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Research Article

COMPARATIVE EVALUATION OF EFFICACY OF DIODE LASER AS AN ADJUNCT TO OPEN FLAP DEBRIDEMENT IN THE TREATMENT OF CHRONIC PERIODONTITIS – A CLINICAL AND RADIOGRAPHIC STUDY

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ABSTRACT

The primary goal of periodontal therapy is to remove the bacterial deposits and their toxins in order to slow or arrest the disease progression and regenerate the lost periodontal tissue. Lasers have gained attention recently as an adjunct for periodontal therapy. The purpose of this study is to compare the efficacy of diode laser as an adjunct to open flap debridement in the treatment of chronic periodontitis. A split mouth study was conducted in 20 subjects diagnosed with chronic periodontitispresenting at least 3 teeth in each quadrant with probing pocket depth of ≥ 5 mm after phase I therapy. One quadrant i.e. the control site (site A) was treated with open flap debridement and the contralateral quadrant i.e. the test site (site B) was treated with open flap debridement and diode laser. (GaAlAs) (Zolar Photon™). The result of the study showed that the probing depth reduction and gain in relative attachment level in both the groups from baseline to 6 months was statistically significant but, the difference in the two groups at the end of 6 months was statistically insignificant. Radiographically bone density changes were compared in both the group and there was a statistically significant increase in site B from baseline to 6 months.

INTRODUCTION

The primary goal in treating periodontitis is to remove bacterial deposits and halt the progression of disease. Complete removal of bacterial deposits and their toxins from the root surface is not always possible by conventional mechanical therapy because of limited access to areas such as furcations, concavities, developmental grooves and therefore such sites require surgical intervention. (Gokhale SR *et al*, 2012). Also, it does not eliminate the microorganisms in the soft tissue wall of periodontal pocket. These are sources for recolonization and reinfection. Thus, the limitations of the conventional therapy have probed us to implement the use of adjunctive antimicrobial measures.

Laser-assisted periodontal therapy has attracted attention recently as a potential alternative or adjunct to conventional mechanical debridement. A part of the laser energy scatters and penetrates during irradiation into periodontal pockets. The attenuated laser at a low energy level might then stimulate the cells of surrounding tissue resulting in reduction of the inflammatory conditions, in cell proliferation, and in increased flow of lymph, improving the periodontal tissue attachment and possibly reducing postoperative pain.(Gokhale SR *et al*, 2012).It enhances bone reparation, osteoblast cell proliferation and differentiation, and increases bone matrix formation, hence it might be useful to accelerate alveolar bone healing process. The mechanism of action is based on the increase of ATP (Adenosine triphosphate), thus accelerating mitosis and enhancing tissue reparation. (Romao MM *et al*, 2015)

Lasers have been used in the therapy of periodontal pocket for hard tissue as well as soft tissue management. (Ishikawa I *et al*, 2009)

Diode laser (GaAlAs) is an excellent soft tissue surgical laser which does not interact with dental hard tissues. Therefore, it is indicated for cutting and coagulating gingiva and oral mucosa, and for soft tissue curettage or sulcular debridement. The use of low-power laser can have a significant influence on the rate of healing of bone defects. (Markovica A *et al*, 2005). It has a bactericidal effect. (Moritz A *et al*, 1997). It is also effective in removing the complete epithelial layer of the periodontal pocket. (Romanos GE *et al*, 2004). Laser therapy with GaAlAs laser has demonstrated promising results on the acceleration of

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bone repair; however, most studies were performed in vitro or in vivo in laboratory animals, rather than in humans.
Very few trials have been conducted on the use of diode lasers as an adjunct to periodontal surgery. Hence this study was conducted to evaluate the adjunctive effects of diode laser in open flap debridement as compared with conventional mechanical debridement in the treatment of chronic periodontitis as assessed by clinical and radiological parameters.

MATERIALS AND METHOD

A split mouth study was conducted in subjects diagnosed with chronic periodontitis presenting at least 3 teeth in each quadrant with probing pocket depth of ≥ 5 mm after phase I therapy. They were selected from the Out Patient Department, Department of Periodontology of the dental institution. Ethical committee approval was taken prior to conducting the study. 20 subjects diagnosed with chronic periodontitis with probing pocket depth of ≥5mm with at least 3 teeth in each quadrant after phase I therapy were selected as a part of split mouth study design with a 6 months follow up. One quadrant i.e. the control site (site A) was treated with open flap debridement and the contralateral quadrant i.e. the test site (site B) was treated with open flap debridement and diode laser. (GaAlAs) (Zolar Photon™)

The subjects were selected under the following inclusion and exclusion criteria:

Inclusion criteria

Subjects in the age group of 25-55 years of either sex diagnosed with chronic periodontitis; systemically healthy, with at least 20 teeth present andatleast 3 teeth in each quadrant with probing pocket depth of ≥ 5 mm after phase I therapy. Presence of bilateral horizontal bone loss as determined by the orthopantomograph (OPG).Subjects willing to participate in the study and comply with the study procedures.

Exclusion criteria

Smokers (AHA guidelines) & tobacco chewers, pregnant & lactating women & those on oral contraceptive pills, history of medications such as antibiotics and analgesics within past 3 months, periodontal flap surgery within the last 6 months, subjects with bony architecture where regenerative or resective surgeries are indicated; were excluded.

Clinical parameters

Clinical parameters were recorded at baseline, 3 months and 6 months interval. Customized acrylic occlusal stents were fabricated for each patient to record accurate clinical parameters. This technique provided a fixed reference point and fixed angulation for measurements at each site. (Clark DC *et al*, 1987)

- Plaque index (Silness and Loe, 1964)(Loe H and Silness. J, 1963)
- Gingival index (Loe H, 1967)
- Probing depth (measured from crest of gingival margin to base of the pocket)
- Relative attachment level [(RAL) measured from fixed reference point to the base of the pocket]
- Gingival recession [measured from the fixed reference point (FRP) to the gingival margin]
- The intensity of pain and discomfort experienced by the subject was recorded at day 1 post-operatively and 1 week post-operatively with the help of visual analogue scale (VAS) with markings from 0-10, with 0 = no pain, 1-3 = mild pain, 4-6 = moderate pain, and 7-10 = severe pain. The subject had to rate the intensity of the pain from 0 to 10.

Radiographic parameter

Radiovisiograph (RVG) of site with greatest probing pocket depth was taken at baseline, 3 months and 6 months to measure bone density changes, using the available software. Paralleling technique with position indicating device was used. Radiographic bone density was calculated at the most coronal margin of the alveolar crest in the region of deepest probing pocket depth at baseline, 3 months and 6 months.

Oral hygiene instructions were given to all the subjects participating in the study.

They were recalled 21 days post Phase I therapy during which the clinical parameters (i.e gingival index, plaque index, gingival recession radiographic parameters were assessed.

Surgical procedure

The selected quadrant was randomly allocated by draw of lottery method, into control and test site. Control site (Site A) was treated with open flap debridement and test site (Site B) was treated with open flap debridement and diode laser (GaAlAs) (Zolar Photon™). RVG was taken at the deepest site in the control and test sites. Pre-procedural rinse with 0.2% chlorhexidine mouth wash for 60 secs was carried out followed by Perioral scrub using povidone iodine (7.5% conc.) solution. The surgical procedure was performed using local anesthesia with 2% lignocaine hydrochloride with 1:80,000 adrenaline. Sulcular incisions were made for the teeth indicated. Conventional mucoperiosteal flap was raised on the buccal and lingual/palatal aspects of the teeth. Thorough debridement, scaling and root planing was accomplished with hand instruments and ultrasonic instruments.

Following which control site (site A) was approximated and sutured using 3-0 black-braided silk suture (Mersilk™). In the test site (site B), at the site of deepest probing depth, 810nm wavelength Diode laser (GaAlAs) with the power setting of 1W was used in continuous, contact mode for 10 seconds with the help of a flexible fiber optic delivery system. The fiber was used in a ‘‘brush stroke’’ motion on the undersurface of the flap to remove the pocket lining.

Thereafter the flap was approximated for closure and then sutured with 3-0 black-braided silk suture (Mersilk™) using simple interrupted sutures.

Periodontal dressing was given at both the sites. Appropriate post- operative instructions and suitable antibiotics, analgesics and anti-inflammatory drugs were given to the subjects. They were advised to rinse with 0.2% chlorhexidine gluconatemouthwash twice daily for two weeks and were motivated to maintain the oral hygiene and were recalled at 3 months, 6months post-surgery to assess clinical parameters.

Statistical Analysis

Data obtained was compiled on a MS Office Excel Sheet (v 2010) & subjected to statistical analysis using Statistical package for social sciences (SPSS v 21.0, IBM).

Inter group comparison of all clinical indices / variables was done using t test.

Comparison of variables with time intervals was done using repeated measures ANOVA (since there were more than 2 observations)

$p<0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

RESULTS

Of the 20 patients (n=20) selected for the study there were 12 females (60%) and 8 males (40%) with mean age 40.50±6.84years.

Plaque index

Site B showed a greater reduction in plaque index scores over a period of 6 months compared to Site A but this change was not statistically significant.(p =0.899)

Table 1 Intergroup comparison of change in plaque index over a period of 6 months

Change in relative PI (Mean ± SD)	Baseline -3M	Baseline - 6M
Group A	0.224 ± 0.132	0.512 ± 0.184
Group B	0.227 ± 0.127	0.505 ± 0.159
p value (Unpaired t test)	0.933#	0.899#

*p<0.05 is statistically significant

Gingival index

Both sites showed similar reduction in gingival index over a period of 6 months which was not statistically significant.(p =0.542)

Table 2 Intergroup comparison of change in gingival index over a period of 6 months

Change in relative GI (Mean ± SD)	Baseline -3M	Baseline - 6M
Group A	0.303 ± 0.158	0.569 0.189
Group B	0.335 ± 0.117	0.602 ± 0.147
p value (Unpaired t test)	0.474#	0.542#

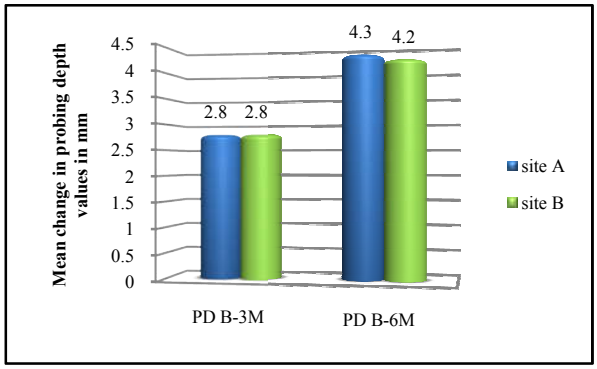
*p<0.05 is statistically significant

Probing depth

The mean change in probing depth over the period of 6 months was 4.3±0.979 mm at Site A and 4.2±0.768 mm at Site B.

Site A showed a marginally greater reduction in probing depth over a period of 6 months compared to Site B but this change was not statistically significant.(p =0.721)

Graph 1/Table 3 Intergroup comparison of change in probing depth over a period of 6 months



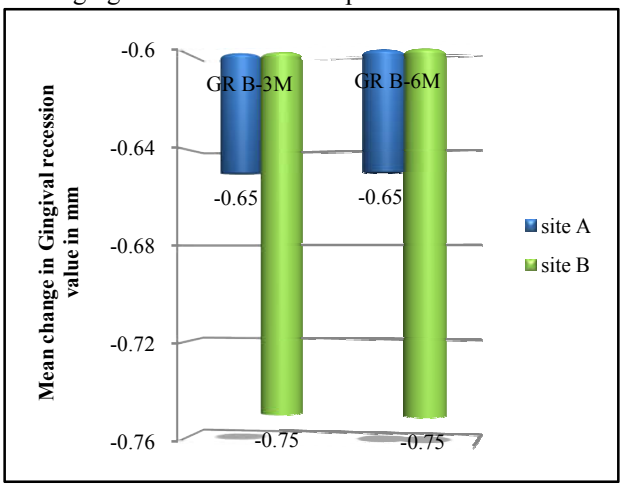
Change in relative PD (Mean ± SD), mm	Baseline -3M	Baseline – 6M
Group A	2.80 ± 0.696	4.3 ± 0.979
Group B	2.80 ± 0.616	4.2 ± 0.768
p value (Unpaired t test)	1.00#	0.721#

Gingival recession

The mean change in gingival recession at Site A was 0.65±0.489 mm at 3 months which remained constant at 6 months. Similarly the mean change in gingival recession at Site B was 0.75±0.44 mm at 3 months which remained constant at 6 months.

The change in gingival recession at site B was slightly greater than Site A over the period of 6 months but this was not statistically significant. (p =0.503)

Graph 2/Table 4 Intergroup comparison of change in gingival recession over a period of 6 months

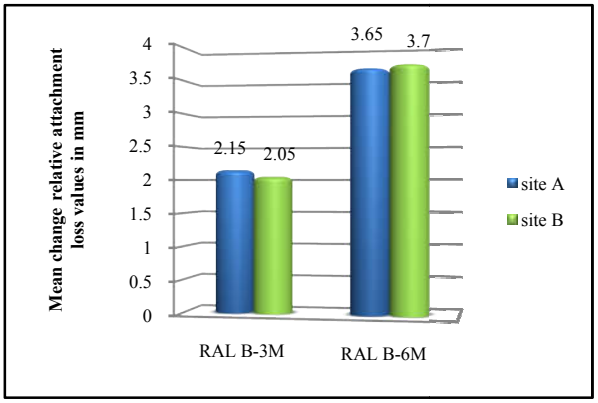


Change in relative GR (Mean ± SD), mm	Baseline -3M	Baseline – 6M
Group A	-0.65 ± 0.489	-0.65 ± 0.489
Group B	-0.75 ± 0.444	-0.75 ± 0.444
p value (Unpaired t test)	0.503#	0.503#

Relative attachment level

The gain in relative attachment level over the period of 6 months was 3.65±1.04mm at Site A and 3.70±2.827mm at Site B. Site B showed a slightly greater gain in relative attachment as compared to Site A over the period of 6 months which was not statistically significant.(p =0.617)

Graph3/Table 5: Intergroup comparison of change in relative attachment level over a period of 6 months



Change in relative RAL (Mean ± SD), mm	Baseline -3M	Baseline – 6M
Group A	2.15 ± 0.745	3.65 ± 1.04
Group B	2.05 ± 0.605	3.70 ± 2.827
p value (Unpaired t test)	0.644#	0.617#

VAS score

The mean change in VAS score from baseline to 1 week is 0.800±0616 of site A and 0.95±0.605 of site B.

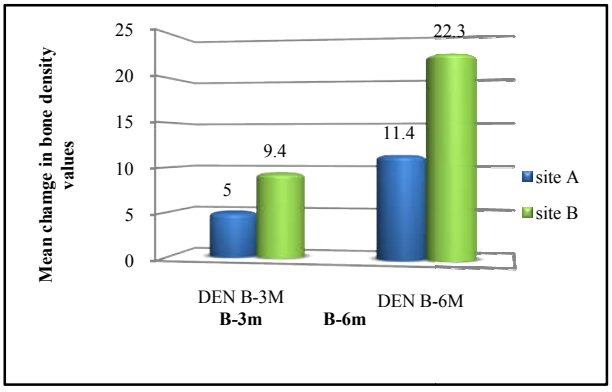
The change in VAS score at site B was slightly greater than at site A over a period of 1 week but it was not statistically significant. (p=0.442)

Bone density

The mean change in radiographic bone density values from baseline to 3 months and baseline to 6 months at site A were 5.00±0.414 and 11.40±1.984 and at site B were 9.40±1.667 and 22.30±2.273 respectively.

There was a greater increase seen in radiographic bone density at site B over a period of baseline to 3 months and baseline to 6 months which was statistically significant. (p<0.001)

Graph 4/ Table 6 Intergroup comparison of change in bone density over a period of 6 months



Change in relative bone density (Mean ± SD)	Baseline -3M	Baseline – 6M
Group A	5.00 ± 0.414	11.40 ± 1.984
Group B	9.40 ± 1.667	22.30 ± 2.273
p value (Unpaired t test)	0.00**	0.00**

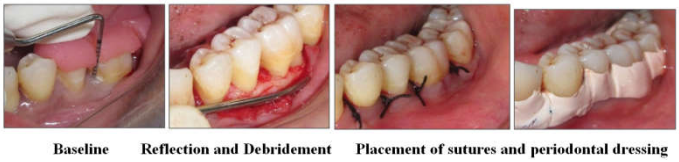


Figure 1 Site A (Conventional Flap Surgery)

Figure 2 Site B (Laser Assisted Flap Surgery)

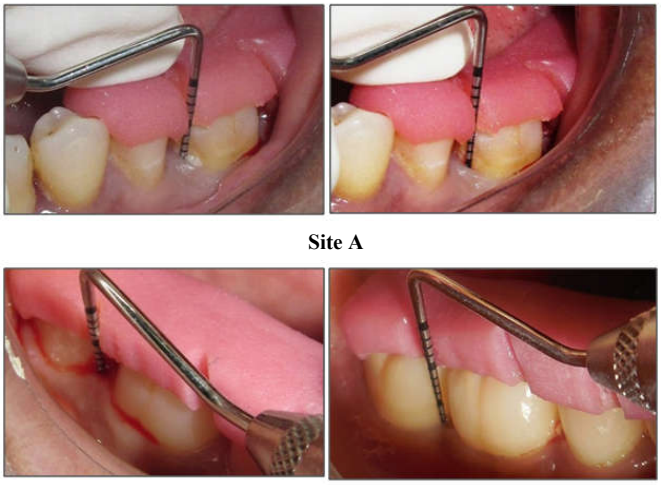


Figure 3 Clinical parameters

Baseline 6 months follow up

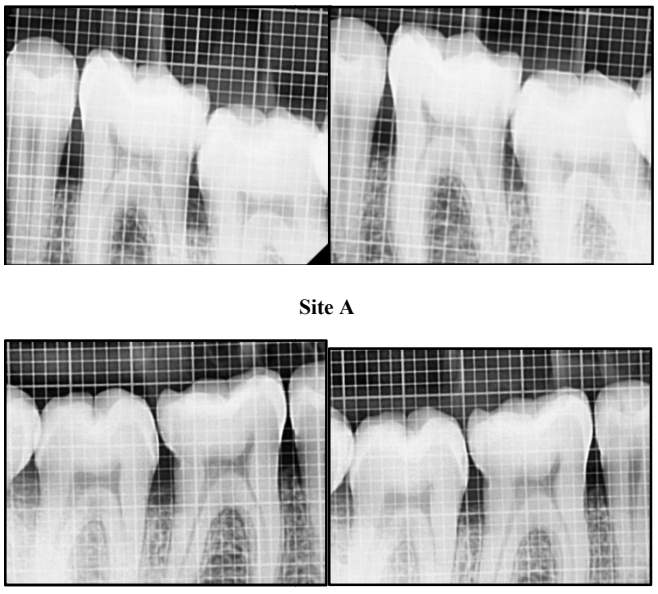


Figure 4 Radiographic Parameter

Baseline 6 months follow up

DISCUSSION

The limitations of conventional therapy have probed us to look for alternative or adjunctive measures. Laser assisted periodontal therapy has attracted considerable attention as a potential alternative or adjunct to conventional mechanical debridement. Lasers have been used in the therapy of periodontal pocket for hard tissue as well as soft tissue management. (Gokhale SR *et al*, 2012). The epithelial migration can be prevented by the use of lasers for removing pocket lining. Removing the epithelial lining with a laser retards the epithelial down growth (Rossmann JA, Israel M, 2000) and may achieve a more complete epithelial removal than conventional mechanical methods as shown *in vitro*. (Romanos GE *et al* 2004)

Gokhale *et al* (2012) in their study evaluated the adjunctive effects of the diode laser in open flap debridement and assessed it by clinical and microbiological parameters. Similarly Jayachandran *et al* (2015) conducted a study and noted significant improvement in the probing pocket depth and clinical attachment level. Patient acceptance and comfort were more in laser treated sites compared to conventional surgical sites.

Keeping in mind the advantages of lasers as an adjunct to periodontal therapy this study was designed. A split mouth design was selected to avoid natural variation between individuals and to limit patient based and defect based factors. The study was only conducted in nonsmokers, compliant patients with good oral hygiene and with comparable subjects and defects characteristics among the cohorts.

Therapeutic results were measured clinically by using measurements like pocket depth, relative attachment level and gingival marginal level. While measuring all the soft tissue parameters a fixed reference point at the apical edge of the custom made acrylic stent was used.

The effect of bone density was measured radiographically using the RVG software, although subtraction radiography and CBCT are more accurate predictors of changes in bone density. Both plaque index and gingival index showed significant difference from baseline over the period of 6 months. This could be attributed to an improvement in the home care and reinforcement of oral hygiene instructions at each recall visit. However on intergroup comparison the difference in both parameters i.e. plaque index and gingival index was found to be statistically insignificant at all recorded intervals.

The probing depth reduction in both the groups from baseline to 6 months was statistically significant. Site A showed marginally greater reduction, this was not significant.

The results showed statistically significant gain in relative attachment level as compared to baseline in both the groups. However, the difference in relative attachment level in the two groups at the end of 6 months was statistically insignificant. This result was in accordance with Becker *et al* (1990) Gokhale SR *et al* (2012) and Lobo T *et al* (2015).

Gingival recession increased significantly in both the groups from baseline to 3 months and thereafter remained constant. This change in the gingival marginal level was statistically significant. When the gingival recession was compared in the control and the test groups it was statistically insignificant. These results were in accordance with Lobo T et at (2015).

The post-operative pain perception was evaluated on the VAS. The subjects did not report any significant difference in pain in either site. However in a study conducted by Sanz‐Moliner JD *et al* (2013) they found a significant change in pain perception in the laser group. The results of the present study were in accordance with Gokhale *et al* (2012). The use of diode laser as an adjunct to mechanical debridement neither led to postoperative complications nor to delayed healing. This indicates that diode laser did not seem to have any detrimental effect when employed in conjunction with periodontal surgery. Bone density was evaluated in the region of deepest pocket with help of the RVG software. When density changes were compared in both the group there was a statistically significant increase in site B. These results were in accordance to the animal study conducted by Silva Junior AN *et al* (2002). In another study by Dortbudak O *et al* (2000), it was found that diode laser had a biostimulatory effect on osteoblasts in vitro.

CONCLUSION

In the present study, the use of laser as an adjunct to flap sugery showed promising results. Further studies are required to provide an insight into the healing and possible role of diode laser in the formation of new attachment. Bone density changes and understanding the exact mechanism of the biostimulatory effect is required with the use of techniques like computer assisted densitometric image analysis (CADIA) or CBCT. To assess whether lasers will provide additional benefits to periodontal treatment future long term follow up, multi-center, prospective, longitudinal, randomized control trials are needed.

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