COMPARATIVE EVALUATION OF EFFICACY OF SCALING AND ROOT PLANING WITH AND WITHOUT CHLORHEXIDINE CHIP AND DIODE LASER IN CHRONIC PERIODONTITIS PATIENTS

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Abstract

Introduction: The motive of the present study is to comparatively measure the competence and effectiveness of diode laser and chlorhexidine chip as adjuncts to the scaling and root planing procedure, in patients with chronic periodontitis.

Aim: To evaluate the efficacy of diode laser and chlorhexidine chip before and after scaling and root planing in the management of chronic periodontitis. The objective is to compare the efficacy of chlorhexidine chip and diode laser before and after scaling and root planning on clinical parameters.

Study and design: Randomized clinical trial with split mouth design done in the Department of Periodontics and Implantology.

Materials and methods: Twenty chronic periodontitis patients having a probing pocket depth of 5mm-7mm on at least one interproximal site in each quadrant of the mouth were selected in the study. After initial treatment, four sites in each patient were randomly subjected to scaling and root planing (control), chlorhexidine chip application (CHX chip group), diode laser (810 nm) decontamination (Diode laser group) or combination of both (Diode laser and chip group). All subjects received a clinical periodontal examination by single examiner who recorded all the variables by manual procedure. Clinical parameters namely Plaque index (PI), Gingival Index (GI), probing pocket depth (PPD) and clinical attachment level (CAL) were assessed at baseline, one month and three months. Results were statistically analysed using one-way ANOVA followed by Post Hoc Analysis.

Results: The differences in PPD reduction and CAL gain between control group and CHX chip and combination groups were statistically significant ($p < 0.05$) at three months, whereas, the diode laser group did not show any significant difference from the control group.

Conclusion: Within the limitations in the present study, the following conclusions were derived, i.e., chlorhexidine local delivery alone or in combination with diode laser decontamination is effective in improving oral hygiene, reducing gingival inflammation, reducing probing pocket depth and improving clinical attachment levels when used as adjuncts to scaling and root planing in non-surgical periodontal therapy of patients with chronic periodontitis.

Keywords: Diode laser decontamination, Local drug delivery, Scaling and root planing.

Introduction:

Periodontal disease is initiated by pathogenic plaque biofilm and characterized by bacteria induced inflammatory destruction of tooth-supporting structures and alveolar bone.¹ Periodontal pathogens evade the host response by releasing virulence factors in surrounding environment² and cannot be completely eradicated with nonsurgical periodontal therapy due to their tissue invasive property. Recurrent periodontal tissue destruction is almost inevitable in patients who fail to achieve an

acceptable plaque control during treatment or maintenance phase of periodontal therapy.³

A local drug delivery device comprises of a limiting element that steers the rate of medicament release and a drug reservoir. This maintains the concentration of active agents at the site of activity for long periods, despite loss of drug from crevicular fluid clearance.⁴ Different drugs used for local delivery are tetracyclines, including metronidazole and chlorhexidine. chlorhexidine has proven to be the

most effective, safe and clinically effective in reducing plaque and gingivitis of all the chemical plaque control agents, and is the time-tested gold standard for the treatment of periodontal diseases.⁵

Chlorhexidine (CHX) is a broad-spectrum antimicrobial agent that at low concentrations causes damage to the cell membrane of microorganisms, while at higher concentrations is known to cause precipitation and coagulation of the proteins in the cytoplasm of exposed microbes.⁶ Various studies have validated the efficacy of CHX chip, and it has been noticed that the average concentration of CHX in the gingival crevicular fluid remains greater than 125 mg/mL for eight days and is inhibitory to 99% of bacteria isolated from periodontal pockets.⁷

Periochip™ is the controlled release subgingival delivery of chlorhexidine. It measures 5 mm × 4 mm × 0.3 mm, weighs about 7.4 mg.⁸ Each Periochip™ – CG contains approximately 2.5 mg of chlorhexidine gluconate in a biodegradable matrix of Type 1 collagen. PerioChip™-CG releases chlorhexidine with a release of approximately 40-45% within 24h and then after in linear fashion for 7-8 days.⁹

Diode lasers are a group of lasers operating by a solid-state semiconductor, among which the most commonly used are the Gallium-aluminium-arsenide (GaAlAs) laser with a wavelength of 810 nm and the Indium-gallium-arsenide-phosphide (InGaAsP) laser at 980 nm of wavelength.¹⁰ Laser light at 800-980 nm is very poorly absorbed by water and by hard tissues, being highly absorbed by hemoglobin and pigments. Diode lasers are very effective for soft tissue applications including incision, hemostasis and coagulation.¹³ The advantages include a bloodless operating field, minimal swelling and scarring, and much less or no postsurgical pain.^{12,14} Studies have shown enhanced, faster and more comfortable wound healing when the diode laser is used in conjunction with scaling and root planing.¹⁵

Aim

The main aim of the present study was being undertaken to evaluate the efficacy of diode laser and chlorhexidine chip before and after scaling and root planing in the management of chronic periodontitis. And to compare the efficacy of chlorhexidine chip and diode laser before and after scaling and root planing on clinical parameters.

Materials and Methods

Study design

It was a randomized clinical trial study with split mouth design. A total of 20 chronic periodontitis patients (as per criteria) were chosen for the study. The purpose of the study was explained to the patients and written consent was obtained. The ethical clearance was taken from D.J College of Dental Sciences and Research, Modinagar.

Inclusion Criteria:

A minimum of 15 teeth must be present. Probing pocket depth measuring 5mm-7mm in each quadrant with one interproximal site was obtained. Patients should be non-smokers, co-operative and able to attend the hospital for regular follow-up.

Exclusion Criteria:

Patients suffering from any known systemic disease. Patients who had received any known nonsurgical or surgical periodontal therapy or who had taken antibiotics, chemotherapeutic mouth rinses within the last six months of the start of the study. Patients with known hypersensitivity to chlorhexidine were also excluded.

Treatment Procedure

All subjects received a clinical periodontal examination by single examiner who recorded all the variables by manual procedure. Clinical parameters namely Plaque Index (PI), Gingival Index (GI), Probing pocket depth (PPD) and Clinical attachment level (CAL) were recorded in all selected patients.

After 1 week, one interproximal site in each quadrant with a probing depth of 5mm-7mm was randomly assigned to receive one of the following treatments modalities. One of the sites assigned as control group, 1 week before treatment, supragingival scaling was performed for each patient by using hand instruments (Gracey curettes, Hu-Friedy) and ultrasonic devices. Full-mouth subgingival scaling and root planing was performed in a single appointment for each patient in all groups using an ultrasonic scaler and hand instruments.

1 week after Spathe laser treatment was performed by Gallium-Aluminum-Arsenide (Gaius) diode laser with optimal fiber emitting light at wavelength of 810 nm with a tip diameter of 400 micrometer. The periodontal pocket was set at 0.5 W with a pulse

interval of 20 ms and pulse length of 20 ms delivering 20 s/ cm² and 15 J/cm² of energy. Irradiation was accomplished with a 400 µm fiber optic delivery system.

The fiber was inserted into the periodontal pocket with 1mm short of measured periodontal pocket depth from apical to coronal directions continuously almost parallel to the tooth, in a sweeping motion during the laser light emission. Time duration of 10 seconds per site was used with power setting of 0.5 watts in continuous mode. The sweeping motion was done mesially to distally at the buccal aspect for 10 s and distally to mesially at the lingual aspect for 10 s, a total of 20 s for each tooth. After each session of irradiation, the periodontal pocket was irrigated with saline solution. Pockets were also rinsed with saline after SRP in the control group in order to control for the same conditions. During laser application both the patients and the operator wore protective glasses.

Chlorhexidine chip placement: -The area was dried after SRP. Chlorhexidine chip was then inserted into periodontal pocket with the help of tweezers. The curved end of chlorhexidine chip was first inserted into periodontal pocket and the flat end was grasped with a sharp tweezer.

The sites where chlorhexidine chip application was done periodontal dressing (coe-pack) was placed. For the evaluation of any displacement of chip, all the patients were recalled after 10 days. Approximately 2.5 mg of chlorhexidine was contained in each chip, in a biodegradable matrix of collagen type-1 which is derived from the air bladder of about 10 mg and the thickness is 0.25-0.32 mm. The size of the chip is 4*5mm. However, the coronal edge of chip is degraded in just 10 days, the chip is resorbed in 30 days. Re-evaluation and all clinical parameters were recorded at 1 month and 3 months. A same examiner who was blinded for the procedure recorded the data at all intervals.

Laser decontamination and chlorhexidine chip application: -In this procedure, first laser decontamination procedure was performed then on the same day followed by chlorhexidine chip application and evaluation was done and at time interval of baseline, 1 month and 3 months all clinical parameters were recorded. The same examiner who was blinded for the procedure recorded the data at all intervals.

FIGURE 1: CHLORHEXIDINE CHIP (PERIOCHIP CONTAINING 2.5MG OF CHLORHEXIDINE GLUCONATE)

Statistical Analysis

The data for the present study was entered in the Microsoft Excel 2007 and analyzed using the SPSS statistical software 19.0 Version. The descriptive statistics included mean, standard deviation. The level of the significance for the present study was fixed at 5%. The intergroup comparison for the difference of mean scores between independent groups was done

using the One Way ANOVA followed by Post Hoc Analysis.

Results

This study was conducted to evaluate the efficacy of scaling and root planing with and without chlorhexidine chip and diode laser in chronic periodontitis patients. A total of 20 chronic

periodontitis patients of either sex was selected and a randomized clinical trial with split mouth design was carried out. Following clinical parameters were recorded at baseline, 1 month and 3 months after treatment: -Plaque Index (PI); Gingival Index (GI); Probing pocket depth (PPD); Clinical attachment level (CAL).

Healing was uneventful in all cases and no adverse effects, such as discomfort, burning sensation, or pain related to the laser irradiation or CHX chip application, were reported by any of the subjects. One-way ANOVA test was carried out in order to assess whether this difference is significant. The mean reduction in plaque index score, Gingival Index score, mean reduction in probing pocket depth and mean gain in relative clinical attachment level were statistically significant between both the interval i.e., in all the four groups, from baseline to one month ($p < 0.01$) and baseline to three months ($p < 0.01$).

Table-1- showed the intragroup comparison of plaque index between different time intervals-Baseline, 1 month and 3 months. All of these values were found to be statistically significant. Result showed that the **CHX chip** group was slightly more efficient in the

reduction of the Plaque index as compared to the other three groups.

Table-2- showed the intragroup comparison of gingival index between different time intervals-Baseline, 1 month and 3 months. All of these values were found to be statistically significant. Here the result showed that the **CHX chip** group was slightly more efficient in the reduction of the Gingival index as compared to the other three groups.

Table-3- showed the intragroup comparison of probing depth scores between different time intervals-Baseline, 1 Month and 3 Months. All of these values were found to be statistically significant. In the result, it was found that the **Diode + CHX chip** group was slightly more efficient in the reduction of the Probing depth as compared to the other three groups.

Table-4 showed the intragroup comparison of clinical attachment level (CAL) between different time intervals-Baseline, 1 Month and 3 Months. All of these values were found to be statistically significant. Here the result showed that the **Diode + CHX chip** group was slightly more efficient in the reduction of the CAL score as compared to the other three groups.

Table 1:

		Baseline	1 Months	3 Months	P value
Plaque Index	SRP	2.45±0.06	1.92±0.28	1.17±0.19	0.001 (Significant)
	Diode	2.35±0.20	1.62±0.20	0.79±0.25	0.001 (Significant)
	Chx Chip	2.38±0.12	1.52±0.11	0.61±0.06	0.001 (Significant)
	Diode and Chx	2.24±0.10	1.39±0.10	0.58±0.09	0.001 (Significant)

TABLE 2:

		Baseline	1 Months	3 Months	P value
Gingival Index	SRP	2.49±0.06	1.97±0.20	1.21±0.21	0.001 (Significant)
	Diode	2.37±0.10	1.64±0.13	0.84±0.17	0.001 (Significant)
	Chx Chip	2.38±0.14	1.53±0.10	0.67±0.07	0.001 (Significant)
	Diode and Chx	2.16±0.26	1.38±0.11	0.61±0.12	0.001 (Significant)

TABLE 3:

		Baseline	1 Months	3 Months	Percentage Change
Probing Depth	SRP	6.40±0.24	5.03±0.38	4.71±0.37	0.001 (Significant)
	Diode	6.20±0.08	4.98±0.31	4.83±0.30	0.001 (Significant)
	Chx Chip	6.12±0.06	3.55±0.12	3.30±0.16	0.001 (Significant)
	Diode and Chx	6.21±0.13	3.66±0.30	3.14±0.34	0.001 (Significant)

TABLE 4:

		Baseline	1 Months	3 Months	P value
CAL	SRP	8.20±0.35	7.19±0.106	6.88±0.149	0.001 (Significant)
	Diode	8.42±0.082	7.62±0.465	7.39±0.480	0.001 (Significant)
	Chx Chip	8.49±0.079	6.04±0.272	5.65±0.173	0.001 (Significant)
	Diode and Chx	8.53±0.082	5.89±0.247	5.67±0.198	0.001 (Significant)

Discussion

Periodontal diseases are bacterial infections characterized by inflammation and destruction of the attachment apparatus, often leading to tooth level. Periodontitis is defined as "an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession, or both."¹⁶

The diode laser in dentistry is used for removal of the inflammatory products while creating excellent hemostasis and the treatment of diseased periodontal soft tissue, allowing significant bacterial reduction. A flexible fiber optic delivery system allows the clinician safe and easy access around the periodontal pocket. The wavelengths are transmitted through water and are very poorly absorbed in apatite crystals.¹⁷

Chlorhexidine has wide spectrum of activity and acts on both gram negative and gram-positive bacteria, yeast and some lipophilic viruses. The first slow-release device -containing chlorhexidine was developed by *Friedman and Golomb*.¹⁸

It was concluded in the study that all the four treatment modalities resulted in significant improvements in all clinical parameters (Plaque index, Gingival index, Probing pocket depth and clinical attachment level) after periodontal treatment. However, clinical reductions were the most in the (Diode laser + CHX chip) group compared to the other three groups.

The inter-group comparison of plaque index and gingival index showed significant differences between all groups at three months. The test groups showed more reduction when compared with control (SRP) Arsenide (reduction was seen in CHX chip group, when compared with other three groups (Spinode and Diadochy chip). Present study showed no significant improvement in pocket depth and

clinical attachment gain in laser group when compared to control group.

Nguyen NT¹⁹ showed that by using the diode laser, intragroup analyses showed that sites treated with SRP + Laser or SRP alone had a statistically significant reduction of PD, gain in CAL at 3 months after treatment but in intergroup analyses showed no statistically significant difference in the mean change of the clinical parameters between the SRP + Laser and SRP alone groups. SRP + Laser did not enhance clinical outcomes compared to SRP alone in the treatment of inflamed sites with 5 mm PD it is confirmed.

According to *Dukic W²⁰* et al found that the results were significant PD gain in moderate pockets during the baseline to 18-week and 6-to-18-week periods, whereas no difference was found between Control group and laser group in the remaining clinical parameters and multiple adjunctive applications of a 980-nm diode laser with SRP showed PD improvements only in moderate periodontal pockets indicated that when compared to SRP alone.

This study showed statistically significant reduction in PPD and mean gain in CAL in CHX chip group when compared with control group. Intergroup comparison of test groups revealed that the combination of laser decontamination and chlorhexidine chip group showed statistically significant difference in PPD reduction and gain in CAL compared to diode laser group at three months. But comparing chlorhexidine group with combination group there was no statistical significant difference. It can be interpreted that prior to local delivery of chlorhexidine there is no added benefit of laser decontamination of a pocket.

According to *Marjorie K. Jeffcoat²¹*, found that at 9 months, there was significant differences in the change in probing depth and clinical attachment levels favoring the active chlorhexidine chip over SRP alone. It also indicated that CHX group, when

used as adjunct to scaling and root planing, significantly reduces loss of alveolar bone.

According to a study done by *Tansel Mizrak et al.*²², when used as adjunctive therapy to SRP in patients with chronic periodontitis, the chlorhexidine chip had a positive effect on clinical parameters i.e., plaque index, probing depth, clinical attachment level and subgingival flora.

The current study was designed to test if the diode laser or CHX chip enhances the treatment outcomes of the SRP in periodontitis. More vigorous work needs to be done to confirm the usefulness of the diode laser and CHX Chip with SRP which would greatly facilitate the treatment of periodontal diseases.

Conclusion

In the present study following conclusions were derived, chlorhexidine local delivery alone or in combination with diode laser decontamination when used as adjuncts to scaling and root planing in non-surgical periodontal therapy of patients with chronic periodontitis is effective in reducing improving clinical attachment levels and probing pocket depth.

Though there are some limitations of the present study, such as the study period being too short and the study population being very less. Also no microbiological investigations were carried out to evaluate the antimicrobial effects of both Laser and CHX chip. To come to a final conclusion, Diode along with CHX chip acts as an effective tool as an adjunct to SRP for the treatment of Chronic periodontitis. However to substantiate the role of Laser decontamination and CHX chip of periodontal pockets as an effective tool in the management of Chronic periodontitis, further studies employing a larger sample size with multiple Laser and CHX chip applications are warranted.

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