

# Assessing the Impact of Low-level Laser Therapy on Anesthetic Depth in Patients with Irreversible Pulpitis: A Randomized Controlled Trial

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## ABSTRACT

**Aims and background:** Pain, linked to tissue injury, contributes significantly to dental phobia and anxiety, often rooted in painful childhood experiences. Effective dental anesthesia is crucial, but achieving an inferior alveolar nerve block (IANB) can be challenging due to anatomical variability. Low-level laser therapy (LLLT) provides a noninvasive method to promote healing and reduce pain by modulating sensory nerve activity. This study aims to assess LLLT's effect on anesthesia depth during endodontic therapy for symptomatic irreversible pulpitis in the North Indian population.

**Materials and methods:** This blinded, prospective, randomized controlled trial was conducted from September to November 2023, with a 1:1 allocation ratio. Seventy participants with symptomatic irreversible pulpitis in mandibular molars were randomly assigned to a laser group receiving 940 nm diode laser therapy or a placebo group receiving light emitting diode (LED) light treatment. Pain levels were assessed during dentinal cutting and pulp chamber entry using the Heft-Parker visual analog scale (VAS). Statistical analysis was conducted using one-way ANOVA in SPSS to evaluate the findings.

**Results:** Participants receiving LLLT reported significantly lower pain scores than the placebo group, indicating effective pain reduction during dental procedures.

**Conclusion:** The study confirms that LLLT alleviates pain and reduces the need for supplemental injections during root canal treatments, enhancing pain management.

**Clinical significance:** The growing use of lasers in dentistry now includes endodontics, with this study indicating their potential as a valuable adjunct for supplemental injections in nerve blocks.

**Keywords:** Anesthesia, Inferior alveolar nerve block, Irreversible pulpitis, Low-level laser therapy.

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## INTRODUCTION

Pain is a distressing sensory and emotional experience linked to, or resembles to, what is felt during an actual or potential tissue injury.<sup>1</sup> Pain and dental phobia are interconnected, as the anticipation of pain can significantly contribute to an individual's fear of dental procedures. Research has consistently highlighted a notable connection between painful experiences during childhood dental treatments and the development of anxiety regarding dental procedures in adulthood.<sup>2</sup>

Dental anesthesia is widely used to induce a temporary loss of sensation in a specific area of the mouth or to sedate a patient during dental procedures. This technique aims to minimize pain and discomfort, making treatments more tolerable for patients. Achieving adequate anesthesia in the inferior alveolar nerve block (IANB) can be difficult due to anatomical variability, improper technique, dense cortical bone, inadequate anesthetic volume, patient anxiety, and factors like infection or inflammation.<sup>3,4</sup> Addressing these challenges requires precise technique and sometimes supplemental methods for better results.

Low-level laser therapy (LLLT) is a noninvasive treatment that uses specific wavelengths of light to promote healing, reduce pain, and decrease inflammation.<sup>5</sup> It can play a role in blocking nerve impulses by modulating the activity of sensory nerves.<sup>6</sup> Given the limited evidence regarding the impact of LLLT on the depth of local

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anesthesia during root canal treatments, and the lack of similar studies within the North Indian population, this investigation aimed to assess LLLT's effect on anesthesia depth in endodontic therapy for teeth with symptomatic irreversible pulpitis.

## MATERIALS AND METHODS

The present study was a blinded, prospective, randomized controlled trial (as per the consort guidelines, with a 1:1 allocation ratio, conducted from September to November 2023. Participants were

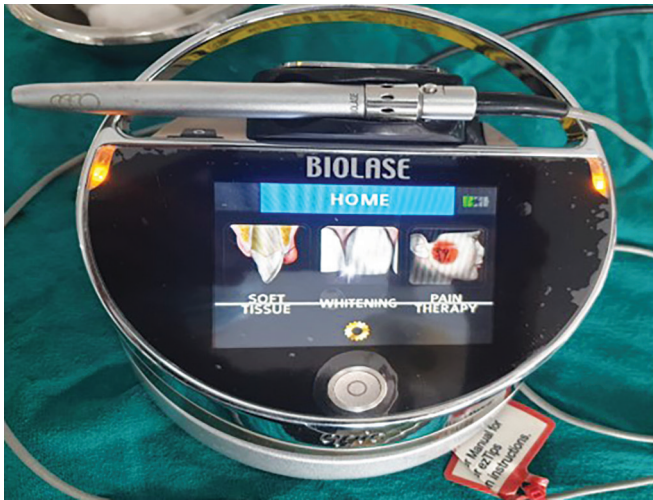


Fig. 1: 940 nm diode laser

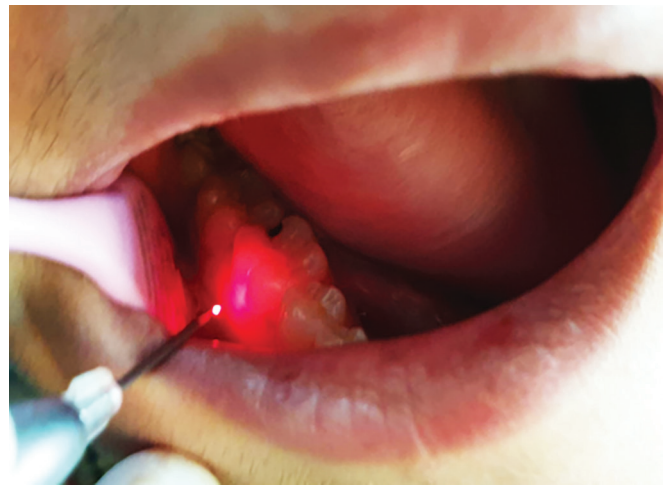


Fig. 2: Laser group

informed about the study's objectives, and signed informed consent was obtained prior to their participation.

### Patient Selection

A total of seventy individuals who reported to the Department of Conservative Dentistry and Endodontics at the National Dental College and Hospital, Derabassi, with the provisional diagnosis of symptomatic irreversible pulpitis in mandibular molars, were selected for this present study. The inclusion criteria were patients with tenderness to percussion, a history of spontaneous pain, and teeth with healthy gums (probing depth of <3 mm). Patients with non-vital teeth, patients who took systemic painkillers 24 hours prior, patients on psychiatric medications, and pregnant women were excluded from the study.

### Randomization

Randomization was done by drawing slips of folded paper from a box, with thirty-five slips each for laser group, in which participants received low level laser therapy and placebo group, in which a placebo was given to the participants.

### Methodology

In the laser group, the buccal aspect of the involved tooth was irradiated with a 940 nm diode laser (Epic X, Biolase, USA) (Fig. 1) for 20 seconds, close to the gingival margin (Fig. 2). While, in the placebo group, the buccal aspect of the involved tooth was irradiated with a light emitting diode (LED) curing light (Coltolux, Coltene Whaledent, Switzerland) (Fig. 3) for 20 seconds, close to the gingival margin (Fig. 4).

Following this, both the groups were administered with an IANB using 2% lignocaine with 1:80,000 adrenaline (Lignox 2% A, Indoco Remedies Ltd, India). The sign for determining if anesthesia was profound was lip numbness. Then, the steps for access opening were followed, and pain levels were recorded.

### Data Collection

Pain levels were recorded using the Heft-Parker visual analog scale (VAS), where-in patients were asked to record the pain on two instances: on dentinal cutting (VAS1) and at time of drop into the pulp chamber (VAS2).



Fig. 3: Light emitting diode light (placebo)



Fig. 4: Placebo group

### Statistical Analysis

One-way analysis of variance (ANOVA), including standard deviation (SD), was done for statistical evaluation, using an SPSS

**Table 1:** Laser group

Score	VAS 1	VAS 2
0–4 mm	11	13
5–44 mm	10	9
45–74 mm	9	8
75–100 mm	5	5
	SD 2.62	SD 3.30
	$p = 0.05$	$p = 0.02$

**Table 2:** Placebo group

Score	VAS 1	VAS 2
0–4 mm	6	5
5–44 mm	13	14
45–74 mm	12	11
75–100 mm	4	5
	SD 3.20	SD 4.5
	$p = 0.10$	$p = 0.10$

software (SPSS Statistics v28, SPSS inc., IBM). 0.05 level of statistical significance was set.

## RESULTS

Table 1 depicts the pain scores for the laser group. The  $p$ -value and SD for VAS1 and VAS2 were calculated as 0.05 with a 2.62 SD and 0.02 with a 3.30 SD, respectively.

Table 2 depicts the pain scores for placebo group. The  $p$ -value and SD for VAS1 and VAS2 were calculated to be 0.10 with a 3.20 SD and 0.10 with a 4.50 SD, respectively.

On intergroup comparison, it was seen that the intervention group with patients receiving laser therapy had mean pain scores that were lower for both instances of VAS recording. The results inference that the LLLT had a positive effect on pain levels.

## DISCUSSION

Ensuring effective anesthesia for pain-free root canal treatment is a critical goal in dentistry. Endodontic therapy demands reliable anesthesia, and one of the most challenging aspects is providing it for mandibular molar teeth affected by irreversible pulpitis. The IANB is the most frequently used mandibular injection technique for achieving local anesthesia during root canal treatment.<sup>7</sup>

Now, IANB has a success rate of 14–57% in cases of mandibular posterior teeth presenting with irreversible pulpitis.<sup>8,9</sup> This correlates to the present study, in which 54.2% in the placebo group had no to mild pain.

In symptomatic teeth with irreversible pulpitis, the inadequacy of local anesthesia depth is linked to prostaglandin-induced sensitization of peripheral nociceptors. Increased levels of inflammatory mediators such as prostaglandins, from the inflamed pulp produce their effect by binding to various receptors, in turn activating the peripheral receptors.<sup>10</sup>

In present study, 68.5% of laser group showed no pain level at both VAS1 and VAS2, which is in conclusive with a similar result by Kreisler et al.<sup>11</sup>

Now, it is known that acute pain is typically triggered by the activation of pain receptors associated with A-fibers, which transmit sharp, localized pain sensations resulting from noxious stimuli.

This discomfort often persists even after the harmful stimulus has been removed. In contrast, C-fibers convey ongoing pain signals throughout the peripheral nervous system; due to their extensive branching, pain is perceived not only at the site of injury but also in adjacent areas.<sup>5</sup> Research on rat subjects has shown that low level laser therapy selectively blocks nerve transmission in both myelinated A-fibers and unmyelinated C-fibers, thereby contributing to pain relief.<sup>12</sup>

This study presents an innovative strategy for mitigating pain during root canal treatment, positioning LLLT as a viable and noninvasive option for alleviating the discomfort associated with this procedure.<sup>13</sup> Nonetheless, it is important to acknowledge that the current investigation is characterized by a short-term design and a restricted sample size, which may constrain the broader applicability of the findings. Subsequent research endeavors will be necessary to rigorously evaluate the postoperative success rates of root canal treatments utilizing LLLT in comparison to a placebo, thereby further elucidating its efficacy in clinical practice.

## CONCLUSION

The results of the present study substantiate that LLLT, employing diode laser irradiation at 940 nm prior to the administration of local anesthesia, effectively mitigates pain and reduces the necessity for supplemental injections during root canal treatment. This integration of LLLT as a method for pain alleviation alongside conventional anesthetic techniques represents a noteworthy advancement in dental practice.

## Clinical Significance

The use of lasers in dentistry has experienced a significant surge in popularity. Initially, their application was primarily restricted to periodontal and surgical procedures, but they have since been expanded to include endodontics. This study suggests that lasers can serve as a valuable adjunct for supplemental injections in IANBs.

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