**The Effect of Photodynamic therapy in the Treatment of Chronic Periodontitis:**

**A Review of The Literature**

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***Abstract:***

***Objective****:* Chronic periodontitis is the most common periodontal disease which is related to the chronic accumulation of bacterial plaque. Since the mechanical methods are not sufficient in treatment of this disease. Administration of local/systemic antibiotic is recommended following mechanical debridement. However, side effects of antibiotics such as microbial resistance and patient allergy led to development of alternative methods. One of these suggested methods is the antimicrobial photodynamic therapy (aPDT). PDT is a local non invasive treatment modality without the side effects caused by antibiotics. The aim of this study was to review the articles related to the application of PDT with laser in the treatment of chronic periodontitis.

***Review of literature***: In the present review of literature, the authors used key words such as, Chronic Periodontitis, Laser and Photodynamic therapy, and conducted a literature search via Google Scholar and PubMed for the period of 1990 to 2015. A total of 47 articles in English were found. The articles that were not associated with the topic of research and review articles were deleted and only clinical trials were evaluated. After reviewing 23 articles’ abstracts, the full text of 16 articles was analyzed.

***Conclusion***: According to safety, the lack of side effects and general advantages like more patient compliance, the PDT treatment with SRP is recommended as an efficient adjunctive modality for the treatment of localized chronic periodontitis especially in maintenance phase in non-surgical treatment.

***Key Words****:* Chronic Periodontitis, Laser, Photodynamic therapy.

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***Objective:***

Chronic periodontitis is one of the most common periodontal diseases and bacterial biofilm is its etiologic factor (1). Of the most important pathogens causing periodontal disease, complex microorganisms such as Aggregaitbacter Actinomycetemcomitans (Aa), Porphyromonas Gingivalis (Pg), and Treponema Denticola (TD), Tannerella Forsythia (TF) bacterias can be noted (2).

Due to the fact that the main goal of periodontal treatments is to reduce microbial agents, common treatments such as the mechanical debridement (the use of ultrasonic equipment and manually) as well as the use of topical antibiotics or systemic are considered as the main therapeutic measures in the treatment of chronic periodontitis (3). Although the use of antibiotics can reduce the periodontal pathogens, their frequent use can cause bacterial resistance. Also, causing allergy in patients and the inability to make proper concentration of drug in the periodontal pockets is one of the disadvantages of using antibiotics (4).

In addition, in a systematic review side effects such as skin rash, itching, oral candidiasis, nausea, vomiting, after the use of antibiotics have been proposed (5).

Moreover, the complex anatomy of the furca area, the depth of pockets, and the penetration of microorganisms into the tissues caused these section to not have an appropriate access to clean up. Therefore, for reasons outlined, efforts to find adjunctive treatment have improved (6). One of these treatments is photodynamic therapy(PDT).

This method was first used in 1990 for the treatment of cancer. It was determined that its use, stimulates autophagy (a method of cell catabolism, which leads to the destruction of abnormal cells) in resistant cancer cells or precancerous cells. In this method, wavelengths between 650-900 nanometer which are within the visible red light and near infrared, and have great influence on biological tissue are used. So far, more than 400 substances have been identified as photosensitizers, where Indocyanine Green is one of them. After excitation with light, this substance gains properties such as wound healing, antibacterial effect and the treatment of chronic infections of the skin and mucosa. This substance is very safe and does not cause any harm to host cells and it has been approved by FDA (7 & 8). According to Allison et al (2006), photodynamic therapy involves the use of three components: 1) Light; 2) Oxygen free radicals; 3) photosensitizer (9).

When the photosensitizer is stimulated by an appropriate light wavelength (wavelengths between 650-900 nanometer which are within the visible red light and near infrared) provides the free radicals of oxygen that causes tissue damage (10 & 11). The cytotoxic products have a short half-life about (0.04 microsecond) and limited radius effect of (0.20 micrometer). In other words, they are limited to the infected area, where the photosensitizer is accumulated there. Thus, photodynamic therapy is a topical method that does not affect other host tissues (12).

Due to its safety, no side effects and more acceptability of non-surgical methods of treatment to patients, photodynamic therapy is important as an adjunctive therapeutic method with SRP in order to increase the efficiency of non-surgical treatments.

Therefore, the aim of this study was to evaluate the effects of photodynamic therapy using laser in the treatment of chronic periodontitis. Thus, in this review of literature, we examined the medical literature, seeking to identify and synthesize relevant information to formulate the best approach to treat chronic periodontitis.

***Review of Literature:***

In the present review of literature, the authors used key words such as Laser, Chronic Periodontitis, and Photodynamic therapy, and conducted a literature search via Google Scholar and PubMed for the period of 1990 to 2015. A total of 47 articles in English were found. The articles that were not associated with the topic of research and review articles were deleted and only clinical trials were evaluated. After reviewing 23 articles’ abstracts, the full text of 16 articles was analyzed.

In a randomized clinical trial that was conducted by Andersen et al in 2007, 23 patients with chronic periodontitis were randomly divided into 3 groups: group 1-treatment with PDT, Group 2-treatment with SRP and PDT (laser diodes) and Group 3-treatment with SRP alone (control group). The results of the study showed that the addition of PDT to SRP significantly improved clinical attachment level (CAL) and the depth of probing pocket (PPD) statistically (13).

In another randomized clinical trial that was conducted by Braun et al in 2008, the main purpose was to compare clinical outcomes of doing SRP with or without PDT. In this study, 20 patients with chronic periodontitis were randomly divided into two groups by using the Split-Mouth method. All patients were under SRP. In a quadrant, PDT was performed (by means of laser diode 660 mm and photosensitizer phenothiazine chloride).

At the beginning of the study, 1 week and 3 months after treatment, the GCF, PPD, BOP and gingival recession (GR) were measured. In all cases except for gingival recession, better results in the group treated with PDT were obtained; however, no difference in the recession in the two groups was observed (14).

In another clinical trial that was conducted in 2008 by Christodoulides et al, 24 patients with chronic periodontitis were randomly divided into two groups: 1- treatment with SRP, 2-treatment with SRP and PDT (diode laser 670 nm and power of 75 mw) and no statistically significant difference were seen between the two groups and only BOP in the group treated with SRP and PDT had significant improvements compared to those treated with SRP alone (15).

In another clinical trial that was conducted in 2009 by Chondros et al, 24 patients with chronic periodontitis were divided into two groups: group 1- treatment by SRP and group 2- treatment with SRP and PDT (670 nm, 75 mw laser diode and photosensitizer phenothiazine chloride for 60 seconds), respectively. Both groups were assessed at two time periods 3 and 6 months. No significant differences in terms of PPD, CAL, and the amount of plaque were seen, but the BOP was significantly reduced in group of treatment by SRP and PDT. (16).

In 2009, Polansky et al, treated 58 patients with chronic periodontitis in two treatment groups: 1-treatment with SRP and 2-treatment with SRP and PDT (laser diode 680 and 75 mv), and no difference in the amount of CAL, BOP, and PPD were seen between the two groups. Based on the results obtained, the use of PDT once, did not have significant clinical effect compared to SRP treatment alone (17). In a similar study by Ruhling et al (2010) on 25 patients using 636 nm diode laser photo synthesizer phenothiazine chloride, similar results were obtained (18).

Lui et al in 2011 in a clinical trial investigated 24 patients with chronic periodontitis. The patients were randomly divided into two groups: group 1- under SRP treatment and group 2-under SRP and PDT treatment (diode laser 940 nm for 3 days). A month later, BOP and GCF had a greater reduction in the first group, but after 3 months no difference between the two groups was seen. Also, the amount of IL-1β had dropped more in the second group than the control group in a 1week; therefore; the researchers concluded that the use of PDT with SRP is more effective in improving patients in the short term (19).

In 2011, Aykol et al divided 24 patients with chronic periodontitis into two groups during a clinical trial. 1-Treated with SRP 2-Treated with SRP and PDT (diode laser 808nm, power of 0.25 watts in the first day, the second day and the seventh day of the treatment). Then all the patients were divided into two groups of smokers and non-smokers. The group treated with SRP and PDT for both smokers and non-smokers showed better results in terms of improved clinical parameters (20).

In 2011, Cappuyns et al randomly assigned 32 patients with history of non-surgical chronic periodontitis treatment into 3 groups in a clinical trial. 1- treatment with SRP 2-treatment with diode laser 810 nm 3-treatment with photodynamic therapy, diode laser 660nm and photosensitizer phenothiazine chloride. All of the three groups showed an improvement in GR, BOP and PPD clinical parameters and there was not any difference between them (21).

In 2012, Noro et al investigated 12 patients with HIV and chronic periodontitis treatment history in a clinical trial by the method of Split Mouth. They have randomly divided them into two groups. 1- Treatment with SRP 2-Treatment with SRP and PDT (diode laser 660nm,photosensitizer methylene blue). Six months later they have observed improvements in PPD and CAL clinical parameters in the second group (22).

In another clinical trial investigation in 2012, Breakdar et al randomly assigned 22 patients with chronic periodontitis with at least 4 teeth in each quadrant with residual pockets over 5 millimeters into two groups. 1- Treatment with SRP 2-treatment with SRP and PDT (laser 670 nm, 150mw and photo sensitizer 0.005% methylene blue). They have observed PD, CAL and BOP improvement in both groups but the amount of PD improvement was significant in the second group (23).

In a study in 2012, Giannelli et al compared the clinical outcomes of chronic periodontitis treatment with SRP and SRP combined with photodynamic therapy and photo-ablation with diode laser. They have perused 26 patients. The results of the study showed that treatment of chronic periodontitis with photo-ablation along side with several photodynamic therapy sessions is more effective in improving patients compared to SRP alone (24).

In 2013, Blata et al have divided 22 patients with chronic periodontitis with depth of 5-7 millimeters pockets in each quadrant into two groups during a clinical trial by using split mouth method. Group one was treatment with SRP. Group two was treatment with SRP and PDT (laser 660nm, 100w and photo sensitizer methylene blue 0.005%). They have checked BOP, CAL and PD clinical parameters before the treatments as well as one month, 3 months and 6 months after the treatment. In each group no statistically significant difference was observed clinically after the treatment (25).

In 2013, Souza et al studied the impacts of microbial photodynamic therapy on the level of transforming Growth factor β1 in GCF on patients. In this study they have chosen 50 patients with bilateral Grade III furcation involvement in molars of mandible. Each pair of molar teeth was randomly divided into groups of experimental group and control group. They have applied SRP into control group and SRP accompanied with PDT applied into the control group.45 days later the control group have received flap surgery and SRP and the experiment group have received flap surgery, SRP and PDT. They have checked GCF collected by Elisa method by the amount of TGF β1- at baseline, 45 days after the initial treatment and 21 days after the surgical treatment. The experiment group compared to the control group at 45 days after the initial treatment and 21 days after the surgical treatment has shown statistically significant difference (26).

In 2014, Pourabbas et al in a clinical trial which carried out for 3 months on 22 patients affected with chronic periodontitis has shown that adding one extra therapy session with toluidine blue and concentrated light of 638 nm does not add any extra improvements on clinical indicators. Although that would causes reducing the rate of TNFα in gingival sulcus fluid, therefore flashing concentrated light only once along side with scaling may impact the ability to show the effects of treatment with photodynamic therapy and makes it impossible to interpret the results (27).

In 2014, Kolbe et al randomly assigned 22 patients with chronic periodontitis during a clinical trial by split mouth method. They have divided the patients into three groups based on the random points they have been selected before. 1-treatment with SRP 2-treatment with SRP and photosensitizer (PS) 3-treatment with SRP and PDT. Patients were checked at baseline, 3 months and 6 months after it was done. The results of the study showed that each group resulted in improvements of clinical conditions but only in the third group increasing of IL-4 perception and reduction of IL-6, IL-8 and IL-1β was reported (28).

***Discussion****:*

The aim of this study was the effects of photodynamic therapy using of laser in periodontitis treatment. The result of studies done on the impact of photodynamic therapy as an adjunctive way of treatment for chronic periodontitis is different.

Although in most of these studies, laser diode has been used but neither of these studies has mentioned which types of laser, photosensitizer, wavelength, power and intensity is more effective (29).

It appears that the use of multiple doses of laser is more effective than only one dose (30). But only in one of the five studies shows that using laser results positively in improving clinical parameters. In a study by Malik et al, in 2010 was carried out to this result that only one use of laser doesn’t affect patients with chronic periodontitis. There should be several times of laser therapy in the first week of treatment to reveal antimicrobial effects (31).

Although the use of laser in many studies have similar results to SRP, but we can’t disregard the shorter treatment time, more rapid onset of action, reduced the need for anesthesia and lack of resistant forms of bacteria when using laser.

It seems that the most useful effect in using laser is in the maintenance phase because usually at this time retreatment is limited to residual deep pockets and is localized. Using laser prevents removing extra dental tissues. Also this method prevents tooth sensitivity.

In addition, there is no need of using antibiotics after surgery due to use of laser with its anti bacterial effect.

Since the use of photodynamic therapy reduces bacteremia, it is possible that using it would be beneficial for patients who are at risks of endocarditis.

The use of PDT as an adjunct therapy in non-surgical treatments in comparison to periodontal surgeries is economical.

In addition, due to its focal effect, using systematic antibiotics is unnecessary. Also high concentrated photosensitizer at the site of infection is an important role in reducing the bacteria without adverse effects on host cells (32).

In overall with general attention to safety, other benefits and no side effects, PDT is recommended as a adjunctive therapy with SRP for treatment of localized periodontitis, Specially in the maintenance phase to complete and increasing efficiency in non-surgical treatments.

Considering the fact that the important role of laser in the treatment of periodontal diseases and reducing the periodontal pathogens such as A.Actinomycetemcomitans and P.Gingivalis has been completed and approved, comparing different variety of photosensitizer, laser powers and wavelength would bring the best and the most effective clinical outcomes. Also the frequently of using laser, duration, and other laser characterizes should be used to determine the best way of using it.

***Conclusion:***

Of the 16 articles studied, in 8 of them using photodynamic therapy with SRP caused more improvement in CAL, PPD and BOP (clinical parameters) and in rest of them using PDT with SRP together did not mention more improvement. But in most of them PDT and SRP caused significant improvement in BOP compare to SRP alone. Also using photodynamic therapy several times is more effective than only once.

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