

Efficacy of Scaling and Root Planing with and without Adjunctive Use of Diode Laser or 1% Ornidazole Gel as Local Drug Delivery in the Management of Chronic Periodontitis: An Experimental Study

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KEYWORDS

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ABSTRACT

Background: Chronic periodontitis is a prevalent inflammatory disease affecting the supporting structures of the teeth. Scaling and root planing (SRP) is a conventional non-surgical therapy. However, adjunctive treatments like diode lasers and local drug delivery systems (e.g., 1% Ornidazole gel) have been proposed to enhance treatment outcomes. This study aimed to assess the efficacy of SRP alone and combined with diode laser or 1% Ornidazole gel as adjunctive therapies for managing chronic periodontitis.

Materials and Methods: This experimental study included forty five individuals of both gender aged between 27 and 60 years diagnosed with chronic periodontitis and having pocket depths >4 mm in different quadrants of the mouth were selected and divided equally into three groups as Group-I (treated with SRP only), Group-II (treated with SRP and diode Laser application of 1.5 w, 980nm, 30sec continuous wave), Group-III (treated with SRP and Application of 1% Ornidazole gel, as local drug delivery). Clinical parameters including gingival index (GI), probing pocket depth (PPD), clinical attachment level (CAL) were recorded at baseline and after 1 month of treatment. Statistical analysis was performed to compare the outcomes among the three groups.

Results: All groups exhibited significant improvement in periodontal health, with reductions in GI, PPD and improvements in CAL. The intra-group comparison of all three groups from baseline to one month showed a statistically significant reduction in GI, PPD and CAL. In contrast, the intergroup comparison between Group I (SRP only) and Group II (SRP+Diode laser) showed statistically non-significant results in PPD and CAL. A statistically significant reduction in PPD and CAL was observed in Group III (SRP+ 1% Ornidazole gel) compared to Group I and Group II.

Conclusion: Adjunctive use of diode laser and 1% Ornidazole gel enhances the efficacy of SRP in treating chronic periodontitis. Both modalities offer clinical benefits over SRP alone, with the 1% ornidazole showing marginally better results. when used as an adjunct to scaling and root planing in non-surgical periodontal therapy of patients with chronic periodontitis. Further research with a larger sample size and longer follow-up is needed to validate these findings.

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1. Introduction

Periodontitis is an inflammatory disease which causes destruction of the tooth supporting tissues which is characterized by multifactorial aetiology with pathogenic bacteria being primary etiologic agents that harbours sub gingival area.¹ The clinical signs include changes in the morphology of gingival tissues with gingival bleeding and periodontal pocket formation. This pocket makes an ideal environment for the growth and proliferation of anaerobic pathogenic bacteria.² Hence the treatment of periodontal disease is based on the eradication of gingival inflammation, elimination of bleeding, reducing pocket depth and arrest of the progressive destruction of soft tissue and bone.

Mechanical debridement alone may fail to eliminate the putative pathogens from the pockets completely because of the location of these organisms within gingival tissue or in deeper areas inaccessible to periodontal instrumentations and thus results in recurrence of disease. Moreover, recolonization of pathogenic bacteria occurs from the residual bacterial reservoir in dentinal tubules causing renewal of the inflammatory condition.³

Apart from conventional treatment modalities, numerous adjunctive therapeutic strategies have evolved to manage periodontal diseases. The use of lasers or local drug delivery agents are some of the adjunctive therapeutic agents presently available. 4

Laser is an acronym for Light Amplification by Stimulated Emission of Radiation. In 2015, Antonio Crispino evaluated the effect of a 940-nm diode laser as an adjunct to SRP in patients affected by periodontitis. He concluded that the laser diode can be routinely associated with mechanical non-surgical therapy (SRP) in the treatment of periodontal pockets of patients with moderate-to-severe chronic periodontitis.⁶ The microbiological effects of laser decontamination is perhaps a lesser investigated aspect of lasers in periodontal treatment. Just as conventional root debridement removes biofilm and accretions from the hard tooth surface; laser decontamination removes biofilm within the necrotic tissue of the pocket wall. The laser energy interacts strongly with inflamed tissue components (from preferential absorption by chromophores, which are more abundant in diseased tissues) and less strongly with healthy tissue. This nonsurgical therapy uses very low settings and decontaminates rather than cutting the tissue. ⁷

The addition of antimicrobials both locally and systemically would augment a treatment protocol and serve as an adjunct to mechanical therapy. Systemic use of antimicrobials has adverse effects such as drug toxicity, acquired bacterial resistance, drug interaction and patient's compliance.⁸ Local delivery of antibacterial agents into periodontal pockets overrides these shortcomings. This mode of drug delivery avoids most of the problems associated with systemic therapy, limiting the drug to its target site and hence achieving a much higher concentration.⁹ Some of the antimicrobials available as local drug delivery systems are Tetracycline fibers, Metronidazole gel, Minocycline ointment and microspheres, Chlorhexidine gel and Doxycycline hyclate etc.¹⁰ Nitroimidazole (Ornidazole) compound acts by inhibiting DNA synthesis. It works on the principle that inactive form passively diffuses into cell where it is activated by chemical reduction. The nitro group gets reduced into anion radicals which causes oxidation of DNA leading to strand breakage and cell death. Hence, it has both antimicrobial and mutagenic effects. This effect is primarily seen on obligate Gram-negative anaerobes such as *Porphyromonas gingivalis*, *Prevotella intermedia*, *Fusobacterium*, *Selenomonas sputigena*, *Bacteroides forsythus*, and the Gram-positive anaerobes such as *Peptostreptococcus* and *Campylobacter rectus*, which are implicated in periodontal disease.¹¹

In spite of being the two prominent adjuncts to scaling and root planing, only a few studies have compared local drug delivery and lasers in the management of periodontal diseases.¹²

Hence, the present study was designed to evaluate and compare the treatment outcomes of SRP alone versus SRP combined with laser therapy or Ornidazole gel as adjunctive treatment.

2. Materials and Methods

The study was conducted in the outpatient Department of Periodontics at Chhattisgarh Dental College & Research Institute. The institutional ethical committee approved the randomized controlled study (CDCRI/DEAN/ETHICSCOMMITTEE/PERIO/PG-01/2022 Dated 27/09/2022). A total of forty-five patients who fulfilled the inclusion and exclusion criteria were included in the study and divided equally into three groups as Group-I (treated with SRP only), Group-II (treated with SRP and diode Laser application of 1.5 w, 980nm, 30sec continuous wave), Group-III (treated with SRP and Application of 1% Ornidazole gel, as local drug delivery). There were 27 males and 18 females in the age group of 27 – 60 years. The purpose of the study was explained to the patients, and written informed consent was obtained. The inclusion criteria required patients to have at least 15 teeth, a periodontal probing depth of 4 mm or more in different quadrants on single or multiple teeth, be non-smokers, and exhibit cooperation. The exclusion criteria included patients who had undergone any surgical or nonsurgical periodontal therapy, taken antibiotic or chemotherapeutic mouth rinses within six months before the study, were pregnant or lactating or used tobacco.

Each patient's complete medical and dental history was taken. The proforma was duly filled on the first visit with all the baseline clinical index and clinical parameters (GI, PPD, CAL) with the help of UNC 15 periodontal probe. The sites to be treated were infiltrated with 2% solutions of lignocaine hydrochloride with 1:200000 adrenaline. In group I patients, sub-gingival scaling and root planing were accomplished with either universal or area-specific Gracey curettes.¹³

In group II patients, selected sites were treated by diode laser after SRP. The diode was set at 1.5 w, 980nm, 30-

second continuous wave and the tip was inserted into the pocket. After inserting the tip of the laser fiber into the base of the pocket, it was moved for a few seconds within the pocket and slowly withdrawn from the site. In group III Patients, after SRP, Ornidazole gel was subgingivally injected with a 2ml disposable syringe with a blunt needle bent at its shank by 130°. This procedure was continued until the pocket was completely filled. Care was taken to apply the gel without traumatizing or damaging the periodontal tissues. After insertion of the local drug delivery system, the region was secured with a periodontal pack, and the patients were advised not to eat hard food that could traumatize the gingiva.¹⁴ They were also advised not to brush the treated areas for 12 hours or floss or use interproximal cleaning devices for 10 days. They were instructed not to use mouthwash during the study, and Group III subjects were recalled for periodontal pack removal after 1 week.¹⁵

After completion of phase I therapy and the adjunct use of laser and Ornidazole gel, the patients were reviewed at 1 month to record the clinical parameters. Clinical parameters for the groups were recorded.

STATISTICAL ANALYSIS: -

Statistical analyses were performed using SPSS 16.0. Descriptive analyses were performed by the calculation of mean and SD. The data were analysed by paired t-test, one-way-ANOVA, chi square test or Fisher's exact test, and repeated measure ANOVA. A statistical significance was assumed when $p < 0.05$.

3. Results:

Intra-group comparison: -

The baseline values of all three parameters were statistically significant as determined by one-way ANOVA. The chi-square test was done to analyse statistically significant differences among three groups at one month and one month. The mean reduction in Gingival Index score (Table 1), mean reduction in probing pocket depth (Table 2) and mean gain in clinical attachment level (Table 3) were statistically highly significant between baseline to one month ($p < 0.01$).

Table 1: Gingival Index showing comparison between baseline and 1 month of all three groups, $p < 0.001$ highly significant

Gingival Index (GI)	Observation period	Mean \pm SD	Comparison	Difference	P value
SRP	Baseline	2.33 \pm 0.62			
	1 month	1.33 \pm 0.62	BL vs 1 month	1.00 \pm 0	<0.001 HS
Ornidazole Gel	Baseline	2.27 \pm 0.59			
	1 month	0.6 \pm 0.63	BL vs 1 month	1.67 \pm 0.72	<0.001 HS
Laser	Baseline	2.33 \pm 0.62			
	1 month	1.27 \pm 0.59	BL vs 1 month	1.07 \pm 0.26	<0.001 HS

Table 2: Probing Pocket Depth showing comparison between baseline and 1 month of all three groups, $p < 0.001$ highly significant

Probing Pocket Depth (PPD)	Observation period	Mean \pm SD	Comparison	Difference	P value
SRP	Baseline	6.67 \pm 1.44			
	1 month	4.87 \pm 1.2	BL vs 1 month	1.8 \pm 0.49	<0.001 HS
OrnidazoleGel	Baseline	7.87 \pm 1.36			
	1 month	3.17 \pm 0.86	BL vs 1 month	4.7 \pm 0.96	<0.001 HS
Laser	Baseline	7.23 \pm 1.56			
	1 month	4.17 \pm 1.11	BL vs 1 month	3.07 \pm 0.98	<0.001 HS

Table 3: Clinical attachment level showing the intra-group comparison between baseline and 1 month of all three groups, $p < 0.001$ highly significant

Clinical Attachment Level (CAL)	Observation period	Mean \pm SD	Comparison	Difference	P value
SRP	Baseline	6.87 \pm 1.38			
	1 month	5.03 \pm 1.2	BL vs 1 month	1.83 \pm 0.52	<0.001 HS

Ornidazole Gel	Baseline	7.97±1.49			
	1 month	3.3±0.9	BL vs 1 month	4.67±1.03	<0.001 HS
Laser	Baseline	7.27±1.67			
	1 month	4.5±1.71	BL vs 1 month	2.77±1.4	<0.001 HS

Intergroup Comparison: -

In table 4, the change in mean reduction of PPD compared to Group I (SRP Only) was 0.06mm & 0.73mm in diode laser group and Ornidazole gel group respectively. Comparison of SRP with Ornidazole gel group showed insignificant result in PPD reduction ($p < 0.01$) whereas comparison of SRP group with Diode laser group showed non insignificant result in PPD reduction ($p > 0.01$). Comparison of GI based on groups at one month showed significant changes between any groups ($p < 0.05$). Comparison between adjunct groups i.e SRP with Diode Laser Group and SRP with Ornidazole Group showed significant difference in PPD reduction and mean gain in CAL.

Table 4: Gingival Index, Probing Pocket Depth, Clinical attachment level showing the inter-group comparison of mean difference at 1 month, where $p < 0.001$ highly significant (HS), and $p > 0.05$ non-significant (NS)

	Mean difference at 1 month	P value
Gingival Index (GI)		
SRP vs Ornidazole Gel	0.73	0.003 HS
SRP vs Laser	0.06	0.76 NS
Ornidazole Gel vs Laser	-0.67	0.006 HS
Probing Pocket Depth		
SRP vs Ornidazole Gel	1.70	<0.001 HS
SRP vs Laser	0.70	0.11 NS
Ornidazole Gel vs Laser	-1.00	0.01 S
Clinical Attachment Level		
SRP vs Ornidazole Gel	1.73	<0.001 HS
SRP vs Laser	0.53	0.33 NS
Ornidazole Gel vs Laser	-1.2	0.02 S

4. Discussion:

Periodontitis is an infectious, inflammatory disease affecting the Periodontium, the supporting tissues around teeth. Bacteria are believed to play a primary etiological role in this disease.¹⁶

The primary goal of periodontal therapy is the removal of supra and sub gingival bacterial deposits by mechanical debridement consisting of scaling and root planing (SRP) using manual or power- driven instruments.¹⁷ Clinical studies have shown that long- term clinical success of periodontal therapy is dependent on the continuing periodontal maintenance phase of therapy after active phase.^{18,19} During maintenance therapy, sites may have persistent disease which never resolved or may become reinfected, which requires further treatment. Lasers, photodynamic therapy, local drug delivery and others have been tried in maintenance therapy. Few studies have reported the use of various laser to treat reoccurring periodontal disease in periodontal maintenance patients.²⁰⁻²¹ Diode laser-assisted periodontal therapy using photodynamic therapy was not superior to conventional mechanical debridement²² however photodynamic therapy was shown to be superior in eliminating pockets especially in single rooted teeth maintenance phase as seen by Campos et al.²³

Although systemic administration of antibiotics significantly improves the clinical outcome, it is associated with inherent adverse effects. To overcome these shortcomings, local drug delivery systems has been developed.²⁴

Among the various antimicrobials used as LDD agents, ornidazole is the most recent one. Even though it belongs to nitroimidazole family, unlike metronidazole, it requires a very low minimum inhibitory concentration to inhibit the growth of periodontal pathogens as compared to that of metronidazole. Although the antimicrobial activity of ornidazole has been proposed to be due to the reduction of nitro group to a more reactive amine, thus attacking the microbial DNA, a combination of ornidazole and CHX on the other hand shows a prolonged antiplaque action, substantivity, and its ability to adsorb and desorb, thereby providing in effect, a timed release of the antimicrobial agent.^{25,26,27}

In the present study, GI, BOP and PPD was reduced in all three groups which is in accordance with the studies

by (Saglam M. et al. (2014)²⁸, Caruso U et al. (2008)²⁹, Ambrosini P et al. (2005)³⁰ .

Reduction of BOP in group II and Group III may be attributed to the reduction of periodontal inflammation and may also be related to the reduction of prostaglandin E2 (PGE2) levels, due to the effects of laser treatment. Prostaglandin E2 levels increase in the periodontal connective tissues of periodontal lesions being a potent stimulator of inflammation and bone resorption.³¹ A study done by Sakurai et al showed that low level laser irradiation may inhibit PGE2 production by lipopolysaccharide of periodontopathogens in human gingival fibroblast (hGF). The inhibitory effects on PGE2 production was time and dose dependent.³² Moderate pockets were reduced only in group II and III which was also found by various studies by Kamma JJ et al. (2009)³³, Dukić W et al. (2013)³⁴, Wilson TG Jr et al. (1987)²⁰. We observed that this reduction was more so at 30th day and was not seen at 7th day which may be indicative of healing period of the treated pocket. The reduction in PD can be due to the availability of new site for the attachment of connective tissue. In cases of PDs, all the treatment modalities were able to improve the condition when comparing with base line which was not in consistent with the study done by Ambrosini et al. (2005)³⁰ who stated there was no improvement in deep pockets with these treatment modalities from base line. This may be due to incomplete elimination of microbial plaque.³⁵ Group I showed statistically significant difference than group II on comparing moderate attachment loss at 7th day only, which may be due to greater retraction of periodontal tissues in the laser group and this achieved stability by 30th day.³⁶

This present study shows better improvement in clinical parameters in Group III where treatment with ornidazole along with scaling was performed in comparison with Diode Laser.

When the gingival scores were taken into consideration, there was significant difference in the gingival scores between Group II and Group III & Group I and Group III. However additional benefits were elicited when antimicrobial gel was used as an adjunctive therapy on scaling and root planing as depicted in a study done by Wust J. 1977³⁷. In this study systemically administered ornidazole was used as an adjunct to scaling in treatment of periodontitis and a statistically significant difference in gingival index was noted. In another study done by Nagasree M et al³⁸, SRP along with Ornidazole had shown better efficacy in terms of all clinical parameters and microbial analysis when compared to that of those who were treated with SRP alone. In a study done by Awasthi et al³⁹, the efficacy of systemically administered Ornidazole was found to highly effective in treatment of chronic periodontitis.

The results of our study showed a significant improvement in the Gingival index and pocket depth measurements of all three groups at the end of 4 weeks but no statistically significant improvement was noticed between Group II and Group I. Taking CAL into consideration, there is significant improvement from baseline to 4 weeks was observed in Ornidazole Group.

5. Conclusion:

Hence, it can be concluded that the localized application of Ornidazole gel was better than application of Diode Laser alone and SRP alone and can give desired beneficiary effect.

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