



REVIEW ARTICLE

Use of lasers in the treatment of periodontal disease

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ABSTRACT

Introduction: laser surgery has emerged as an adjuvant therapeutic alternative with the potential to optimize clinical periodontal outcomes.

Objective: to analyze the available scientific evidence on the use of laser therapy in the treatment of periodontal disease.

Methods: a systematic literature review was conducted in accordance with PRISMA guidelines. Electronic databases were consulted using a search algorithm that enabled the identification of existing sources. A selection process was carried out based on predefined inclusion and exclusion criteria, followed by an in-depth analysis of the studies that allowed for an adequate approach to the topic addressed.

Development: the analyzed literature describes the use of different types of lasers, including Er:YAG, Nd:YAG, diode, Er,Cr:YSGG, and InGaAsP, in both surgical and non-surgical therapies. The main findings indicate improvements in periodontal clinical parameters, such as reduced probing depth, gain in clinical attachment level, decreased bleeding on probing, and reduced subgingival bacterial load. Additionally, photothermal and biostimulatory effects have been reported, promoting wound healing and tissue regeneration.

Conclusions: laser surgery represents a promising adjuvant alternative in the management of periodontal disease, with potential benefits in inflammation reduction, bacterial control, and tissue regeneration. However, current evidence is not conclusive regarding its superiority over conventional therapies. Well-designed clinical studies with standardized protocols and long-term follow-up are required to more precisely define its effectiveness and clinical applicability.

Keywords: Periodontics; Guided Tissue Regeneration, Periodontal; Laser Therapy.

INTRODUCTION

Periodontal disease is a prevalent oral condition affecting a large proportion of the global population. It is characterized by progressive inflammation and destruction of the tissues supporting the teeth, including the gingiva, periodontal ligament, and alveolar bone.⁽¹⁾ If left untreated, it can lead to tooth loss and has been associated with systemic conditions such as cardiovascular disease and diabetes. This disease poses a significant challenge for dental professionals, as it affects oral health and has implications for patients' overall systemic health.⁽²⁾

The primary cause of periodontal disease is the accumulation of dental plaque and calculus on the teeth. This accumulation triggers an inflammatory response in the periodontal tissues, involving the release of inflammatory mediators and destructive enzymes. As the disease progresses, periodontal pockets form—deep spaces between the teeth and gums—that favor bacterial proliferation and hinder proper oral hygiene, thereby perpetuating inflammation and tissue destruction.⁽³⁾

In addition to bacterial plaque, several risk factors can influence the progression of periodontal disease, including smoking, diabetes, and genetic predisposition. Smoking is a significant risk factor, as it impairs immune response and delays tissue healing. Diabetes increases susceptibility to infections and alters the inflammatory response. Genetic predisposition may also play a key role in individual susceptibility to periodontal disease.⁽⁴⁾

While official global prevalence data on periodontal disease are limited, it is well established that the condition is more prevalent and severe among individuals diagnosed with diabetes mellitus. In Ecuador, a study conducted at the health center in Guano Canton, Chimborazo Province, found a high prevalence of periodontitis, with a prevalence index of 77,5 % among diabetic patients attending public health centers.⁽⁵⁾

Additionally, a study in Guayaquil reported a 5,6 % prevalence of periodontal disease in the general population, with 60 % of affected individuals aged 50–59 years.⁽⁶⁾ Another study in Quito found that 71 % of surveyed adults self-reported periodontal disease, with a significantly lower prevalence among women compared to men.⁽⁷⁾

In recent decades, significant advances have been made in the treatment of periodontal disease. New techniques and technologies have been developed to improve treatment efficacy and patient outcomes. Among these innovations, laser-assisted periodontal therapy has emerged as a promising option in periodontal care. Laser use in periodontal treatment offers several advantages over conventional surgical techniques.⁽⁸⁾

Laser surgery employs a high-intensity light beam to cut and vaporize diseased tissue, allowing greater precision and control during the procedure. This minimizes damage to surrounding healthy tissues and enhances clinicians' ability to effectively eliminate periodontal pockets and affected areas. Moreover, laser surgery has demonstrated reduced postoperative bleeding and inflammation, contributing to faster and more comfortable patient recovery.⁽⁹⁾

Despite the potential benefits of laser therapy in periodontal treatment, its clinical efficacy and applications remain under investigation and debate. While some studies report positive outcomes—such as reduced pocket depth and improved gingival health—others question its superiority over conventional methods.^(10,11) Given this context, the present study was conducted with the objective of analyzing the available scientific evidence on the use of lasers in the treatment of periodontal disease.

METHODS

A systematic bibliographic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The methodological objective was to identify, analyze, and synthesize the available scientific evidence on the topic. The literature search was carried out over a defined period from January 2010 to December 2024 to ensure inclusion of up-to-date and clinically relevant information.

Information sources included internationally recognized electronic databases in the biomedical and health sciences: PubMed/MEDLINE, SciELO, ScienceDirect, Google Scholar, LILACS, and BVSALUD. Additionally, reference lists of selected articles were manually reviewed to identify potentially relevant studies not captured in the initial search. Relevant grey literature—including academic documents and technical reports from institutional repositories—was also considered, provided it met established quality and relevance criteria.

The search strategy was designed by combining controlled descriptors and keywords adapted to each database. Terms in Spanish, English, and Portuguese were used with Boolean operators AND and OR. An example search string was: (“main keyword” AND “related topic”) OR (“concept synonym”). Descriptors were selected from DeCS and MeSH vocabularies to maximize search sensitivity and specificity.

Inclusion criteria encompassed original articles and reviews published within the defined timeframe, available in full text, and directly addressing the research topic. Studies with methodologically appropriate designs were included. Exclusion criteria comprised duplicate articles, studies outside the search period, publications without full-text access, irrelevant documents, and those lacking substantial information for analysis.

The selection process was carried out in multiple stages, as illustrated in Figure 1, which presents the PRISMA flow diagram of the review process.

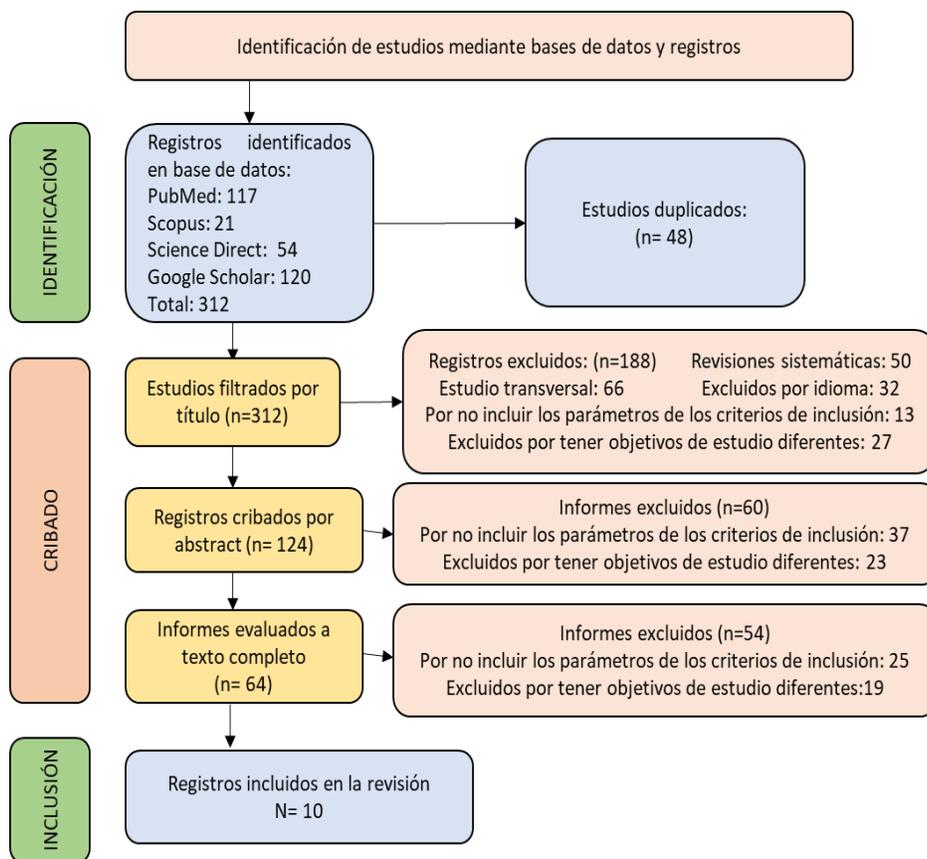


Fig. 1. PRISMA Flow Diagram.

Initially, titles and abstracts were screened to identify potentially eligible articles. Subsequently, full texts of preselected studies were assessed, applying inclusion and exclusion criteria strictly. After the selection and screening process, a total of 10 sources were included in the final analysis.

For data extraction and analysis, key variables from each study were collected, including author, publication year, methodological design, sample size, and main findings. Results were synthesized through a narrative qualitative analysis, given the methodological heterogeneity of the included studies; no statistical meta-analysis was performed. This synthesis enabled structured and coherent integration and comparison of the available evidence.

DEVELOPMENT

The literature review identified studies evaluating the efficacy of different laser types in the treatment of periodontal disease. One study observed that the adjunctive use of InGaAsP and Er,Cr:YSGG lasers in non-surgical treatment of severe periodontitis resulted in significant clinical improvements compared to subgingival debridement alone, both at 12 and 24 months post-therapy.⁽¹²⁾ Another study showed that Nd:YAG laser monotherapy induced significant reductions—nearly 60 %—in total cultivable proportions of red/orange complex periodontal pathogens per patient prior to mechanical root instrumentation.⁽¹³⁾

Additionally, diode laser therapy was found to be effective in managing chronic periodontitis in patients with type 2 diabetes mellitus, yielding significant improvements in both clinical and microbiological parameters.⁽¹⁴⁾ In another study, combined Er:YAG and Nd:YAG laser irradiation demonstrated potential advantages in improving clinical attachment level compared to conventional scaling and root planing (SRP) in non-surgical treatment of severe periodontitis.⁽¹⁵⁾ A clinical case demonstrated that the combination of interstitial-intralesional laser therapy, photocoagulation, and LANAP successfully treated an aggressive pyogenic granuloma while preserving the tooth.⁽¹⁶⁾

It was also found that adjunctive Er:YAG laser use with SRP for non-surgical periodontitis treatment significantly improved probing depth (PD) and clinical attachment level (CAL) compared to SRP alone, although differences were minimal and clinically insignificant.⁽¹⁷⁾ One study reported that Nd:YAG laser application in residual periodontal pockets did not improve clinical outcomes compared to SRP alone.⁽¹⁸⁾

Another study found that Er,Cr:YSGG laser as an adjunct to conventional mechanical periodontal therapy was more successful than diode laser + SRP in treating aggressive periodontitis.⁽¹⁹⁾ A retrospective study of 22 patients treated with the LANAP® surgical protocol showed substantial improvements in PD, CAL, and furcation involvement.⁽²⁰⁾ Finally, one study concluded that diode laser or photodynamic therapy combined with conventional SRP does not appear superior to SRP alone in reducing probing depth and bleeding on probing at 6 months post-treatment.⁽²¹⁾

Table 1 summarizes the most relevant findings from the reviewed articles and their contribution to this review.

Table 1. Synthesis of obtained results.

Source	Treatment Success Rate	Key Results	Contribution to the Article
Gheorghiu et al.,(2020) ⁽¹²⁾	Up to 40% reduction in bleeding on probing	Significant clinical improvements with InGaAsP and Er,Cr:YSGG lasers	Evidence of efficacy of InGaAsP and Er,Cr:YSGG lasers in severe periodontitis
McCawley et al.,(2022) ⁽¹³⁾	~60% reduction in mean total cultivable red/orange complex pathogens	Significant pathogen reduction with Nd:YAG laser	Evidence of Nd:YAG's antimicrobial efficacy
Chandra et al.,(2019) ⁽¹⁴⁾	46.27% reduction in colony count in treatment group	Significant clinical and microbiological improvements with diode laser in diabetic patients	Evidence of diode laser efficacy in chronic periodontitis with diabetes
Zhu et al.,(2022) ⁽¹⁵⁾	42% reduction in bleeding on probing	Improved clinical attachment level with Er:YAG + Nd:YAG lasers	Evidence of combined Er:YAG/Nd:YAG efficacy in severe periodontitis
Akkarapatum et al.,(2022) ⁽¹⁶⁾	Data not reported	Successful treatment of aggressive pyogenic granuloma using interstitial-intralesional laser, photocoagulation, and LANAP	Evidence of laser therapy in managing aggressive pyogenic granuloma
Zhou et al.,(2019) ⁽¹⁷⁾	PD = 2.91 mm at 6 months with Er:YAG	Improved PD and CAL with Er:YAG laser	Evidence of Er:YAG efficacy in periodontitis treatment

Dortaj et al.,(2022) ⁽¹⁸⁾	Data not reported	No clinical improvement with Nd:YAG laser in residual pockets	Evidence of limited efficacy of Nd:YAG in residual periodontal pockets
Talmac et al.,(2022) ⁽¹⁹⁾	~52% reduction in bleeding on probing	Greater success with Er,Cr:YSGG vs. diode + SRP in aggressive periodontitis	Evidence of Er,Cr:YSGG superiority in aggressive periodontitis
Yukna et al.,(2023) ⁽²⁰⁾	41.5% PD reduction; ~40% bleeding reduction	Substantial improvements in PD, CAL, and furcation with LANAP®	Evidence of LANAP® surgical protocol efficacy
Katsikanis et al.,(2020) ⁽²¹⁾	~80% bleeding on probing across all groups	No superiority of diode or photodynamic therapy + SRP over SRP alone	Evidence of limited added benefit of diode/photodynamic therapy

This review demonstrated that the use of low-level lasers in periodontal therapy can have a significant impact on improving periodontal health. Results indicated that low-level lasers can reduce inflammation and enhance periodontal tissue regeneration. Additionally, improvements were observed in reducing periodontal pocket depth and gaining clinical attachment level.

The efficacy of lasers in periodontal therapy may be attributed to their ability to stimulate tissue regeneration and reduce inflammation. Low-level lasers can promote cell proliferation and neovascularization, thereby enhancing periodontal tissue repair. Moreover, lasers may exert anti-inflammatory effects that help mitigate inflammation in treated areas.

These findings have significant clinical implications. Low-level laser therapy may serve as an effective tool to improve periodontal health and prevent disease progression. Furthermore, laser therapy may offer a less invasive alternative to traditional periodontal treatments such as scaling and root planing.

These results are consistent with other studies investigating laser use in periodontal therapy. For example, Santonocito et al.,⁽²²⁾ reported clinically beneficial effects of lasers in periodontal treatment. Similarly, a review by Chambrone et al.,⁽²³⁾ concluded that laser therapy can enhance periodontal tissue regeneration.

However, some studies have reported mixed results. For instance, Theodoro et al.,⁽²⁴⁾ found that although certain lasers may offer benefits in periodontal treatment, there is limited clinical evidence supporting additional advantages of lasers as adjunctive therapies in periodontology. The same review noted that low-level laser therapy appears to reduce bone healing time in oral surgery, though standardized protocols are lacking and the level of evidence remains weak.

Further research is recommended to explore the long-term effects of laser therapy in periodontics and to establish optimal laser protocols. Additionally, larger-sample studies are needed to confirm these findings.

CONCLUSIONS

Overall, the available evidence suggests that laser therapy holds significant potential as an adjunctive approach in the management of periodontal disease. Various laser types—including Er:YAG, Nd:YAG, diode, and InGaAsP—have demonstrated improvements in key clinical parameters such as probing depth, clinical attachment level, bleeding reduction, inflammation control, and periodontal pathogen suppression, likely through anti-inflammatory, bactericidal, and biostimulatory effects. However, results are not conclusive regarding its superiority over conventional periodontal therapy, due to methodological variability and inconsistent benefits across studies. This underscores the need for additional high-quality research with robust designs, larger samples, and long-term follow-up to establish standardized protocols and guide critical clinical application.

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