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Comparative evaluation of efficacy of diode laser and photodynamic therapy as an adjunct to scaling and root planing (SRP) in the treatment of chronic periodontitis - a clinical study

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Abstract

Background: Scaling and root planing (SRP) is considered as a gold standard to attain and maintain gingival and periodontal health by elimination of bacterial plaque. Although mechanical debridement significantly decreases the prevalence and levels of subgingival microorganisms, it does not necessarily eliminate all pathogens. Therefore various other treatment modalities like laser therapy, photodynamic therapy are being used as an adjunct to SRP.

Aim: To comparatively evaluate the efficacy of diode laser and photodynamic therapy as an adjunct to scaling and root planing in the treatment of chronic periodontitis.

Methodology: 20 patients (between 30 and 65 years of age) with chronic periodontitis were selected for this study. A split mouth study was designed among all the selected subjects by categorizing randomly into three different groups. Group A (N=20) will be Control group (CG), Group B (N=20) will be Laser group (LG), Group C (N=20) will be PDT group (PG). Clinical parameters like Plaque index (PI), Sulcus bleeding index (SBI) and Gingival index (Loe and Silness) (GI), Probing pocket depth (PPD) and clinical attachment levels (CAL) were recorded at baseline, 1 month and 3 months. One-way ANOVA test followed by Bonferroni's post hoc Analysis and Student Paired t test were used in the study.

Results: All the clinical parameters were found to be statistically significant at the end of 1 month and 3 months ($P<0.001$) when compared with baseline in all the three groups. However, the mean index scores, PPD and CAL was higher in PDT group (Group C) when compared to Laser (Group B) and control group (Group A).

Conclusion: PDT and Laser therapy as an adjunct to SRP had added benefit over the conventional scaling and root planing alone. However photodynamic therapy + SRP showed a better result compared to Laser + SRP and SRP alone.

Keywords: Scaling, root planing, chronic periodontitis, photodynamic therapy, laser therapy.

Introduction

Scaling and root planing is considered as a gold standard to attain and maintain gingival and periodontal health by

elimination of bacterial plaque. Although mechanical debridement significantly decreases the prevalence and levels of subgingival microorganisms, it does not necessarily eliminate all pathogens. As the probing depth increases, the effectiveness of scaling and root planing decreases, leaving subgingival plaque and calculus on root surfaces that promotes the persistence of periodontopathic microorganisms.[1,2]

Various other treatment modalities are being used as an adjunct to scaling and root planing to facilitate nonsurgical treatment of chronic periodontitis. These may include laser therapy, photodynamic therapy, local drug delivery, administration of antibiotics etc. Administration of antibiotics brings undesirable side effects and also cause development of bacterial drug resistance.[3]

A more efficient and atraumatic technique is the use of lasers for periodontal treatment. Amongst all the lasers, the most commonly used laser is diode laser. The diode laser is a solid-state semiconductor laser and its active medium composed of Gallium (Ga), Arsenide (Ar), and other elements such as Aluminium (Al) and Indium (In). They convert electrical energy into light energy. The wavelength range is about 800–980 nm. In periodontology lasers have been used for control of bacteremia, removal of the pocket epithelium, bacterial reduction, subgingival calculus removal (using Er: YAG lasers) etc[4]

The other adjunctive procedure includes the combination of laser light and photosensitizer known as photodynamic therapy (PDT). The energy transfer from the activated photosensitizer to available oxygen leads to the formation of reactive oxygen species, such as singlet oxygen and free radicals. These chemical species are extremely reactive and can damage proteins, lipids, nucleic acids, and other components of the bacterial cell wall.[6]

Studies conducted by Nicos et al, Balata et al, Ravi Raj et al compared the efficacy of PDT (using methylene blue as photosensitizer) as an adjunct to SRP.[7] PDT in conjunction with SRP has shown additional improvement in periodontal parameters when compared to SRP alone and has a beneficial effect in chronic periodontitis patients.[8,9]

But only very few studies in the literature are available that compared the effectiveness of diode laser and photodynamic therapy (using methylene blue as a photosensitizer) as an adjunct to scaling and root planing in the treatment of chronic periodontitis.[10]

In the present study, authors have evaluated and compared the effectiveness of photodynamic therapy and diode laser as an adjunct to conventional scaling and root planing in the treatment of patients with chronic periodontitis

Methodology

A total of 20 patients having chronic periodontitis (Based on the 1999 world classification of periodontal disease and conditions) were selected from the outpatients visited the Department of Periodontology, D.A.P.M.R.V Dental College, Bangalore. The Ethical clearance for the study was obtained from the ethical committee and review board of the institution.

Study Protocol

The nature of the study was explained verbally in a language comprehensible to the patient, information sheet was given and informed consent was obtained from the patient.

Inclusion criteria

1. Chronic periodontitis patients having minimum of six teeth in three quadrants with at least 2 teeth in each quadrant with a periodontal pocket depth equal to or greater than 5mm.
2. Age between 30 and 65years.
3. Both sexes were included.
4. No systemic conditions that would contraindicate routine periodontal procedures.

Exclusion criteria

1. Subjects who had received periodontal therapy in the past 6 months.
2. Pregnant and lactating patients.
3. Patients who had taken antibiotics in 6-month period preceding study.
4. Teeth exhibiting class II and class III mobility.
5. Current Smokers.
6. Acute oral infections
7. Patients with known allergy to methylene blue dye.

Study design

A split mouth design was followed in which 3 quadrants from each patient were selected and each quadrant was allotted to different groups randomly.

Quadrants in each patient were divided into 3 groups as follows:

Group A (n = 20) Control group (CG). This group received only scaling and root planing.

Group B: (n =20) Laser group (LG). This group received SRP + low level diode laser therapy.

Group C: (n=20) PDT group (PG). This group received SRP+ PDT (used 0.01% methylene blue as photosensitizing agent).

Clinical parameters

The clinical parameters recorded were Plaque Index (Silness and Loe 1964), Gingival Index (Loe and Silness 1963), and Sulcus Bleeding Index (SBI). Also, Pocket Probing Depth (PPD) and Clinical attachment loss (CAL) were recorded using UNC 15 Probe and customized acrylic stent (as shown in figures 1&4). All the clinical parameters were recorded at baseline, 30 days and 90 days.

Treatment Procedures

At the first appointment, brief case history of the patient and full mouth periodontal examination was conducted. Before any treatment, all the clinical parameters were recorded. After which scaling and root planing (SRP) was performed in all 20 patients. After 1 week quadrants were randomly allocated to one of the groups.

GROUP A (Control group):

In group A, after recording the clinical parameters at baseline, a thorough scaling and root planing (SRP) was done using supragingival scalers, Gracey curettes and universal curettes.

Group B

(SRP+ Laser) -. This group received SRP followed by sulcular debridement using low level soft tissue diode laser by means of optical fibre with contact mode (Laser parameters; wave length of 980 nm for 60 seconds, power 0.5 W continuous wave) and bio stimulation using low level soft tissue diode laser by means of optical fiber with noncontact mode at a distance of 2-3 mm from tissue (Laser parameters; wave length of 980 nm for 60 seconds and power of 0.5 W)(As shown in Figure 2).

Group C

(SRP + PDT with 0.01% methylene blue) – This group received SRP followed by the application of photosensitizer liquid with blunt needle to the instrumented site starting from apical end of the pocket moving coronally to avoid the entrapment of air bubble. After 3 minutes all pockets were thoroughly rinsed with sterile saline to remove excessive photosensitizer. Immediately after rinsing the LED light of PDT unit was focussed at the depth of the pocket and moved circumferentially in sweeping motion around the teeth for one minute (As shown in figure 3)

In each group the clinical parameters were recorded again at 1 month and 3 month post operatively.

Results

- In group A the mean plaque index scores at baseline, 1 month and 3 months were 2.39±0.35, 1.31±0.15 and 1.15±0.10 respectively. In group B the mean plaque index

scores at baseline, 1 month and 3 months were 2.42±0.33, 1.27±0.07 and 1.09±0.07 respectively. In group C the mean plaque index scores at baseline, 1 month and 3 months were 2.47±0.33, 1.20±0.08 and 1.07±0.05 respectively. The mean PI was found to be statistically significant between all-time intervals in all the groups (P<0.001). The reduction of mean plaque index score in group C was slightly higher than that of Group A and B. (Table 1 and Graph 1)

- In group A the mean GI scores at baseline, 1 month and 3 months were 2.40±0.17, 1.37±0.10 and 1.18±0.10 respectively. In group B the mean GI scores at baseline, 1 month and 3 months were 2.42±0.18, 1.29±0.10 and 1.11±0.05 respectively. In group C the mean GI scores at baseline, 1 month and 3 months were 2.45±0.16, 1.23±0.09 and 1.05±0.03 respectively. The mean Gingival index (GI) was found to be statistically significant between all-time intervals in all the groups (P<0.001). The reduction of mean gingival index score in group C was slightly higher than that of Group A and B. (Table 2 and Graph 2)
- In group A the mean SBI scores at baseline, 1 month and 3 months were 2.57±0.16, 1.46±0.09 and 1.34±0.06 respectively. In group B the mean SBI scores at baseline, 1 month and 3 months were 2.57±0.16, 1.34±0.05 and 1.24±0.05 respectively. In group C the mean SBI scores at baseline, 1 month and 3 months were 2.57±0.13, 1.23±0.06 and 1.06±0.04 respectively. The mean Sulcus Bleeding Index (SBI) was found to be statistically significant between all-time intervals in all the groups (P<0.001). However, the mean reduction in Sulcus bleeding index score in group C was slightly higher than that of Group A and B. (Table 3 and Graph 3)
- In group A the mean PPD scores at baseline and 3 months were 7.18±1.09 and 6.15±0.89 respectively. In group B the mean PPD scores at baseline and 3 months were 7.30±1.06 and 5.37±0.76 respectively. In group C the mean PPD scores at baseline and 3 months were 7.40±1.32 and 4.70±0.70 respectively. The difference in mean PPD was found to be statistically significant from baseline to 3 months in all the three groups (P<0.001). (Table 4 and Graph 4)
- In group A the mean CAL scores at baseline and 3 months were 7.73±0.97 and 6.58±1.15 respectively. In group B the mean CAL scores at baseline and 3 months were 7.75±1.11 and 5.85±0.78 respectively. In group C the mean CAL scores at baseline and 3 months were 7.73±1.06 and 4.98±0.75 respectively. The difference in mean CAL was found to be statistically significant at from baseline to 3 months in all the three groups (P<0.001). (Table 4 and Graph 4)
- On inter group comparison the mean PI, GI, SBI, PPD and CAL didn't show any statistical significant differences at baseline between different groups. (P value 0.73, 0.46, 0.98, 0.83, 0.99 respectively) (Table 5, graph 5)
- At the end of one month (Table 6 and Graph 6) there was a statistically significant difference in PI score among the groups (P value 0.006). When compared between groups the difference was statistically significant between group A & group C (P value 0.004), but not statistically significant between group A & group B and group B & group C (P value 0.38, 0.12 respectively). There was a statistically significant difference in GI score among the groups (P value 0.001). When compared between groups the difference was statistically significant between group A & group B (P value 0.04) and group A & group C (P value 0.01) but not statistically significant between group B & group C (P value 0.20, 0.41).

There was statistically significant difference in SBI score among the groups (P value 0.001) as well as between different groups at one month group A & group B, group

A& group C, group B& group C (P values 0.001, 0.001, 0.001 respectively).

At the end of three months (Table 7, graph 7) there was a statistically significant difference in PI score among the groups at three months (P value 0.008). When compared between groups the difference was statistically significant between group A & group B (P value 0.04) and group A & group C (P value0.01) but not statistically significant between group B & group C (P value 0.84). There was a statistically significant difference in GI score, SBI score, PPD score and CAL score among the groups at three months (P value 0.001). When compared between groups the difference was statistically significant between all the groups.

Discussion

The ultimate goal of periodontal therapy is to eliminate supragingival and subgingival plaque and arrest the progression of periodontal disease. Mechanical debridement (scaling and root planing) are considered as the gold standard for the management of chronic periodontitis. Although many studies have shown significant improvements following SRP, complete elimination of subgingival periodontal pathogens and irritants is not always possible.[11,12]

Residual pockets during SRP present similar challenges and additional therapeutic approaches to achieving periodontal health are required. To improve the results of mechanical debridement, antibiotics are widely used.[13,14]

Although the use of antibiotics can reduce the periodontal pathogens, their frequent use can cause bacterial resistance. Therefore, for the reasons outlined, efforts to find adjunctive treatment have increased. Some of these treatments are photodynamic therapy (PDT) and lasers.[15]

Antimicrobial PDT was introduced in 1904 as the light-induced inactivation of cells, microorganisms or molecules. This treatment modality is based on the principle that a photoactivatable substance, called a photosensitizer, is activated by the light of a particular wavelength. The transfer of energy causes the formation of free radicals of singlet oxygen, which exert destructive action on bacteria and their products.[16,17]

Another adjunctive therapy to mechanical debridement is laser therapy. The word “laser” is an acronym for “light amplification by stimulated emission of radiation.” It refers to a device that emits light that is spatially coherent and collimated; a laser beam can remain narrow over a long distance, and it can be tightly focused. When directed at tissues, different interactions result. The absorption, reflection, transmission, and scattering of the laser light vary depending on the wavelength of the laser and the characteristics of the tissue.[18]

Amongst all the lasers, the most commonly used laser is diode laser. The diode laser is a solid-state semiconductor laser and its active medium composed of Gallium (Ga), Arsenide (Ar), and other elements such as Aluminium (Al) and Indium (In). They convert electrical energy into light energy. The wavelength range is about 800–980 nm. Lasers are emitted in continuous-wave and gated-pulsed modes, and is usually operated in a contact method using a flexible fiber optic delivery system.[19]

The remarkable benefits from the use of diode laser in addition to the traditional procedures of SRP in the treatment of periodontal pockets include bactericidal effect, curettage effect and bio-stimulating effect. Combining laser therapy with conventional procedures achieved a more effective decontamination of the pocket, with also a recolonization slower than sites treated only mechanically.[9]

Various studies have been conducted previously comparing photodynamic therapy with SRP and SRP alone or Laser therapy with SRP and SRP alone but there were very few studies conducted to compare PDT & Laser

therapy as an adjunct to SRP or to each other and SRP alone. Hence, the present study was planned to comparatively evaluate the efficacy of diode laser and photodynamic therapy as an adjunct to scaling and root planing in the treatment of chronic periodontitis.

The results of the study were as follows:

The mean PI score showed a statistically significant reduction at three months when compared with baseline within Control group, Laser group and PDT group. When compared between groups the difference was not statistically significant between PDT & Laser groups, but was statistically significant between control & PDT groups and control & Laser group. These results were in agreement with the study conducted by Raj KR[9] et al in 2016 in which he indicated that, compared to SRP alone, applications of PDT with SRP showed improvement in PI scores. The results obtained from the study done by Segarra- Vidal M[20] in 2017 were also in agreement with the present study in which he stated that compared to SRP alone, SRP+PDT showed significantly greater improvement in PI scores.

The mean GI score showed a statistically significant reduction at three months when compared with baseline within Control group, Laser group and PDT group and the reduction was statistically significant when compared between the groups. These results were in agreement with study done by Theodoro, L.H et al in 2012 in which, PDT in conjunction with SRP had shown additional improvement in GI scores when compared to SRP alone.[21] The additional benefits of using PDT with SRP in reduction of GI scores is that they release reactive oxygen species that helps in reducing the microbial load and further reducing gingival irritation. The additional benefits of using laser therapy is because of its bactericidal effect, curettage effect, bio-stimulating effect and there is an accelerated healing of gingiva and thus resulting in further reduction of GI scores.[22]

The mean SBI score showed statistically significant reduction at three months when compared with baseline in all the groups and the reduction was statistically significant when compared between the groups. This result is in agreement with the study done by Lui et al in 2011 in which he concluded that, single application of PDT along with SRP resulted in significantly higher reduction of bleeding scores when compared with SRP alone.[23] The results obtained from the study done Saglam et al in 2014 indicated that, compared to SRP alone, applications of diode laser with SRP showed decrease in all periodontal parameters.[24]

There was a statistically significant reduction in PPD and CAL scores at three months in all the groups and the reduction was statistically significant when compared between the groups. These results were in agreement with the study done by Cappuyns et al in 2012 where he suggested that a combined course of photodynamic therapy with low-level laser therapy could be a beneficial adjunct to nonsurgical treatment of chronic periodontitis.[25] However the results obtained in this study were not in agreement with the study done by Balata et al. in 2013 in which he stated that application of a single episode of PDT to scaling and root planing failed to result in an additional improvement in terms of PPD reduction and CAL gain.[27]Reduction of all clinical parameters in PDT group was slightly higher followed by Laser group and then Control group.

The Systematic review conducted by Joseph B et al[28] in 2017 evaluated whether antimicrobial photodynamic therapy (aPDT) as either a primary mode of treatment or an adjunct to non-surgical treatment was more effective than scaling and root planing (SRP) alone in treating chronic periodontitis. This review concluded that although

there was a wide range of heterogeneity in the included studies, they all indicated that PDT has the potential to be an effective adjunct in the treatment of chronic periodontitis. The discrepancy between various studies might be due to different types of laser application, wavelength used in the study and the type of photosensitizer used in the study.

Figures

Figure 1 : Pre-Operative Probing Depth

Figure 2: Laser therapy

Figure 3: Application of photo sensitizing agent and irradiation with PDT unit

Figure 4: Three month post-operative probing depth

Table 1

Comparison of mean plaque index values between different time intervals in each study group using Repeated measures of ANOVA followed by Bonferroni's post hoc Analysis

Group	Time	N	Mean	SD	F	P-Value	Sig. Diff	P-Value
Group A	BL	20	2.39	0.35	244.390	<0.001*	T1 Vs T2	<0.001*
	30D	20	1.31	0.15			T1 VS T3	<0.001*
	90D	20	1.15	0.10			T2 Vs T3	<0.001*
Group B	BL	20	2.42	0.33	347.356	<0.001*	T1 Vs T2	<0.001*
	30D	20	1.27	0.07			T1 VS T3	<0.001*
	90D	20	1.09	0.07			T2 Vs T3	<0.001*
Group C	BL	20	2.47	0.33	400.522	<0.001*	T1 Vs T2	<0.001*
	30D	20	1.20	0.08			T1 VS T3	<0.001*
	90D	20	1.07	0.05			T2 Vs T3	<0.001*

Note: T1 - BL, T2 - Post-Operative 30 Days, T3 - Post-Operative 90 Days
* - Statistically Significant

Table 2

Comparison of mean gingival index values between different time intervals in each study group using Repeated measures of ANOVA followed by Bonferroni's post hoc Analysis								
Group	Time	N	Mean	SD	F	P-Value	Sig. Diff	P-Value
Group A	BL	20	2.40	0.17	2231.096	<0.001*	T1 Vs T2	<0.001*
	30D	20	1.37	0.12			T1 VS T3	<0.001*
	90D	20	1.18	0.10			T2 Vs T3	<0.001*
Group B	BL	20	2.42	0.18	1156.147	<0.001*	T1 Vs T2	<0.001*
	30D	20	1.29	0.10			T1 VS T3	<0.001*
	90D	20	1.11	0.05			T2 Vs T3	<0.001*
Group C	BL	20	2.47	0.16	1758.523	<0.001*	T1 Vs T2	<0.001*
	30D	20	1.23	0.09			T1 VS T3	<0.001*
	90D	20	1.05	0.03			T2 Vs T3	<0.001*

* - Statistically Significant

Table 3

Comparison of mean Sulcus Bleeding index values between different time intervals in each study group using Repeated measures of ANOVA followed by Bonferroni's post hoc Analysis								
Group	Time	N	Mean	SD	F	P-Value	Sig. Diff	P-Value
Group A	BL	20	2.57	0.16	1953.752	<0.001*	T1 Vs T2	<0.001*
	30D	20	1.46	0.09			T1 VS T3	<0.001*
	90D	20	1.34	0.06			T2 Vs T3	<0.001*
Group B	BL	20	2.57	0.16	1324.087	<0.001*	T1 Vs T2	<0.001*
	30D	20	1.34	0.05			T1 VS T3	<0.001*
	90D	20	1.24	0.05			T2 Vs T3	<0.001*
Group C	BL	20	2.57	0.13	2132.780	<0.001*	T1 Vs T2	<0.001*
	30D	20	1.23	0.06			T1 VS T3	<0.001*
	90D	20	1.06	0.04			T2 Vs T3	<0.001*

* - Statistically Significant

Table 4

Comparison of mean Pocket depth & CAL values between baseline and post-operative 90 days period in different groups using Student Paired t test								
Group	Parameters	Time	N	Mean	SD	Mean Diff	t	P-Value
Group A	PPD	BL	20	7.18	1.09	1.03	5.832	<0.001*
		90D	20	6.15	0.89			
	CAL	BL	20	7.73	0.97	1.15	5.596	<0.001*
		90D	20	6.58	1.15			
Group B	PPD	BL	20	7.30	1.06	1.93	11.363	<0.001*
		90D	20	5.37	0.76			
	CAL	BL	20	7.75	1.11	1.90	11.018	<0.001*
		90D	20	5.85	0.78			
Group C	PPD	BL	20	7.40	1.32	2.70	12.171	<0.001*
		90D	20	4.70	0.70			
	CAL	BL	20	7.73	1.06	2.75	15.639	<0.001*
		90D	20	4.98	0.75			

* - Statistically Significant

Table: 5

Comparison of mean values of different clinical parameters during baseline period between 03 groups using One-way ANOVA test								
Parameters	Groups	N	Mean	SD	Min	Max	F	P-Value
PI	Group A	20	2.39	0.35	1.7	2.8	0.313	0.73
	Group B	20	2.42	0.33	1.7	2.7		
	Group C	20	2.47	0.33	1.8	2.8		
GI	Group A	20	2.40	0.17	2.1	2.6	0.793	0.46
	Group B	20	2.42	0.18	2.1	2.7		
	Group C	20	2.47	0.16	2.2	2.7		
SBI	Group A	20	2.58	0.16	2.3	2.8	0.016	0.98
	Group B	20	2.57	0.16	2.3	2.8		
	Group C	20	2.57	0.13	2.3	2.8		
PPD	Group A	20	7.18	1.09	5.0	9.0	0.188	0.83
	Group B	20	7.30	1.06	5.0	9.0		
	Group C	20	7.40	1.32	5.0	9.0		
CAL	Group A	20	7.73	0.97	6.0	9.0	0.004	0.99
	Group B	20	7.75	1.11	5.0	9.0		
	Group C	20	7.73	1.06	6.0	9.0		

Table 6

Comparison of mean values of different clinical parameters during post-operative 30 days period between 03 groups using One-way ANOVA test followed by Tukey's HSD post hoc Analysis										
Parameters	Groups	N	Mean	SD	Min	Max	F	P-Value	Sig. Diff	P-Value
PI	Group A	20	1.31	0.15	1.1	1.6	5.626	0.006*	G-A Vs G-B	0.38
	Group B	20	1.27	0.07	1.2	1.4			G-A Vs G-C	0.004*
	Group C	20	1.20	0.08	1.1	1.3			G-B Vs G-C	0.12
GI	Group A	20	1.37	0.12	1.2	1.6	8.795	<0.001*	G-A Vs G-B	0.04*
	Group B	20	1.29	0.10	1.1	1.4			G-A Vs G-C	<0.001*
	Group C	20	1.23	0.09	1.1	1.3			G-B Vs G-C	0.20
SBI	Group A	20	1.46	0.09	1.3	1.6	48.336	<0.001*	G-A Vs G-B	<0.001*
	Group B	20	1.34	0.05	1.3	1.4			G-A Vs G-C	<0.001*
	Group C	20	1.23	0.06	1.1	1.4			G-B Vs G-C	<0.001*

* - Statistically Significant

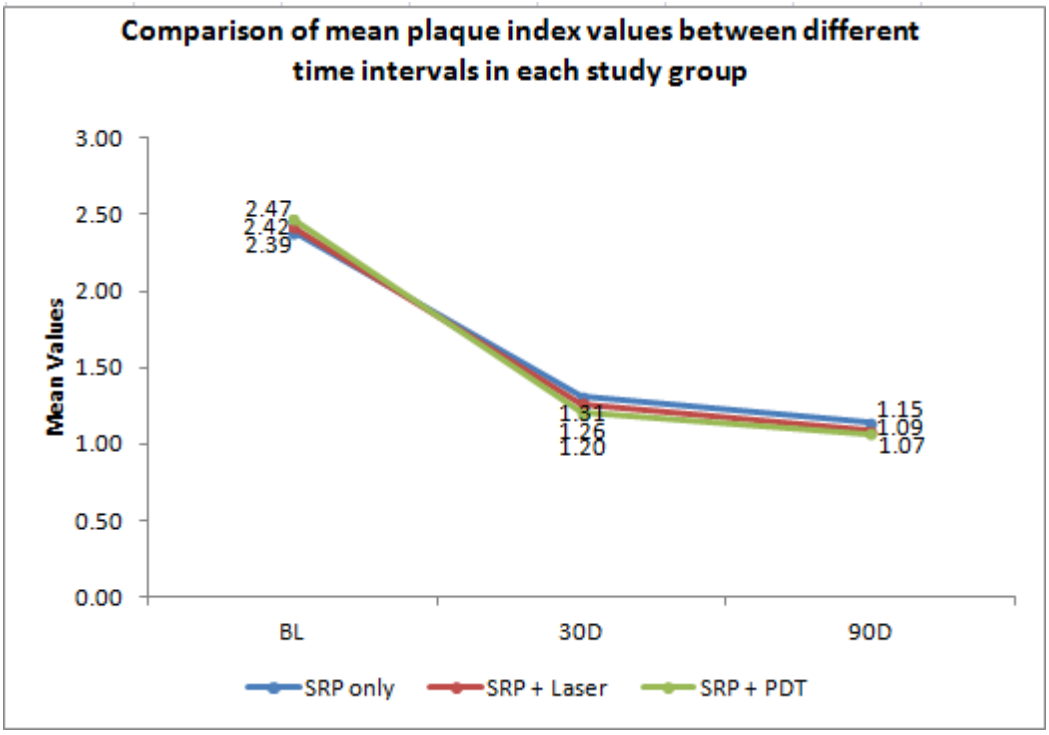
Note: G-A - Group A, G-B - Group B, G-C – Group C

Table 7

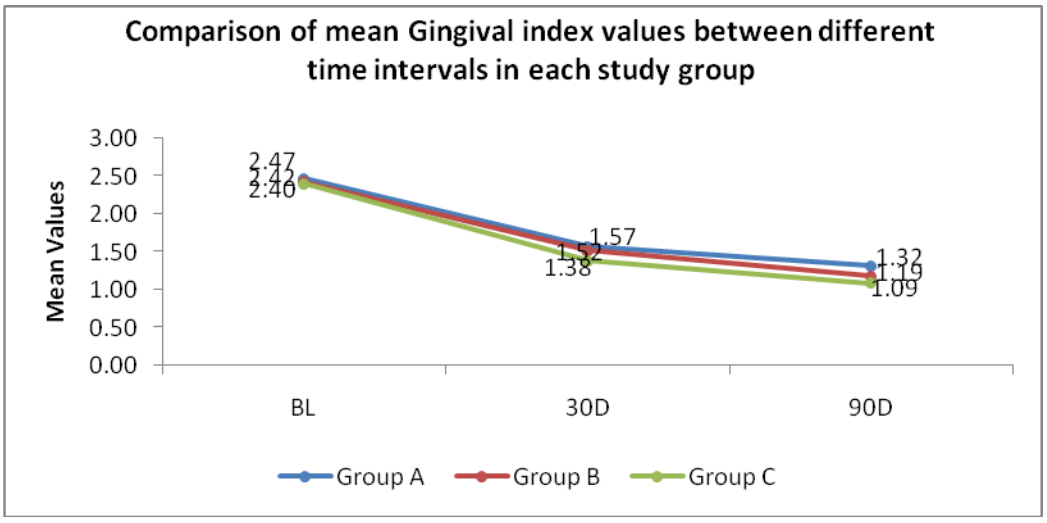
Comparison of mean values of different clinical parameters during post-operative 90 days period between 03 groups using One-way ANOVA test followed by Tukey's HSD post hoc Analysis										
Parameters	Groups	N	Mean	SD	Min	Max	F	P-Value	Sig. Diff	P-Value
PI	Group A	20	1.15	0.10	1.0	1.3	5.255	0.008*	G-A Vs G-B	0.04*
	Group B	20	1.09	0.07	1.0	1.2			G-A Vs G-C	0.01*
	Group C	20	1.07	0.05	1.0	1.2			G-B Vs G-C	0.84
GI	Group A	20	1.18	0.10	1.0	1.4	20.515	<0.001*	G-A Vs G-B	0.005*
	Group B	20	1.11	0.05	1.1	1.2			G-A Vs G-C	<0.001*
	Group C	20	1.05	0.03	1.0	1.1			G-B Vs G-C	0.007*
SBI	Group A	20	1.34	0.06	1.3	1.5	140.427	<0.001*	G-A Vs G-B	<0.001*
	Group B	20	1.24	0.05	1.2	1.4			G-A Vs G-C	<0.001*
	Group C	20	1.06	0.04	1.0	1.2			G-A Vs G-C	<0.001*
PPD	Group A	20	6.15	0.89	5.0	8.0	17.069	<0.001*	G-A Vs G-B	0.007*
	Group B	20	5.37	0.76	4.0	6.5			G-A Vs G-C	<0.001*
	Group C	20	4.70	0.70	4.0	6.0			G-B Vs G-C	0.03*
CAL	Group A	20	6.58	1.15	5.0	9.0	15.429	<0.001*	G-A Vs G-B	0.04*
	Group B	20	5.85	0.78	4.0	7.0			G-A Vs G-C	<0.001*
	Group C	20	4.98	0.75	3.5	6.5			G-B Vs G-C	0.01*

* - Statistically Significant

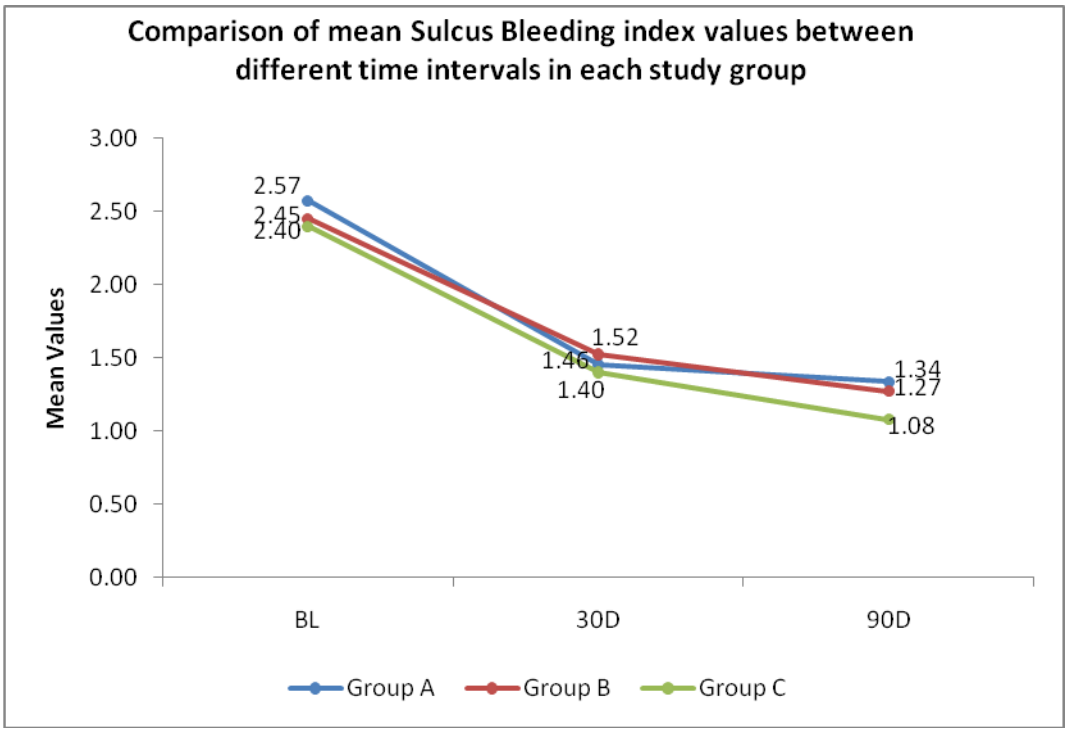
Graph 1



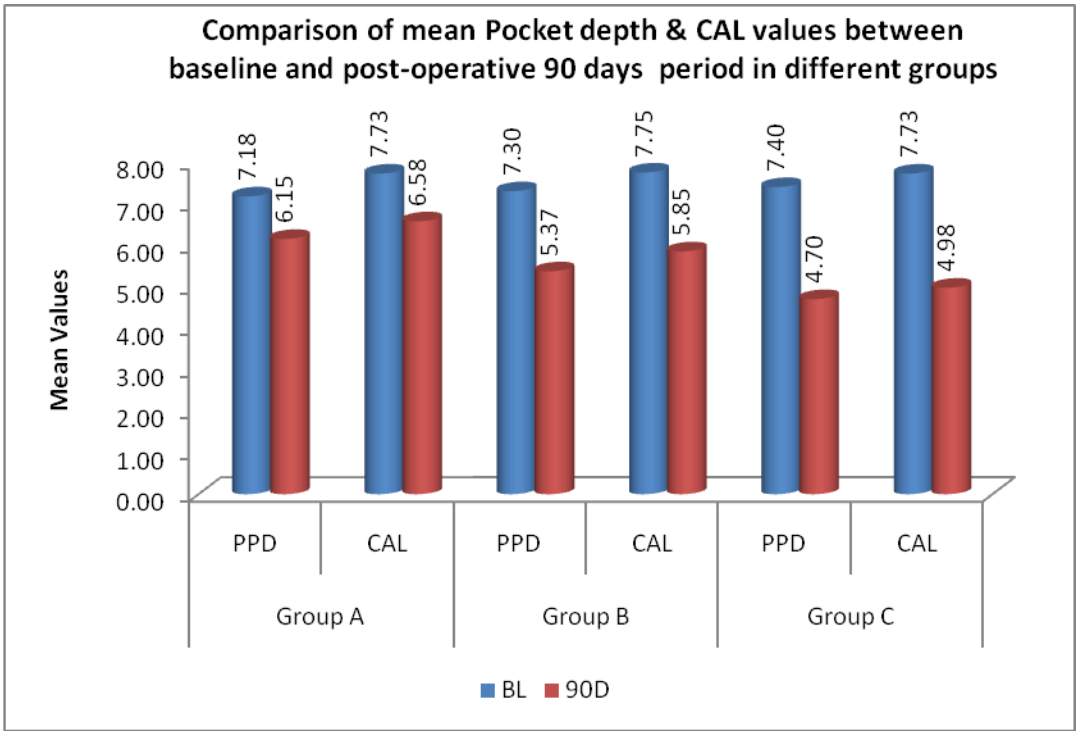
Graph 2



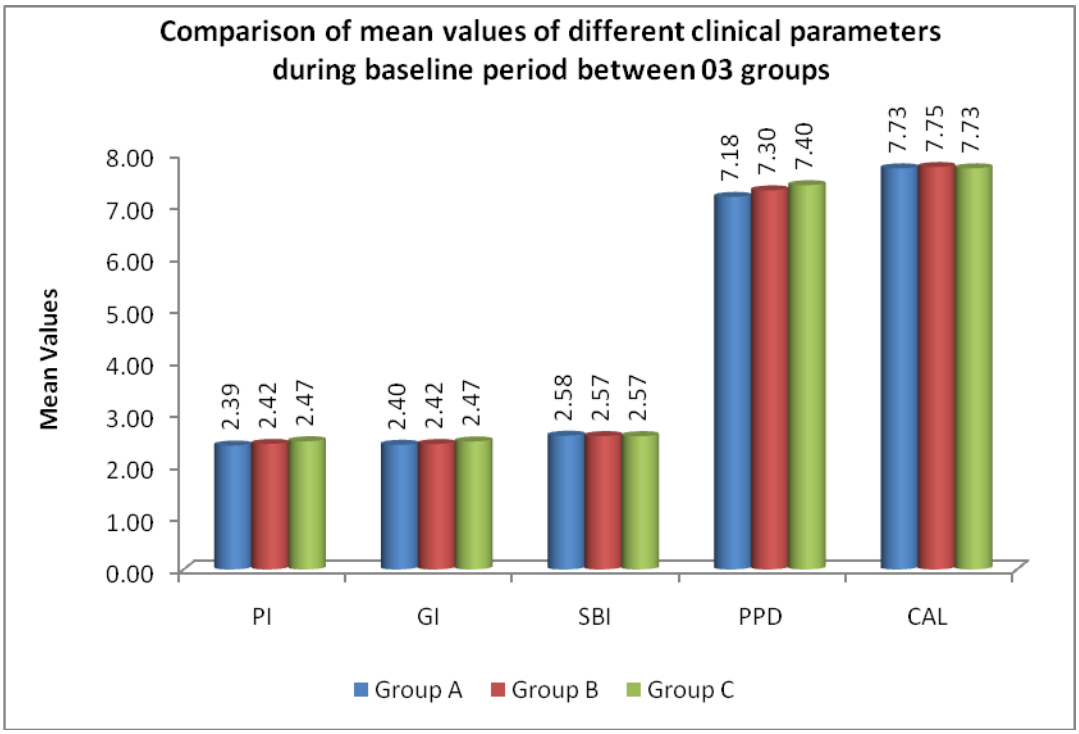
Graph 3



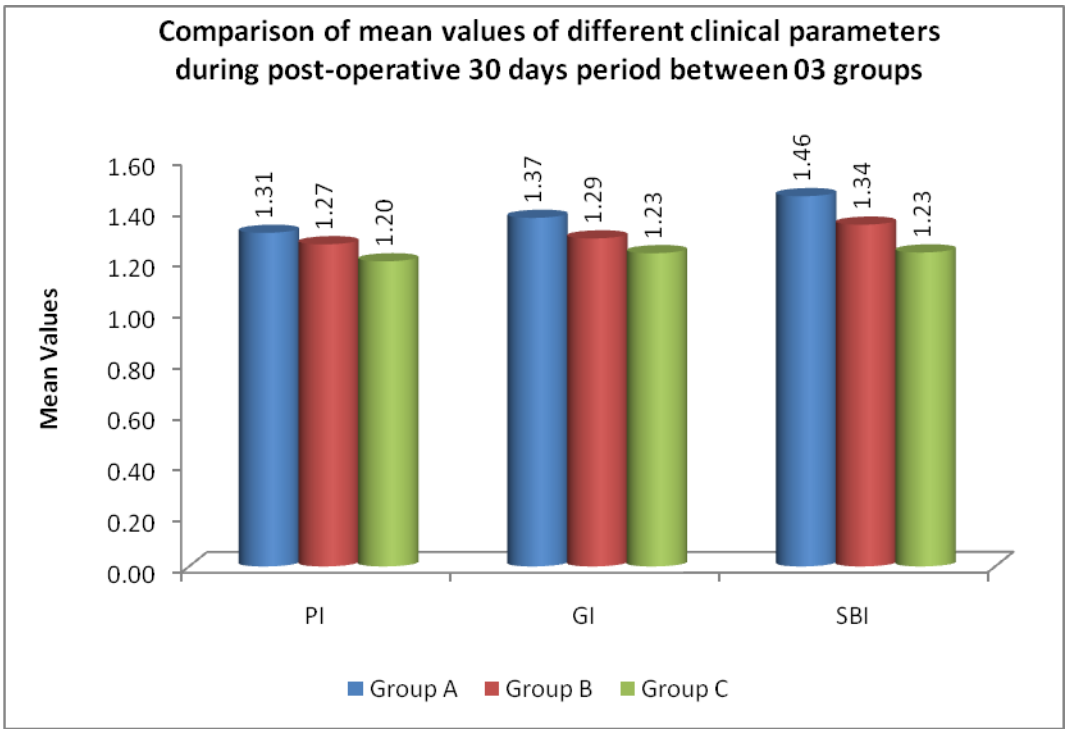
Graph 4



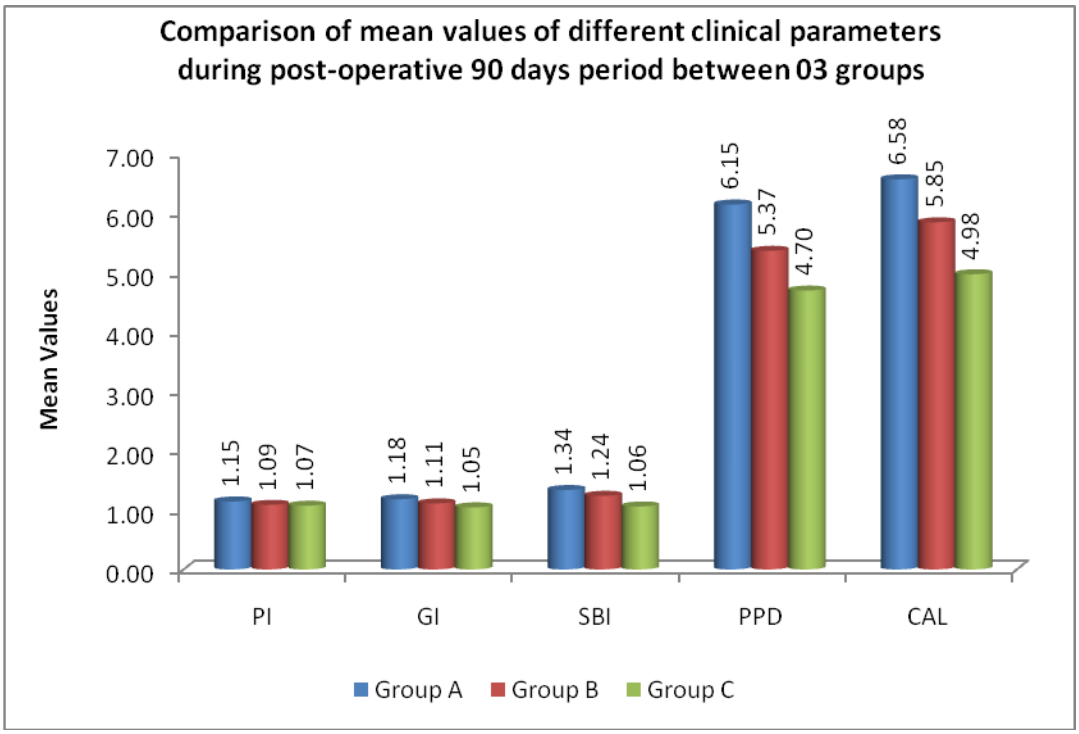
Graph 5



Graph 6



Graph 7



Conclusion

The present study concluded that laser therapy and photodynamic therapy as an adjunct to SRP had added benefit over the SRP alone. However photodynamic therapy + SRP showed a better result compared to Laser + SRP and SRP alone.

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