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Original Research Article

Evaluation of Nd: YAG laser as an appurtenance to scaling and root planning in treating chronic periodontitis

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ABSTRACT

Aim: Chronic Periodontitis (CP) causes inflammation of teeth's supporting tissues and progressive loss of bone and attachment. The purpose of this study was to compare the treatment methodology for CP using Scaling and Root Planning alone and in combination with Nd: YAG Laser.
Materials and Methods: Sixty patients diagnosed with generalized moderate chronic periodontitis were randomly assigned to two different groups. Group 1: SRP, group 2: SRP and Nd: YAG Laser. A clinical examination of Plague Index PI, Gingival Index GI, and Probing Pocket Depth PPD was performed on each patient. Four follow-ups were conducted: at baseline, at one month, at three months, and six months.
Result: A gradual reduction was seen in PI, GI, and PPD in both groups, but significant effects were observed in group 2 patients. In group 2, the PI had a more considerable F value of 291.22 and was more substantial than the control group.
Conclusion: It can be concluded that although SRP is a conventional technique for Chronic Periodontitis but when combined with non- surgical laser treatment it provides with prolonged benefits.

1. Introduction

A bacterial infection caused by *T. forsythia, P. gingivalis, T. denticola*, and *P. intermedia* which leads to inflammation of periodontium is known as chronic periodontitis. It is aside from bleeding gums and increased pocket depths, these bacteria are also responsible for plaque deposition on the periodontium and the formation of periodontitis.

Bone destruction and loss of teeth in adults are significant factors of chronic periodontitis. Chronic periodontitis can be defined as the disintegration of periodontal fibers at the neck of the tooth, alveolar bone resorption, and apical junctional epithelium proliferation beyond cementoenamel intersection.[1]

A gold standard treatment method for periodontal disease is scaling and root planning (SRP), usually done manually but can also be performed using an ultrasonic instrument. SRP is an initial step to periodontal therapy. Some studies have reported its quality results and reduced microbial growth. Better oral hygiene (removal of calculus, plaque, and endotoxins),[2,3] but prolonged results with SRP is still a matter of concern because there are studies that showed SRP as an effective treatment modality but for short time interval and the problem regenerated due to bacterial infection.[4]

Dental Lasers are an adjunctive method that can aid a successful conventional periodontal therapy for a sustained period. Yet, there are many objections among dentists to accepting dental lasers as an effective methodology in periodontal treatment, specifically for chronic periodontitis[5] It is investigated that chronic periodontitis is a bacterial infection and toxins extricated by the removal of the disease

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altogether. Along with SRP, lasers have improved oral health and reduced pocket depth.[3,6] There are lasers like diode lasers, Er: YAG, Nd: YAG lasers, etc., that have been effectively used as a minimally invasive treatment procedure to cure periodontal infections.

The neodymium: yttrium-aluminum-garnet (Nd: YAG) laser facilitates pulsed delivery of laser rays on periodontium with less heat generated. Nd: YAG laser alone is responsible for removing calculus[7] and, along with SRP, showed constructive results in soft tissue surgery[8] and is also responsible for reducing dentinal hypersensitivity.[9]

Periodontal infection is widespread among people who fail to maintain good oral hygiene and seek a non-surgical treatment, which may cause periodontal disease. This clinical study aimed to evaluate the effectiveness of SRP followed by Nd: YAG laser therapy to cure chronic periodontitis and compare the effects with the patients who were only treated with SRP.

2. Materials and Methods

Sample size calculation was done using G*Power v. three software.[10]

A total of 60 patients were enrolled in the study. The patients who reported to the outpatient department of Periodontology of host institution, complained of generalized moderate chronic periodontitis with a minimum of 25 teeth having at least two non-adjacent sites in each quadrant having PPD of ≥5 mm.[11] The inclusion criteria include patients that have no critical medical history, no prior periodontal treatment, should not be on immunosuppressants, no smokers or alcoholics, and no pregnant women. The patients who did not fulfill the criteria were excluded. The ethical committee approved the protocol of this study at our Institution (9390/Ethics/R.Cell-16).

2.1. Clinical examination

All the enrolled patients were analyzed for the Plaque index (PI) of Silness and Loe (1964),[12] Gingival index (GI) of Loe and Silness (1963),[13] and Periodontal pocket depth (PPD) using William's periodontal probe[14] on the buccal, mesial, distal and lingual surfaces of all experimental teeth for better analysis of result before non-surgical periodontal treatment, i.e., manual scaling and root planing done by using Hu-Friedy scales and curettes and will be divided into two groups: Control group and Laser group.

The clinical parameters of each patient were observed at baseline, one month, three months, and six months post-treatment in both groups.

1. *Group 1: Control group:* The patients were given mechanical treatment using Hu-Friedy scales and curettes known as scaling and root planning, which are fundamental procedures usually performed on supragingival and subgingival tooth surfaces to remove bacterial or fungal plaque and tartar deposited on them. Root planning was performed to remove irregularities and smooth the root surface.[15]
2. *Group 2: Laser group:* The patients of this group first received the same treatment as the first group of patients; in addition, they were treated with Nd: YAG laser therapy (Fotona, AT Fidelis, Slovenia). A standard manufacturer's protocol was followed for the procedure. The procedure involved using Nd: YAG fiber tip kept at a distance of 1-2 mm from the target tissue. Various settings were made for power, frequency, and time to be 1 Watt, 10 Hz, and 60 seconds/cm^2, respectively. This step was repeated 5-20 times in a sweeping manner and at continuous wave mode.

While performing Laser therapy, all the precautionary measures were followed in every patient visit.

3. Statistical Analysis

The values obtained were calculated statistically using SPSS software, and the technique involved was one-way ANOVA and unpaired t-test.

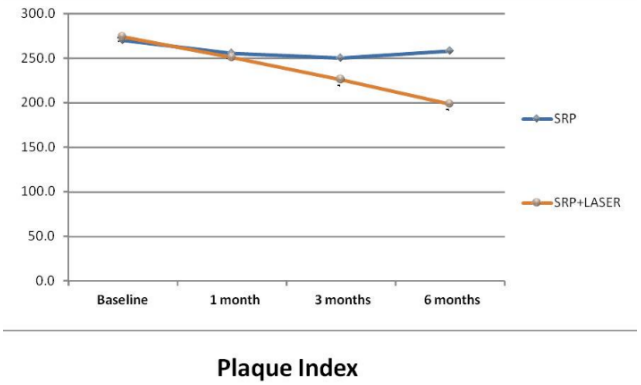

Fig. 1: Comparison of plaque index(PI) between the two groups.

4. Result

The reduction in CP of each patient was analyzed based on Plaque Index, Gingival Index, and Pocket probing depth. The results obtained were compared within the groups in different time intervals and between the groups.

On comparing the Plaque Index (PI) between the groups, it was observed that at baseline, the control group showed a smaller mean PI (270.1±19.4) than the LASER group (274.0±17.9). However, no significant difference in mean PI was observed between the two groups at baseline (p=0.425). Similarly, there was no significant difference after one month (p=0.331). But after three months LASER group was recorded with a smaller mean PI (226.0±22.6) and was statistically significant (p<0.001). After six months,

Table 1: Comparison of plaque index (PI) between the two groups.

PI	Control group		Laser Group		Between Groups!	
	Mean	SD	Mean	SD	t	**p-value**
Baseline	270.1	19.4	274.0	17.9	-0.80	.425
1 month	255.6	18.7	251.0	17.9	0.98	.331
3 month	250.3	19.3	226.0	22.6	4.48	<.001
6 month	258.1	17.4	198.7	25.1	10.65	<.001
Within Group!!	F=43.50, p<0.001		F=291.22, p<0.001			

! Using unpaired t-test
!! Using Repeated Measures ANOVA

Table 2: Comparison of plaque index (PI) change from baseline between the two groups.

PI	**Control group**		**Laser Group**		**Between Groups**	
	Mean	SD	Mean	SD	t-value	p-value
1 month	14.5	5.5	23.0	8.0	-4.79	<.001
3 month	19.8	10.1	47.9	13.7	-9.06	<.001
6 month	12.0	10.9	75.3	20.9	-14.68	<.001

Table 3: Comparison of gingival index (GI) between the two groups.

GI	**Control group**		**Laser Group**		**Between Groups**	
	Mean	SD	Mean	SD	t	p-value
Baseline	265.3	21.8	266.7	24.5	-0.24	.812
1 month	246.2	22.2	249.3	18.9	-0.59	.559
3 month	231.0	25.4	229.2	21.7	0.30	.765
6 month	229.7	33.0	207.3	18.9	3.22	.002
Within Group	F=58.78, p<0.001		F=79.54, p<0.001			

Table 4: Comparison of gingival index (GI) change from baseline between the two groups.

GI	**Control group**		**Laser Group**		**Between Groups**	
	Mean	SD	Mean	SD	t-value	p-value
1 month	19.1	8.2	17.4	28.6	0.31	.755
3 month	34.3	13.7	37.5	30.6	-0.53	.596
6 month	35.6	21.6	59.4	31.7	-3.40	.001

Table 5: Comparison of pocket probing depth (PPD) between the two groups.

PPD	**Control group**		**Laser Group**		**Between Groups**	
	Mean	SD	Mean	SD	t	p-value
Baseline	476.6	22.8	478.4	20.7	-0.32	.750
1 month	448.9	23.9	453.0	21.7	-0.70	.489
6 month	437.7	32.4	426.7	17.4	1.63	.109
Within Group	F=68.54, p<0.001		F=402.38, p<0.001			

Table 6: Comparison of pocket probing depth (PPD) between the two groups.

PPD	**Control group**		**Laser Group**		**Between Groups**	
	Mean	SD	Mean	SD	t-value	p-value
1 month	27.7	10.9	25.4	9.8	0.86	.396
6 month	39.0	21.6	51.7	11.0	-2.88	.006

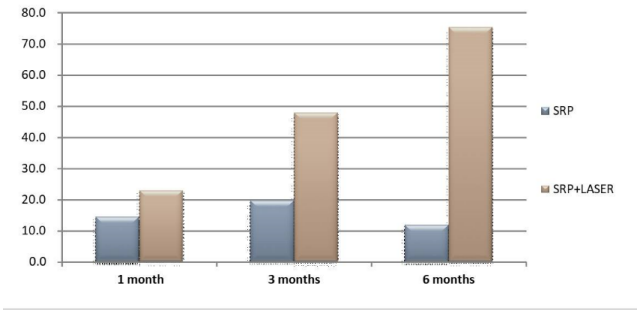

Fig. 2: Comparison of plaque index (PI) Change from baseline between the two groups.

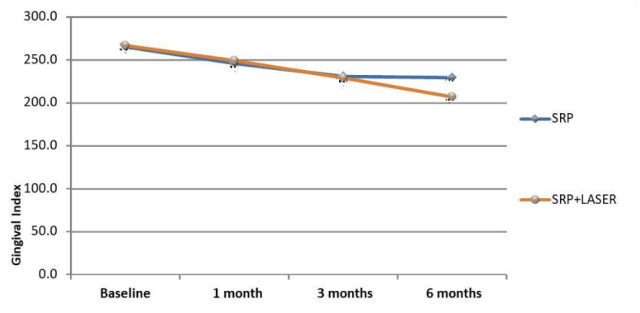

Fig. 3: Comparison of gingival index (GI) between the two groups

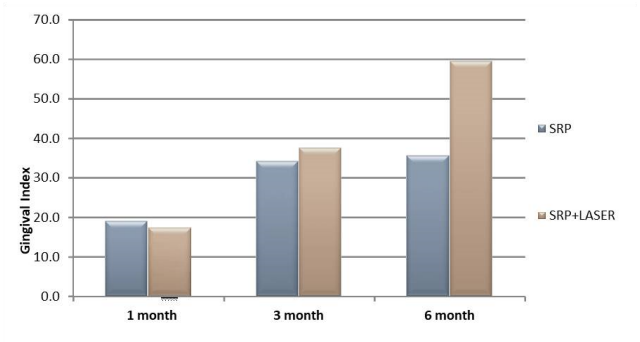

Fig. 4: Comparison of gingival index (GI) Change from baseline betweenthe two groups.

the LASER group showed a highly significant difference in mean PI between the two groups ($p<0.001$) (Table 1). The repeated measures ANOVA revealed that a significant reduction occurred in PI within both the groups; however, a more significant decrease was seen in the LASER group (with a more considerable F value of 291.22).

In Table 2, Plaque Index (PI) change was compared from baseline among the groups; it was observed that after one month more significant mean PI change (23.0±8.0) was found in the LASER group, while in the control group, this change was only 14.5±5.5. A highly significant difference

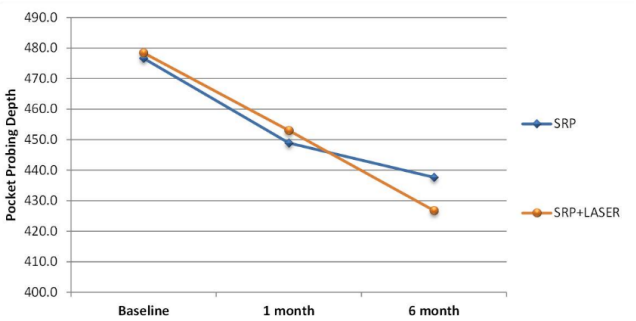

Fig. 5: Comparison of pocket probing depth(PPD) between the two groups

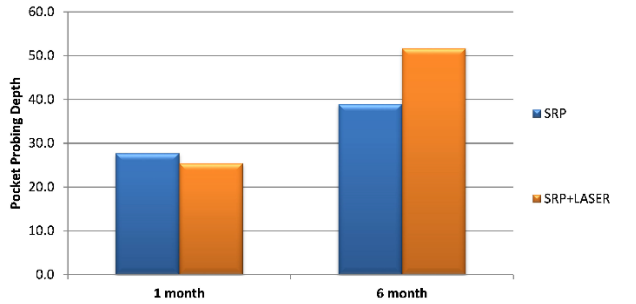

Fig. 6: Comparison of pocket probing depth(PPD) change between the two groups.

in mean PI changes was observed between the two groups after one month ($p<0.001$), and similar results were found after 3 and 6 months.

The Gingival Index (GI) comparison was made between the groups in Table 3, which revealed that at baseline, the control group had a smaller mean PI (265.3±21.8) than the LASER group (266.7±24.5). However, no significant difference in mean GI was observed between the two groups at baseline ($p=0.812$). Similarly, after one month and three months, no significant changes were observed with values ($p=0.559$) and ($p=0.765$), respectively. After six months, the mean reduction was noted in the LASER group (207.3±18.9) and was highly significant ($p=0.002$). The larger F value was observed in the LASER group (79.54).

The change in GI from baseline among the groups, it was seen that after one month, the control group had a more remarkable GI change (19.1±8.2) when compared with the LASER group (17.4±28.6) and was not significant ($p=0.755$). After three months, the larger mean GI change, 37.5±30.6, was found in the LASER group but with no significant difference ($p=0.596$). After six months, there was a highly significant difference between the two groups with $p=0.001$ (Table 4).

From Table 5, it can be noted that the mean Pocket Probing depth (PPD), when compared between the groups,

the LASER group showed a reduction in mean PPD than the control group in a different interval of time. Still, no significant difference was observed till six months. On comparing the PPD change from baseline between the groups, it was observed that the larger mean PPD change, 27.7±10.9, was seen in the control group after one month. However, no significant difference in mean PPD changes was observed between the two groups after 1 month (p=0.396) (Table 6) after 6 months, a significant change was observed in the LASER group (p=0.006).

5. Discussion

The sign of CP is the extermination of osseous support of dentine.[16] This destruction occurs due to the host's inflammatory response against bacterial deposition on the dentin and periodontium, which slowly degrades the tissue and ultimately leads to tooth loss if not treated. Periodontitis is prevalent but can be prevented to a large extent. Usually, it is the consequence of bad oral hygiene. Patients with poor oral hygiene are advised for non-surgical periodontal therapy like scaling and root planing (SRP), which removes dental plaque and calculus responsible for periodontal inflammation. According to a study, SRP is considered a gold standard for treating chronic periodontitis.[17]

The prevalence of periodontal infection increases with age. A literature review on prevalence of Periodontitis in India revealed age group 12, 15, 35-44, 65-74 years suffer from 57%, 67.7%, 89.6% and 79.9% respectively, periodontal infection.[18] Due to poor oral hygiene, bacterial plaque accumulates on the external surface of the teeth, which causes inflammation on the marginal tissue leading to gingivitis which, if ignored, may progress to chronic periodontitis. Nearly 90% of the US population suffers from gingivitis.[19] Generally, patients do not seek any dental treatment specifically for CP because CP headway slowly and painlessly.[20] A study showed some chief complaints of patients related to periodontitis in which patients with CP were unaware of it and thought it was a gum disease[21] which led to a late diagnosis of CP in which mobility of tooth and bone loss becomes prominent.[20] American Academy of Periodontology and the American Dental Association have formulated some early detection methods to decrease the consequences of CP.[22]

Since the mid-1980s, laser technology has become a gift for patients dealing with dental infections.[23] For soft tissue surgeries, the laser has become a competent replacement for traditional methods. Lasers can quickly reshape and remove infected oral tissue. When applied to soft tissue, the laser increases hemostasis using heat-induced occlusion and coagulation of capillaries, venules, and arteries. In CP, laser plays a significant role as laser releases intense heat, which has a bactericidal effect on the target. Lasers are also helpful as they cause negligible blood loss, less pain, a faster healing process, and less swelling.[24]

The present study used the conventional SRP technique and Laser therapy to treat CP and compared it with patients treated with only SRP. Using a conservative two-tailed testing approach, the sample size was calculated using G*Power v. three software with a significant level of 0.05 and power = 0.80. Hence, 30 patients were included in each group, which yielded adequate statistical power for group comparisons.[10]

The current study examined the patients who fulfilled the inclusion criteria for periodontal infection. A researcher of periodontology named Irving Glickman explained Epidemiological indices to measure the clinical conditions of teeth quantitatively on a graduated scale.[25] These clinical parameters included.

(a): Plaque Index: it was recorded on the Silness and Löe index criteria and is used to record the mineralized deposits and soft debris on teeth. Table 1 and Figure 1 depicted the plaque index and compared it with both groups using the unpaired t-test. At baseline and after one month, the mean PI was 0.425 and 0.331, respectively, insignificant. The significance level increased after 3 and 6 months. The mean PI values showed that laser group patients significantly reduced CP with time, i.e., leading to a prolonged effect.

In contrast, the control group patient's mean PI values were reduced till three months, but after six months, there was a gradual increase. Table 2 and Figure 2 noted the change in mean PI values. From baseline to 6 months, a maximum increase in change in mean PI values was observed in the laser group.

(b): Gingival Index: recorded based on the Harlod Löe index,[13] which measures gingival condition/ inflammation. Table 3 and Figure 3 revealed the comparison of a gingival index between the two groups and found that the laser group showed a significant decrease in mean GI values after 3 and 6 months but meant GI values of the control group also showed a reduction. The effect of laser is much greater than the effect of SRP. The mean GI change was highly significant (p= 0.001) in the laser group after six months, with a value of 59.4, while the control group was 35.6 (Table 4 and Figure 4). (c): Pocket probing depth: it is usually done to measure the distance between the pocket base and gingival margin. It is considered to be an essential part of the periodontal examination. The deeper probing depths of a tooth lead to frequent bleeding, unable to maintain good oral hygiene, more risk of pathogenic growth, etc.[26] To compare the effect of hyaluronan as an adjunct in SRP and SRP alone to treat chronic periodontitis, Shah et al.[27] performed the periodontal assessment using PI, GI, and PPD at different time intervals. They observed a significant reduction in both groups, similar to our study. The laser and control groups both showed (Table 5 and Figure 5) almost equal reduction in mean PPD values; no significant difference was observed at baseline, one month, or six months (p= 0.750, p= 0.489, p= 0.109, respectively).

While the change in mean PPD values was highly significant in the laser group compared to the control group, p= 0.006. It can be observed in Table 6 and Figure 6.

The control group treated with SRP showed promising results after 1^{st} and 2^{nd} visits, but the sensitivity was again detected after the 3^{rd} visit of the patient. In the laser group, the patient responded positively after the 1^{st} visit and was completely cured after the last visit.

Various types of lasers have been reported that are also responsible for the treatment of CP. In a study by Singh et al.,[28] 2018, they evaluated clinical and microbiological analysis using a diode laser as an adjunct to SRP for treating CP. Similar to our study, they calculated PI, GI, and PPD after each treatment of the patient and found a significant reduction in CP at ten weeks. Another study on diode laser was used as an adjunct to SRP for treating CP. Their result revealed a substantial improvement in patients' PI, GI, and PPD.[15] Elias and Orbak[29] compared the efficacy of Nd: YAG laser with SRP for treating CP in smokers and non-smokers. They calculated clinical parameters like PI, GI, gingival crevicular fluid (GCF), and then after SRP, Laser application was applied. Their results support laser therapy as an effective process for CP. Another type of laser, i.e., Er: YAG Laser used by Birang et al.[30] compared ultrasonic scaler and laser therapy on CP patients. The clinical parameters involved were PPD, papillary bleeding index (PBI), and clinical attachment level (CAL). Their result noted that both techniques were effective. But the superiority of laser was not recorded.

Thus, the results of the present study justify that lasers can be a better alternative for the treatment of CP but can also be used along with mechanical scalpel treatment procedures.

6. Conclusion

This study revealed that the SRP technique was effective in treating CP for 1 to 3 months in patients, but the problem started after three months. The laser group patients had no complaints regarding CP even after six months. Hence, it can be concluded that SRP, along with laser, can give prolonged effects and reduce the PI, GI, and PPD indices.

7. Source of Funding

None.

8. Conflict of Interest

None.

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