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# THE EFFECT OF LOW- LEVEL DIODE (GaAlAs) LASER THERAPY AS AN ADJUNCT TO NON SURGICAL PERIODONTAL TREATMENT IN SUBJECTS WITH CHRONIC PERIODONTITIS – A CLINICAL STUDY

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**ABSTRACT**

**Background**: Periodontitis is a chronic inflammatory disease that affects the supporting structures of teeth, resulting in tooth loss. The aim of the study is to evaluate and compare the effect of scaling and root planing alone and combination of scaling and root planing (SRP) with low level Gallium Aluminium Arsenide (GaAlAs) laser therapy in patients with moderate chronic periodontitis.

**Materials and methods:** A total of 25 patients with mean age of 38.08 years (35-48 years) having chronic generalized moderate periodontitis were included in the study. A total of 4740 sites were evaluated out of which 2370 were the control sites and 2370 were the test sites. Plaque index (PI), gingival index (GI), sulcus bleeding index (SBI), periodontal probing depth (PPD), and clinical attachment level (CAL) were recorded at baseline, 1 and 3 months after the treatment. A low level diode laser with a wavelength of 810 nm, power output 0.4 W and energy density of 2 J/cm2 & 4 J/cm2 was applied to the gingival surface after periodontal treatment on the first, second, and seventh day.

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**Result:** At all time points, the LLLT at test sites showed significantly more improvement in plaque index (PI), gingival index (GI), sulcus bleeding index (SBI), clinical attachment level (CAL) and periodontal probing depth (PD) levels compared to the control group (P <0.001).
**Conclusion:** LLLT as an adjunctive therapy to non-surgical periodontal treatment is beneficial in improving periodontal status of patients with chronic periodontitis.
**KEY WORDS:** Low level laser, Biostimulation, Chronic Periodontitis, Gingival inflammation, Scaling and root planing

## Introduction

Periodontal treatment aims to restore biological compatibility of periodontally diseased root surfaces for subsequent new attachment of the tissues.(1)

Non-surgical periodontal therapy by mechanical instrumentation in which dental plaque and calculus deposits are removed from supra- and subgingival teeth and root surfaces using hand instruments (such as curettes and scalers),is the primary recommended approach to control periodontal infection.(2)

Although SRP reduces periodontal inflammation and is considered gold standard in Non Surgical Periodontal Therapy, this treatment approach is unable to completely eradicate periodontal disease. It has some limitations as in cases of unfavourable tooth root anatomy or deep periodontal pockets. The consequence of such therapeutic procedures results in wounding of already inflamed tissues which depends largely on the cellular and molecular events associated with wound healing. (3,4)

Laser therapy in dentistry is an innovative potential molecular pathway mediating the nexus between inflammation and wound healing in oral tissues. Amongst recent advances, low-level laser therapy (LLLT) is highly recommended for its pain reducing, wound healing promoter and anti-inflammatory effects. (5)

Low-level laser therapy uses photonic energy to provide biological therapeutic advantages and is considered a non-invasive and painless process. The biostimulatory and inhibitory effects of lasers are based on Arndt- Schultz Law, which indicates that weak stimuli will increase physiological processes and strong stimuli will inhibit physiological activity. (6)

The therapeutic effect is non cutting and low intensity and the laser energy is delivered over a wider area than the traditional laser. US Food and Drug Administration listed these lasers as non-significant risk Class III medical devices. (1)

For low-level laser therapy to be effective the various irradiation parameters (wavelength, power and power density) are crucial to the infra-surgical effects of biostimulation in the periodontal pocket.

The purpose of this study is to evaluate the effectiveness of low level GaAlAs diode laser therapy as an adjunct to non surgical therapy on clinical parameters in patients with moderate chronic periodontitis.

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## MATERIALS AND METHODS

### SOURCE OF DATA

The patients were recruited from the patient pool coming from OPD in the Department of Periodontology, School of Dental Sciences, Sharda University, Greater Noida. The nature and the outcome of the study were explained to the patients following which a verbal and written consent will be obtained. Ethical committee approval was obtained.

### METHOD OF COLLECTION OF DATA

A total of 25 patients with chronic periodontitis were included in the study. Patients with mean age of 38.08 years (35-48 years) having moderate Chronic generalized periodontitis i.e.>30 % sites involved and radiographic bone loss, 3-4mm of clinical attachment loss, patients with Pocket depth of 4-7mm and patients who agree to sign informed consent forms were included in the study.

Patients with history of systemic diseases, mental disorder, any periodontal treatment or used antibiotics during the last 6 months, acute oral infection, pregnant females, smokers, patients with pocket depth of >7mm, with less than 16 teeth, those who do not agree to sign informed consent forms and patient who fails to follow –up were excluded from the study.

### STUDY DESIGN

This study was a double blind randomized controlled split mouth clinical trial.

### DURATION OF THE STUDY

The duration of the study was 3 months.

### METHODOLOGY

The study was performed by two clinicians- Clinician 1 and Clinician 2. Clinician 1 and the patient were blinded. The sites were randomly allocated to experimental and control sites, 2 quadrants (one superior and one inferior) each. Each patient was presented in 6 visits.

VISIT 1

In the first visit, patient recruitment and oral hygiene instructions were given by clinician 1 and 2. The subjects went through complete dental and systemic history recordings and received radiographic and periodontal examination.(Fig 1)

Baseline measurements -Full mouth Plaque index (PI) (Silness and Loe 1964) (7), Gingival Index (GI) (Loe and Silness 1963) (7), Sulcus Bleeding Index (SBI) (Muhlemann & son 1971) (7), Periodontal Probing Depth (PD) and Clinical Attachment Level (CAL) were recorded on six sites per tooth at mesio- , mid- and disto-buccal; mesio-, mid-, and disto-palatal by clinician 1.

Removal of supra gingival plaque deposits was done by clinician 2.

Maxillary and mandibular alginate impressions were made and acrylic stents were prepared according to the periodontal probing depth to ensure intraexaminer reliability and to standardize clinical attachment level measurements.

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VISIT 2

In the second visit full mouth subgingival scaling and root planing under local anesthesia was performed using hand instruments[¶] and ultrasonic device. [#] After scaling and root planing, two quadrants (one superior and one inferior) were randomly chosen by flip of coin as control and experimental sites.

Specially designed safety glasses were provided to the patient and operator for protection of the eyes from the laser beam. Plastic instruments were used for prevention of any laser hazards.

Experimental site was subsequently treated with three sessions of low level Gallium Aluminum Arsenide (GaAlAs) diode laser **operating at a wavelength of 810 nm, power output of 0.4 W in continuous mode which was delivered by means of a 10 mm long 400 micron optical fiber tip with a tip at 600 angulations'. In the first session the fiber was activated and inserted into the periodontal pocket slowly in contact mode from apical to coronal direction in a sweeping motion at six sites per tooth - mesio-, mid- and disto-buccal; mesio-, mid- and disto-palatal during laser light emission. Laser light emission was done for 20 seconds to the gingiva of molars (4 J/cm2) and 10 seconds to the gingiva of incisors and premolars (2 J/cm2) by the operator.(Fig 2)

VISIT 3 and 4

The second and third sessions of low level GaAlAs laser application was repeated on experimental site on 2nd and 7th day after scaling and root planing.

VISIT 5 and 6

Patients were followed up and clinical parameters were recorded again after 1 month and 3 months. (Fig 3, 4)

All measurements were done by a masked, examiner by using a graduated Williams Probe[††] calibrated in millimeter and acrylic stents for standardization of clinical attachment level.

¶ Gracey curets, Hu-Friedy,

# Piezoelectric ultrasonic (EMS; Model No. - SA CH -1260 NYON)

†† Hu-Friedy

**Picasso II AMD diode laser

## STATISTICAL ANALYSIS:

Data was analysed using Statistical Package for Social Sciences (SPSS) version 21. All the variables were continuous variables like Plaque Index, Gingival Index, Bleeding Index, Probing depth & CAL which were summarized as mean and standard deviation.

Inferential statistics were performed using Paired Student's t test & Repeated Measures of Analysis of Variance (ANOVA) Test. Paired t-test was used for comparison of mean value of 2 related samples or groups. Repeated measures of ANOVA test was used to compare more than two related means. The level of statistical significance was set at 0.05.

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## RESULTS

A total of 4740 sites were evaluated out of which 2370 were the control sites and 2370 were the test sites.

All patients included in the evaluation completed the 3-month study. Healing was uneventful in all cases. No adverse effects, such as burning sensation or pain, related to the laser irradiation have been reported.

Inter-group comparison of PI scores showed that at baseline, mean PI score of control sites was significantly lower than that at experimental sites but at 1 month or 3 months follow ups, mean PI scores was significantly lower at experimental site. (Graph 1,2)

Inter-group comparison of GI scores showed that at baseline, mean GI score of control sites was significantly lower than that at experimental sites but at 1 month or 3 months follow ups, mean GI scores was significantly lower at experimental site (Graph 3,4).

Inter-group comparison of SBI scores showed that at baseline, mean SBI score of control sites was significantly lower than that at experimental sites but at 1 month or 3 months follow ups, mean BI scores was significantly lower at experimental site.Mean SBI score of Control sites was significantly lower as compared to the experimental sites (Graph 5,6)

Mean reduction in PD scores from baseline to 1 month follow up was found to be significantly higher at experimental sites ($p<0.001$) as compared to control sites. Similarly, overall mean reduction (from baseline to 3 months follow up) was also found to be significantly higher at experimental sites as compared to control sites.(Graph 7,8)

Mean reduction in CAL scores from baseline to 1 month ($p<0.001$)follow up and from 1 month to 3 months follow up, was found to be significantly higher at experimental sites as compared to control sites. Similarly, overall mean reduction (from baseline to 3 months follow up) was also found to be significantly higher at experimental sites as compared to control sites. (Graph 9,10)

## DISCUSSION

The basic principle of LLLT is based on the biostimulation or the biomodulation effect, which consists of the fact that irradiation at a specific wavelength, is able to alter cellular behavior. Low-level lasers do not cut or ablate the periodontal tissues.(8,9,10)

The systematic review by Quadri T 2015 shows that a diode laser with a wavelength 808–980 nm and power of 0.8–2.5 W can be used as an adjunct therapy with good results.(4)

Results from some further studies have reflected that if the laser parameters are suitable, a good effect in >5 mm deep pockets can be achieved. (8,4,11,12). Laser-assisted Non Surgical periodontaltherapy is one of the novel approaches that have been considered as one of the modalities in non-surgical periodontal therapy and is deemed to be strategically important for patient care and clinical practice.Further the cost-effectiveness of laser as a supportive periodontal-care for patients with chronic periodontitis. could serve as a good adjunctive treatment tool.(13,14)

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Quadri et al studied the effects of irradiation with low-level lasers as an adjunctive treatment of inflamed gingival tissue. The study assessed clinical parameters – PPD, GI, PI; biochemical parameters from GCF for analyses of elastase, IL-1b, MMP-8 and for microbiology subgingival plaque samples were taken. The results showed statistically significant reductions in GI, PI and PPD on the low level laser side (15).

Similar findings were observed in our study and the results showed statistically significant reduction in PI, GI, and PPD after 1month and 3 months. In addition our study also found significant reduction in SBI score and significant gain in clinical attachment level after 1 month which further reduced significantly after 3 months in LLLT group.

In a previous study GaAlAs laser was operated at 1.0 Watt, 809 nm and the clinical outcome was evaluated by means of Quigley Hein Index (QHI), Gingival Index , Bleeding on probing, sulcus fluid flow rate (SFFR), Periotest (PT), PPD, and CAL at baseline and at 3 months post treatment. The QHI, GI, and SFFR were significantly reduced in both groups at the end of the observation period ($P<0.001$). However, no statistically significant differences between the two respective groups were observed (6).

In the present there was significant reduction in mean PI and GI scores at 1 month and then further to 3 months ($p<0.001$) in LLLT group. In addition to the above study, significant reductions was also observed in SBI, PPD and gain in CAL scores at 1 month and 3 months in LLLT group.

Ribeiro IW, Sbrana MC, Esper LA, Almeida AL in 2008 evaluated the auxiliary effect of the low-intensity laser in subgingival scaling and root planing by analysis of its clinical aspects, as well as its analgesic potential during the procedure. There was a reduction in gingival inflammation, yet without a statistically significant difference between the study and control sides, both in clinical aspects and evaluation of pain during the procedure (16).

Our study has also presented significant reduction in gingival inflammation, in addition has shown statistically significant results in mean reduction of PI, GI, SBI scores, PPD and gain in CAL level at 1 month and 3 months.

In another study the effect of LLLT as an adjunct to non-surgical periodontal therapy of smoking and non-smoking patients with moderate to advanced chronic periodontitis was evaluated. The subjects were assessed on clinical parameters and samples were taken to evaluate GCF level of Matrixmetalloproteinase-1, tissue inhibitor matrixmetalloproteinase-1, transforming growth factor-b1, and basic-fibroblast growth factor levels at baseline, 1 month and 3 months. There were significant reductions in SBI scores, PD, and CAL reduction in the LLLT group at 1 month and 3 months ($P <0.001$). No statistically significant difference of reduction was observed in CAL changes at 6 months between the subgroups. Also no statistically significant difference was observed in PD and CAL changes of the LLLT group between the smokers and non-smokers at 1 month, 3 months and 6 months (17).

The present study is a split mouth design evaluating 25 patients who were systemically healthy and non smokers and assessment of clinical parameters PI, GI, SBI, PPD and CAL were done. Our study has been conducted with a wavelength of 810 nm GaAlAs laser and at a low level

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power setting of 0.4 W. Similar results were obtained in our study in terms of significant reduction in SBI scores, PPD, and gain in CAL at 1 month and 3 months (P <0.001). And also statistically significant reduction was seen in PI and GI scores at 1 month and 3 months.

Another study evaluated the short term effect of adjunctive LLLT on nonsurgical treatment of chronic periodontitis. After SRP quadrants were randomly assigned for 10 sessions of LLLT. The sites treated with SRP+LLLT exhibited greater reductions in PPD at 5 weeks and 3 months but not at 6 months. Further, SRP+LLLT-treated sites had a statistically significant increase in mean radiographic bone density when comparing 6- and 12-month data and overall from baseline to 12 months. SRP combined with LLLT improved radiographic bone density and short-term PPD reduction in patients with chronic periodontitis, but did not significantly affect either the gingival crevicular fluid of IL-1β or the gingival or plaque index (18).

In our study three laser sessions were provided at the LLLT group in a week at 810 nm and 0.4 W. Further sites treated with SRP+LLLT had a statistically significant reduction in PI, GI, SBI, PPD and gain in CAL at 1 month and 3 months. No radiographic analysis for bone density was done.

A more recent split-mouth, single-blind, controlled clinical study by Gündoğar H in 2016 evaluated the impact of low level laser therapy (LLLT) as an adjunct to non-surgical treatment of chronic periodontitis. Twenty-five systemically healthy and non-smoking adults with chronic periodontitis who had at least two bilateral premolar teeth with PPD of $7 \geq x \geq 5$ mm were included in the study. In the first month, PPD levels were significantly ($p < 0.05$) lower in the SRP + LLLT group than in the SRP group. At the third and sixth months, CAL, PPD, and GI were significantly ($p < 0.05$) lower in the SRP + LLLT group than in the SRP group. Differences in GCF cytokines levels among the group were not statistically significant.(19)(20)

This study by Angelov N. assessed the effects of LLLT in combination with scaling and root planing (SRP) in patients with periodontitis. Sixty subjects with chronic advanced periodontitis were assigned randomly to three treatment groups (n = 20) after collecting gingival clinical parameters. Group A received SRP on a single quadrant per day for four consecutive days; on the fifth day, all quadrants were reassessed. Group B received the same treatment as Group A, followed by laser application for five days. Group C received the same treatment as Group B but the laser treatment was administered for a total of 10 days. For Groups B and C, a low-level diode laser (630 to 670 nm) was used. The plaque index, gingival index, and sulcular bleeding index were recorded for all groups. For all clinical parameters, all three groups reported statistically significant differences ($p < 0.005$) compared to baseline data. Compared to Group A, Groups B and C showed statistically significant improvement for all clinical parameters. These findings suggest that a low-level diode laser can have a beneficial effect for treating inflammatory chronic advanced periodontitis.(21)

The findings of Meta-analysis by Ren C 2017 have reflected that LLLT-mediated SRP demonstrated significant short-term benefits over SRP monotherapy in the improvement of the probing pocket depth ($p = 0.0009$ at 1 mo; $p = 0.03$ at 2 mo) and the level of interleukin-1β in the gingival crevicular fluid ($p = 0.01$ at 1 mo).

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So, the results of the study shows that the application of LLLT shows statistically significant reduction in clinical parameters such as GI, PI, SBI, PPD and CAL as compared to control group. The beneficial effect of LLLT as an adjunct to non surgical periodontal treatment can be further evaluated on biochemical parameters (such as MMP-1, TIMP-1, TGF-b1, and b-FGF levels in GCF) and radiographical parameters (such as radiographic bone density).

## CONCLUSION

The application of the low level GaAlAs diode laser in the treatment of chronic periodontitis at the irradiation parameters as described in the study is a safe clinical procedure and can be recommended as an adjunct to conventional scaling and root planing.

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**FIGURES**

Fig 1. Pre Scaling and Root Planing

Fig 2. APPLICATION OF LOW LEVEL LASER THERAPY AT TEST SITE

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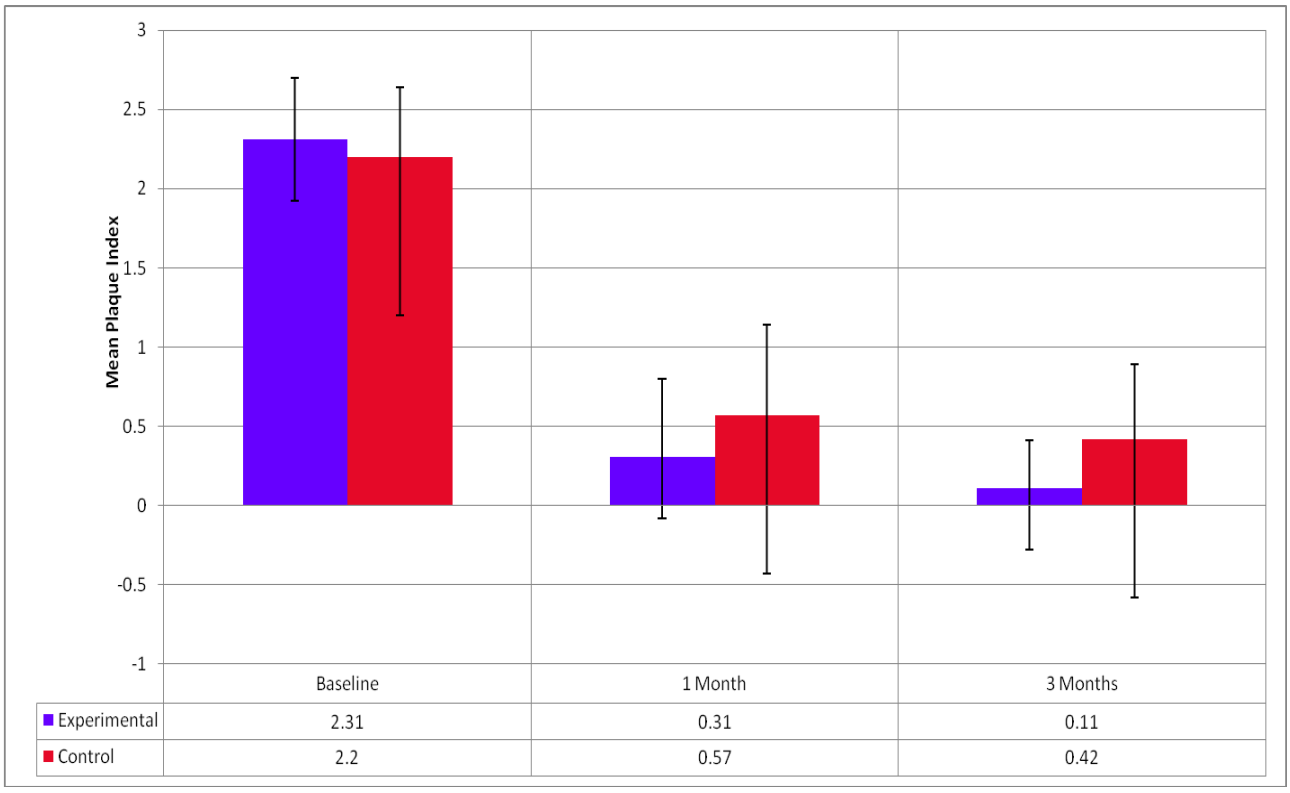
Fig 3. Post Operative- 1 MONTH

Fig 4. Post Operative- 3 MONTHS




**Graph 1 Intergroup comparison of PI at Experimental and Control Site at baseline, 1 month & 3 months**

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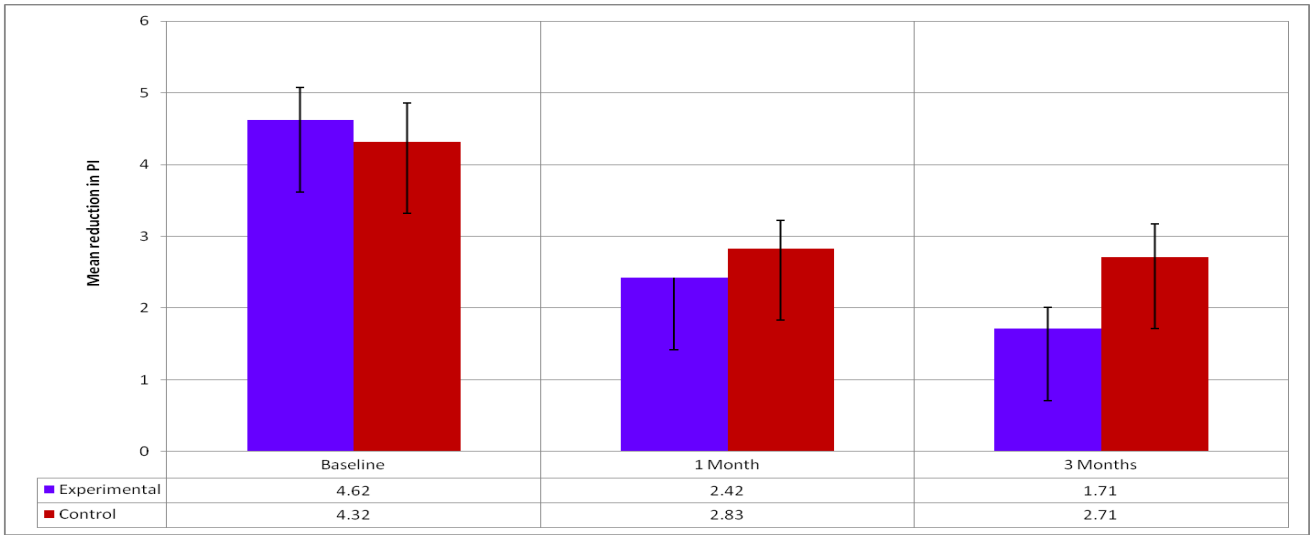
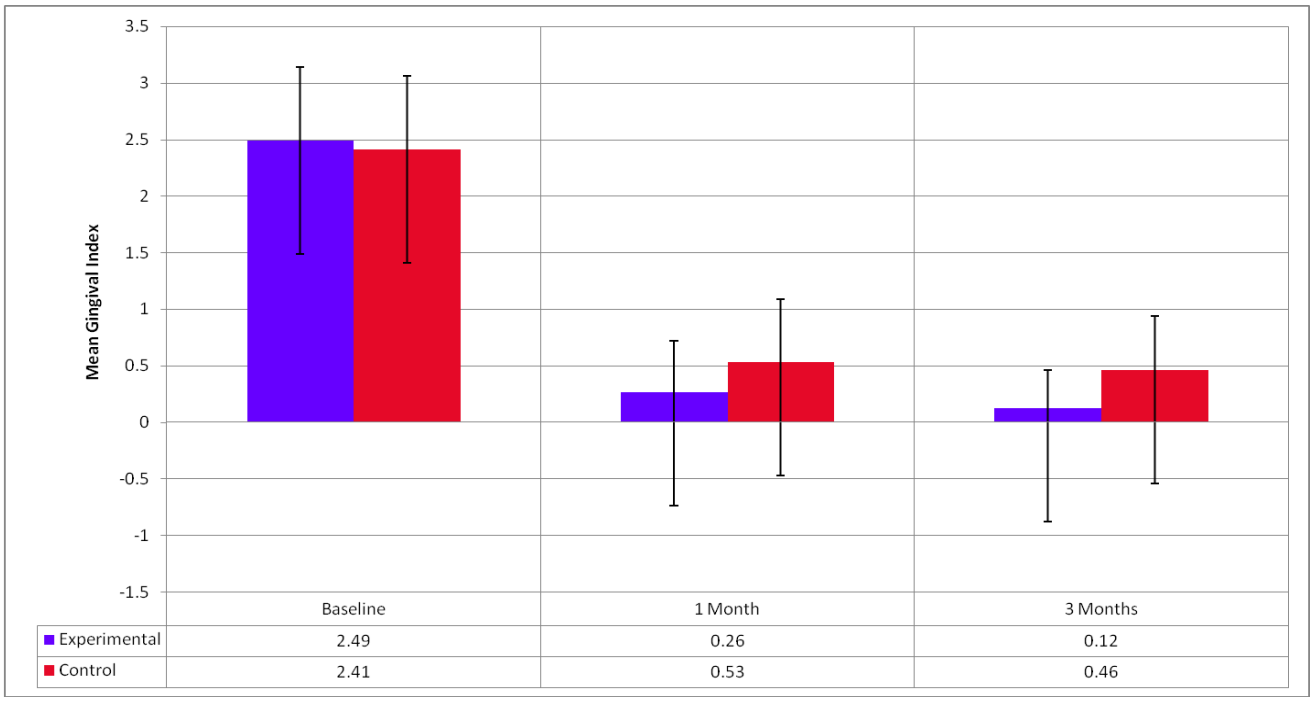



**Graph 2 Comparison of Mean reduction in PI scores between Experimental & Control sites**




**Graph 3 Intergroup comparison of GI at Experimental and Control Site at baseline, 1 month & 3 months**

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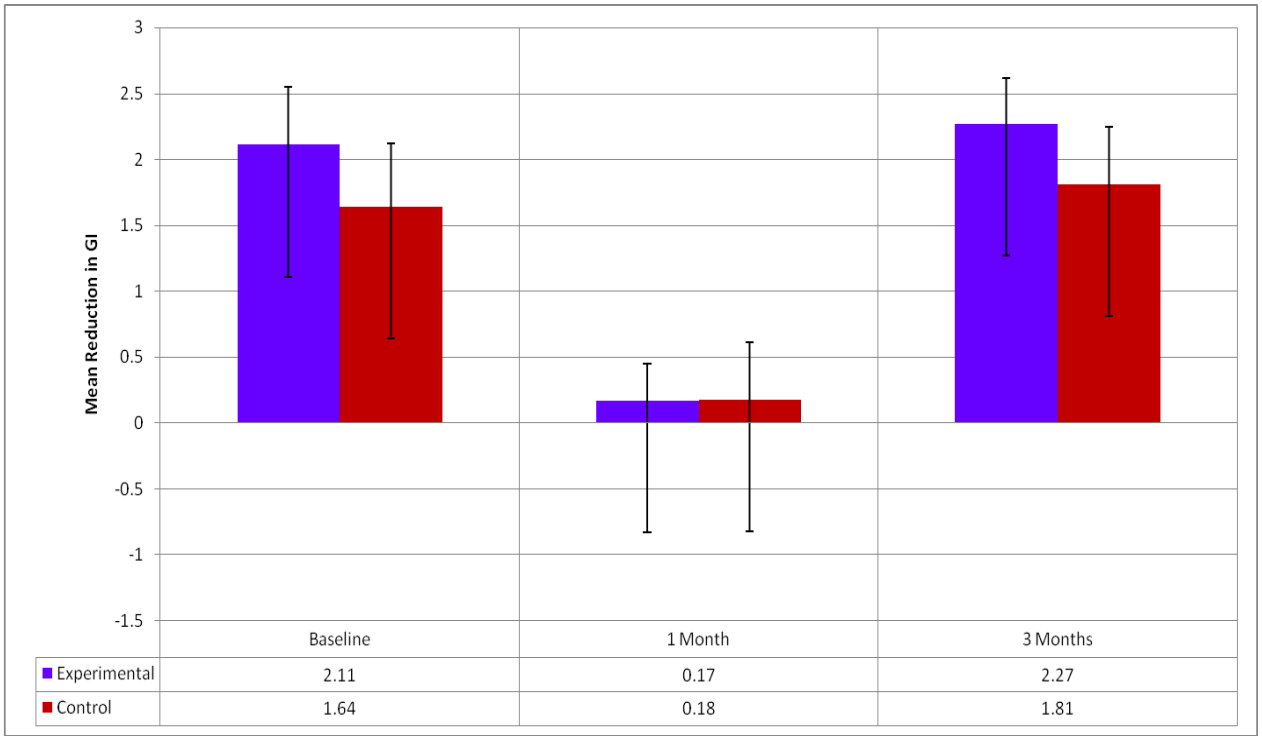
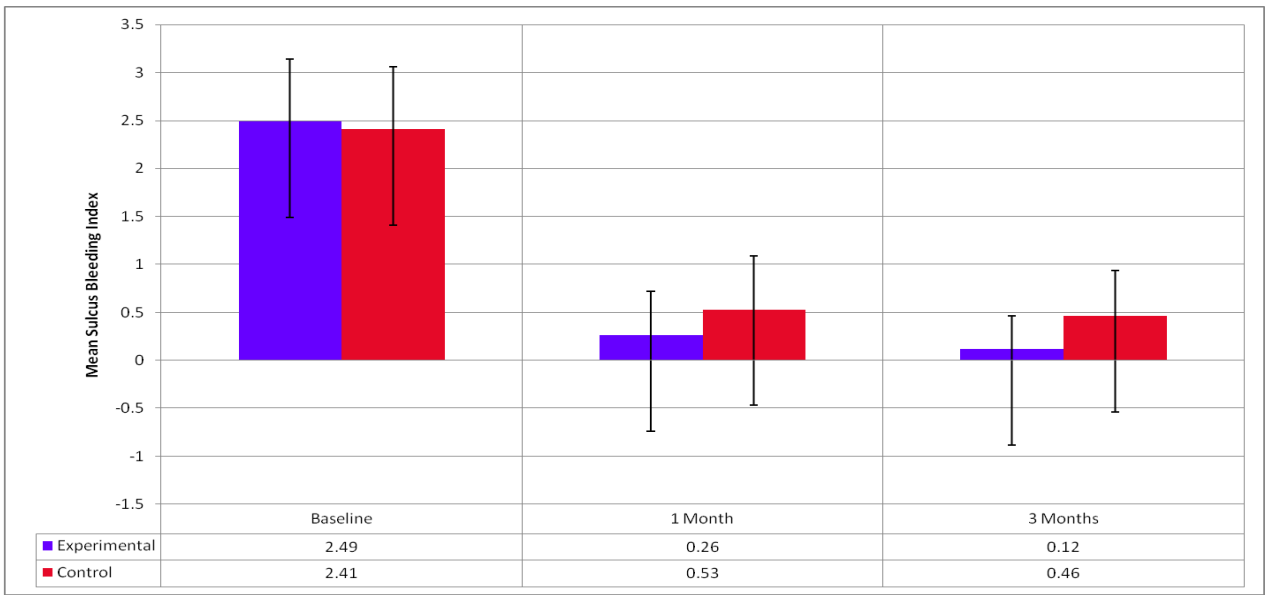



**Graph 4 Comparison of Mean reduction in GI scores between Experimental & Control sites**




**Graph 5 Intergroup comparison of SBI at Experimental and Control Site at baseline, 1 month & 3 months**

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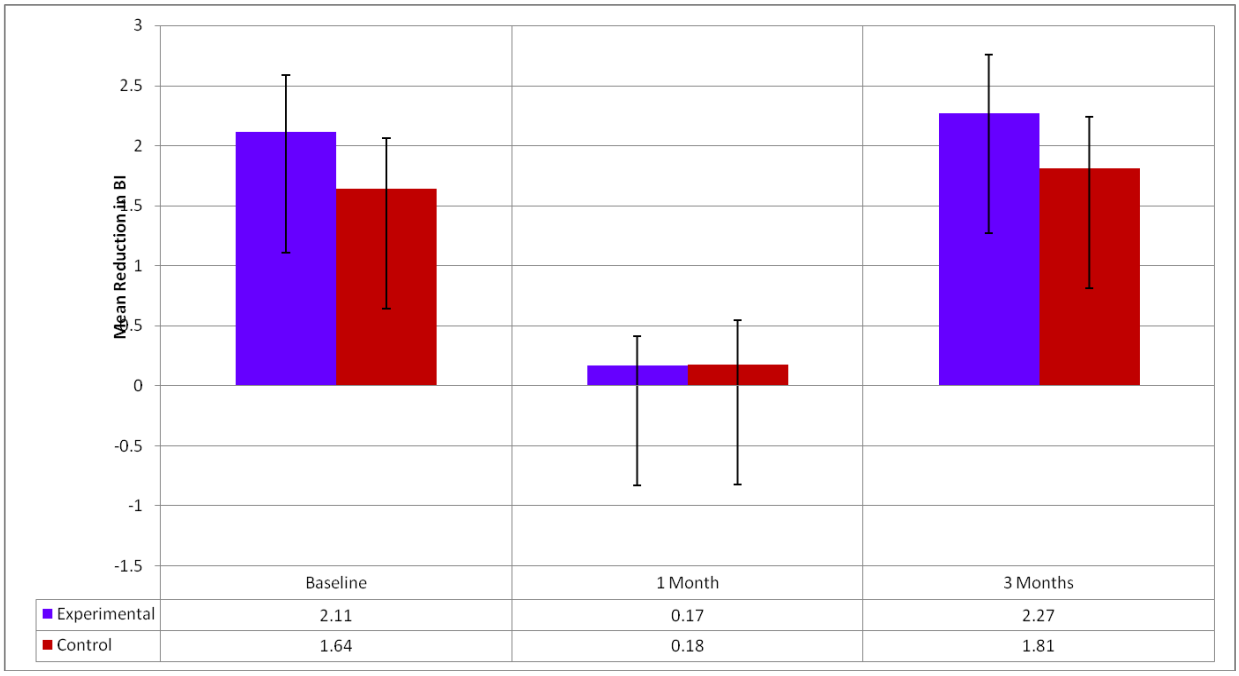
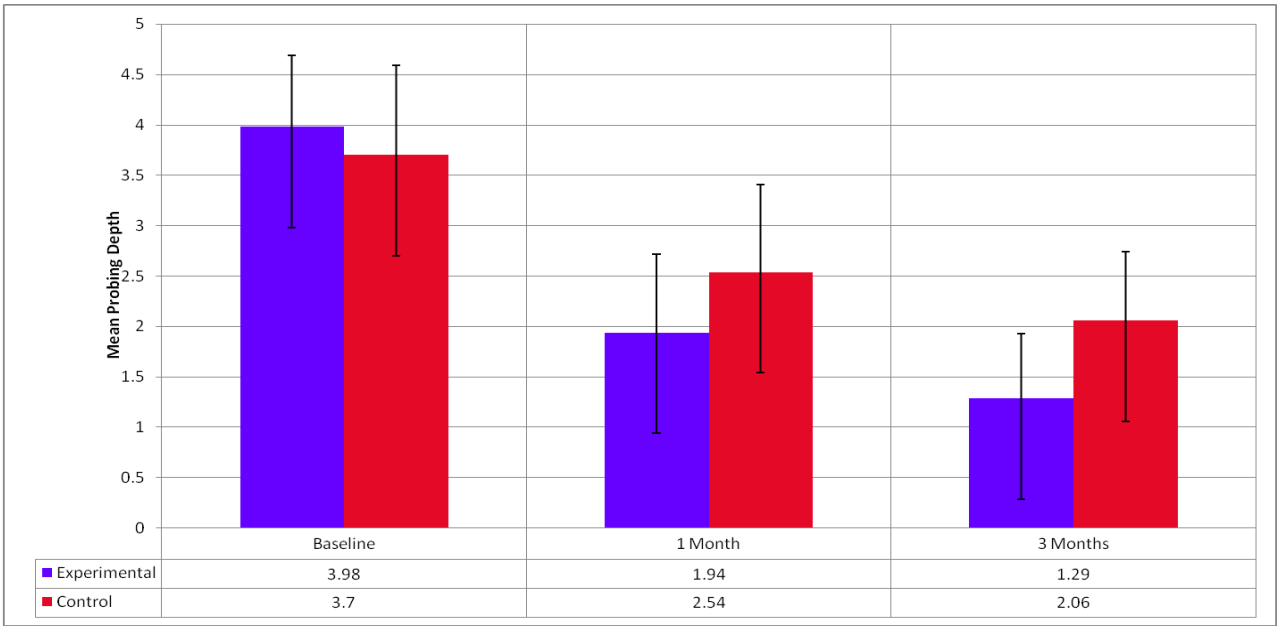



**Graph 6 Comparison of Mean reduction in SBI scores between Experimental & Control sites**




**Graph 7 Intergroup comparison of PPD at Experimental andControl Site at baseline, 1 month & 3 month**

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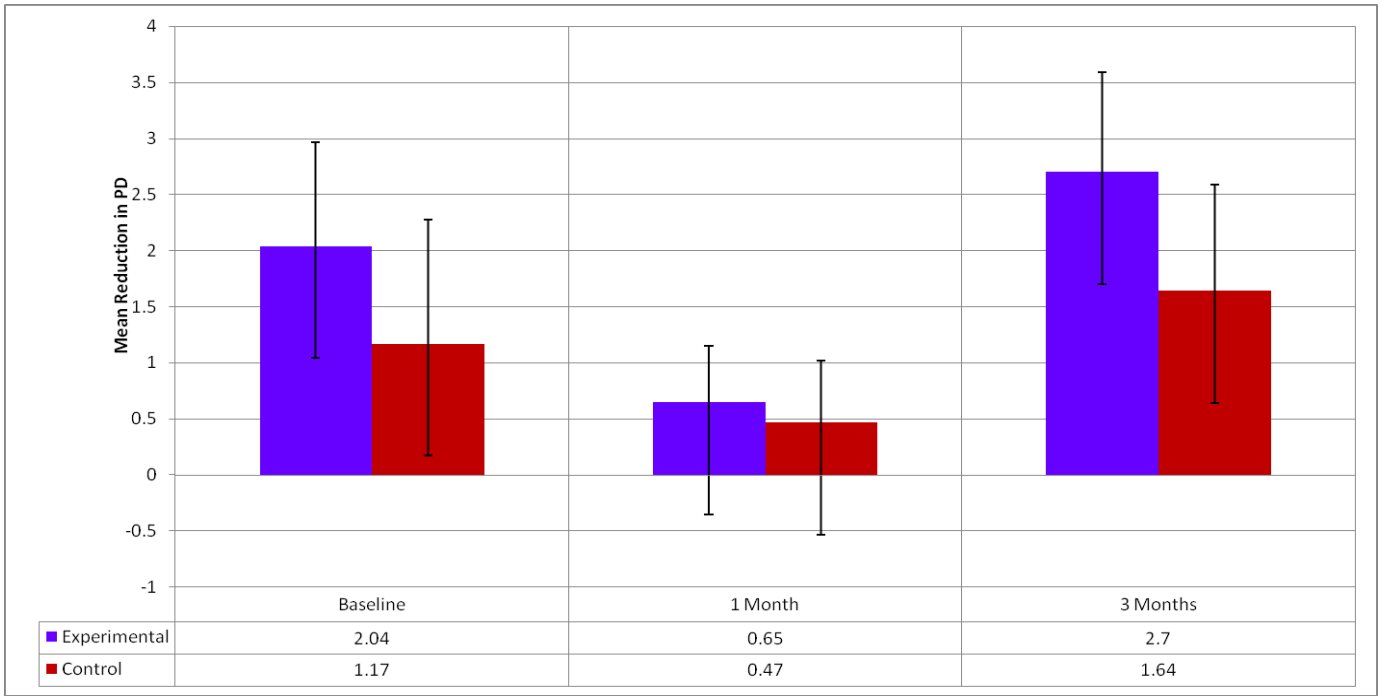
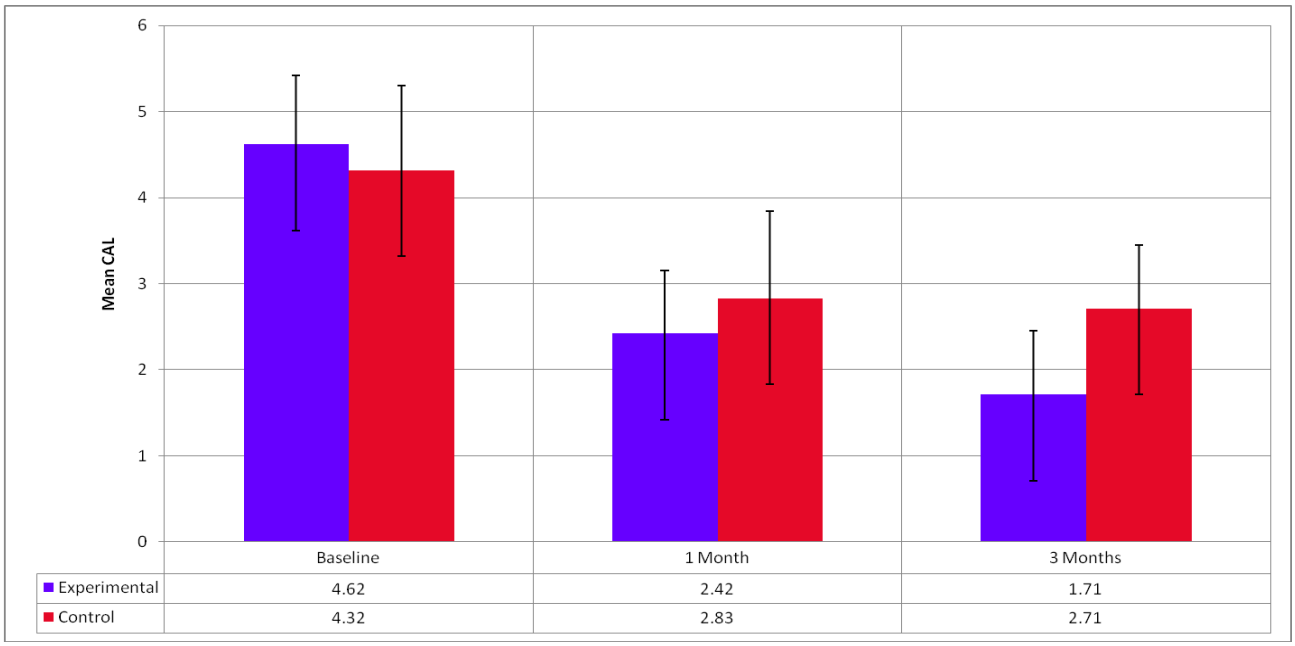



**Graph 8 Comparison of Mean reduction in PPD scores between Experimental & Control sites**




**Graph 9 Intergroup comparison of CAL at Experimental andControl Site at baseline, 1 month & 3 months**

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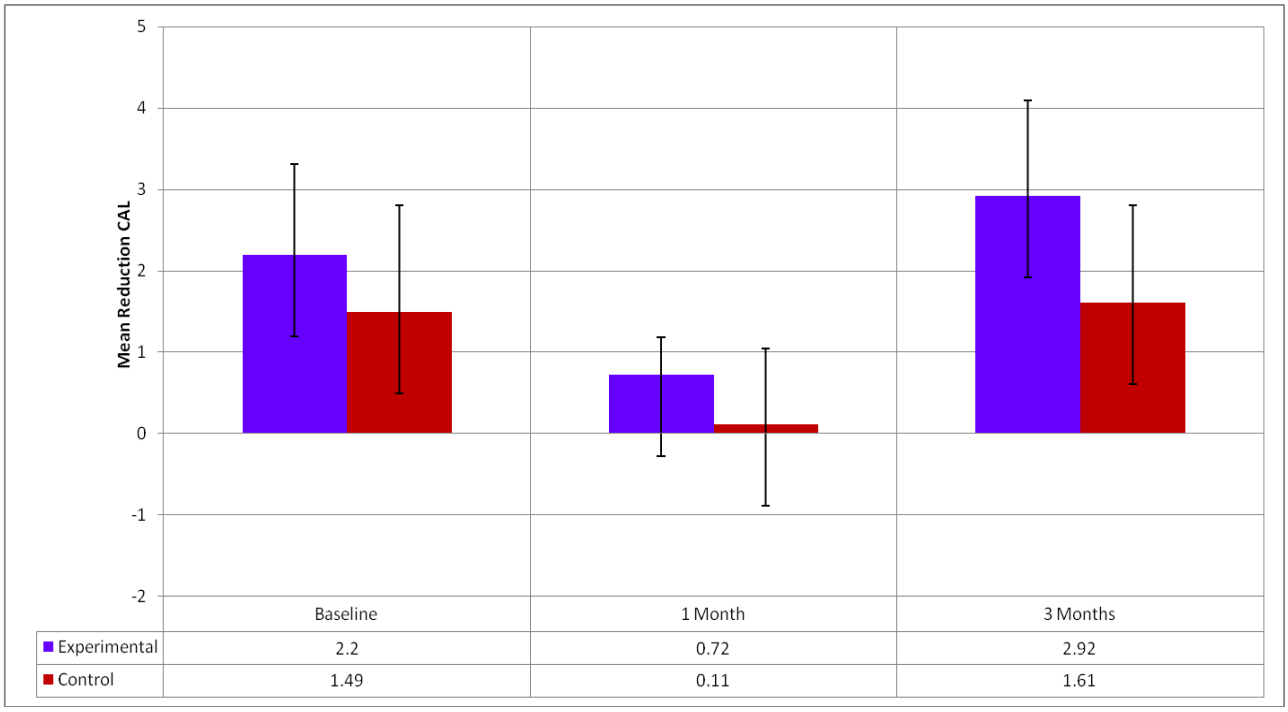


**Graph 10 Comparison of Mean reduction in CAL scores between Experimental & Control sites**