group, which can be attributed to the bactericidal effects of diode laser. However, the reduction of P.i in the control group after 90 days of therapy was found to be non-significant with the P value of 0.081.

The results of our study are in accordance with those of Moritz et al in 1997[22] who also found a significant reduction in A.a, P.g and P.i, in the lased sites compared to the sites treated with scaling and root planing and normal saline irrigation. Contrary to our study, Borrajo et al[23] could not find additional improvement when adjunctive application of laser was done in comparison to SRP alone.

However, future studies with more evidences in this area are required to validate the results reported here. Though the use of lasers is finding very good acceptance among patients and practitioners because it involves minimal pain, trauma and post operative comfort, scientific studies indicating positive clinical results of laser are still insufficient. The actual mechanisms of all possible laser bacterial interactions still have to be scrutinized. Further studies using different laser wavelengths and power settings to find out the optimum settings for periodontal pocket irradiation are necessary.

## CONCLUSION

The application of diode laser has additional clinical benefits such as better patient compliance, enhanced or improved tissue response, greater access and ability to sterilize the periodontal pocket. As the beneficial effect of adjunctive laser application in terms of clinical parameters and bacterial reduction were well documented in the present study, it can be concluded that, laser can constitute an alternative device to maintain periodontal health in chronic periodontitis patients.

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