

# Impact of laser therapy added to non-surgical therapy in non-insulin dependent diabetic Saudi patients with chronic periodontitis

## Abstract

**Background:** Chronic periodontitis (CP) is a common medical problem associated with non-insulin dependent diabetes mellitus (NIDDM) that affects about 47% of adult worldwide. The conventional therapy of CP is scaling and root planning (SRP). Although SRP is the golden therapy for CP, it cannot eliminate the whole bacteria within periodontal tissues. Therefore, the need for innovative adjunct therapy for effective management of CP.

**Objective:** Our study aimed to assess the value of LILT added to SRP upon periodontal inflammation in NIDDM Saudi patients with CP.

**Material and methods:** Forty six NIDDM Saudi patients with chronic periodontitis (25 men and 21 women), their age ranged from 31- 58 year (mean 41.2±5.17 year) participated in the study. The participants randomly divided between 2 equal groups. Group (A) received conventional treatment for CP that composed of scaling and root planing (SRP group); while Group (B) received low intensity laser therapy conventional treatment for CP (SRP+LILT group).

**Results:** Mean values of IL-6, TNF- $\alpha$ , HBA1c, Plaque index, Probing pocket depth and gingival index reduced significantly after treatment in both groups. However, comparison between both groups after treatment revealed significant differences between group (A) and group (B). Moreover, group (B) received SRP+LILT gained greater reduction in the measured parameters.

**Conclusion:** Low intensity laser therapy as an effective adjunct to periodontal therapy upon periodontal inflammation in NIDDM Saudi patients with CP.

**Keywords:** periodontal therapy, non-insulin dependent diabetes mellitus, chronic periodontitis, low intensity laser therapy

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**Abbreviations:** SRP, scaling and root planning; CP, chronic periodontitis; NIDDM, non-insulin dependent diabetes mellitus; LILT, low level laser therapy

## Introduction

Chronic periodontitis (CP) means inflammatory disorder that destroys the gingiva and is one of the most prevalent chronic dental infection of bacterial origin in adults affect about 90% of people and 22% of diabetic patients globally.<sup>1</sup> Chronic periodontitis destroy the teeth supporting structures that lead to progressive alveolar bone and soft tissue destruction associated with gingival recession and formation of deep pocket.<sup>2</sup>

Poor glucose control associated with non-insulin dependent diabetes mellitus (NIDDM) is an important risk factor for CP and systemic inflammation.<sup>3,4</sup> In the other hand CP which has a negative effect on glucose control.<sup>5</sup> Moreover, systemic inflammatory associated with CP increased the risk of some disorders as renal failure, cardiovascular disorders and diabetes.<sup>6</sup>

Scaling and root planing (SRP) is a conventional therapy for CP associated with some limitations in managing deep periodontal pockets.<sup>7</sup> Therefore, many pharmacological adjuncts include

antibiotics, anti-inflammatory and anticytokines were used to control inflammation and reduce bacterial.<sup>8-12</sup> In addition, low level laser therapy (LILT) considered as an adjuncts to conventional therapy for CP.<sup>13</sup> However, LILT Laser has excellent tissue ablation ability with a strong bactericidal effect as laser treatment improve the ability to access areas that are impossible to reach with conventional mechanical treatment.<sup>14-16</sup> While, the accurate LLLT anti-inflammatory control mechanism of CP remains inconclusive. Therefore, this study aimed to assess the value of LILT added to SRP upon periodontal inflammation in NIDDM Saudi patients with CP.

## Patients and methods

### Subjects

Forty six NIDDM Saudi patients with chronic periodontitis (25 men and 21 women), their age ranged from 31-58 year (mean 41.2±5.17 year) were selected from the Department of Periodontics, King Fahd Hospital at Jeddah. Inclusion criteria included NIDDM patients with  $\geq 4$  periodontal pockets and probing depth  $\geq 5$ mm. However, exclusion criteria included smoking, autoimmune disorders, pregnancy, hemorrhagic disorders, acute illness, intake of anticoagulant, antibiotics and corticosteroid therapy during the

previous three months. The participants randomly divided between 2 equal groups. Group (A) received conventional treatment for CP that composed of scaling and root planing (SRP group); while Group (B) received low intensity laser therapy conventional treatment for CP (SRP+LILT group).

### Measurements

**Periodontal parameters:** Degree of periodontal indices were assessed by gingival index (GI) that was measured from 0 (indicated healthy gingiva) to 3 (indicated spontaneous bleeding, severe inflammation), the level of hygiene was assessed by plaque index (PI) that was measured from 1 (indicated presence of plaque detectable with probe) to 3 (abundant accumulation of plaque) and the pocket depth (PD) that measure the distance between base of the pocket and the free gingival margin, the values were converted into a score called T-score that was measured from 0 (PD ranged from 0 to 2mm) to 3 (PD>6mm).<sup>17-19</sup>

**Biochemical parameters:** From all participant an overnight fasting venous brachial blood sample was drained in clean test tube has few ml of K2EDTA for detection of glycosylated hemoglobin (HbA1c) using the standard colorimetric method with automated HbA1c analyzer (Quo-Lab® HbA1c). In addition, ELISA kits were used for the measurement of tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6) levels in the gingival crevicular fluid samples (Diacclone SAS®, Besançon, Bourgogne- Franche- Comté, France).<sup>20</sup>

### Procedures

The participants randomly divided between 2 equal groups

**Group (A) :** Twenty three NIDDM patients CP received conventional treatment for CP that composed of scaling and root planing (SRP group) to enhance periodontal tissue healing that included scaling that consisted of removal of tartar and plaque from supragingival and subgingival tooth surfaces mucobacterial by using inserts fixed on an

ultrasonic scaler. However, root planning that consisted of removing granulation tissue, subgingival calculus deposits, infected & necrotic cementum, in addition to abolishing root surface irregularities by using manual tools as curettes for 3 months.

**Group (B):** Twenty three NIDDM patients CP received conventional treatment for CP that composed of scaling and root planing in addition to low intensity laser therapy (LILT) (SRP+LILT group) using a 940 nm diode laser (ezlase™ soft tissue diode laser–Biolase Technology Inc.). Wave length was 940nm, application power was 3 W, the optical diameter fiber and tips was 300-400μ, pulse frequency was 15Hz, fluency was 1.2 J/mm<sup>2</sup>, pulse duration and relaxation time equal 10 and 20 millisecond respectively for 3 months.

### Statistical analysis

Comparison between mean values of the investigated before and after the study in both groups was calculated with Paired –t- test. However, comparison between groups was calculated with independent –t- test (P<0.05).

### Results

Forty-six participants enrolled in group (A) received SRP (n=23; 13 males and 10 females), while group (B) received SRP + laser therapy (n=23; 12 males and 11females). No statistical significant difference has been found between both groups regarding the criteria of participants (Table 1).

Mean values of TNF-α, IL-6, HbA1c, Plaque index, Probing pocket depth and Gingival index reduced significantly after treatment in both groups (Table 2 & 3). However, comparison between both groups after treatment revealed significant differences between group (A) and group (B). Moreover, group (B) received SRP+ LILT gained greater reduction in the measured parameters (Table 4).

**Table 1** Criteria of all participants

	Mean±SD		Significance
	Group (A) (SRP group)	Group (B) (SRP + LILT group)	
Age (year)	42.76±5.38	41.92±5.16	P>0.05
Gender ratio (male/female)	13/10	12/11	P>0.05
BMI (kg/m <sup>2</sup> )	31.65±1.73	30.92±1.84	P>0.05
Fasting blood glucose (mg/dl)	132.43±15.72	134.16±14.51	P>0.05
Random blood glucose (mg/dl)	191.57±17.38	193.38±19.24	P>0.05
Duration of diabetes, years	11.45±2.37	10.12±2.81	P>0.05
Systolic blood pressure (mm Hg)	137.71±12.18	139.23±11.75	P>0.05
Diastolic blood pressure (mm Hg)	82.76±6.19	83.94±6.65	P>0.05

BMI, Body mass index

**Table 2** Mean value and significance of TNF- $\alpha$ , IL-6, HBA1c, PI, PD and GI in group (A) before and after treatment

	Mean+SD		T- value	Significance
	Before	After		
TNF- $\alpha$ (pg/ml)	5.86 $\pm$ 1.47*	5.12 $\pm$ 1.35*	3.56	P<0.05
IL-6 (pg/ml)	8.25 $\pm$ 1.61*	7.13 $\pm$ 1.39*	3.47	P<0.05
HBA1c (%)	8.12 $\pm$ 1.35*	7.24 $\pm$ 1.31*	3.29	P<0.05
Plaque index (percentage of sites)	49.91 $\pm$ 8.56	31.15 $\pm$ 5.2*	3.87	P<0.05
Probing pocket depth (in millimeters)	6.48 $\pm$ 1.29	4.61 $\pm$ 1.12*	3.45	P<0.05
Gingival index	1.51 $\pm$ 0.35	0.63 $\pm$ 0.19*	3.31	P<0.05

TNF- $\alpha$ , tumor necrosis factor – alpha; IL-6, Interleukin-6; HBA1c, glycosylated hemoglobin; (\*) indicates a significant difference between the two groups, P < 0.05

**Table 3** Mean value and significance of TNF- $\alpha$ , IL-6, HBA1c, PI, PD and GI in group (B) before and after treatment

	Mean+SD		T- value	Significance
	Before	After		
<b>TNF-<math>\alpha</math></b> (pg/ml)	5.92 $\pm$ 1.42	4.71 $\pm$ 1.27*	6.31	P<0.05
<b>IL-6</b> (pg/ml)	8.31 $\pm$ 1.65	6.15 $\pm$ 1.42*	7.12	P<0.05
<b>HBA1c</b> (%)	8.16 $\pm$ 1.41	6.34 $\pm$ 1.25*	6.45	P<0.05
<b>Plaque index</b> (percentage of sites)	51.25 $\pm$ 9.17	20.78 $\pm$ 3.26*	6.93	P<0.05
<b>Probing pocket depth</b> (in millimeters)	6.53 $\pm$ 1.32	3.11 $\pm$ 1.14*	6.25	P<0.05
<b>Gingival index</b>	1.62 $\pm$ 0.41	0.28 $\pm$ 0.11*	6.34	P<0.05

TNF- $\alpha$ : tumor necrosis factor – alpha; IL-6: Interleukin-6 ; HBA1c: glycosylated hemoglobin; (\*) indicates a significant difference between the two groups, P < 0.05

**Table 4** Mean value and significance of TNF- $\alpha$ , IL-6, HBA1c, PI, PD and GI in group (A) and group (B) after treatment

	Mean+SD		T- value	Significance
	Group (A)	Group (B)		
TNF- $\alpha$ (pg/ml)	5.12 $\pm$ 1.35	4.71 $\pm$ 1.27*	3.14	P<0.05
IL-6 (pg/ml)	7.13 $\pm$ 1.39	6.15 $\pm$ 1.42*	4.11	P<0.05
HBA1c (%)	7.24 $\pm$ 1.31	6.34 $\pm$ 1.25*	3.26	P<0.05
Plaque index (percentage of sites)	31.15 $\pm$ 5.23	20.78 $\pm$ 3.26*	3.34	P<0.05
Probing pocket depth (in millimeters)	4.61 $\pm$ 1.12	3.11 $\pm$ 1.14*	3.25	P<0.05
Gingival index	0.63 $\pm$ 0.19	0.28 $\pm$ 0.11*	3.28	P<0.05

TNF- $\alpha$ , tumor necrosis factor – alpha; IL-6, Interleukin-6; HBA1c, glycosylated hemoglobin; (\*) indicates a significant difference between the two groups, P < 0.05

## Discussion

Periodontal diseases are 2.8 times more among diabetic patients with hyperglycemia about 5 times higher risk of oral infections than non-diabetic subjects.<sup>21</sup> However, CP is the 6<sup>th</sup> complication of diabetes.<sup>22</sup> In the other hand, periodontal therapy improves metabolic control in diabetics.<sup>23</sup> Our study aimed to assess the value of LILT added to SRP upon periodontal inflammation in NIDDM Saudi CP patients. The outcomes of our study proved that SRP added to LILT significantly reduced the GCF levels of TNF- $\alpha$  and IL-6 greater than SRP alone in NIDDM patients with CP, these findings agreed with many studies. *Sun et al.* stated that conventional treatment improved inflammatory cytokines in NIDDM patients with CP.<sup>24</sup> However,

Kocak et al.<sup>25</sup> proved that adjunct LLLT to SRP significantly reduced GCF IL-6 with no significant change in GCF IL-8 among NIDDM patients with CP.<sup>25</sup> While, Calderin et al.<sup>26</sup> reported that 2 months of adjunct LLLT to SRP significantly reduced GCF TNF- $\alpha$  in patients with CP. Also, Gundogar et al.<sup>27</sup> and Üstün et al.<sup>28</sup> mentioned that adjunct LLLT to SRP significantly reduced GCF cytokines in patients with CP. Moreover, Lee et al.<sup>29</sup> mentioned that LLLT significantly reduced the pro-inflammatory genes expression in periodontal inflammatory disease.<sup>29</sup> In the other hand, Kellesarian et al.<sup>30</sup> conducted a systematic review on 22 randomized control trials and reported that the impact of adjunct LLLT to SRP upon pro-inflammatory cytokines expression in CP patients was inconclusive.

Concerning the periodontal parameters, the study results showed a significantly reduced Plaque index, Probing pocket depth and Gingival index that indicated improvement in periodontal wound healing after 3 months of SRP adjuvant LLLT which agreed with Ustun et al.<sup>31</sup> reported that 810 nm diode laser can cause significant reduction in GCF and IL-1 $\beta$  compared to control group, which could be an explanation for the decrease in GI and PD. However, Demirturk-Gocgun et al.<sup>32</sup> found significant improvement in PI and PD one month following SRP adjuvant LLLT in patients with NIDDM. While, Crispino et al.<sup>33</sup> mentioned that diode LILT in addition to SRP was associated with more evident results in periodontal parameters (GI, PI and PD) of CP patients. Moreover, Obradović et al.<sup>34</sup> proved that LLLT improved healing of gingival tissue as evident of histologic findings and absence of inflammatory cells.

Regarding glycemic control, our findings revealed significantly reduced level of HbA1c that indicated improvement in glycemic control after 3 months of scaling and root planing, adjuvant LLLT, while many studies indicated that periodontal therapy resulted in low level of HbA1c in NIDDM patients.<sup>35–37</sup> While, Stewart et al.<sup>35</sup> stated that nine months of periodontal treatment significantly improved glucose control in NIDDM patients.<sup>38</sup> However, Yun et al.<sup>39</sup> reported reduction in glycated hemoglobin (HbA1c), plaque index and bleeding on probing scores after 16 weeks of SRP in 46 NIDDM patients with CP.<sup>39</sup> Similarly, Botero et al.<sup>40</sup> mentioned that their systematic review proved that 3 months of periodontal treatment in NIDDM patients with CP. Moreover, Kocak et al.<sup>41</sup> proved that 3 months of LILT in addition to SRP significantly reduced HbA1c in type 2 diabetics with periodontitis.

The possible mechanisms for the positive effects of combining laser therapy with SRP were achieved via more effective decontamination and slower recolonization of the pocket.<sup>42–44</sup> However, the curettage effect of laser ensure complete removal of infected sulcular epithelium.<sup>45,46</sup> While, infected granulation tissue removal induce connective tissue healing that minimize the GI and PD.<sup>47–51</sup> In addition to the diode laser antimicrobial effect that kills the periodontal microorganism.<sup>51</sup> In the other hand, laser accelerates mitochondrial production of adenosine triphosphate (ATP) through respiratory chain system biomodulative effect which induce halving of cell duplication times.<sup>52,53</sup>

## Conclusion

Low intensity laser therapy as an effective adjunct to periodontal therapy upon periodontal inflammation in NIDDM Saudi patients with CP.

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## Conflicts of interest

Author declares that there is no conflict of interest.

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