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CLINICAL AND MICROBIAL EVALUATION OF DIODE LASER ASSISTED PERIODONTAL TREATMENT – A CLINICAL STUDY

Periodontology

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ABSTRACT

Soft tissue diode laser has vast range of its applications in dentistry. This study was done to assess the application of laser in surgical periodontal therapy.Open flap debridement with laser and open flap debridement alone was compared in the management of chronic generalized periodontitis by clinical and microbiological evaluation (A.a , P.g) . The bactericidal effect of the diode laser was clearly evident by greater reduction of CFU of obligate anaerobes in the test group as compared to the control group .The results of the present study are definitely encouraging.. The use of lasers have been reported to cause less mechanical trauma, less swelling and scarring and less post-operative pain. Thus lasers can form an integral part of periodontal therapy in the future.

KEYWORDS

INTRODUCTION

Periodontitis is characterized by microbial-associated, host mediated inflammation that results in loss of periodontal attachment. Marginal alveolar bone loss – a key secondary feature of periodontitis – is coupled with loss of attachment by inflammatory mediators. Thus, requiring the need for periodontal therapy to arrest the progression of disease aiming at resolution of inflammation forming an environment conductive to maintenance of health.[1]

Nonsurgical periodontal therapy or "Cause- related therapy aims at regaining gingival health by mechanical removal of plaque, calculus, and endotoxins responsible for gingival inflammation either through hand instruments or ultrasonic instruments.[2] However, Instrumentation is not possible in inaccessible areas like furcation, grooves and concavities and deep periodontal pocket.[3] Also, according to **Schenk et al (2000)**[4], sonic and ultrasonic instrumentation does not lead to killing of periopathogens they only help to reduce the bacterial load by mechanical removal of plaque and calculus.

Surgical therapy provides better accessibility to root surfaces as well as osseous defects. However, periopathogens persist in the mixed species plaque biofilm on tooth surfaces, adhere to and enter the epithelial cells and are tissue invasive in nature. These are sources for recolonization and reinfection.[5] Eradication or adequate suppression of these pathogenic bacteria is therefore required for successful periodontal therapy. The limitations of the conventional therapy have probed us to implement the use of adjunctive anti microbial measures.

Therefore newer novel methods to overcome the demerits of conventional therapy are being introduced.

Recently, use of Lasers as an adjunctive or alternative to conventional mechanical therapy has been investigated. '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.**[6] Since then, lasers have been used in many different areas in medicine and surgery and of late in Periodontics.

Different properties and uses of different wavelengths of lasers have been investigated over several years now. The wavelengths of the lasers most commonly used in periodontics with a range from 810to 10,600 nm. Various advantageous characteristics of lasers such as haemostatic effect, selective calculus ablation or bactericidal effects against periodontopathic microorganisms might lead to improved treatment outcomes.[7]

The diode laser is manufactured from solid semiconductor crystals made from a combination of aluminium (with wavelength of 800 nm) or indium (900 nm), gallium and arsenic. These wavelengths penetrate deep into the mucosa and highly attenuated by the pigmented tissue, although haemostasis is slow as compared with the argon laser.[8] These lasers are excellent soft tissue surgical lasers, so surgery can be performed safely as these wavelengths are poorly absorbed by the dental hard tissue. This laser is indicated for gingivoplasty, sulcular debridement and deeper coagulation process on gingival and mucosa. The chief advantage of the diode lasers is one of a smaller size, portable instrument. These lasers can also stimulate fibroblastic proliferation at low energy levels.[8]

Thus, the purpose of this clinical study was to evaluate soft tissue diode laser with open flap debridement in the management of chronic periodontitis assessed by clinical and microbiological parameters.

MATERIAL AND METHODS

The study population was of twenty subjects through convenient sampling who were in the age (30-55 yrs) with chronic periodontitis were selected from the outpatient section, Department of Periodontics, Hitkarini Dental College and Hospital, Jabalpur (Madhya Pradesh) India. written informed consent form explaining the nature of the study and procedure was signed by the patient.

Patients diagnosed as having chronic generalized periodontitis with probing depth of ≥ 5mm with radiographic evidence of horizontal bone loss and good general health, without any history of systemic disease were included in the study .

Patients showing unacceptable oral hygiene during maintenance presurgical (phase I) period, Pregnant women and lactating mothers, Smokers, Patients with systemically compromised status(e.g. hypertensive , cardiac , renal patients), Patients taking any antibiotics within last 6 months were excluded from the study .

Clinical parameters-

The clinical parameters include Plaque index (Silness and Loe, 1964),

Gingival bleeding index (Loe and Silness,1963), Probing pocket depth (using UNC- 15 probe with occlusal stent), Relative attachment level (using UNC- 15 probe with occlusal stent), Where Probing Pocket Depth and Relative Attachment Level were primary criteria and microbial sampling were secondary .

The clinical parameters were recorded at baseline and one month after the surgery.

Surgical phase :
A total of 20 patients were taken through convenient sampling, two groups were made, and 10 patients were assigned to each treatment groups.The test group was designated as Group A which included open flap debridement along with the application of soft tissue diode laser with wavelength of 810 nm & a power setting of 1.8 W was used in continuous, contact mode with help of flexible fibre optic delivery system. The fibre was used in a "brush stroke" motion on the under surface of the flap to remove the pocket lining and the control group was designated as Group B – which included Open flap debridement.

Microbial sampling:
Plaque samples were collected from both the groups at the site of deepest probing pocket depth both at baseline i.e at the day of surgery and one month after the surgery. Subgingival plaque samples were collected through paper points. The paper points were inserted into the pocket and were kept for 30 seconds. The plaque samples were transported in thyoglycollate media to the microbiology laboratory within 1 h of collection.

Samples were labelled and processed immediately. CFU of obligate anaerobes were calculated by:

$$y \times 10^{-d} \times 1/v$$

Where d = dilution plated, v = volume plated, and
y = colony Count on the plates (between 30 and 300)

Post operative care
Patients were given routine postoperative instructions. Antibiotics were not prescribed, as they would alter the flora and modify the effect of diode laser.

STATISTICALANALYSIS

The data of the present study were recorded into the computers and after its proper validation, check for error, coding & decoding were compiled and analysed using the software SPSS 18 for windows. Appropriate univariate and bivariate analysis were carried out using the repeated measure ANOVA inter group comparisons followed by Post Hoc (Turkey's test) for intra group comparisons Student *'t'* test for the continuous variable (e.g. Age, RAL, PPD, PI, GI) and . All means are expressed as mean ± standard deviation and proportions were expressed in percent. The critical levels of significance of the results were considered at 0.05 levels i.e. $P < 0.05$ was considered significant.

RESULTS

There were no significant differences between the test and control groups at any time point in terms of PI, GI, BOP, PPD, CAL and microbial count . However, there were significant differences within the groups.

There were no statistically significant differences in probing depth and clinical attachment level between test and control groups at any time point .The probing depth and clinical attachment level reductions were similar in the test and control groups between baseline and 1 month.

There was significance difference in mean value microbial count (A.a ,P.g) post surgically for open flap debridement with lasers was (15.2±5.63)significantly less than open flap debridement (25±10.56).

1. PLAQUE INDEX [Table 1, Graph 1]
Intra group observations

The intra group comparison between the test site and control site was highly significant in plaque index ,gingival index with p value being ($p<0.001$).

Intergroup analysis
Comparative analysis of test site and control site at baseline in plaque index revealed mean scores of 2.3 ±0.25 and 2.8± 0.43 respectively with a 't' value of 0.986 ; $p > 0.05$ indicating a non significant difference between the 2 sites.

Whereas Comparative analysis of test site and control site at baseline in gingival index revealed mean scores of 1.1 ±0.51 and 1.2 ±0.54 respectively with p value 0.676 indicating a non significant difference between the 2 groups.

2. GINGIVAL INDEX [Table 1, Graph 2]
Intra group comparison
In Group A The mean change of 0.002 p value was observed with a 'statistically significant ($p<0.001$). whereas in GROUP B a mean change of 0.001 p value was observed which is statistically highly significant ($p<0.05$ significant)

Inter group comparison
Comparative analysis of experimental site and control site at baseline p value 0.676 indicating a non significant difference between the 2 groups. On the day of surgery mean of experimental and control sites were 0.41 ±0.23 and 0.57 ±0.16 with a p value of 0.093 indicating a non significant difference between two groups. Post surgically after one month , mean value of experimental site is 0.95 ±0.43 and control site is 1.01 ±0.44 resulting in a p value of 0.764 indicating no significant difference between the two groups.

3. PROBING POCKET DEPTH [Table 1, Graph 3]
Intra group observations
On comparison from baseline to post surgically in both the test site and control site after one month p value 0.001 statistically highly significant reduction [$p<0.001$highly significant].

Inter group observations
Comparative analysis of experimental site and control site at baseline revealed mean scores of 5.9 ±1.1 and 6.0 ±1.15 respectively with a 'p' value of p=0.601; indicating a significant difference between the 2 groups. Post surgically after one month , mean value of experimental site is 3.8±0.78 and control site is 4.0 ±0.94 resulting in a 'p' value of p=0.801 ,indicating no significant difference between the two groups .

4. RELATIVE ATTACHMENT LEVEL [Table 1, Graph 4]
Intra group comparison
There was significant difference in both the control site and test site in there relative attachment level with p value being significant (0.001)

Intergroup comparison
Comparative analysis of experimental site and control site at baseline revealed mean scores of 13.0 ±1.63 and 11.7 ±1.56 respectively with a 'p' value of 0.105 indicating a non significant difference between the 2 groups.post surgically after one month , mean value of experimental site is 11.7 ±1.56 and control site is 13.0 ±2.05 resulting in a 'p' value of 0.130 [$p>0.05$ non significant]indicating a non significant difference between the two groups.

5.COLONY FORMING UNITS/ML OF P.GINGIVALIS (P.G) AND AGGREGATIBACTER ACTINOMYCEMCOMITANS(A.A) [Table 2a, 2b, Graph 5]

Intra group observation
Group A : The mean colony forming units /ml of Aggregatibacter actinomycemcomitans and Porphyromonas gingivalis at baseline was 225.50 ±44.57 after scaling and root planning which reduced to 82.3 ± 21.59 .On the day of surgery it was 82.3 ±21.59 which reduced to post surgically after one month to 17.2±10.56. On comparasion from baseline to day of surgery to postsurgical after one month p value p=0.001 indicating a highly significant reduction.

Group B: The mean colony forming units/ml of Aggregatibacter Actinomycemcomitans and Porphyromonas gingivalis at baseline was 233.6±68.1 after scaling and root planning which reduced to 87.6 ±21.56. On the day of surgery 87.6± 21.59 which reduced to postsurgically after one month 25.0 ±10.56. On comparison from baseline to day of surgery to post surgical after one month p value p= 0.001 indicating a highly significant reduction .

Inter group observations
Group A& GROUP B shows the comparasion between open flap debridement with lasers and open flap debridement of mean colony forming units/ml of aggregatibacter actinomycemcomitans and

porphyromonas gingivalis .There were no significant difference between the results of open flap debridement and open flap debridement with lasers at baseline, at the time of surgery (p=0.754 & p=0.603). But there was significant difference between open flap debridement with lasers & open flap debridement post surgical after one month (p=0.043) on the basis of microbial count(A.a,P.g). This significance states mean value microbial count (A.a,P.g) post surgically for open flap debridement with lasers was (15.2±5.63) significantly less than open flap debridement (25±10.56).

DISCUSSION

To the best of our knowledge this is the first study comparing the effect of diode laser with the microbial analysis of Aggregatibacter Actinomycemcomitans (Aa) and Porphyromonas gingivalis(Pg).

The objective of periodontal therapy is to eliminate the pathological changes in the pocket wall so as to create a stable and maintainable state which will promote periodontal regeneration.

The present study evaluated the adjunctive use of diode laser in open flap debridement as compared with open flap debridement alone with the help of clinical and microbiological parameters.

Rosling et al. 1976[9] observed that the pocket depth was significantly reduced, the level of attachment was enhanced, and considerable amount of osseous fill was obtained after surgical periodontal therapy. However, **Hill et al. in 1981**[10] did comparative evaluation pocket elimination surgery, modified Widman flap, subgingival curettage, and scaling and root planing only and concluded that the results of scaling and root planing alone in maintenance of periodontal support at any pocket depth results as significant treatment outcome. **Listgarten and Levin 1981**[11] stated regarding the large subgingival population of spirochetes and motile rods tended to precede a clinically detectable deterioration of the periodontium . **Lindhe et al. 1982, Pihlstrom et al. 1983, Ramfjord et al.1987**[12] suggest that surgical pocket therapy in moderate to deep pockets leads to greater reduction in probing depth and greater gain in clinical attachment level in deep pockets .

Lavanchy et al. 1987[13]**,** in a split mouth study concluded that the bacterial recolonization returned to baseline levels within 70 days after treatment, although clinical parameters showed improvement. *Based on the above mentioned results and conclusions regarding the healing and bacterial recolonization after periodontal therapy, the measurement of clinical and microbiological parameters after 1 month of therapy is justified.*

Successful periodontal therapy depends on anti infective procedures aimed at eliminating or suppressing pathogenic organism found in dental plaque .hence,surgical therapy is performed , which provides visualization of the root surfaces and defects . **Moritz et al. 1997**[14] reported pocket irradiation with a diode laser(805nm) following scaling at a power output of 2.5W in pulsed mode (50 Hz, pulse duration 10 ms). It produced considerable bacterial elimination from periodontal pockets at a much higher level than the scaling alone group, especially in terms of gram-negative organisms. They concluded that diode laser therapy, in combination with scaling, supports healing of periodontal pockets by eliminating bacteria. Thus diode laser also has a bactericidal effect along with the other properties. **Ramond A.et al. 2007**[15] observed histological wound healing following use of LANAP (laser assisted new attachment procedure) surgery for periodontal pockets. This study demonstrated consistently positive histologic responses in periodontal pockets in humans treated with the LANAP.

Diode laser with a wavelength of 810nm, continuous contact mode at 1.8W with a flexible fiber optic delivery system is an excellent soft tissue laser and is available in smaller cost effective units.

The disadvantages of the diode laser are ineffectiveness of calculus removal from the root surface and possibility of thermal damage to the bone in presence of blood and at high power settings. However, thermal damage can be avoided with appropriate power settings and by using the laser intermittently which would allow the tissues to cool.

CONCLUSION

Though there was significant difference in the microbial count in group undergoing periodontal treatment assisted with laser when compared to the group who received periodontal treatment only. However, further longitudinal studies are required to evaluate the long term effects of diode laser on clinical as well as microbiological parameters.

Table 1 – mean ± SD values of inter and intra group comparison of plaque index, gingival index and probing pocket depth applying ANOVA and post hoc (turkey's test)

	Baseline (Mean ±SD)	At the time of surgery (Mean ±SD)	Post surgical (Mean ±SD)one month after surgery	P value
GI				
GROUP A	1.1±0.51	0.41±0.23	0.95±0.43	0.002
GROUP B	1.2±0.54	0.57±0.16	1.01±0.44	0.001
PI				
GROUP A	2.3±0.25	0.54±0.32	1.42±0.28	0.001
GROUP B	2.8±0.43	0.58±0.35	1.45±0.28	0.001
PPD				
GROUP A	5.9±1.1		3.8±0.78	0.001
GROUP B	6.0±1.15		4.0±0.94	0.001
CAL				
GROUP A	13.0±1.63		11.7±1.56	0.001
GROUP B	14.3±1.76		13.0±2.05	0.001

GI –Gingival index, PI- plaque index, PPD- probing pocket depth, CAL- clinical attachment level, Group A- Open flap debridement+ laser,
Group B – Open flap debridement only, SD- standard deviation,
p- level of significance

GROUP A	225.4±44.57*	87.6±21.59**	25.0±10.56***	0.001(S)
GROUP B	233.6±68.1*	82.3±23.13**	17.2±5.63***	0.001(S)

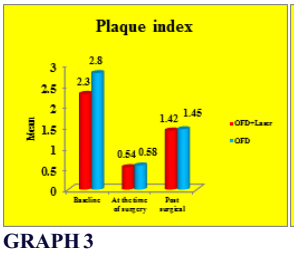
TABLE 2a- Mean CFU (at baseline, on day of surgery, and post surgical one month)

*- at baseline, **-on the day of surgery, ***- one month after the surgery
±- standard deviation, S- value of significance (P>0.001)

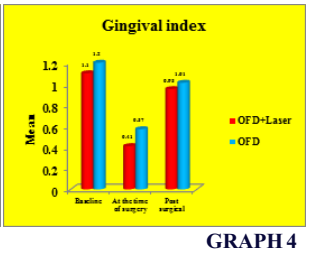
TABLE 2b: Comparasion between OFD with laser and OFD

	GROUP A	GROUP B	P value
Baseline	225.4±44.57	233.6±68.1	0.754
At the time of surgery	82.3±23.13	87.6±21.59	0.603
Post surgical	15.2±5.63	25.0±10.56	0.043

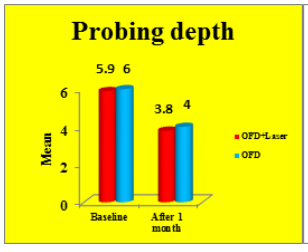
GRAPH 1



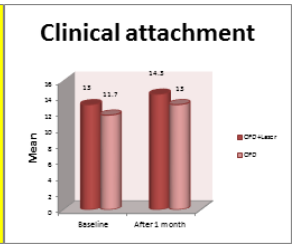
GRAPH 2



GRAPH 3



GRAPH 4



GRAPH 5

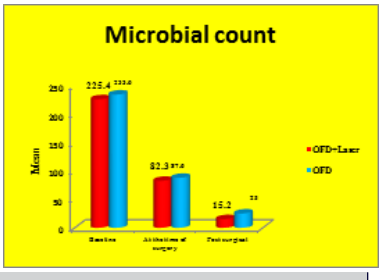


Figure 1

Figure 2

Figure 3

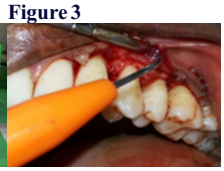


Figure 4

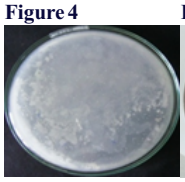


Figure 5

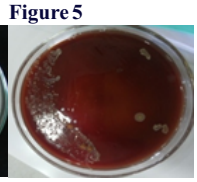


Figure 6

Figure 1- collection of microbial samples
Figure 2 – transportation of samples in thyoglycollate media.
Figure 3- star shaped colonies of Aa.
Figure 4 – black pigmented colonies of Pg.
Figure5 – OFD along with laser application
Figure 6- OFD alone.

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