



# Laser therapy and endodontic treatment: major considerations and systematic review

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## Abstract

**Introduction:** Laser application in endodontics has increased due to its safety and effectiveness in dental treatments, involving dentin hypersensitivity, removal of decayed tissues, dental preparations, pulp capping or pulpotomy, and root canal treatment. Postoperative pain after endodontic treatments is a common complication, affecting 3% to 58% of patients. Low-level laser therapy has been used in dentistry to promote analgesia, modulation of inflammation, and tissue healing.

**Objective:** performed a concise systematic review to present the main clinical outcomes of endodontic treatment with low-intensity laser therapy. **Methods:** The research was carried out from April 2021 to July 2021 and developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar, following the Systematic Review-PRISMA rules. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results:** After the selectivity of articles and literary findings through the following descriptors, a total of 65 studies were analyzed, with only 17 medium and high-quality studies selected, according to GRADE rules, and with risks of bias that do not compromise scientific development. The authors showed that low-intensity laser therapy has the property of oral sterilization, facilitating tissue healing after surgical procedures. The effects related to anti-inflammatory and analgesic capacities with the application of low-intensity laser were also evidenced. **Conclusion:** Laser therapy has been shown to improve the healing of soft and hard tissues after endodontic surgery and has also shown favorable effects on pain and patients' quality of life.

**Keywords:** Endodontic treatment. Laser therapy. Low-intensity laser. Healing. Pain.

## Introduction

The laser was introduced in the 1970s. The use of laser in endodontics has increased due to its safety and effectiveness in dental treatments, involving dentinal hypersensitivity, removal of decayed tissues, dental preparations, pulp capping or pulpotomy, and root canal treatment [1]. In this context, the search for new devices and technologies for endodontic procedures has always been challenging. With the development of thinner, more flexible, and more durable laser fibers, laser applications in endodontics have increased [2].

In this scenario, the application of laser in endodontics for apicoectomy is also noteworthy, including the effect on apical sealing, effect on dentin permeability, effect on postoperative pain, effect on crack formation, effect on root morphology, effect on treatment outcome, and connective tissue response to laser-treated dentin [3].

Furthermore, postoperative pain after endodontic treatments is a common complication, affecting 3% to 58% of patients. The etiology of postoperative endodontic pain is multifactorial and can be induced by inflammatory mediators produced by chemicals, mechanical or microbial lesions of the pulp and periapical tissues. Low-level laser therapy has been used in dentistry to promote analgesia, modulation of inflammation, and tissue healing. Low-level laser therapy-mediated analgesia results in vasodilation, increased levels of adenosine triphosphate (ATP) and cortisol, inhibiting the production of inflammatory

factors. There is also an increase in the synthesis of endogenous endorphins, a reduction in the synthesis of bradykinin, a reduction in the release of histamine, and an alteration in the synthesis of prostaglandin. Recent studies have reported that the use of low-level laser has enabled the treatment of post-endodontic pain compared to control [4].

Also in this context, the use of laser therapy (photobiomodulation) that uses non-ionizing or infrared light to stimulate tissues, cells, and molecules at the systemic level, stimulates microcirculation with an increase in the production of adenosine triphosphate (ATP), nitric oxide (NO) and reactive oxygen species (ROS) [5,6]. This low-intensity application provides comfort to the patient due to its associated anti-inflammatory, analgesic, and healing properties [7-9].

Thus, the effect of laser therapy improves vascularization, increases collagen synthesis, and, to the bone, modulates inflammation, accelerates cell proliferation [5]. Also, it has been shown that laser therapy stimulates bone stem cells and accelerates their repair process [10]. However, to make laser therapy more promising, it is important to limit its exposure time [5,9].

Therefore, the present study performed a concise systematic review to present the main clinical outcomes of endodontic treatment with low-intensity laser therapy.

## Methods

### Study Design

This was followed by a systematic literature review model, according to the PRISMA rules [11].

### Data sources and research strategy

The search strategies for this review were based on the descriptors: "Endodontic treatment. Laser therapy. Low-intensity laser. Healing. Pain". The research was carried out from April 2021 to July 2021 and developed based on Google Scholar, Scopus, PubMed, Scielo, and Cochrane Library. Also, a combination of the keywords with the Booleans "OR", "AND", and the operator "NOT" were used to target the scientific articles of interest.

### Study Quality and Bias Risk

The quality of the studies was based on the GRADE instrument [12], with guidelines, randomized controlled clinical studies, prospective controlled clinical studies, and studies of systematic review and meta-analysis listed as the studies with the greatest scientific evidence. The risk of

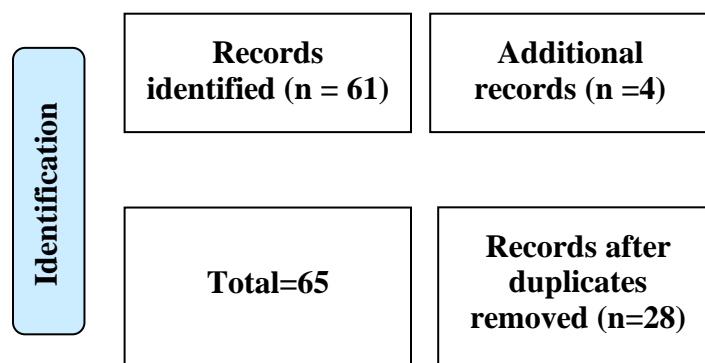
bias was analyzed according to the Cochrane instrument [13].

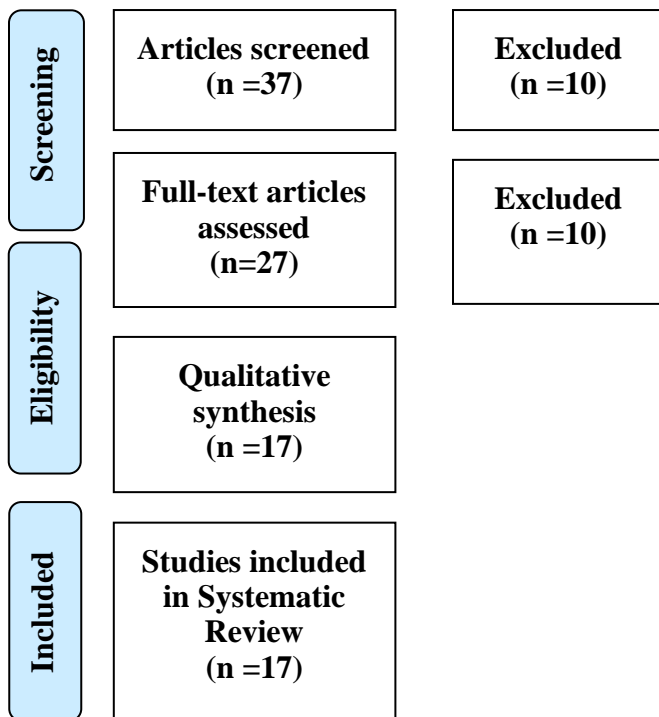
## Results and Discussion

After the selectivity of articles and literary findings through the following descriptors *Endodontic treatment; Laser therapy; Low-intensity laser; Healing; Pain*, a total of 65 studies were analyzed, with only 17 medium and high-quality studies selected, according to GRADE rules, and with risks of bias that do not compromise scientific development, based on the Cochrane instrument (**Figure 1**). After analyzing the major studies, it was analyzed that authors showed that low-intensity laser therapy has the property of oral sterilization, facilitating tissue healing after surgical procedures [14,15].

The findings show the effects related to anti-inflammatory, analgesic, and healing capacities with the application of low-intensity laser [6-8]. A study with 120 patients evaluated the effect of low-intensity laser irradiation and ibuprofen in reducing the onset and intensity of postoperative pain after a single endodontic visit. Group A (n = 30) received 400 mg of ibuprofen orally 1 hour before the institution of an endodontic procedure. Group B (n = 30) received low-power laser irradiation at 50 Hz for 3 minutes after the standard endodontic procedure in the periapical region, both on the buccal and lingual surfaces. Group C (n = 30) received preoperative ibuprofen followed by a low-intensity laser at 50 Hz for 3 minutes after endodontic treatment and Group D (n = 30) received no treatments. Results showed that pain was significantly reduced in all postoperative treatment groups. Low-level laser therapy can be an effective alternative to the conventional use of non-steroidal anti-inflammatory drugs to control post-endodontic pain, thus eliminating the adverse effects of these drugs on patients [16].

**Figure 1.** Scheme for selecting the studies





Furthermore, a prospective study with 76 patients analyzed the possible benefits of low-intensity laser therapy in the healing of soft and hard tissues after endodontic surgery. The laser group showed better results in edema, wound healing, and in the number of analgesic tablets used on the 1st, 3rd, and 7th postoperative days. A significant reduction in bruises was observed in the laser group on the 3rd and 7th postoperative days. Patients had significantly less pain on the first and third postoperative days in the laser group. Therefore, laser therapy improved soft and hard tissue healing after endodontic surgery and also showed favorable effects on pain and quality of life of patients, especially in the initial phase of the healing period [17].

Besides, new alternative treatment modalities have been proposed, including high-power lasers and antimicrobial photodynamic therapy (aPDT). Thus, a systematic review study evaluated the outcome of root canal disinfection to the effectiveness of various treatment modalities. The study concluded that the combination of aPDT with antimicrobial irrigants may provide a synergistic effect. However, there is a lack of a standardized protocol [18].

Also, a study investigated the effect of a placebo, intracanal diode laser application and low-intensity laser therapy in changing the total amount of calcitonin gene-related peptide (CGRP) in gingival fluid (GCF) in the placebo group, the changes in the total level of CGRP in the GCF before and after treatment were significantly greater for experimental teeth than for control teeth. However, there was no significant difference between experimental and

laser groups. Thus, the application of intracanal laser and low-intensity laser therapy has immunomodulating effects linked to the modulation of the total amount of CGRP in the GCF [19].

In addition, a study evaluated and compared the clinical and radiographic success rates of low-intensity laser therapy and formocresol (FC) for pulpotomy in primary teeth. A total of 106 primary molars from 36 children aged five to eight years were included. At six months, the clinical success rate was 98 percent for each group. Radiographic success was 100% for the low-intensity laser group and 98% for the CF group. At 12 months, both groups showed a clinical success of 96.1%. Radiographic success at 12 months was 100% and 98% for low-intensity laser and HR, respectively. Thus, both low-intensity laser therapy and pulpotomy techniques with formocresol showed favorable clinical and radiographic results in human primary molar teeth over 12 months [20].

Finally, a systematic review study evaluated the influence of low-intensity laser therapy on postoperative pain after endodontic treatment. Twelve studies were included in the qualitative synthesis. Six studies evaluated postoperative pain after primary root canal treatment, two studies after root canal retreatment, and four after periapical surgery. Most studies reported significantly less postoperative pain after low-intensity laser therapy at different periods [4].

## Conclusion

Laser therapy has been shown to improve the healing of soft and hard tissues after endodontic surgery and has also shown favorable effects on pain and quality of life for patients.

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#### **Data sharing statement**

No additional data are available

#### **Conflict of interest**

The authors declare no conflict of interest

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