



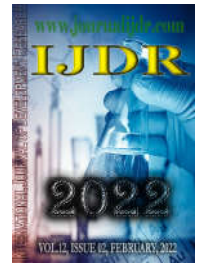
ISSN: 2230-9926

Available online at <http://www.journalijdr.com>

IJDR

International Journal of Development Research
Vol. 12, Issue, 02, pp. 54150-54152, February, 2022

<https://doi.org/10.37118/ijdr.23511.02.2022>



REVIEW ARTICLE

OPEN ACCESS

CLINICAL APPLICATION OF PHOTODYNAMIC THERAPY AS AN ADJUNCT TO THE NON-SURGICAL TREATMENT OF CHRONIC PERIODONTITIS: LITERATURE REVIEW

Santos O. Viviane*¹, Mendes N. Giovanna², Mai J. Rafaela¹, Silva A. Dayane¹, Matos F. Ivana¹, Júnior A. B Anildo¹, Silva C. Janaína¹, Bruck O. C Kelly¹, Lopes A. A Quércia¹ and Júnior T. Ivair³

¹Dentistry Undergraduates Faculdade Adventista da Bahia; ²Dentist Surgeon. Program Resident Residência Multiprofissional em Saúde da Família for the FESF-SUS/Fiocruz-Ba; ³Dentist Surgeon. Professional Master in Integrated Clinic-TAL FACUL. Professor of the Dentistry Course at Faculdade Adventista da Bahia

ARTICLE INFO

Article History:

Received 09th December, 2021
Received in revised form
07th January, 2022
Accepted 20th January, 2022
Published online 26th February, 2022

Key Words:

Photodynamic therapy. Lasers.
Periodontal medicine.
Chronic Periodontitis.

*Corresponding author:

Santos O. Viviane,

ABSTRACT

The present study aims to evaluate and compare the effects and advantages of photodynamic therapy (PDT) as an adjunct in the treatment of scaling and root planing (RPR), on the reduction of the clinical effects of chronic periodontitis, in relation to RPR alone. **Method:** Papers were collected in the PubMed, LILACS and SciElo databases and descriptors were used in English and Portuguese, searched in DeCS: Photodynamic therapy (photodynamic therapy); Lasers (Lasers); Periodontal Medicine; Chronic Periodontitis (Chronic Periodontitis). A total of 35 studies were excluded and 19 were elected. **Results:** The analyzed studies showed differences in relation to the therapy used in terms of photoinitiators, treatment time and wave spectrum used. However, as a whole, they presented advantages regarding the use of PDT as an adjunct in the treatment of chronic periodontitis. **Conclusion:** PDT as an adjunct to non-surgical periodontal treatment of chronic periodontitis showed benefits in reducing the clinical aspects of the disease such as plaque index, gingival bleeding and gum inflammation. However, further studies are needed to develop application protocols and guidelines for dentists, and thus ensure the effectiveness and safety of photodynamic therapy in chronic periodontal treatment.

Copyright © 2022, Santos O. Viviane et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Santos O. Viviane, Mendes N. Giovanna, Mai J. Rafaela, Silva A. Dayane, Matos F. Ivana, Júnior A. B Anildo, Silva C. Janaína, Bruck O. C Kelly, Freitas S. Tiago and Júnior T. Ivair. "Clinical application of photodynamic therapy as an adjunct to the non-surgical treatment of chronic periodontitis: Literature Review", *International Journal of Development Research*, 12, (02), 54150-54152.

INTRODUCTION

Chronic periodontitis is a disease characterized by local inflammation that affects the oral tissues responsible for supporting the teeth, causing a progressive loss of alveolar bone (da Silva ICS *et al.*, 2017; Bernhard J *et al.*, 2015). Its cause is due to pathogenic bacteria already existing in the dental biofilm, which, when migrating to the gingival sulcus, lead to a complex host response to bacterial infection, which can be modified by systemic and behavioral factors (da Silva ICS *et al.*, 2017; Bernhard J *et al.*, 2015; Bundidpun P, Srisuwantha R, Laosrisin N, 2017). One of its clinical signs are gingival bleeding, migration of pathogenic bacteria, bone loss and the presence of periodontal pockets, and this pathology is classified according to its severity and extension (da Silva ICS *et al.*, 2017). Mechanical treatment of chronic periodontitis consists of removing supragingival and subgingival bacterial plaque, and microbial control through non-surgical periodontal therapy, using manual and ultrasonic equipment, where scaling and root planing (RPR) is performed, which is considered gold standard for its treatment, (Joseph B *et al.*, 2017; Sculean A *et al.*, 2015).

Thus, halting the progression of periodontal disease. However, some affected areas may not respond well to RPR treatment, requiring other complementary therapies for better efficacy (Ferreira A V, 2017). The use of topical or systemic antibiotics, in addition to mechanical treatment, are considered the main means of reducing microbial agents. Although the drug can help to reduce these pathogens, the frequent use of this type of drug can cause bacterial resistance, in addition to the difficulty of reaching considerable levels in the gingival fluid of periodontal pockets, to extinction of these bacteria (Meimandi M *et al.*, 2017; Nguyen, S; Hiorth, M, 2017). Photodynamic Therapy (PDT) is a technique in increasing use in dental practice, being applied to treatments of various pathologies of the stomatognathic system, such as soft tissue injuries (Abduljabbar, T, *et al.*, 2017). Viruses, fungi and bacteria are sensitive to PDT when exposed to the photosensitizer, with a reduction in bacterial load, suggesting its applicability in chronic periodontitis, eradicating periodontopathic pathogens (Bundidpun, P; Srisuwantha R, Laosrisin N, 2017). PDT is not intended to replace the antimicrobial treatment of drugs used as adjuvants in the treatment of chronic periodontitis or any other conventional treatment, such as RPR. This new modality comes to offer a complement in the treatment of localized oral

infections, as is the case with the topic discussed here (Eduardo, CDP, *et al.*, 2015). The advantages that PDT offers compared to antibiotic therapy include the immediate elimination of microorganisms, as well as virulence factors and local deleterious effect only where the photosensitizer and light are irradiated concurrently (de Freitas, LM, *et al.*, 2016). Therefore, studies to update the dental clinical practice on methods complementary to conventional treatments such as RPR for the control of chronic periodontitis are essential. The aim of this paper is to present, through a literature review, the clinical applications and advantages of using PDT as an adjunct to the non-surgical periodontal treatment of chronic periodontitis compared to the treatment of isolated RPR.

RESULTS

Table I refers to the authors, the subject of the articles, year of publication, sample number and results of clinical cases and randomized studies. A critical synthesis of the main results was carried out, taking as a time interval the years 2016 to 2019 with regard to conventional periodontal treatment associated with the use of PDT in the following aspects: evaluation of oral hygiene conditions, Visible Plaque Index (VPI); Gingival Bleeding Index (GBI), Probing Bleeding (PB), Probing Depth (PD) and Clinical Insertion Level (CIL) at the beginning and end of each treatment, and the light spectrum used in the treatment.

articles were found in the databases. As inclusion criteria, original articles published in English and/or Portuguese were considered, indexed in a period of 6 years, between 2015 and 2020; observational studies, randomized clinical trials, case-control studies, case reports and systematic reviews were chosen. Exclusion criteria were: not presenting the article in its entirety, not meeting the type of study required, or approaching an in vitro sample or animal studies. After applying the filter of year of publication and languages, the number was reduced to 23, and of these only 19 met the pre-established study type criteria.

DISCUSSION

The mechanism of action of PDT is through the activation of a photosensitive chemical substance that is not toxic to oral tissues, at a specific wavelength that damages cell membranes and DNA of pathogenic bacteria, causing cell lysis (Fonseca, RR, *et al.* 2017) The advantages that PDT offers compared to antibiotic therapy include immediate elimination of microorganisms, as well as virulence factors and local deleterious effect only where the photosensitizer and light are irradiated concurrently (de Freitas, LM, *et al.*, 2016). The most used photosensitizers in oral medicine treatment are phenothiazine dyes, especially Methylene Blue (Eduardo, CDP, *et al.*, 2015). The use of PDT in the treatment of chronic periodontitis aims to reduce or

Table 1. Description of articles included in the review

Nº	Authors	Theme	Sample	Intervention	Results
1	Biasi PR, Santos BM, Guerra LF, Campos LA. 2019	Low-intensity laser as auxiliary therapy in periodontal treatment- Case reports	Two patients, male, with generalized chronic periodontitis	After dividing the 4 quadrants of the dental arch, the therapies in each quadrant were randomly selected: RPR + LASER; PDT+ LASER+ photoinitiator; RPR+ chlorhexidine 2% or PDT isolated	It was concluded that the treatment made with the use of LASER and PDT helps to reduce bleeding and has an anti-inflammatory effect, associated with a photoinitiator such as methylene blue has bactericidal effects
2	Silva NTD, Silva DNA, Azevedo MLDS, Silva Júnior FLD, Almeida ML, Longo JPF, Moraes M, <i>et al.</i> 2016	The Effectiveness of photodynamic therapy as a complementary therapy to mechanical instrumentation on residual periodontal pocket clinical parameters: a clinical split-mouth test	114 sites, with 57 sites in the test group and 57 in the control group, with periodontal pockets	Four quadrants were randomly treated by scraping and root smoothing (SRP), diode laser (810nm wavelength, 1.5W and 320 µm fiber, contact and scanning technique), SRP + PDT (with 808 diode laser nm, 0.5 W) and laser + SRP (with 808 nm diode laser, 1 W) in each patient	It was concluded that PDT was more effective as an adjunct treatment to SRP than SRP alone; however, no distinct differences were found between the two treatment modalities regarding the reduction of certain pathogenic bacteria
3	Bundidpun P, Srisuwantha R, Laosrisin N. 2018	Clinical effects of photodynamic therapy as an adjunct to full-mouth ultrasonic scaling and root planing in treatment of chronic periodontitis	Twenty patients with moderate to severe chronic periodontitis.	They were treated with a subgingival piezoelectric ultrasonic device alone in the control group and auxiliary treatment with PDT in the test group	The study showed that the addition of a single application of PDT as an adjunctive therapy to SRP did not result in an improvement in terms of reduced probing pocket depth, reduced plaque index and clinical attachment gain, but did result in a reduction significantly greater gingival bleeding and gingival inflammation
4	Fonseca RR, Ramos UD, Menezes SA, Neto AR, Oliveira PG. 2018	Use of antimicrobial photodynamic therapy in type 2 diabetic patients with chronic periodontitis: case report	1 Male, 56-year-old patient, black, type II diabetes. was diagnosed with chronic periodontitis.	The whole mouth RPR was performed using manual and ultrasonic instruments together with several applications of PDT with phenothiazine hydrochloride at 10 mg/ml, each dental element being irradiated for 1 minute, in 4 consultations carried out within 14 days	In this case, PDT proved to be an excellent adjuvant therapy in the treatment of periodontal disease, as clinical signs such as gingival bleeding, bacterial plaque, dental mobility and PD had a significant decrease with PD of an average of 3 mm were observed

METHODS

This is a narrative review of the literature, which addresses works related to PDT as an adjunct in the treatment of chronic periodontitis in RPR. Papers were collected from PubMed, LILACS and SciELO databases. For research using descriptors in English and Portuguese, searched in DeCS: Photodynamic therapy (Photodynamic therapy); Laser (Laser); Periodontal Medicine (periodontal medicine); Chronic Periodontitis (Chronic Periodontitis), using different search strategies according to the specificity of each base. Through an advanced search carried out between the periods of August and September 2020, 35

remedy the clinical signs of the disease such as bleeding, tooth mobility, probing depth (PS), bacterial plaque and gingival recession (Fonseca, RR, *et al.*, 2017). Analyzing the decrease in PD in patients with chronic periodontitis from the conjugated therapy treated here, reported by Fonseca (2018), he presented the treatment of the pathology in four sessions of PDT with phenothiazine hydrochloride at 10mg/ml, together with RPR, in a diabetic patient, in a period of 14 days, resulting in a decrease in PD from >5mm to 3mm (Fonseca RR, *et al.*, 2018) This result is similar to the study by Biasi (2019), in which the use of RPR + PDT+ methylene blue photoinitiator, brought a reduction in PD in quadrant 3, ranging over a 45-day period from 133mm before treatment to 78mm after, according to the sum of PD

at each site in the quadrant (Park, D, *et al.*, 2019). Taking into account the difference in systemic issues, type of photoinitiator and period of treatment, the common term PDT used in both cases proved to be efficient in terms of reducing PD for both patients. According to Bundidpun *et al.*, the randomized clinical trial with a sample group of twenty patients with moderate to severe chronic periodontitis treated with a subgingival piezoelectric ultrasonic device alone in the control group and auxiliary treatment with PDT in the test group showed that the addition of a single application of PDT as an adjunct therapy to RPR did not result in an improvement in terms of reduced probing pocket depth, reduced plaque index and clinical attachment gain, but resulted in a significantly greater reduction in gingival bleeding and gingival inflammation (Park, D, *et al.*, 2019).

In the clinical study by Silva *et al.* (2016), 114 sites were analyzed, with 57 sites in the test group and 57 in the control group, with residual periodontal pockets from each hemiarch divided into two treatment groups: RPR, right side; RPR + to PDT, left side or RPR, left side; RPR + to PDT, right side. The results of the study suggest a better response of single-rooted teeth in relation to periodontal disease and level of clinical attachment, even in the test group, leading to the conclusion that PDT was effective for single-rooted teeth, and, for multirooted teeth, higher application frequencies would be necessary to obtain similar results in both types of teeth (Biasi, PR. 2019). Malgikar *et al.* (2016) mentioned that the use of low-level laser in photodynamic therapy involves the proper wavelength to eliminate microorganisms treated with photosensitizing drugs, based on an artifice that is based on a set of photo-oxidative reactions, which when triggering morphobiological changes, promote cell necrosis. The photosensitizing agent in periodontics is impregnated into the subgingival biofilm, penetrating bacterial cells. The oxygen from bacterial cells, upon absorbing the released energy, transforms into singlet oxygen, which, together with highly reactive free radicals, degrade polysaccharides and destroy bacterial biological systems (Silva, NTD, 2020). One of the calculations to define the energy dose explained by Luke (2019), is the mW/second, which corresponds, for example, to 100 mW/10 seconds = 1000 J = 1J (Malgikar, S, *et al.*, 2020).

Just like this calculation, in the study by Bundidpun (2018) a laser diode dose was used, which is equivalent to a wavelength of 660nm, output power of 100mW. Application was performed at six sites per tooth and 10 seconds per site resulting in a significantly large reduction in gingival bleeding and inflammation (Park, D, *et al.*, 2019). A study by Lulic M (2019) demonstrated that repeated applications of PDT (5 times in 2 weeks) adjunct to root planing and scaling (RAR) significantly improved probing cavity depth, fixation, clinical level, and probing bleeding. After 6 months compared to the group treated with RAR alone. Another study by Bundidpun P. (2018) showed that addition of a single application of PDT as adjunctive therapy did not result in an improvement in terms of reduced pocket depth and reduction in plaque index, but did result in a significant reduction in bleeding and gingival inflammation. With this we can see that there are still some controversies (Bundidpun P, *et al.*, 2018). PDT as an adjunct to the non-surgical periodontal treatment of chronic periodontitis compared to the treatment of isolated RPR has beneficial effects, such as reducing the depth of the periodontal pocket, reducing the plaque index, gingival bleeding and gingival inflammation. However, new clinical studies, randomized with a larger number of samples, are needed, with the development of application protocols and guidelines for dentists, in order to guarantee the effectiveness and safety of photodynamic therapy in chronic periodontal treatment.

REFERENCES

Abduljabbar T, Vohra F, Javed F, Akram Z. Antimicrobial photodynamic therapy adjuvant to non-surgical periodontal therapy in patients with diabetes mellitus: a meta-analysis. *Photodiagnosis Photodyn Ther.* 2017; (17): 138-146.

- Berhard J, Jepsen S, Jervøe-Storm PM, Needleman I, Worthington HV. Full-mouth treatment modalities (within 24 hours) for chronic periodontitis in adults. *Cochrane Database Syst Rev.* 2015;(4):CD004622.
- Biasi PR, Santos BM, Guerra LF, Campos LA. Laser de baixa intensidade como terapia auxiliar no tratamento periodontal-Relatos de casos. *Braz J Periodontol.* 2019;29(3):16-23.
- Bundidpun P, Srisuwantha R, Laosrisin N. Clinical effects of photodynamic therapy as an adjunct to full-mouth ultrasonic scaling and root planing in treatment of chronic periodontitis. *Laser Ther.* 2018;27(1):33-39.
- Christodoulides N, Nikolidakis D, Chondros P, Becker J, Schwarz F, Rössler R, et al. Photodynamic therapy as an adjunct to non-surgical periodontal treatment: a randomized, controlled clinical trial. *J Periodontol.* 2010;79(9):1638-1644.
- da Silva ICS, dos Santos PVV, Gomes JLR, Lima MFP, de Andrade NK. A Terapia Fotodinâmica como coadjuvante de tratamento da doença periodontal crônica: revisão de literatura. *Revista da AcBO.* 2017; 7(1).
- de Freitas LM, Calixto GMF, Chorilli M, Giusti JSM, Bagnato VS, Soukos NS, et al. Polymeric Nanoparticle-Based Photodynamic Therapy for Chronic Periodontitis in Vivo. *Int J Mol Sci.* 2016;17(5):769.
- Eduardo CDP, Bello-Silva MS, Ramalho KM, Lee EMR, Aranha ACC. A terapia fotodinâmica como benefício complementar na clínica odontológica. *Revista da Associação Paulista de Cirurgiões Dentistas.* 2015; 69(3), 226-235.
- Ferreira AV, Ferreira ACR, Queiroz ANPG, Barbosa OLC. Braz. J. Terapia fotodinâmica como coadjuvante ao tratamento periodontal não cirúrgico na periodontia. *Surg. Clin. Res.* 2017; 134-13.
- Fonseca RR, Ramos UD, Menezes SA, Neto AR, Oliveira PG. Uso da terapia fotodinâmica antimicrobiana em pacientes diabéticos tipo 2 com periodontite crônica: relato de caso. *LILACS.* 2018;28(3):68-72.
- Joseph B, Janam P, Narayanan S, Anil S. Is Antimicrobial Photodynamic Therapy Effective as an Adjunct to Scaling and Root Planing in Patients with Chronic Periodontitis? A Systematic Review. *Biomolecules.* 2017 Nov 24;7(4):79.
- Luke AM, Mathew S, Altawash MM, Madan BM. Lasers: A Review of Their Applications in Oral Medicine. *J Lasers Med Sci.* 2019; 10(4):324-329.
- Lulic M, Leiggenger GI, Salvi GE, Ramseies CA, Mattheos N, Lang NP (2009): One-year outcomes of repeated adjunctive photodynamic therapy during periodontal maintenance: a proof-of-principle randomized-controlled clinical trial. *Journal of Clinical Periodontology,* 36:661-666.
- Malgikar S. et al. Clinical effects of photodynamic and low-level laser therapies as an adjunct to scaling and root planing of chronic periodontitis: A split-mouth randomized controlled clinical trial. *Indian Journal of Dental Research* , v.27, n.2, p.121-126,
- Meimandi M, Talebi Ardakani MR, Esmaeil Nejad A, Yousefnejad P, Saebi K, Tayeed MH. O efeito da terapia fotodinâmica no tratamento da periodontite crônica: uma revisão da literatura. *J Lasers Med Sci.* 2017; 8 (1): S7-S11.
- Nguyen S., Hiorth M. Advanced drug delivery systems for local treatment of the oral cavity. *Ther. Deliv.* 2015; 6: 595-608.
- Park D, Choi EJ, Weon KY, Lee W, Lee SH, Choi JS, et al. Non-Invasive Photodynamic Therapy against -Periodontitis-causing Bacteria. *Sci Rep.* 2019;9(1):8248.
- Sculean A, Aoki A, Romanos G, Schwarz F, Miron RJ, Cosgarea R. Is Photodynamic Therapy an Effective Treatment for Periodontal and Peri-Implant Infections?. *Dent Clin North Am.* 2015;59(4):831-858.
- Silva NTD, Silva DNA, Azevedo MLDS, Silva Júnior FLD, Almeida ML, Longo JPF, Moraes M, et al. The effectiveness of photodynamic therapy as a complementary therapy to mechanical instrumentation on residual periodontal pocket clinical parameters: A clinical split-mouth test. *Photodiagnosis Photodyn Ther.* 2020 Mar; 29:101565]