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BIO-Modulation Effect of Low Intensity Laser as an Adjunct to Mechanical Debridement of Periodontitis

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ABSTRACT

Purpose: The current study was conducted to elaborate the clinical, osteocalcin biomarker radiographic effect of biomodulaion effect of low intensity laser as an adjunct to mechanical debridement in the treatment of patient suffering of chronic periodontitis. **Material and methods**: This current study was conducted on twelve (12) healthy patients that were alienated randomly into two groups: Group A (non lased, control group) twelve (12) patients side with one stage mechanical debridement without using of the low intensity laser as an adjunctive treatment; Group B (Test group, lased) twelve (12) patients side with three stage treatment high level laser decontamination, mechanical debridement with the application of biomodulation six sessions of low intensity laser. **Results:** lased group showed a significant increase in the clinical parameter, osteocalcin biomarker level after three and six months in comparison with control group after three and six months follow up. **Conclusion**: The using of laser decontamination, low intensity laser with conventional mechanical debridement showed an improvement in the treatment outcome of chronic periodontitis.

KEYWORDS

Keywords: periodontitis, low intensity laser, biomodulation, laser.

INTRODUCTION

Chronic Periodontitis is a complex inflammatory disease. Which lead to periodontium tissue destruction [(1)]. It Consist of iterative interactions between the inflammatory system and the immune system

A paper extracted from Master thesis titled "Biomodulaion effect of low intensity laser as an adjunct to mechanical debridement of chronic periodontitis"

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of the susiptable host, sub gingival micro biota and modifying environmental factors [2].

Periodontal disease management is aiming to bacterial load reduction. It can be reached by conventional scaling and root planning (SPR), or by the host modulation therapy (HMT) [3].Conventional (SPR) can improve all clinical parameters [4], but it show some limitations as in case of Unfavorable tooth root anatomy and moderate deep periodontal pockets [5] .

Laser in periodontal treatment is consider as a valuable addition, it improve the therapeutic outcomes [6]. Low level lasers (LLL) are used in the activation of antimicrobial agent, and cellular biostimulation after the conventional (SPR) [6].

(LLL) is recommended due to it is analgesic, biostimulation and photochemical role in anti inflammation. (LLL) dosage (10^{-2}:10 ^{2}j/cm^{2}) and (600:1000 nm) wave length [6].Laser periodontal pocket decontamination improves mRNA expression of vascular endothelial growth factor, transforming growth factor-β and insulin growth factor in gingival fibroblast, thus leading to metabolism of connective tissue [7].

LLL increase the production of ATP through the mitochondrial respiratory chain, which allows the proliferation of osteoblast and fibroblast [8, 9]. LLL can provide angiogenesis and vasodilatation thus improve the local microcirculation which leading to decrease tissue inflammation and edema [10] LLL can suppresses periodontal inflammation by modulation of the local immune response to decrease the release and production of proinflammatory cytokines, such as prostaglandin E2, interleukin-1b and tumor necrosis alpha [11, 12].

Several studies prove the osteoblast biological role, and elaborate the bone derived osteocalcin (OC). OC remarked as the most sensitive serum marker which demonstrate the osteoblastic activity in bone formation. OC play important role in regulate the bone matrix mineralization [13].

Many clinical trials, demonstrate the additional aid of the LLLT in periodontal non surgical treatment [14, 15]. LLL can decrease the bleeding index (BI),probing pocket depth (PPD) , clinical attachment level (CAL) ,plaque index (PI)and matrix metalloproteinase-8 level in the gingival crevicular fluid, , over the short term[16] .

Several studies in vivo and vitro demonstrate the photobiomodulation effect of LLL which can improve osteoblastic proliferation via the incensement of growth factor and cofactor of bone mineralization [17]. Other studies elaborated the LLL effect on the bone morphogenic (BMP-2) gene expression, osteocalcin, transforming growth factor β1 [18], thus stimulate the mineralization of bone [19].

MATERIAL AND METHODS

Study design

This current study was a randomized clinical trial on24sides chosen from the out-patient clinic of Periodontology, Oral Medicine and radiology department, faculty of Dental Medicine for Girls, Al-Azhar University.

Sample Size:

The sample size of 24 patient's sides (12sides in each group) will be sufficient to detect the difference. Total numbers of patients were alienated randomly in to two groups.

(Control group): twelve (12) patients side with one stage mechanical debridement without using of the low intensity laser as an adjunctive treatment.

(Laser group): twelve (12) patients side with three stage treatment laser decontamination, mechanical debridement with the use of bio modulation six sessions of low intensity laser.

The patients were selected according to selected criteria (The patients were free from any systemic diseases as evaluated by modified Cornell medical index, Presence of at least seven natural teeth to provide reasonable number of teeth matched chronic periodontitis with a PD ≥6 mm and attachment loss ≥4 mm, non-smoker and non-pregnant women). The selected patients signed an informed consent.

Study procedures:

All patients in this study were received conventional scaling and root planning using hand instruments and ultrasonic scalar followed by oral hygiene instructions.

Laser application:

In laser group laser disinfection to the pockets will be done first by 3ooμm (non initiated tip), holed parallel to the tooth long access of each tooth (continuous mode CP2, with peak power 1.60W, average power 0.80W, pulse length 1.00ms and pulse interval 1.00ms).

Specific protective glasses were used for patient, dentist. One week after the completion of initial therapy, the laser group will receive laser therapy and continued once a week per 6 weeks. Laser application was done by using laser tip for biostimulation.(Wavelength 940±10nm, power output 0,5watt).

Clinical evaluation:

- Bleeding index (BI) and Plaque index (PI) were recorded at baseline, 3, 6 months for each patient around the healing abutment.
- Probing depth (PD): The distance from the base of the pocket to the gingival margin was measured using Williams's periodontal probe with the following graduations: [1, 2, 3, 5,7,8,9 and 10 millimeters (mm)].
- Clinical attachment level (CAL): The distance from the cement-enamel junction (CEJ)to the base of the periodontal pocket is CAL. The readings were recorded at the same location of PD.
- Collection of GCF samples and osteocalcin biochemical bone markers:

At each three appointment (baseline, 3and 6 months), GCF samples were collected from one pocket site. Level of osteocalcin in GCF samples will be determined by using a commercially available means of Enzyme Linked Immune sorbent Assay (ELISA).

RESULTS

Clinical evaluation results:

Bleeding Index: by comparing the bleeding index at baseline between control and laser group there was no significant difference was found at P value 0.231, while by comparing the bleeding at three month between laser and control group there was a significant difference at P value 0.000, while by comparing the bleeding at six month between lased group and control group there was a significant difference at P value 0.004.

Plaque Index**:** by comparing the plaque index at baseline between laser and control group, there was no significant difference was found at P value0.051, while by comparing the plaque index at three month between control and laser group there was a significant difference at P value 0.000, while by comparing the plaque index at six month between lased group and control group there was a significant difference at P value 0.028.

Probing depth: by comparing the probing depth at baseline between laser and control group, there was no significant difference was found at P value 0.722, while by comparing the probing depth at three month between control and lased group there was a significant difference at P value 0.011, while by comparing the probing depth at six month between laser and control group there was a significant difference at P value 0.022.

Clinical attachment loss: by comparing the clinical attachment loss at baseline between lased and non lased control group there was no significant difference was found at P value 0.712, while by comparing the clinical attachment loss at three month between laser and control group there was a significant difference at P value 0.004, while by comparing the clinical attachment loss at six month between laser and control group there was a significant difference at P value 0.000.

Table (1) *Descriptive analysis of Absolute change in clinical parameters within the study groups through the whole study period.*

	At zero Point	After 3 months	After 6 months	Significance Test (ANOVA test)	P value
●Bleeding index in Laser group (mean ±SD)	2.50±0.30	0.32±0.18	0.41±0.29	t=256.64	0.000*
●●Bleeding index in control group (mean ±SD)	2.66±0.30	1.10±0.30	0.99±0.53	t=66.70	0.000*
●Plaque index in Laser group (mean ±SD)	2.13±0.38	0.55±0.23	0.12±0.22	t=159.39	0.000*
●●Plaque index in control group (mean ±SD)	2.40±0.35	0.97±0.25	0.41±0.35	t=127.09	0.000*
●Probing depth in Laser group (mean ±SD)	3.72±0.43	2.56±0.43	2.40±0.50	t=29.44	0.000*
●●Probing depth in control group (mean ±SD)	3.65±0.51	3.15±0.59	2.95±0.58	t=4.84	0.014*
●Clinical attachment loss in Laser group (mean ±SD)	1.50±0.28	0.63±0.24	0.35±0.27	t=62.37	0.000*
●●Clinical attachment loss in control group (mean ±SD)	1.46±0.26	1.00±0.29	0.75±0.22	t=21.83	0.000*

**Significant difference (p value<0.05).*

Osteocalcin: by comparing the osteocalcin at baseline between lased and non lased control group there was no significant difference was found at P value 0.431, while by comparing the osteocalcin three month between lased and non lased control group there was a significant difference at P value 0.253, while by comparing the osteocalcin at six month between control and laser group there was a significant difference at P value0.465 .

Table (2) *Descriptive analysis of absolute change in ELISA from zero point to 3&6 months between groups*

	Laser Group	Control Group	Significance Test (Student t test)	P value
Osteocalcin at zero point (mean±SD)	21.46±2.42	22.26±2.48	t=0.80	0.431
Osteocalcin after 3months (mean±SD)	25.08±2.42	23.98±2.16	t=1.17	0.253
Osteocalcin after 6 months (mean±SD)	24.03±2.11	23.40±1.99	t=0.74	0.465

**Significant difference (p value<0.05).*

DISCUSSION

In the present investigation chronic periodontitis patients were selected because this condition is the most common one affected 36% of Western Europe population and 47.2% of American population as reported[20,21].

Clinical evaluation of chronic periodontitis patient include radiographic evidence of alveolar bone loss, measurement of clinical attachment loss (CAL), pocket depth (PD), gingival inflammation signs and plaque index (PI) [22].

Periodontal therapy primary goal is to arrest inflammation process. Periodontal treatment aim to establishment of micro flora and local environment compatibility with the periodontal health, which can be evaluated through the reduction of PI, BI, PD and CAL [23].

The patients submitted to the present study were selected as having mild to moderate chronic periodontitis since those patients indicated for conventional periodontal treatment alone or combined with other adjunctive treatment such as dental lasers. In the present investigation, chronic periodontitis patients with systemic diseases were excluded since one of these diseases will act as a risk factor that may affect the results of the current study [24, 25].

As regard to gingival crevicular fluid (GCF) analysis to assess the Osteocalcin bone hormone which is the most important biomarkers which is play a major role in the periodontitis [26]. So the present study select osteocalcin as a biochemical marker to detect the response of periodontitis to treatment with conventional scaling and root planning compared with conventional scaling and root planning and laser decontamination and low level laser biostimulation [27].

Laser can maximize pocket decontamination during the periodontal treatment, by providing antiseptic prosperity into the non vascularised tissues (dentine and bone), which overcome the resistance of sub gingival biofilm to antibiotics [28].

Several clinical trials show that the use of adjunctive laser periodontal therapy provides possible avoidance of surgical periodontal therapy intervention [29-35]. Many studies proved that not all the patients treated with conventional SRP alone responded to the treatment, thus laser adjunctive therapy have been encouraged recently [36- 44].

Diode lasers common wavelengths 810, 940, 980 and 1,064 nm. several studies demonstrate the thermal effect of laser on dental soft tissue, At 50°C, deactivation of most nonspore-forming bacteria, which is include periodontopathic anaerobes [45]. At 60°C Both coagulation and homeostasis of the inflamed sulcular epithelium are achieved [46].Low-level laser therapy (LLLT) is one of such a novel techniques whichcan simplifyand improving the outcomes of mechanical root surface management. It is also known as biostimulation therapy.

It has to be noted that the present study did potentially provide that patients with LLLT secondary to the HLLT provided. The true effects of LLLT as a result of HLLT investigated and evaluated cellular modulation and activity [47].

By comparing the effect of LLL single session and LLL multiple sessions. Multiple LLL application during the periodontal treatment show favorable effect on the of proinflammatory mediators reduction, which is in equivalent with some present perspectives [48,49]. It was indicated that multiple laser sessions through the periodontal treatment may induce extra Favorable sound effects[50, 51].

The present research proves that there were significant differences in the laser group and control group in the bleeding index at 3and 6 months observation period when compared to baseline. By comparing the bleeding index between the two groups there was significant difference in the laser group. These results are expected due to the laser anti inflammatory effect which produces a good homeostasis [52, 53].

As regard to plaque index score recorded in the present investigation the results showed that no significant differences between the study groups & there is highly significant difference in lased group and non lased control group at 3, 6 months observation period when compared to base line, this could be attributed to patients cooperation and motivation during the observation period of the study [54, 55].

With reference to periodontal (PD) and (CAL), the results of the existing study show highly significant decrease in measurements of (PD) and (CAL)increase between the two groups at different observation period. There was a significant reduction in both PPD and CAL in the lased grouping than the non lased control group [56, 57].

Osteocalcin level in the present study showed marked raise in the lased group at 3 months when compare to the baseline, this result is parallel to the findings of several authors, in vitro study elaborated the result of low level diode laser therapy on osteocalcin level by using hypoxic culture of human osteoblasts recorded the special effects of LLL on osteoblasts in the gene expression of bone morphogenic protein 2 (BMP-2), osteocalcin, transforming growth factor β1 (TGF-β1)[58], motivation of bone cells propagation and mineralization[59]which in parallel with other experimental study which used LLL (wavelength 808 nm , power 2 w, frequency of 37 J/ cm per site) with exposure time 5 seconds per site after osteotomy in Wister Rats. That study approved the significant increase in osteocalcin level by using immune histochemistry[60].

CONCLUSION

The use of LLL application in the current study procedure within this parameter (940 ±10 wave length, 0.5 watt, six sessions applied once per week)

1. Enhancement in clinical parameter as a sign for the inflammation reduction.
2. Development in bone density and marginal bone level which has been calculated by radiographic assessment.
3. Upgrading in osteocalcin level was related to the enhancement of clinical parameter and bone regeneration in periodontitis patient.
4. Osteocalcin can regard as a sensitive biological marker to evaluate the periodontal treatment out come.

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