



THE EFFECT OF LASER AS AN ADJUNCT TO NON-SURGICAL THERAPY IN THE TREATMENT OF PERI-IMPLANTITIS- A SYSTEMATIC REVIEW

Dentistry

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ABSTRACT

Peri-implantitis is an inflammatory process affecting the tissues around an already osseo-integrated implant, and it is becoming the most challenging problem in clinical implant dentistry. Peri-implant mucositis can be managed through non-surgical therapy, however the effectiveness of Laser as an adjunct to non-surgical therapy in managing peri-implantitis is assessed through this systematic review. An electronic database search was carried out from Pub Med, Google scholar, Web of science, EBSCO host, Embase, Science direct. A total of only 4 articles were assessed as per the inclusion and exclusion criteria. Only randomized controlled clinical trials were included. Data extraction sheet was prepared and all 4 studies were analyzed with parameters including plaque index, peri-implant probing depth, bleeding on probing, suppuration, and radiographic marginal bone level. Laser application improves clinical signs of inflammation without significantly improving bone levels

KEYWORDS

peri-implantitis, laser, non-surgical therapy, supportive peri-implant therapy, mechanical debridement

INTRODUCTION

Peri-implantitis is an "inflammatory process" affecting the tissues around an already osseo-integrated implant, and it is becoming the most challenging problem in clinical implant dentistry.¹

The differential diagnosis between peri-implant mucositis and peri-implantitis is based on evidence that alveolar bone loss following initial healing and bone remodelling has occurred and requires a radiographic evaluation of the bone level around dental implants over time. In the absence of initial radiographs and probing depths, radio-graphic evidence of bone level ≥ 3 mm and/or probing depths ≥ 6 mm in conjunction with profuse bleeding represents peri-implantitis.²

The current principles for the treatment of peri-implantitis were primarily derived from principles established for the therapy of periodontitis.³ Traditionally, nonsurgical mechanical debridement (NSMD) is performed for the treatment of periodontal and peri-implant diseases. The goal in non-surgical therapy of peri-implant mucositis and peri-implantitis is to eliminate or significantly reduce the amounts of oral pathogens in the pockets around implants. The ideal goal of peri-implantitis would be the resolution of the disease (i.e. no bleeding on probing, no suppuration, no further bone loss)⁴ The most common is a non-surgical approach, by mechanical debridement of the affected implants with plastic curettes. However, this conventional treatment has limitations in the resolution of peri-implant mucositis. Non-surgical periodontal therapy carried out with curettes can still result in incomplete removal of plaque, calculus and persistent probing depth, bleeding on probing, suppuration.

To overcome these limitations, different adjunctive therapies have emerged over the years, diode laser therapy being introduced recently. Lasers can effortlessly irradiate the entire surface, especially in irregular and rough areas where mechanical instruments cannot easily reach. They not only eliminate bacteria but also inactivate bacterial diffused toxins. The bio stimulatory properties of lasers yield improvement in peri-implant condition.⁵

Protocol And Registration:

The systematic review was conducted in accordance with the Preferred Reporting Items of Systematic Reviews (PRISMA) and Meta-analyses statement. PROSPERO acknowledgement receipt number [426067]

MATERIALS AND METHODS:

The systematic review was conducted in accordance with the PRISMA guidelines.

Focused Question:

Does LASER as an adjunct to mechanical non-surgical periodontal therapy result in improved outcomes in terms of probing pocket depth and bleeding on probing compared to non-surgical periodontal therapy alone in subjects with peri-implantitis?
Population (P) - periimplantitis

Intervention (I) – mechanical non-surgical periodontal therapy + LASER

Comparison (C) – mechanical non-surgical periodontal therapy alone.
Outcome (O) - absence of peri-implant probing depth > 5 mm, bleeding on probing and no further bone loss.

ELIGIBILITY CRITERIA:

1. Randomized controlled trials (RCT)
2. Studies including cases of osseointegrated dental implants affected by peri-implantitis as per case definition.
3. Original publications evaluating efficacy of LASER as an adjunct to non surgical mechanical debridement (NSMD) in peri-implantitis.
4. Studies using low level laser therapy, using diode laser, Er:YAG laser and diode laser, photobiomodulation therapy along with non-surgical therapy with and without adjunctive laser therapy and having a follow up of at least 6 months.
5. Studies reporting one or more clinical parameters including probing pocket depth (PPD), Bleeding on probing and marginal bone level.

Exclusion Criteria:

Review papers, In- vitro studies, animal studies, case reports, commentaries, interviews.

Information Sources And Search Strategy:

Databases search were MEDLINE/PubMed, Cochrane Central Register of Controlled trials (CENTRAL), EBSCO host, Science Open, Google Scholar and Open Grey databases up to and including Feb 2023. Literature searching for papers that reported the efficacy of adjunctive laser therapy in the treatment of periimplantitis.

Search Strategy:

The selection strategy was based on a combination of *types of studies* AND *disease* AND *therapy* using different combinations of Medical Subject Heading (MeSH) terms and free text words.

MeSH terms (italic) adopted for electronic database search were: "randomized controlled trial" "Peri-implantitis" OR "Peri-implant" OR "Periimplant" OR "Periimplantitis", "Peri-implant infection"

OR "Peri-implant infection" OR "Peri-implant complication" OR "Periimplant complication" OR ("implant" AND "failure") "non surgical therapy" OR "non-surgical mechanical debridement" OR "non surgical periimplant therapy" OR "non surgical peri-implant therapy" AND "LASER peri-implant therapy" "adjunct LASER" OR "laser peri-implant" OR "laser periimplant" OR "diode" OR "Er:YAG" OR "low level laser therapy" OR "photobiomodulation" OR "photobiostimulation".

Study Selection:

1. Assessment of titles and abstracts

2. Assessment of full text articles.

Data Management And Collection Process:

Data extraction sheet was prepared based upon variables associated in the articles analyzed. Data regarding authors, year and country of publication, type of study, aim, clinical, radiographic and microbiologic parameters assessed, sample size, control group, intervention, methodology and conclusion.

Data extraction sheet was prepared based upon variables and the following data were collected:

Author, country, year of publication, study design, length of follow-up, no. of subjects, age, gender, type of NSMD, type and mode of delivery of laser, point of application, supportive peri-implant therapy, peri-implant probing depth, bleeding on probing, marginal bone levels.

The collected data was then transferred into evidence tables to provide an overview of the included studies and available data.

Data Items:

Variables for which data was sought included Peri-implantitis, peri-implant probing depth, bleeding on probing, marginal bone level.

First author, Year of publication	Roccuzzo A et al 2022	Alqahatni F. et al 2020	Abduljabbar T et al 2017	Arisan V et. al 2015
Study design	Single centered double blinded, parallel designed randomized controlled clinical trial.	Single centered, parallel designed randomized controlled clinical trial.	Single centered single blinded, parallel designed randomized controlled clinical trial.	Single centered, split mouth randomized controlled clinical trial.
Country	Switzerland	Riyadh	Saudi Arabia	Turkey
Sample size Population characteristics (no. of subjects, age, gender,)	No. = 25 Age >18 yrs Gender male- 13 female-12 Test group : smokers= 3 Non smokers= 9 Control group Smokers=2 Non smokers=11	No.= 67 Male-31 Female-3 Test- 34 Maxilla-4 Mandible= 30 Control -31 Maxilla= 5 Mandible=28	No. = 63 Age 31- 58 years Gender Male= 63 Test: 32 patients 39 implants Control 31 patients 35 implants Delayed loaded platform switched implants	No.= 48 Age= 43-76years Male=3 Female=7
Periodontal diagnosis : Periimplant diseases	Peri-implantitis	Peri-implantitis	Peri-implantitis	Peri-implantitis
Interventions	Test: Mechanical debridement using titanium curettes and stainless steel curettes + diode laser setting : 810nm , 2.5 W, 50Hz 10ms 3x30s (90s per appointment) Control group : Mechanical debridement with non activated adjunctive diode laser.	Test group : 940-nm indium gallium arsenide phosphorous diode laser (Epic Biolase, Irvine, Calif).- 20 seconds at a constant distance of 15 mm and with a continuous wavelength (3.41 J/cm2 delivery with a 1.76 cm2 spot and average output of 0.3 W	Test : Mechanical debridement by plastic curettes + pulsed Nd : YAG laser 1064nm 60-120s.power 4W 80mJ, pulse width 350 milliseconds, 50Hz with air and water cooling. Control group: Mechanical debridement with plastic curettes.	Test group : Diode Laser wavelength of 810 nm (energy density, 3 J/cm2; power density, 400 mW/cm2; energy, 1.5J; and spot diameter, 1 mm) for a duration of 1 min in pulsed mode with a power level of 1W using a standard 400 lm delivery optical fiber tip.
Point of application	At days 0, 7 and 14 Supportive care: supramucosal prophylaxis at and oral hygiene monitoring at 3 mo and 6mo follow up.	Day 0, 2 ,7 Follow up at 3 and 6 months.	At baseline Follow up at 3 , 6 months.	Day 0 Follow up at 1 month and 6 months.

RESULTS

Study Selection:

A total of 11,600 articles were found after electronic search, 8550 which were duplicates. Total articles screened were 3050, 2994 titles of articles were not fulfilling the eligibility criteria, after which 56 abstracts were analyzed. 45 articles were excluded after reviewing abstracts as the studies did not meet the inclusion criteria. A total of 11 full text articles were evaluated of which 7 articles did not fulfil the eligibility criteria and 4 articles were eligible for qualitative analysis.

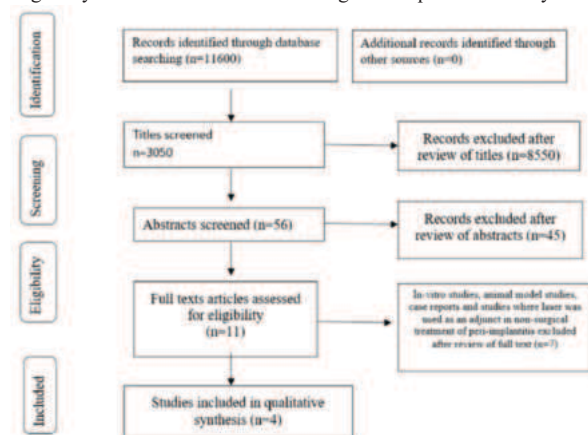


Figure 1- Flow Chart Of Literature Search Results And Study Selection

Studies Included For The Analysis.

Four studies were included for the qualitative synthesis. Out of the 4 studies, all 4 were randomized controlled trials. 3 out of the 4 studies suggest LASER group did not yield significant results when compared to control group. An overview of the included studies for the analysis is presented in Table 1.

Clinical parameters	1.Plaque index 2.Bleeding on probing 3. Suppuration on probing 4. Periimplant probing pocket depth	1.Plaque index 2.Peri-implant probing depth 3.Bleeding on probing	1..Plaque index 2. bleeding on probing 3. probing depth	1.Plaque index 2.Peri-implant depth 3.Bleeding on probing
Radiographic parameters	Measurement of mesial and distal bone level.	Crestal Bone Resorption on mesial and distal aspects.	Crestal bone loss on mesial and distal aspects	Marginal Bone Level (MBL) on panoramic radiograph
Microbiologic parameters	<i>Aa, Pg, Tf, Td, Fn, Cr.</i>		-	<i>Aa, Pg, Pi, Sc, Tf, Cc, Cg, Ec, Fn, Pm, Sm, Td, Vp.</i>
Biomarkers	IL-1B, IL-10, MMP-8		-	

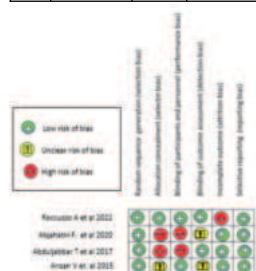
Risk Of Bias In Individual Studies

This assessment was conducted by using the recommended approach for assessing the risk of bias in studies included in Cochrane Reviews (Higgins 2011) using the tool RevMan 5.0.

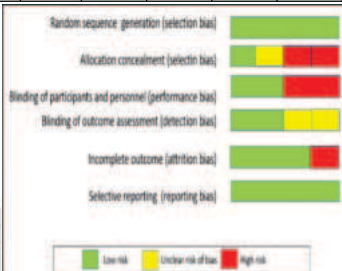
The risk of bias of the included studied is presented in **Table 3. Graph 3** and **Graph 4** shows the assessment of risk of bias in individual studies and across studies respectively.

Table 3: Quality Assessment Of The Studies Included By Judging Risk Of Bias And Applicability Using Cochrane Risk Of Bias Tool For Randomized Controlled Trial

Sr no.	Authors (Year)	Type of study	Random sequence generation	Allocation concealment	Blinding of participants	Blinding of outcome	Incomplete outcome data	Selective reporting
1	Roccuzzo A et al (2022) ⁸	RCT	Low	Low	Low	Low	High	Low
2	Alqahatni F. et al (2020) ⁹	RCT	Low	High	High	Unclear	Low	Low
3	Abduljabbar T et al (2017) ¹⁰	RCT	Low	High	High	Low	low	Low
4	Arsan V et. al (2015) ¹¹	RCT	Low	Unclear	Low	Unclear	Low	Low



Graph 1: Risk Of Bias In Individual Studies



Graph 2: Risk Of Bias Across Studies

DISCUSSION:

The progressive loss of supporting bone beyond biological bone remodeling, if left untreated can lead to failure of implant. Traditionally, nonsurgical mechanical debridement (NSMD) is performed for the treatment of periodontal and peri-implant diseases.² The ultimate goal of this form of therapy is to debride the teeth and peri-implant surfaces from dental plaque/calculus and granulation tissues thereby reducing pathologic microbial load in gingival sulcus, facilitating healing.³

Peri-implantitis management remains unpredictable with no generally acceptable consensus and may require open flap surgery (resective and/or regenerative) as monotherapy, or as a second stage procedure, if the non-surgical treatment fails.⁴ The present data questions the effectiveness of non-surgical therapy since only limited improvements in the main clinical parameters have been reported with high possibility of disease reoccurrence. Mechanical debridement by ultrasonic devices, curettage, air polishing, and remodeling the implant surfaces by implantoplasty together constitutes the non-surgical therapy for Peri-implantitis. Adjunctive therapy including antimicrobials, antiseptics, photobiomodulation have also improved

clinical outcomes in peri-implantitis. In a review by Chala et al, adjunctive LASER therapy showed significant results in reducing inflammation during a short follow up period.

In the study by Abduljabbar et al (2017)¹⁰, Nd: YAG laser was effective in reducing peri-implant soft tissue inflammation only in short term. The wavelength of 1064nm gets absorbed in epithelial lining of periodontal pocket, leaving the hard tissues unaffected. It also reduces the count of periimplant pathogenic bacteria, reducing expression of interleukin-1 beta and matrix metalloproteinases in the GCF of periodontitis patients. Due to potential of implant surface damage, Nd:YAG laser should be cautiously used under copious irrigation.

Alqahatni et al (2020)⁹ concluded that LLLT resulted in no significant difference in marginal bone level up to 6 months follow up but showed improvement in peri-implant soft tissue healing even after 6 month follow-up. The results were not in accordance to those of the study by Abduljabbar et al which may be attributed to multiple laser application following NSMD. LLLT positively influences biological tissues by improving cell proliferation, nerve conduction and microcirculation. As reported by Khadra et al, LLLT stimulates mechanical strength at implant-bone interface.

Roccuzzo et al (2022)⁸ in their randomized controlled trial showed significant reduction in PPD compared to baseline. Though bacterial counts of *Pg*, *Tf*, *Fn* and *Cr* decreased in laser group, clinical and radiographic outcomes did not show any statistically significant improvement. The split mouth study by Arsan et al (2015)¹¹ concluded that laser did not yield any additional positive influence on peri - implant healing when compared to control group.

CONCLUSION:

The results of this systematic review should be interpreted with caution. The effectiveness of LASER as an adjunct to mechanical debridement in improving clinical and radiographic parameters of peri-implantitis has limited evidence till date. Supportive peri-implant therapy with oral hygiene monitoring plays an important role in treatment of periimplantitis. Laser therapy under optimal power settings and copious irrigation should be carried out to avoid over heating of implant surfaces. Non-surgical mechanical debridement with or without laser therapy reduces clinical signs of inflammation without significantly improving bone levels.

REFERENCES:

- Heitz-Mayfield, L., & Mombelli, A. (2014). The Therapy of Peri-implantitis: A Systematic Review. *The International Journal of Oral & Maxillofacial Implants*, 29(Supplement), 325–345.
- Roccuzzo, A., Klossner, S., Stähli, A., Imber, J. C., Eick, S., Sculean, A., & Salvi, G. E. (2022). Non-surgical mechanical therapy of peri-implantitis with or without repeated adjunctive diode laser application. A 6-month double-blinded randomized clinical trial. *Clinical oral implants research*, 33(9), 900–912.
- Darby, L. (2022). Risk factors for periodontitis & peri-implantitis. *Periodontology 2000*, 90(1), 9–12.
- Muthukuru, M., Zainvi, A., Esplugues, E. O., & Flemmig, T. F. (2012). Non-surgical therapy for the management of peri-implantitis: A systematic review. *Clinical Oral Implants Research*, 23, 77–83.
- Renvert, S., Roos-Jansäker, A. M., & Claffey, N. (2008). Non-surgical treatment of peri-implant mucositis and peri-implantitis: a literature review. *Journal of clinical periodontology*, 35, 305–315.
- Figuero, E., Graziani, F., Sanz, I., Herrera, D., & Sanz, M. (2014). Management of peri-implant mucositis and peri-implantitis. *Periodontology 2000*, 66(1), 255–273.
- Abduljabbar, T., Javed, F., Kellesarian, S. V., Vohra, F., & Romanos, G. E. (2017). Effect of Nd: YAG laser-assisted non-surgical mechanical debridement on clinical and radiographic peri-implant inflammatory parameters in patients with peri-implant disease. *Journal of Photochemistry and Photobiology B: Biology*, 168, 16–19.
- Alqahatni, F., Alqahatni, N., Celur, S. L., Divakar, D. D., Al-Kheraif, A. A., & Alkhtani, F. (2020). Efficacy of Nonsurgical Mechanical Debridement With and Without adjunct low-level laser therapy in the treatment of Peri-Implantitis: a randomized controlled trial. *Journal of Oral Implantology*, 46(5), 526–531.
- Arsan, V., Karabuda, Z. C., Arici, S. V., Topcuoglu, N., & Külekci, G. (2015). A randomized clinical trial of an adjunct diode laser application for the nonsurgical treatment of peri-implantitis. *Photomedicine and laser surgery*, 33(11), 547–554.