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# Low level laser therapy in management of post endodontic retreatment pain: A review

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**Abstract**

Post-endodontic treatment pain is frequent which needs analgesics for patient's pain relief. One of the most common reasons for post operative pain is chemical, mechanical, or microbial injuries to the periapical tissues that result in acute inflammation. Application of recently developed endodontic techniques and devices will reduce postoperative pain. Two proven methods for reducing pain associated with inflammation are low-level laser therapy (LLLT) and antimicrobial photodynamic therapy. The use of LLLT in root canal therapy procedures is supported by more and better-documented evidence.

**Keywords:** low level laser therapy, retreatment cases, pain management, antimicrobial photodynamic therapy

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# Низкоуровневая лазерная терапия в лечении боли после повторного эндодонтического лечения: обзор литературы

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**Резюме**

Боль после эндодонтического лечения встречается часто и требует применения анальгетиков для облегчения состояния пациента. Одной из наиболее частых причин послеоперационной боли являются химические, механические или микробные повреждения периапикальных тканей, вызывающие острое воспаление. Применение новейших эндодонтических техник и устройств позволяет уменьшить послеоперационную боль. Два проверенных метода снижения боли, связанной с воспалением, включают низкоуровневую лазерную терапию (LLLT) и антимикробную фотодинамическую терапию. Использование LLLT в процедурах лечения корневых каналов поддерживается большим количеством хорошо документированных доказательств.

**Ключевые слова:** низкоуровневая лазерная терапия, повторные случаи лечения, управление болью, антимикробная фотодинамическая терапия

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## INTRODUCTION

Post-operative pain after endodontic treatments is common can subside by using analgesics and non-steroidal anti-inflammatory drugs. There are certain factors that can influence the progression of postoperative pain [1; 2], which includes factors like history of preoperative pain and the need for re-treatment. Very common cause of postoperative pain is microorganisms. Mechanical or chemical injury to pulp or peri-radicular tissues are reason for other causes [3]. The main objectives of root canal therapy (RCT) are to properly prepare and shape the canal till the apex in order to maintain access to the apical infection, perform sufficient decontamination, and then provide high-quality root filling [3]. High success and survival rates are attained by nonsurgical RCT provided that the apical infection's access is restored [3; 4]. However, even after appropriate cleaning and shaping retreatment procedures, some degree of pain and discomfort may still be present [5–9]. Debris extrusion using rotating file systems during cleaning and shaping [6] are an additional cause for postoperative pain. Inflammatory mediators like prostaglandins, leukotrienes, bradykinin, and serotonin are responsible for postoperative endodontic pain, linked to that activate nociceptors, leading to activate both peripheral and central mechanisms of hyperalgesia. Critical role played by prostaglandins in the pathogenesis of pulpal and peri radicular disease [10]. Many clinical studies have reported a varying degrees of postendodontic pain, ranging from 20% to 40% [4; 5]. For preventing postoperative pain Nonsteroidal anti-inflammatory drugs (NSAIDs) are the most commonly prescribed analgesics [11–14]. However certain efforts have been made to decrease post-operative pain of the endodontic treatments through laser irradiation, due to the side effects of drugs.

## RESULTS

### Significance of lasers in endodontic therapy

Lasers have been used in dentistry since its introduction, and one of the main areas of research has been in endodontics. Predominately through a photothermal effect, the host tissue interaction with near-infrared (NIR) wavelengths (810–1064 nm) occur. Owing to their deep penetration into tooth tissue, they have been found to penetrate >1000 μm into dentine by scattering and transmitting along the dentinal tubules, which serve as "light guides" [15].

Since chromophores can absorb photonic energy like melanin, only pigmented bacteria will be susceptible to direct inactivation by NIR laser [10]. Both wet and dry root canals have been studied in vitro, with encouraging antibacterial outcomes. Nevertheless, melting of the root canal walls and overheating are disadvantages of using lasers in dry conditions [12].

In recent times, there has been increased investigation into lasers used in dentistry that operate in the mid-infrared region (2780–2940 nm). Partially responsible for this is their potent, wide absorption band resulting from stretching O-H bonds and hydrogen (H) bonding between molecules. This depends on the fast flow of fluid in the root canal, which is induced by the high absorption in the irrigating solutions and the high peak power during pulsed emission, which causes bubbles to burst and explode at the laser tip.

The same phenomenon is used in laser-activated irrigation (LAI), which results in extremely turbulent irrigant movement and improved microorganism and biofilm removal from the root canal system.

As an adjunct alternative Laser use in root canal system has further developed through antimicrobial photodynamic therapy (aPDT). This method is based on applying a photosensitizer (PS) inside the root canal. It is then exposed to light at a wavelength that matches the photosensitizer's absorption band maximum after a predetermined amount of time for incubation. This method depends on the length of incubation: microorganisms need minutes, but host cells need hours [16]. Nonetheless, the microorganisms are the only living cells in the infected root canal system.

### Post-operative-endodontic Pain

A primary concern in endodontic treatment, aside from microorganism infection, is the pain that patients experience after surgery. According to publications in the scientific literature, this has a prevalence of anywhere from 3 to 58%; the variation in these reports can be explained by evaluating POP using different criteria [17]. Patients who experience pain following a root canal may attribute it to ineffective treatment and doubt the clinician's abilities. Therefore, it is crucial to manage pain following a root canal.

Irritation of the peri radicular tissues is assumed to be the source of post-operative endodontic pain, which is linked to microorganisms or mechanical or chemical damage to the radicular area. Inflammation and pain may also be caused by the apical extrusion of dental debris or irrigants, intra-canal medications, and microorganisms [18; 19].

After a root canal, pain usually goes away in 24 to 48 hours, but occasionally it can last up to 72 hours [20]. Pharmacologic and nonpharmacologic techniques are often used to reduce the intensity of endodontic postoperative pain. Pharmacologic methods include prescribing medications like acetaminophen, antihistamines, nonsteroidal or steroidal anti-inflammatory drugs, salicylic acid, narcotic analgesics, intracanal drugs, or long-acting anaesthesia for postoperative pain management. Nonpharmacologic methods include intracanal cryotherapy, various root canal kinematics, intracanal laser irradiation, and low-level laser therapy (LLLT) to reduce postoperative discomfort. Laser application in post-operative endodontic pain management has gained attention due to its potential benefits.

**Photobiomodulation (PBM):** Low-level laser therapy (LLLT) is used to promote tissue healing and reduce inflammation. PBM helps in reducing pain by altering cellular processes, such as increasing ATP production and enhancing cellular repair.

**Antibacterial Effect:** Lasers, particularly diode and erbium lasers, can effectively reduce bacterial load within the root canal system, which is crucial for pain management.

**Anti-inflammatory Effect:** Lasers can reduce the levels of inflammatory mediators and modulate the inflammatory response, contributing to pain relief.

## DISCUSSION

The impact of low-level laser irradiation on post-endodontic pain has only been examined in one study to date. According to Asnaashari et al., low-level laser significantly decreased post-endodontic pain at 4, 8, 12, and 48 hours [21]. According to Lizarelli, there was a noticeable decrease in pain after low-level laser pre- and post-implant procedures [22]. LLLT, which used a semiconductor low-level laser as demonstrated by Sakuraba et al. [23], reduced pain in sensitive pulps. Kreisler et al.'s study [24] showed that the laser group experienced greater pain reduction on the first day following endodontic surgery than the placebo group. A low-level red and infrared laser was found to be a highly effective treatment for dentin hypersensitivity in one investigation [25]. In their meta-analysis, Enwemeka et al. [26] showed that low-level laser therapy was highly successful in reducing pain and repairing tissue. They concluded that, due to small sample size, insignificant results of some studies were shown. LLLT works on a Power range between 0.005 to 12 Watt and a power Density lesser than 670mW/cm$^2$ in a pulse emission mode. However, the optimal dosage range for pain relief is still not fully elucidated based on the current evidence and available literature. Exposure time per teeth ranges from 60–100 seconds. Kert and Rose recommend the use of energy between 0.5 and 10 J per treatment point and in contact with the tissue surface for deeper effect [27]. The laser tip diameter size ranges from 200–600 micrometre. Tip is placed near the apices of tooth in concern both on buccal and lingual / palatal side.

Through LLLT, cellular metabolism and local microcirculation both have rejuvenating effects [21; 28]. Prostaglandin I2, which has anti-inflammatory properties, immunoglobulins, lymphokines, and beta-endorphins, which are implicated in analgesia, are all increased by LLLT.

The release of several inflammatory factors and pain-related neurotransmitters is inhibited by LLLT [29]. Additionally, cyclooxygenase is inhibited and pain-inducing chemicals are removed by LLLT [21; 30]. Moreover, LLLT also doubles the lymphatic drainage [31]. LLLT affects the cell membrane's permeability to potassium, sodium, and calcium ions. This alteration in permeability causes the breakdown of bradykinin [29] and increases the action potential of neurons [31], decreases the activity of C fibres, increases the production of endorphins by activating cellular receptors [32]. Each of these biological processes can account for the beneficial factors that contribute to the decrease in post-operative pain.

## CONCLUSION

Low level laser irradiation reduces discomfort associated with endodontic retreatments in the molars; however, additional research is needed to evaluate the effects of various low level laser parameters in this context.

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