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DIODE LASER THERAPY IN DIABETES MELLITUS PATIENTS WITH PERIODONTITIS - A METANALYSIS

Periodontology

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ABSTRACT

Background: Periodontitis and diabetes have a reciprocal relationship. It is obligatory for diabetic patients to receive adequate treatment for periodontitis. Various therapeutic approaches as Local Drug Delivery, Antimicrobial therapy and various types of lasers were comprised to treat periodontitis in diabetic patients. Although, complete elimination of bacterial deposits can be difficult to accomplish. Among these, the use of lasers has been proposed for its bactericidal and detoxification effects and for its capacity to reach sites that conventional mechanical instrumentation cannot.

Materials and methods: Data was extracted from 3 randomized controlled trials reports. Following parameters were recorded ie, periodontal pocket depth (PPD) and clinical attachment level (CAL) and the analysis was carried out. We performed sensitivity analysis, and looked for publication and other types of bias.

Results: Random effect model (REM) for PPD at the end of 3 months was found to be 0.221 and REM for CAL at the end of 3 months was found to be 0.0422. Significant improvement was found in PPD and CAL when laser was used as an adjunct in SRP.

Conclusion: The results showed that DL and LLLT treatment can provide improved clinical results when it is used as an adjunct to nonsurgical periodontal treatment in CP patients with DM.

KEYWORDS

Laser, Diabetes Mellitus, Periodontitis, Non-Surgical Periodontal Therapy, Adjunct Treatment,Root Planing.

INTRODUCTION

Diabetes Mellitus (DM) is triggered by a deficiency in insulin or its action, subsequently leading to hyperglycemia and hyperlipidemia, which are involved in the progress of many systemic and oral complications, such as periodontitis.[1]

Periodontitis is a biofilm induced infectious process specifically the leading cause of tooth loss and attacks the structures of periodontium, the gingiva, epithelial attachment, cementum and alveolar bone. The most common causative factors are microbes or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with the pocket formation, recession or both.[9]

Periodontitis and diabetes have a reciprocal relationship. Periodontitis is considered as the sixth complication of diabetes. Diabetes Mellitus increases the risk of periodontitis, and severe periodontitis coexists with severe Diabetes Mellitus. Hence, it is obligatory for diabetic patients to receive adequate treatment for periodontitis. The basic treatment modality for periodontitis is scaling and root planning.[7]

Various therapeutic approaches as Local Drug Delivery, Antimicrobial therapy and various types of lasers were comprised to treat periodontitis in diabetic patients. Approaches involve the use of local drug delivery systems based on microparticles/nanoparticles made from biocompatible polymers. Such devices enable the introduction of antimicrobial agents or other drugs directly in the periodontal pocket, or inside the root canal, and the sustained release of constant concentrations of these agents for a better control of infections. A multidisciplinary approach to the delivery of therapeutics to target tissues is needed for a specific control of pharmacokinetics and pharmacodynamics of the drug to ensure adequate concentration at the targeted site.

Although LDD and Antimicrobial Therapy produces significant clinical improvements in patients with periodontitis, the complete elimination of bacterial deposits can be difficult to accomplish. To overcome these limitations of conventional mechanical therapy, several adjunctive protocols have been developed.

Among these, the use of lasers has been proposed for its bactericidal and detoxification effects and for its capacity to reach sites that conventional mechanical instrumentation cannot. Laser therapy involves the intensification of electromagnetic fields excited by external source of energy such as light which emits coherent, well collimated, and monochromatic laser beam. Depending on the tissue interaction result of each wavelength and the power applied, several laser treatment approaches have been proposed. Low-level laser treatment has a bio-stimulatory, anti-infective, and anti-ablation effect.

The laser causes a photochemical reaction in the cell known as photobiomodulation, which induces tissue repair and wound healing. Laser curettage also promotes the synthesis of DNA and RNA, raises the production of proteins, modulates enzymatic activity, affects intracellular and extracellular pH, which accelerates cell metabolism.[7]

When laser curettage is done in the pockets, the ablating action of the laser eradicates the epithelium lining the soft tissue walls of the pocket and the adjacent inflammatory cell infiltrates and the low dose radiation that scatters into the adjacent tissues possess the beneficial effects on the healing process.

The lasers with the longest pathway record in dentistry are the diode, carbon dioxide (Co_2), neodymium yttrium aluminum garnet [Nd:YAG], and erbium yttrium aluminum garnet (Er:YAG) lasers, low level laser therapy{LLLT}. Each type uses different materials in the laser medium to produce varying wavelengths of light. Diode lasers typically operate at a wavelength between 810 nanometers (nm) and 940 nm; CO_2 lasers produce a wavelength of approximately 10,600 nm; Nd:YAG lasers operate at a wavelength around 1064 nm; and Er:YAG lasers typically generate a wavelength of 2940 nm.

Low-level laser therapy (LLLT) was introduced as a therapeutic modality as early as 1968. LLLT includes wavelengths between 500 and 1,100nm and classically involves a dose of 1–4 J/cm2 using lasers with output powers of 10– 90mW.7 The infrared portions of the spectrum (e.g., GaAlAs, 800–900 nm) have been shown to have highly absorbent and unique therapeutic effects in living tissues and seem to provide the best results. LLLT has shown to be effective in the treatment of impaired microcirculation, wound healing, pain relief, fracture healing, and decrease of inflammation and swelling.[6]

Regardless of these potential beneficial effects, metanalysis of effectiveness of laser in treating periodontitis in diabetes mellitus patients have not been described by studies conducted on humans. Moreover, given the results of numerous studies and the absence of any previous meta-analyses, there is a great need to evaluate the literature systematically. The objective of the present meta-analysis is to assess the role of different types of laser in treating periodontitis in diabetes mellitus patients.

SEARCH CRITERIA:

- 1970 – 2018
- English Language
- Pubmed.com
- Cochrane Data Base
- EBSCO
- Medline
- Google.com
- Sci.hub
- Embase

INCLUSION CRITERIA

FOCUSSED QUESTION: How effective is laser as an adjunct in treating periodontitis in patients with Diabetes Mellitus?

1. Population- Individuals with Chronic Periodontitis and Diabetes Mellitus.
2. Intervention- Use of any type of laser as an adjunct to mechanical Scaling and Root Planing.
3. Comparison between Laser Group compared with Placibo/no treatment Group.
4. Outcome – Changes in pocket Depth, Clinical Attachment Level {CAL}.
5. SELECTION CRITERIA:

INCLUSION CRITERIA

1. Publication of Domestic and International peer review literature.
2. Articles written in English.
3. Human Randomized Controlled Trial {RCT}.
4. More than 6 weeks follow-up.
5. More than 10 patients participating in study.
6. Articles reporting data on change of pocket depth/CAL.

EXCLUSION CRITERIA

1. Animal study
2. No definition of inclusion and exclusion criteria reported.
3. No specific information of laser used.
4. Insufficient information on adjunctive therapy during treatment.
5. Retrospective cross-sectional study/case series/case report.

SEARCH STRATEGY

A literature search was performed at Raja Rajeswari Dental College and Hospital, Bangalore using electronic media in following data base, pubmed.com, Cochrane data base, EBSCO, Medline, Google.com, Sci.Hub, Embase between January 1st 1970 to July 30th 2018 using following terms: Laser, Diabetes Mellitus, Periodontitis, Diode Laser, Er:YAG, CO2 laser, Non-Surgical Periodontal Therapy, Adjunct Treatment, Scaling, Root Planing.

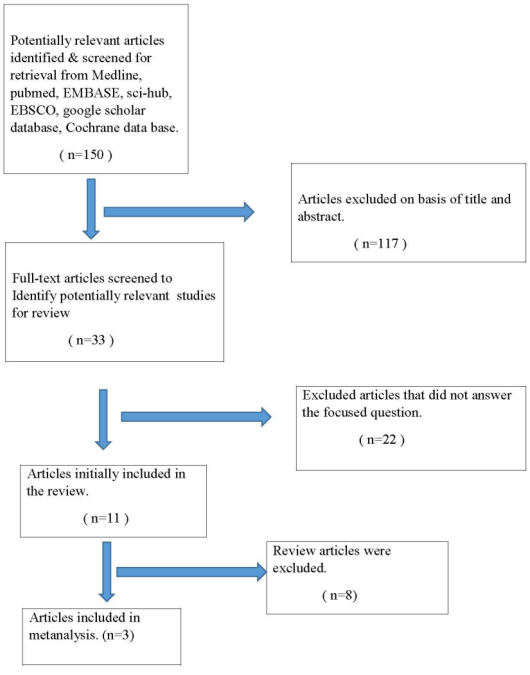
Two reviewers independently performed article search. They first examined title and abstract of article searched and selected paper for full text screening. K value was introduced to examine inter examiner agreement.

RESULT OF THE RESEARCH:

Table no 1: Characteristics Of Included Studies:

Study	Methods	Subjects	Interventions And No. Of Patients Treated Per Group	Outcomes	Sites And Funding
1. Oya Demirturk-Gocgun and colleague (2013)	Randomized controlled clinical trial, 5 months duration	22 chronic periodontitis patients with type 2 DM, aged 41-72yrs (7 males and 15 females); split mouth design applied with 2 quadrants as test and 2 quadrants as control site	SRP/ SRP+LLLT. Measurements were recorded at six sites per tooth.	Changes in Plaque Index [PI], changes in Bleeding on Probing[BOP], changes in Probing Depth[PD], Changes in Clinical Attachment Level[CAL]	Department of Endocrinology, Istanbul Medical Faculty, Istanbul University.
4. Paunami Paul and colleague [2017]	Randomized, double blind, controlled trial	20 subjects,17 male, 3 female, mean age 50.3 in SRP+DL 20 subjects (13 male and 7 female, mean age 53 in SRP group;	SRP, SRP+ DL	Changes in Gingival Index GCB[gingival crevicular blood]	Department of Periodontology, Rajarajeswari Dental College, Bangalore
5. Emrah Kocak and colleague[	Randomized clinical trial	60 subjects with DM 2 and CP (30 males and 30 females, between ages of 35 to 60 yrs)	SRP, (30 patients) SRP+DL(30 patients)	Changes in plaque index, gingival index, PD, clinical attachment level	Department of Periodontology, Faculty of Dentistry, Selcuk University, Konya, Turkey

Fig 1: Flow Chart Of Manuscript Screened Through The Review Process:



Our preliminary search resulted in the documentation of 150 articles. Subsequently, we excluded 117 of them on the basis of title and abstract and screened the full text of 33 studies are considered to be theoretically relevant for this review as shown in flowchart no 1. Of these, we excluded 22 articles during full-text screening because they did not provide individual patients data or comparison between the type of laser used.

In addition, we omitted 8 articles because they were systemic review articles. The K score between examiners were >8, indicating a good level of agreements.

By the end of the search phase, we considered 3 articles eligible, their data are the basis of review. Therefore, we cited the articles with shorter follow-up period. Fig-1 is a flow chart of studies assessed and excluded at various stages of the review.

Characteristics of the included studies:

Of the included studies, 3 studies fulfilled the eligibility criteria were clinical and were either performed at universities or oral health care centers. Characteristics of the included study is shown in table no 1.

In total, the number of participants ranged between 1-72 subjects with chronic periodontitis with type 2 Diabetes mellitus and 72 patients as control group. All individuals were middle aged and their age ranged between 41 to 72 years.

Most of the studies that fulfilled eligibility criteria were controlled clinical trials. All the 3 included studies for meta-analysis reported with moderate to severe chronic periodontitis. All the 72 patients

received scaling and root planning treatment followed by low level laser therapy/diode laser therapy. While the control group patients received only scaling and root planning treatment.

Outcomes measures:
Researchers observed changes in probing pocket depth (PPD), clinical attachment level (CAL) and bleeding on probing during the course of each study. Most of the investigators reported a statistically significant gain in PPD and CAL.

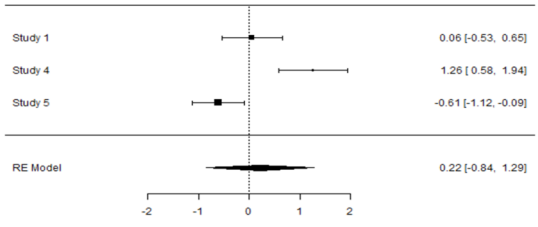
In the study intended to assess the clinical benefits of laser as an adjunct to nonsurgical periodontal treatment in patients with type 2 diabetes mellitus, examining the individual patients data from test group as chronic periodontitis patients with DM 2 and control group there is statistically significant changes from baseline to the three months evaluation for PPD, CAL.

In the metanalysis of 3 studies , assessing clinical benefits of laser as an adjunct to nonsurgical treatment, the results specified a statistically significant reduction in PPD with the summary estimates of treatment effect of 0.22 with a 95% confidence interval of -0.84,1.29 as shown in table 2. Whereas, the CAL are statistically significant with the estimates of treatment effect of 0.04 with a 95% confidence interval of -0.66, 0.75 as shown in table 4. No significant difference was found in PI at the end of 3 month.

Table no 2: PPD at the end of study (Month 3)

Random-Effects Model (k = 3)							
	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound	
Interce	0.221	0.543	0.406	0.6	-0.844	1.285	
	.	.	.	.	.	.	
Note. Tau² Estimator: Restricted Maximum-Likelihood							
Heterogeneity Statistics							
Tau	Tau²	I²	H²	R²	df	Q	p
0.890	0.7917 (SE= 0.8849)	89.66%	9.674	.	2.000	18.406	<.001

Diagram 1: FOREST PLOT OF PPD



PPD-probing pocket depth, CI- confidence interval
Table no 3: Publication Bias Assessment of PPDF

Fail-Safe N Analysis (File Drawer Analysis)				
Fail-safe N		**p**		
0.000		0.186		
Note. Fail-safe N Calculation Using the Rosenthal Approach				

Rank Correlation Test for Funnel Plot Asymmetry				
Kendall's Tau		p		
1.000		0.333		
Regression Test for Funnel Plot Asymmetry				
Z		p		
4.260		<001		

Diagram 2: Funnel Plot of PPD

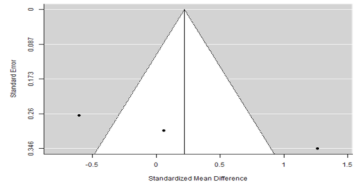
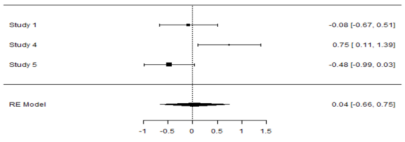


Table no 4: CAL at the end of the Study (Month 2 or Month 3)

Random-Effects Model (k = 3)							
	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound	
Intercept	0.0422	0.359	0.118	0.906	-0.661	0.745	
	.	.	.	.	.	.	
Note. Tau² Estimator: Restricted Maximum-Likelihood							
Heterogeneity Statistics							
Tau	Tau²	I²	H²	R²	df	Q	p
0.546	0.2978 (SE= 0.3862)	77.3%	4.405	.	2.000	8.644	0.013

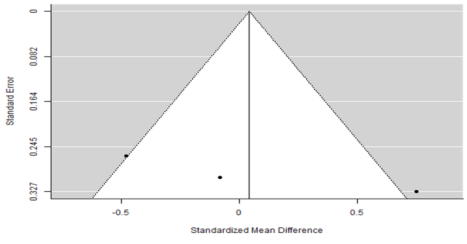
Diagram 3: Forest Plot of CAL



CAL- clinical attachment level, CI- confidence interval
Table no 5: Publication Bias Assessment of CAL

Fail-Safe N Analysis (File Drawer Analysis)				
Fail-safe N		p		
0.000		0.458		
Note. Fail-safe N Calculation Using the Rosenthal Approach				
Rank Correlation Test for Funnel Plot Asymmetry				
Kendall's Tau		p		
1.000		0.333		
Regression Test for Funnel Plot Asymmetry				
Z		p		
2.787		0.005		

Diagram 4: Funnel Plot of CAL



DISCUSSION:
In this review, we explored the literature regarding the potential effect of laser therapy as an adjunct to scaling and root planning in chronic periodontitis patients with type 2 diabetes mellitus, with the aim of evaluating differences in clinical outcomes. 3 clinical trials, fulfilled the proposed inclusion criteria, providing data from patients treated with different types of laser therapy like low level laser and diode laser. The evidence accumulated from individual studies, the pooled data suggested that laser offered minimal short-term additional benefit in deep pocket healing in patients with type 2 DM. Similarly, the result of metanalysis showed within the study comparisons revealed that reduction in probing pocket, clinical attachment gain and bleeding on probing. While there was no significant improvement in PI values.

The present study showed the adjunctive use of laser with SRP provided significant improvements in PPD, CAL. Laser therapy as an adjunct in periodontal therapy significantly reduced gingival inflammation compared to SRP alone in DM2 patients.

For instance, the result from Oya Demirturk-Gocgun et al showed that test sites showed significant improvement in PI and BOP in deep pockets at the 1-month follow-up period ($p < 0.001$ and <0.001, respectively), whereas no alteration was found between the control and the test sites in other periodontal parameters.[1]

In the study by Paunami Paul et al showed that Diode Laser treatment can provide improved clinical results when it is used as an adjunct to nonsurgical periodontal treatment in CP patients with DM. Furthermore, less invasive technique to measure patient's blood glucose level aids the periodontist to better assess the glycemic control which, in turn, contributes to the success of periodontal therapy.[4]

Emrah Koçak et al demonstrated that both SRP and SRP +DL treatments provided a significant improvement in clinical periodontal status, evaluated biochemical parameters in GCF, and glycemic control in patients with DM2 and CP. The results of this study suggest that the use of a 940-nm indium–gallium–aluminum–phosphate diode laser (Perio pocket setting: average 1.5 W with a pulse interval of 20 ms and pulse length of 20 ms delivering 20 and 15 J/ cm2 of energy, respectively) as an adjunct to scaling and root planning produces noteworthy better improvement in the site-specific PD and CAL clinical parameters compared to SRP alone. A remarkable finding of this study was that SRP + DL (0.41 %) was superior in decreasing HbA1c levels compared to SRP alone (0.22 %) in DM2 patients with CP.[5]

LLLT(low level laser therapy) has been shown to be effective in the treatment of impaired microcirculation, reducing inflammation and swelling. Moreover, it can enable collagen synthesis, angiogenesis and reepithelialization, which ultimately accelerate wound healing. Thus, greater reduction in gingival bleeding in deep pockets at the test sites can be explained by the anti-inflammatory effect of vascular stimulation by the laser. [1]

Diode Laser therapy benefits the periodontium directly by eliminating the pathogens and disinfecting the pockets and indirectly by reducing the hyper inflammatory status and improves the collagen formation, and thus, healing will be accelerated of DM patients.[4]

Other researchers have recognized that the use of a low- level laser as an adjunct to SRP showed a minor short-term additional benefit on gingival bleeding, but it did not significantly improve other clinical parameters.

CONCLUSION:

The results showed that DL and LLLT treatment can provide improved clinical results when it is used as an adjunct to nonsurgical periodontal treatment in Chronic periodontitis patients with DM. However, further studies are warranted in this regard before a generalized recommendation of dental lasers as an adjunct to conventional nonsurgical therapy in periodontal treatment of DM2 patients with CP.

REFERENCES

1. Demirturk-Gocgun O, Baser U, Aykol-Sahin G, Dinccag N, Issever H, Yalcin F. Role of low-level laser therapy as an adjunct to initial periodontal treatment in type 2 diabetic patients: a split-mouth, randomized, controlled clinical trial. Photomedicine and laser surgery. 2017;35 (2):111-5.
2. Obradović R, Kesić L, Mihailović D, Jovanović G, Antić S, Brkić Z. Low-level lasers as an adjunct in periodontal therapy in patients with diabetes mellitus. Diabetes technology & therapeutics. 2012;14(9):799-803.
3. Abduljabbar T, Javed F, Shah A, Samer MS, Vohra F, Akram Z. Role of lasers as an adjunct to scaling and root planing in patients with type 2 diabetes mellitus: a systematic review. Lasers in medical science. 2017;32(2):449-59.
4. Paul P, Bilichodmath S, Sameera U. Clinical and glycemic level evaluation of the efficacy of diode laser and antibiotics with scaling and root planing in treating chronic periodontitis patients with diabetes. Journal of Dental Lasers. 2018;12 (1):24.
5. Koçak E, Sağlam M, Kayış SA, Dündar N, Kebapçılar L, Loos BG, Hakkı SS. Nonsurgical periodontal therapy with/without diode laser modulates metabolic control of type 2 diabetics with periodontitis: a randomized clinical trial. Lasers in medical science. 2016;31(2):343-53.
6. Obradović R, Kesić L, Mihailović D, Antić S, Jovanović G, Petrović A et al. A histological evaluation of a low-level laser therapy as an adjunct to periodontal therapy in patients with diabetes mellitus. Lasers in medical science. 2013;28(1):19-24.
7. Elavarasu S, Suthanthiran T, Thangavelu A, Mohandas L, Selvaraj S, Saravanan J. LASER curettage as adjunct to SRP, compared to SRP alone, in patients with periodontitis and controlled type 2 diabetes mellitus: A comparative clinical study. Journal of pharmacy & bioallied sciences. 2015;7(Suppl 2):S636.
8. Moeintaghavi A, Arab HR, Bozorgnia Y, Kianoush K, Alizadeh M. Non‐surgical periodontal therapy affects metabolic control in diabetics: a randomized controlled clinical trial. Australian dental journal. 2012;57(1):31-7.
9. Vieru D, Cortez M, Clayman L, Dumitriu as. low level laser therapy in the treatment of periodontal disease. laser therapy. 2007;16:199-206.