

The Effect of Laser Therapy on Pocket Depth Reduction in Chronic Periodontitis Patients

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Abstract

Because of the limited number of publications in the Middle East about use of laser therapy in periodontal disease treatment, this study serves to fill the gap in the literature. So the aim of the current study was to investigate the effect of diode laser therapy as an adjunct to non-surgical periodontal treatment of chronic periodontitis.

A clinical study was conducted on chronic periodontitis patients. They received laser therapy in addition to scaling and root planning (SRP). We discovered significant improvement in pocket depth reduction. While mechanical therapy reduces microbes inside the periodontal pocket, it cannot alone totally remove them or the infected sulcular epithelium; the laser not only has bactericidal effect but is also highly efficient in removing the infected sulcular epithelium without damaging connective tissue.

There is great potential for use of laser therapy as routine and the primary tool for treating periodontal disease.

Keywords: Laser Therapy; Pocket Depth; Chronic Periodontitis; SRP (Scaling and Root Planning)

Introduction

Periodontal disease is a chronic inflammatory disease caused by a bacterial infection. Chronic periodontitis is thought to be the major cause of tooth loss in adult humans. It is characterized by breakdown of periodontal fibers at the cervical margin, resorption of alveolar bone, and apical proliferation of junctional epithelium beyond the cemento-enamel junction.

Basically the principle of periodontal therapy is to restore function and arrest further progression of periodontal disease by the removal of plaque and other contributing factors through non-surgical periodontal therapy (scaling and root planning). Moreover, use of local and systemic antibiotic, eliminates pathological pocket and creates an oral environment which is relatively simple for patients to facilitate plaque removal and oral hygiene measurement.

The total elimination of the pathogenic subgingival microbiota remains challenging for clinicians. However, mechanical therapy alone fails to eliminate the pathogenic bacteria because of their deep location within the periodontium. Hence, many other adjunctive methods are investigated to improve and increase the success of the conventional periodontal therapy. One of these methods is laser treatment. The subject of laser in periodontics now encompasses a rapidly increasing and significant volume of published literature.

Despite the large number of publications, there is still controversy among clinicians regarding the application of dental lasers to the treatment of periodontal disease, and more specifically chronic periodontitis [1]. Certain lasers are used specifically for soft tissue treatment such as CO₂, Nd: YAG, and Diode lasers. Others which can be used for both soft and hard tissue applications include Er: YAG and Er:

Cr: YSGG lasers. The diode laser has become an important tool in the dental armamentarium due to its exceptional ease of use and affordability [2].

There is very convincing evidence in the dental literature that the addition of diode laser treatment to SRP standard will produce significantly improved results. After SRP, the diode laser is used on the soft tissue side of the periodontal pocket to remove the inflamed soft tissue and reduce the pathogens and it also has key advantages with regard to periodontal treatment.

The diode laser is well absorbed by melanin, hemoglobin, and, other chromophores that are present in periodontal disease. Hence, the diode specifically targets unhealthy gingival tissues. The laser energy is transmitted through a thin fiber that can easily penetrate into deep periodontal pockets to deliver its therapeutic effects [3].

A pilot study evaluated the clinical and microbiological effects of neodymium: yttrium-aluminum-garnet (1064 nm) laser therapy was used as an adjunct to scaling and root planning (SRP) during the hygienic phase and reported that the laser treatment yielded no superiority in clinical efficacy compared to conventional debridement [4].

On the other hand, a more recent study to evaluate the effect of a 940-nm diode laser as an adjunct to SRP in chronic periodontitis patients with concluded that the diode laser can be routinely used with SRP in the treatment of periodontal pockets of patients with moderate-to-severe periodontitis [5].

Because of the limited numbers of publications in the Middle East about the use of laser therapy in periodontal disease treatment, this study serves to fill this gap in the literature. So the aim of the current study was to investigate the effect of diode laser therapy as an adjunct to non-surgical periodontal treatment of chronic periodontitis.

Materials and Methods

A clinical study was conducted at the department of dentistry of the University Hospital in Riyadh city (Riyadh collage of dentistry and pharmacy). Forty adult patients were randomly enrolled on a voluntary basis.

The selected cases were based on the following inclusion criteria:

- 1) Patients between 25 to 60 years.
- 2) Medically fit patients.
- 3) Patients with chronic periodontitis.

The exclusion criteria were:

- 1) Patients who have undergone surgery for 12 months prior to treatment.
- 2) Pregnant patients.
- 3) Patients that underwent periodontal or antibiotic treatment in the last 6 months.

There was no exclusion of smokers.

After having obtained a thorough medical and dentistry history and the underwriting of a specific informed consent, all the patients underwent a periodontal examination (1st visit).

The degree of gingival inflammation was assessed by gingival index (GI) by Silness and Løe [6] and Løe [7], measured from 0 to 3 on each tooth:

- 0 = healthy gingiva
- 1 = mild inflammation (there is change in gingival color and texture and there is absence or pit point of bleeding and probing)

- 2 = moderate inflammation, bleeding on probing
- 3 = severe inflammation, spontaneous bleeding

The level of hygiene was assessed by plaque index (PI) by Silness and Løe [6]:

- 0 = absence of plaque
- 1 = presence of plaque detectable with probe
- 2 = moderate accumulation of plaque, which is visible to the naked eye
- 3 = abundant accumulation of plaque.

GI and PI were detected on 6 index teeth: 16, 21, 24, 36, 41, and 44. Then pocket depth (PD) was measured, which consists in measuring the distance in mm between the free gingival margin and the base of the pocket, making six records for each dental element: mesial, central and distal probing of the buccal, lingual and palatal sides of all teeth [8]. The values in mm of the survey were then converted into a score called T-score:

- 1 = PD between 4 and 5 mm
- 2 = PD between 6 and 7 mm
- 3 = PD between 8 or above mm

Then (Case Group) 20 patients received scaling and root planning using ultrasonic scaler with addition of laser therapy through a 940 nm diode laser (Zolar soft tissue diode laser). The (Control Group) 20 patients received scaling and root planning using ultrasonic scaler only. The operating protocol of the treatment of periodontal pockets in 940 nm diode laser provides for the application of the following dosimetric values (the calculation of absorbed dose and optimization of dose delivery in radiation therapy):

- Power: 3 W
- Pulse frequency: 15 Hz
- Fluency: 1,2 J/mm²
- Emission mode of laser light: pulsed
- On time (pulse duration): 10 ms
- Time-off (relaxation time): 20 ms
- Average power: 1 W
- Optical diameter fiber and tips: 300 - 400 μ .

Statically Analysis

Analysis done using SPSS version 20. Shapiro-Wilks test was used to test the normality of the data the result shows that the data were not normally distributed (P-value = 0.000). Transformation method used to transform data to normal data by LOG function. Paired sample t test used to test the significance difference in Mean of Pocket depth before and after the treatment in laser and control groups. Independent sample t test used to test the significance difference in mean of Pocket Depth between laser and control groups.

Case Group (Laser group)

Paired sample T test shows there is a significant difference in mean of Pocket Depth before and after the treatment by laser ($t_{19} = 4.63$, P-value = 0.000).

Before and after the treatment of Pocket Depth

Test Statistics: Paired sample t test/Laser Group						
	Mean ± SD Before treatment	Mean ± SD After treatment	Mean difference	95%C.I	T- test value	P- value
Pocket Depth	1.69 ± 1.1	1.12 ± 0.84	0.57 ± 0.56	(0.32,0.83)	4.63	0.000

Table 1: Laser group.
*P value significant if < 0.05

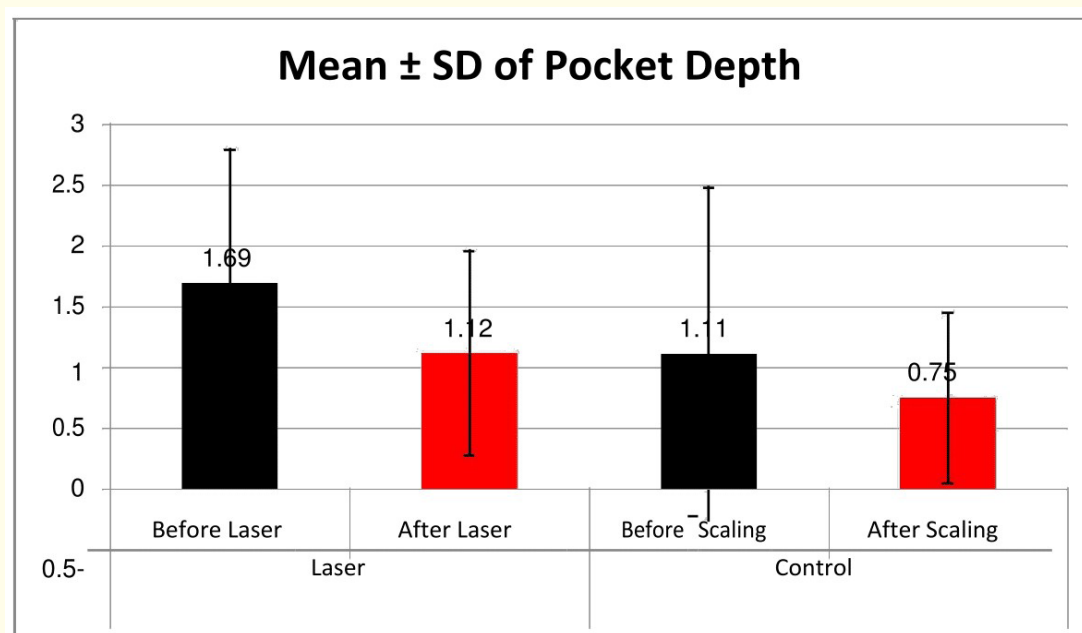


Figure 1: Before and after the treatment for PD (Case and control group).

Before and after the treatment : Plaque Index and Gingival Index

Wilcoxon signed Ranks Test was used to test the significant difference before and after the treatment of Plaque Index and Gingival Index. The result shows there is high significant difference before and after the treatment for Plaque and Gingival Index (p-value = 0.000). See table 2.

	Case group		Wilcoxon Signed Ranks Test	
	Before Treatment	After treatment	Z-Statistics	P-value
Plaque Index				
Mild	5 (25%)	18 (90%)	-3.61	0.000*
Moderate	15 (75%)	2 (10%)		
Median = (2) Moderate = (1) Mild				
Gingival Index				
Mild	3 (15%)	17 (85%)	-3.74	0.000*
Moderate	17 (85%)	3 (15%)		
Median =2, Moderate =1, Mild				

Table 2: Results of Laser Group.

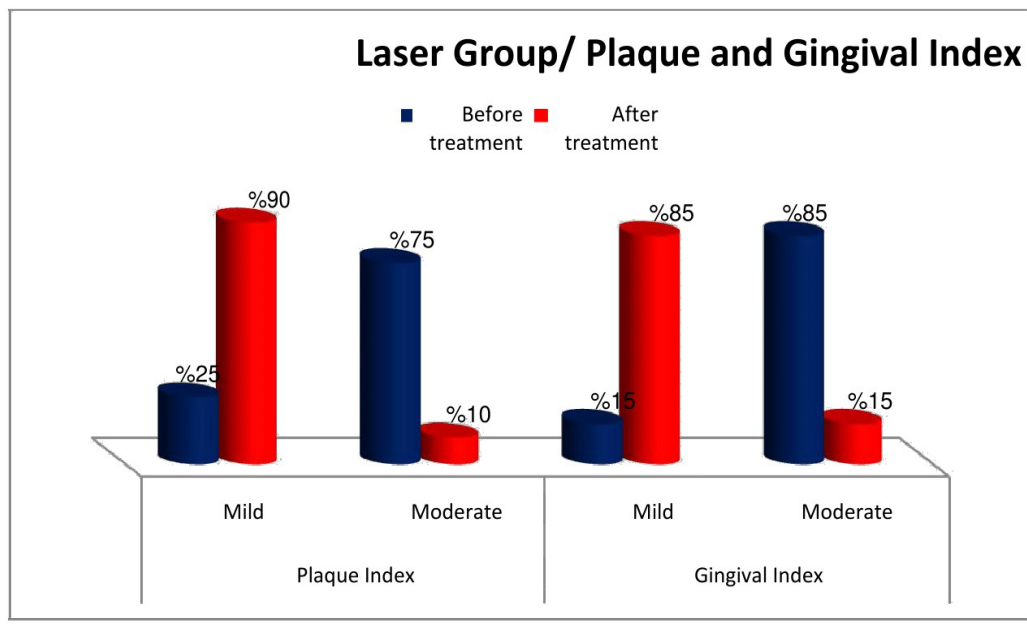


Figure 2

Ranks ^a		N	Mean Rank	Sum of Ranks
Re-evaluation PI - plaque index	Negative Ranks	13 ^b	7.00	91.00
	Positive Ranks	0 ^c	.00	.00
	Ties	7 ^d		
Total		20		

Table 3: Changes in Plaque Index levels.

^b: re-evaluation PI < plaque index

^c: re-evaluation PI > plaque index

^d: re-evaluation PI = plaque index

Above table 3 shows that 13 (65%) patients from laser group their Plaque index become better than before the treatment, 7 (35%) patients had the same level of plaque index after the treatment and no patients had high level of plaque index after the treatment than before the treatment.

Ranks ^a		N	Mean Rank	Sum of Ranks
Re-evaluation Gingival Index	Negative Ranks	14 ^b	7.50	105.00
	Positive Ranks	0 ^c	.00	.00
	Ties	6 ^d		
Total		20		

Table 4: Changes in Gingival Index Levels.

^b:re-evaluation GI < gingival index

^c:re-evaluation GI > gingival index

^d:re-evaluation GI = gingival index

Above table 4 shows that 14 (70%) patients from laser group their Gingival index becomes better than before the treatment change to lower level, 6 (30%) patients had the same level of Gingival index after the treatment and no patients had higher level of Gingival index after the treatment than before the treatment.

Control Group

Paired sample T test shows there is No a significant difference in mean of Pocket Depth before and after the scaling for control group ($t_{19}=1.97$, P-value = 0.064).

Test Statistics: Paired sample t test/Control Group						
	Mean - Before treatment	Mean - After treatment	Mean difference	95%C.I	T-test value	P- value
Pocket Depth	1.11 ± 1.37	0.75 ± 0.70	0.365 ± 0.82	(-0.023, 0.753)	1.97	0.064

Table 5

Before and after the treatment: Plaque Index and Gingival Index

Wilcoxon signed Ranks Test was used to test the significant difference before and after the treatment of Plaque Index and Gingival Index. The result shows there is high significant difference before and after the treatment for Plaque and Gingival Index (p-value = 0.000). See table 6.

Plaque Index	Case group		Wilcoxon Signed Ranks Test	
	Before Treatment	After treatment	Z-Statistics	P-value
Mild	3 (15%)	18 (90%)	-3.36	0.000*
Moderate	17 (85%)	4 (20%)		
Median = (2) Moderate = (1) Mild				
Gingival Index	Before Treatment	After treatment	Z-Statistics	P-value
	Mild	0%	9 (45%)	-3
Moderate	20 (100%)	11 (55%)		
Median =2, Moderate =1, Mild				

Table 6: Results of Control Group.

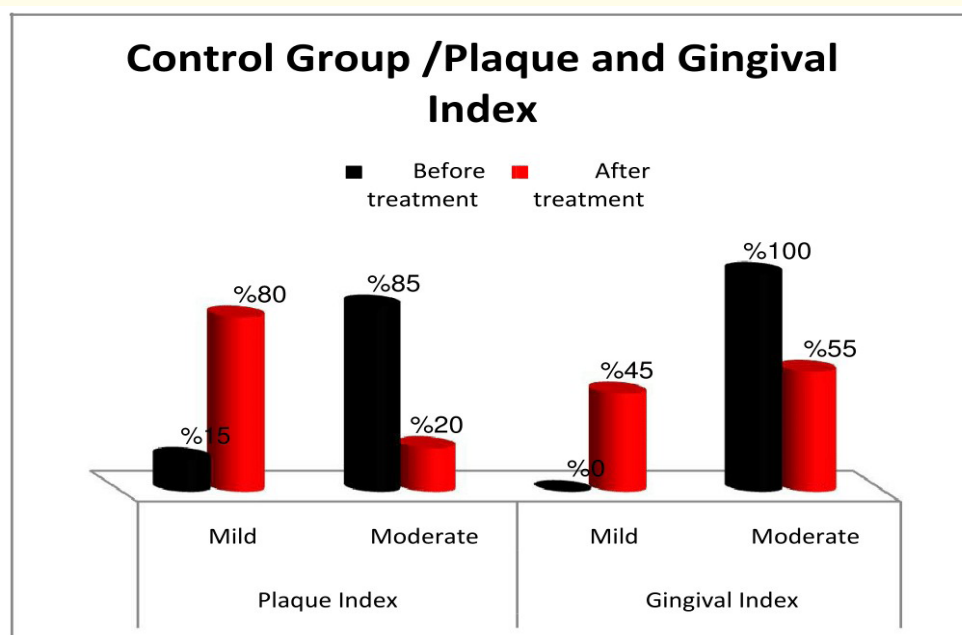


Figure 3

Ranks ^a				
		N	Mean Rank	Sum of Ranks
Re-evaluation PI - plaque index	Negative Ranks	14 ^b	8.00	112.00
	Positive Ranks	1 ^c	8.00	8.00
	Ties	5 ^d		
	Total	20		

Table 7: Changes in Plaque Index Levels.

^b: re-evaluation PI < plaque index

^c: re-evaluation PI > plaque index

^d: re-evaluation PI = plaque index

Above table 7 shows that 14 (70%) patients from control group their Plaque index become better than before the treatment, 5 (25%) patients had the same level of plaque index after the treatment and ONE (5%) patient had higher level of plaque index after the treatment than before the treatment.

Ranks ^a				
		N	Mean Rank	Sum of Ranks
Re-evaluation Gingival Index	Negative Ranks	9 ^b	5.00	45.00
	Positive Ranks	0 ^c	.00	.00
	Ties	11 ^d		
	Total	20		

Table 8: Change in Gingival Index Levels.

^b: re-evaluation GI < gingival index

^c: re-evaluation GI > gingival index

^d: re-evaluation GI = gingival index

Above table 8 shows that 9 (45%) patients from control group their Gingival index becomes better than before the treatment change to lower level, 11 (55%) patients had the same level of Gingival index after the treatment and no patients had higher level of Gingival index after the treatment than before the treatment.

Differences between groups after the treatment

Test the difference in Pocket Depth between Laser and Control groups

Independent sample T test used to test the significant difference in mean of Pocket Depth between laser and control group after treatment, The result shows that there is NO significant difference in mean of Pocket Depth between laser and control groups after treatment (t = 2, p-value = 0.05) but the graph shows lower values of PD in laser group.

But there is High significant difference of Pocket Depth before the treatment between two groups (t = 3, p-value = 0.004).

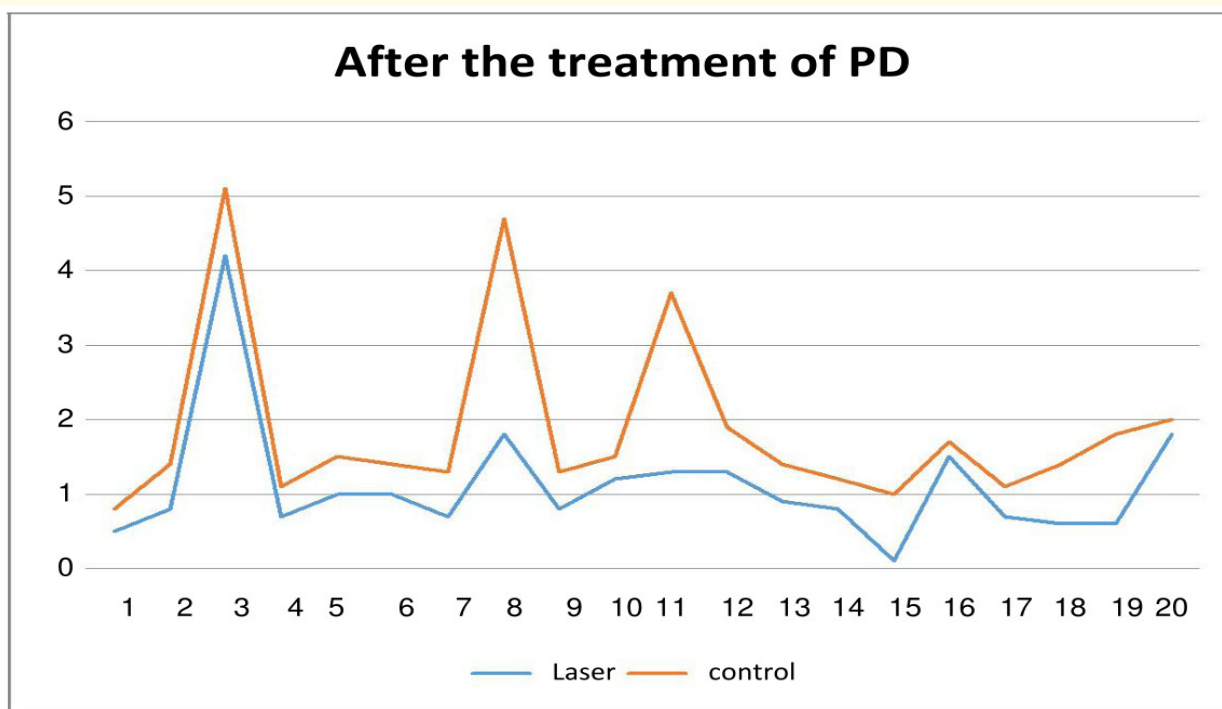


Figure 4

Descriptive Statistics

	Case Group	Control Group
Male	16 (80%)	12 (60%)
Female	4 (20%)	8 (40%)
Smoking	8 (40%)	13 (65%)
Non-Smoking	12 (60%)	7 (35%)
	Mean± SD	
Age	31.75 ± 8.66	35 ± 8

Table 9

Demographic data

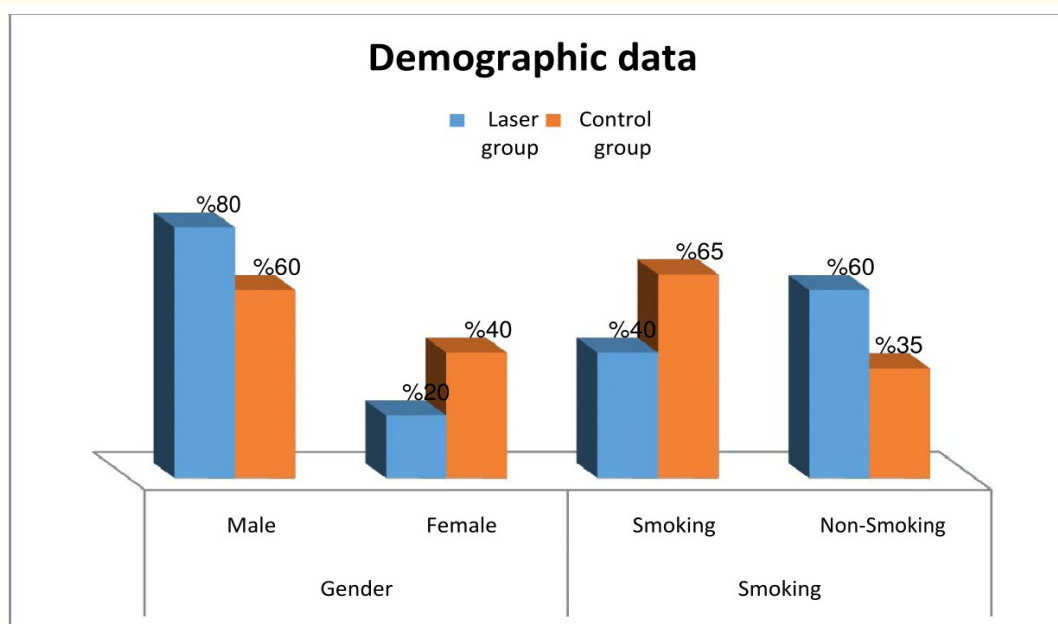


Figure 5

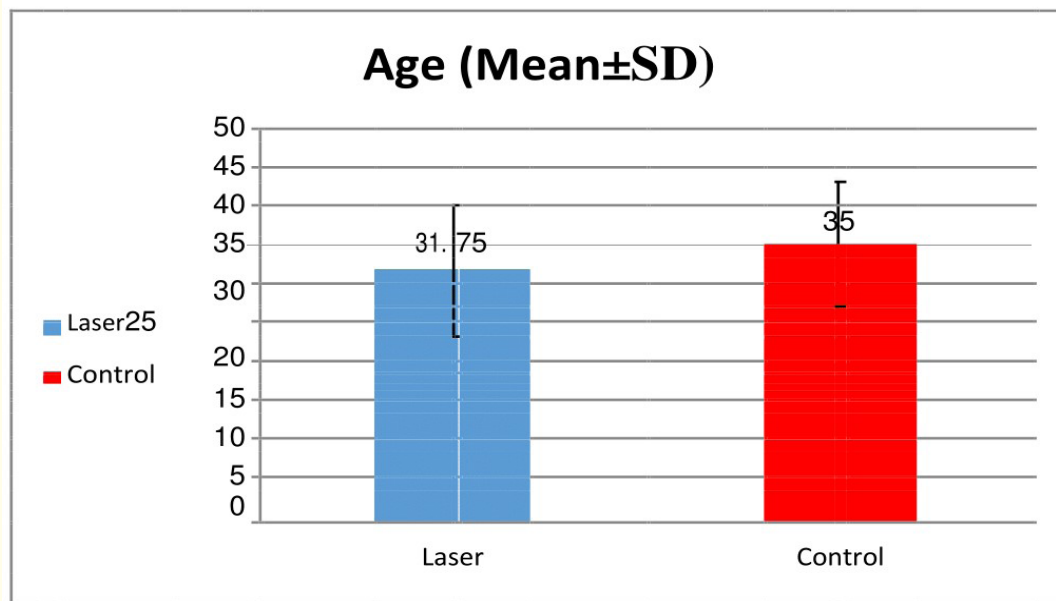


Figure 6

Discussion

According to our results, the Laser therapy has a slight impact on the Pocket Depth reduction, in which it has minimized the PD measurement to the normal level (1 to 3 mm). However, the responses to Diode Laser therapy shows that most of the case group (Laser group) patients which was 95% have an improvement effect after laser treatment despite to the SRP. Similar to another study conducted by Crispino A 2015 [5], which has reported that both SRP associated with Diode Laser therapy procedures were effective in improving the GI, PI, and PD.

On the other hand, De Micheli, *et al.* [9], found that the result of using the two therapeutic procedures (SRP and Laser therapy) are similar and leads to no additional benefits nor improvement, though laser therapy showed an improvement in PD but only in moderate to severe periodontitis cases.

However, the outcome of our study concurs with the finding of Edward A Marcos (2017). Marcos’s result shows that the bacterial reduction with Diode Laser therapy was significantly better than in the Control group. Otherwise, the fact of seeking Diode Laser therapy among our patients seems to be improved due the reduction of bacteria and diminishing PD measurements.

In our study, the differences after the treatment in PD between Laser and Control groups shows that there is NO significant difference in mean of PD. Although the PD differs in both groups before the treatment.

The Laser group in our study has shown improvement in mean of PD before and after the treatment, beside the improvement of PI and GI. This goes in accordance with U Caruso [10] who reported that the additional treatment with diode laser in the treatment of chronic periodontitis may lead to a slight improvement of clinical parameters (PPD, CAL, GI, PI) compared with that of SRP alone.

The Paired sample test (Control group) shows that the mean of PD has no significant difference even after the SRP. The opposite in PI and GI, which the test of the differences after receiving SRP treatment has estimated that there was a high significant difference. However

that the laser acts as adjunct to non-surgical periodontal therapy, not being able to replace traditional mechanical procedures of SRP in this regard, the study of Kamma, *et al.* [11] illustrated that it is better to combine both of the laser therapy with SRP for desirable outcomes [12-19].

Conclusion

Our study showed changes in pocket depth parameters clinically although it's not statistically significant, Considered the better clinical results, the laser diode can be routinely associated with the traditional mechanical non-surgical therapy (SRP) in the treatment of periodontal pockets of patients with moderate-to severe chronic periodontitis. The results of such studies encourage us in hoping that the use of complementary low power laser in the future will become a part of the standard protocol of non-surgical periodontal therapy.

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