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COMPARATIVE EVALUATION OF PHOTODYNAMIC THERAPY AS AN ADJUNCT TO SURGICAL PERIODONTAL TREATMENT APPROACH IN STAGE II OR III WITH GRADE B OR C PERIODONTITIS – A CLINICAL STUDY

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ABSTRACT

Background: Periodontal therapy aims to eliminate the etiological factors which plays a primary role in the initiation and progression of disease. Photodynamic therapy is an advanced technique which involves three components; photosensitizer agent (Indocyanine green dye), source of light (LASER) and oxygen.

Aim: To compare the efficacy of surgical periodontal therapy with PDT versus surgical periodontal therapy alone.

Materials And Methods: 5 participants with Stage II or III, with Grade B or C periodontitis with PPD \geq 5 mm on mandibular anterior teeth, were randomly assigned to surgical periodontal therapy (Group 1) and photodynamic therapy assisted surgery (Group 2). PI, GI, PPD, and CAL were measured using UNC-15 probe at baseline and 3 months.

Results: The intra group comparison of all the clinical parameters between 2 study groups were found to be non-significant. Only the intra group comparison of mean GI scores were found to be statistically significant in PTAS group. The inter gp comparison of all the clinical parameters at baseline and after 3 months were found to be significant for PTAS group.

Conclusion: The adjunctive use of PDT to surgical periodontal treatment is a clinical option for significant improvement in clinical parameters in periodontitis cases.

Keywords: Stage II with Grade B Periodontitis, PDT, ICG dye, Diode LASER.

INTRODUCTION:

Periodontitis is a polymicrobial, polygenetic and multi factorial inflammatory disease of the periodontium.¹ It is characterized by destruction of attachment apparatus including alveolar bone loss.^{2,3,4,5}

The results of periodontal therapy aims to reduce and eliminate etiological factors particularly the microbial causative factors. The gold standard treatment includes Phase I therapy and Phase II therapy. Non-surgical periodontal therapy i.e. SRP is indicated mostly in cases of shallow pockets. However, the deep pockets can be treated with Phase II therapy i.e. Surgical periodontal therapy followed by regenerative procedures in cases of intra bony defects. Therefore, the surgical intervention may be considered as the best treatment option by the clinicians to improve the periodontal status in cases of deep probing depth^{3,7,8}. Phase II therapy provides promising results in long-term PPD reduction, CAL gain.

Photodynamic therapy was first introduced with concept of antimicrobial therapy which may inactivate or destroy cells and microorganisms. Diode laser can be used along with conventional surgical therapy and provides additional benefits particularly in terms of healing¹². Diode laser with a wavelength of 650-980nm and anontoxic photosensitizer dye provides bactericidal effects¹³. The mechanism of photodynamic therapy involves the generation of reactive oxygen species which may react or cause damage to the membrane results in the death of micro-organisms¹⁴.

In the present study, Indocyanine green is used as a photosensitizer dye which is water-soluble tri carbocyanine dye belonging to a family of cyanine dyes. It can produce a powerful photosensitized cellular damage with 800-810 nm range of wavelengths. It exhibits strong absorption with peak at around 700nm. The introduction of indocyanine green as photosensitizer dye results in significant reduction of periodontal pathogens.

MATERIAL AND METHODOLOGY: 5 patients with PPD \geq 5mm in mandibular anterior teeth with Stage III or IV with Grade B or C periodontitis were selected from the OPD services, Department of Periodontology and Oral Implantology. Each subject will be given a detailed description of study and a consent form was signed prior to commencement of the study.

INCLUSION CRITERIA

Patients with 25-50 years. Patients with interproximal attachment loss in mandibular anterior teeth with PPD of \geq 5mm. Systemically healthy patients with no known allergy. No surgical periodontal intervention for the past 6 months.

EXCLUSION CRITERIA

Subgingival periodontal therapy or antibiotic therapy for last 6 months. Individuals with any recognized systemic illnesses. Smoking and alcohol. Pregnant and lactating females.

METHODOLOGY:

5 patients were randomly selected to participate in the study. Phase I therapy i.e. complete SRP was performed in all the patients. After phase I therapy, patients who were suffering from Stage II or III with Grade B or C periodontitis with probing pocket depth of \geq 5mm were selected. This study was a split mouth study.

GROUP I (Surgical periodontal therapy group): Received SPT alone. (Figure 1 and 2)

GROUP II (Photodynamic assisted surgery group): Received surgical periodontal therapy with indocyanine green dye assisted PDT. (Figure 3-5)

Group I (Surgical periodontal therapy group):

Crevicular and Interdental incision were given and flap was reflected. After elevation of the flap mechanical debridement was performed with Gracey's curette for the removal of granulation tissue followed by thorough root planning. 3-0 non resorbable silk sutures were given for re approximation of flap. A periodontal dressing was applied to cover the surgical site and was removed after 7 days.

Group II (Photodynamic assisted surgery group):

Crevicular and Interdental incision were given and flap was reflected. After elevation of the flap, mechanical debridement was performed with Gracey's curette for the removal of granulation tissue followed by thorough root planning. Indocyanine green dye was injected with 2 ml syringe on the photodynamic therapy assisted site. Diode laser was activated with a wavelength of 940nm with a continuous wave frequency and a power of 1 watt with 200µm fibre tip for 20-30 seconds and irrigation was done.

3-0 non resorbable silk sutures were given for re approximation of flap. A periodontal dressing was applied to cover the surgical site and was removed after 7 days.

ASSESSMENT OF CLINICAL PARAMETERS

Probing pocket depth (PPD) using UNC 15 periodontal probe, Clinical attachment loss (CAL) using customised acrylic stent, PI Sillness and Loe 1964 and GI Loe and Sillness 1963 were recorded at baseline and 3 months (**Table 1**)

RESULTS

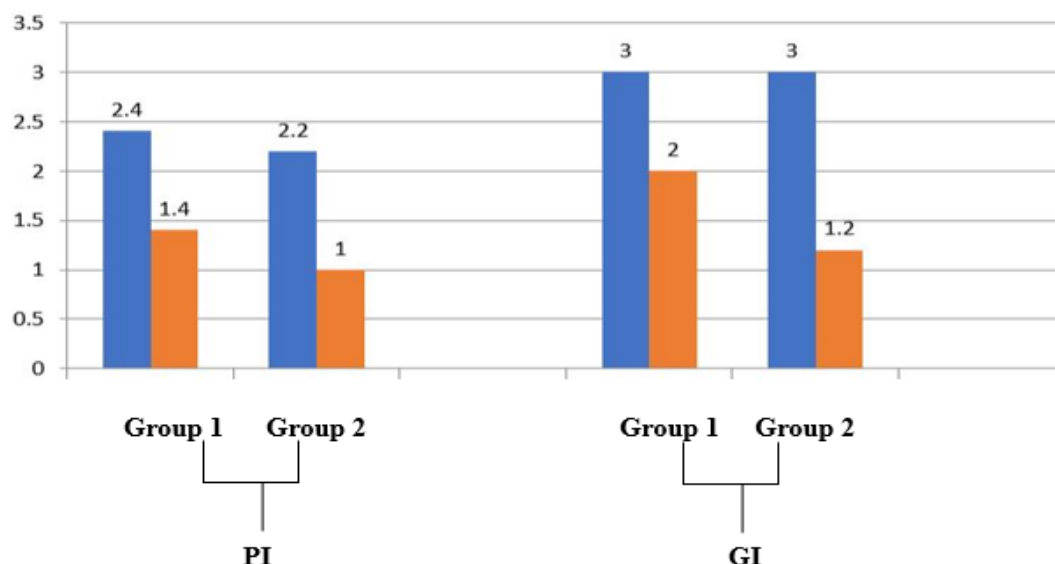
Statistical analysis

Table 1: Intragroup comparison of all the clinical parameters between group 1 and group2

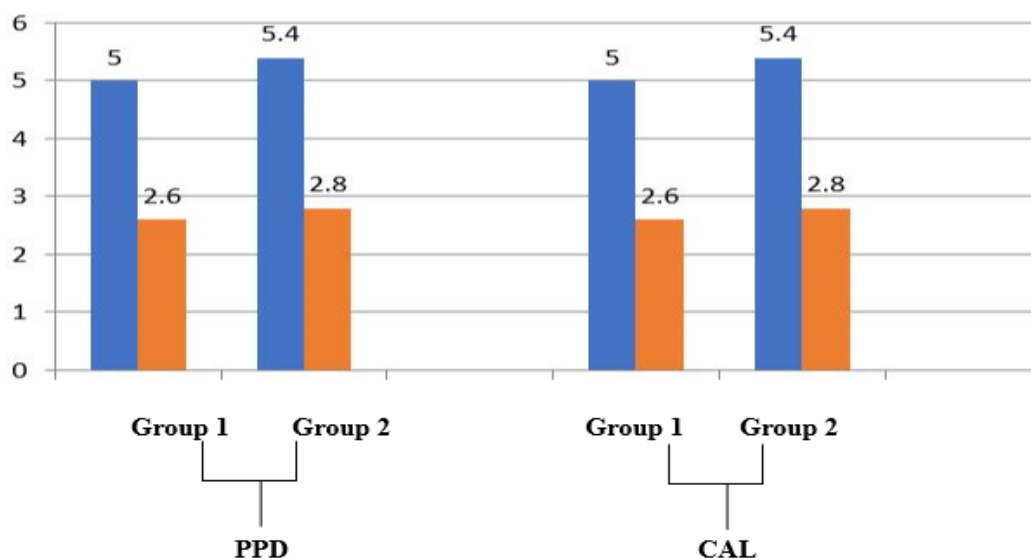
Clinical parameters	Group 1 (Surgical Periodontal Therapy Group)		Group 2 (Photodynamic Assisted Surgery Group)		P value
	Baseline	3 months	Baseline	3 months	
Plaque index	2.40±0.54	1.40±0.54	2.20±0.44	1.00±0.01	0.145*
Gingival index	3.00±0.01	2.00±0.01	3.00±0.01	1.20±0.44	0.001**
PPD	5.00±0.01	2.60±0.54	5.40±0.54	2.80±0.83	1.000*
CAL	5.00±0.01	2.60±0.54	5.40±0.54	2.80±0.83	1.000*

P < 0.05 indicates SS**; P > 0.05 NS*

Paired t test at p value less than 0.05 is significant



Graph 1: Intergroup comparison of plaque index and gingival index between group 1 (Surgical periodontal therapy group) and group 2 (PTAS group)



Graph 2: Intergroup comparison of PPD and CAL between group 1 (Surgical periodontal therapy group) and group 2 (PTAS group)

Table 2: Intergroup comparison between group 1 and group 2 at Baseline and after 3 months

Clinical parameters	Group 1 (Surgical Periodontal Therapy Group)		P value	Group 2 (Photodynamic Assisted Surgery Group)		P value
	Baseline	3 months		Baseline	3 months	
Plaque index	2.40±0.54	1.40±0.54	0.001**	2.20±0.44	1.00±0.01	0.001**
Gingival index	3.00±0.01	2.00±0.01	0.001**	3.00±0.01	1.20±0.44	0.001**
PPD	5.00±0.01	2.60±0.54	0.001**	5.40±0.54	2.80±0.83	0.001**
CAL	5.00±0.01	2.60±0.54	0.001**	5.40±0.54	2.80±0.83	0.001**

P < 0.05 indicates SS**; P > 0.05 NS*

Student t test at p value less than 0.05 is significant

DISCUSSION:

Complete removal of etiological factors is difficult with phase I therapy i.e., SRP alone.¹⁷ After phase I therapy, surgical intervention is indicated in sites having critical probing pocket depth of greater than 5mm. Presence of residual pocket and calculus are the predictive risk factors for the disease progression as well as clinical attachment loss.

Lasers result in enhancing the clinical outcome particularly in terms of healing the periodontal tissues.¹⁸ Photodynamic therapy results in significant reduction of periodontal pathogens particularly red complex and green complex bacteria.¹⁵

There is insufficient data in the literature to evaluate the efficiency of PDT in the surgical management of periodontitis. The findings of the current study also showed that over the surgical periodontal therapy group, the PTAS group with a single application of PDT resulted in clinical differences in PPD values, gain in CAL, reduction in PI, and GI with significant differences between the groups. (Graph 1-2)

The adjunctive use of PDT provides advantages as it can easily irradiate the inaccessible areas. With conventional therapy there are chances of increased bacterial resistance to antibiotics, whereas PDT is highly unlikely to cause bacterial resistance. PDT mainly causes damage to the cytoplasmic membrane and DNA because of photo destruction. An investigation conducted in 2016 by Abbas Monzavi found that the use of indocyanine green as a photosensitizer in the treatment of chronic periodontitis dramatically decreased clinical indices such as GI and PPD.²⁰ (Table 2)

The significant reduction in the GI score in PTAS group is due to reduction of the inflammatory mediators which results in decreased inflammation and BOP. Woodruff et al. showed that the favourable effect of PDT and laser treatment on soft tissue healing would allow an increase in collagen fibre production in the region where PDT was administered.

GROUP I SURGICAL PERIODONTAL THERAPY

Figure 1: PPD measured at baseline wrt 42



Figure 2: PPD measured after 3 months wrt 42

GROUP II PHOTODYNAMIC THERAPY ASSISTED SURGERY

Figure 3: PPD measured at baseline wrt 32



Figure 4: ICG dye application with cannula



Figure 5: PPD measured after 3 months wrt 32

CONCLUSION:

Given the study's limitations, that individuals with periodontitis can benefit from the successful use of both LASER and PDT. PPD and GI score were two clinical parameters where PDT demonstrated improvement. In the future, more research should be done to corroborate the results on the optimization of laser settings and treatment frequency in larger sample sizes. To assess the outcome in a more predictive manner, the microbiological examination of inflammatory markers and periodontal infections should be carried out.

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