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Different ways to control post operative endodontic pain

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Abstract
Post-operative endodontic pain remains a prevalent and multifactorial clinical challenge that can significantly impact patient comfort and treatment outcomes. A comprehensive pain management strategy, combining both pharmacological and non-pharmacological approaches, is essential for effective control. Non-pharmacological interventions including pulpotomy, crown-down technique, proper irrigation methods, and adjunctive therapies like phototherapy and cryotherapy further enhance patient outcomes. Clinicians must adopt an individualized approach based on the patient's medical condition, procedural complexity, and pain profile to optimize post-operative care and enhance the overall success of endodontic therapy. On the other hand, NSAIDs, particularly ibuprofen, remain the cornerstone of pharmacologic intervention, while corticosteroids like dexamethasone and prednisolone offer significant short-term relief when used preoperatively or via local injections. Alternative delivery systems such as transdermal patches and intraosseous injections provide viable options for patients with systemic limitations. Intracanal medicaments, like Ledermix and Odontopaste, have shown efficacy in managing localized inflammation and pain.

Keywords: Analgesic, endodontic, pain, transcranial

Introduction
Most individuals visit the dental office due to varying degrees of pain, primarily stemming from endodontic and periodontal origins, with a significant emphasis on endodontic reasons; therefore, it is crucial for doctors to distinguish between odontogenic and non-odontogenic pain. Consequently, effective endodontic pain therapy relies on a precise identification of the pain's source, supported by clinical evaluation and periapical and pulp assessments, in conjunction with 2D and 3D radiographic analysis [1].

Endodontic therapy involves the comprehensive managing of pre-, intra-, and post-operative manifestations, which includes post-operative endodontic pain, regarded as a therapeutic consequences prone to chronicity and a significant worry for patients. Post-operative pain is prevalent, impacting between 2.5% to approximately 60% of individuals who have received endodontic procedures. It typically escalates between 6 and 12 hours post-treatment, peaking at around 40% within 24 hours and thereafter declining to 11% one week later. Furthermore, post-operative endodontic pain is largely unavoidable, influenced by various factors pertaining to the individual (like gender and age), the managed tooth (which includes pre-operative pulp condition and tooth type), and the treatment administered (whether primary root canal therapies or retreatment) [2].

Endodontic postoperative pain
The main objectives of endodontic therapy are to biomechanically prepare the root canal (shaping, cleaning, and disinfection), hermetically seal it without causing the patient any discomfort, and create an environment that promotes the healing of the periradicular tissues**.** Flare-ups of endodontic pain occur in many patients during endodontic therapy. A flare-up is characterized as swelling and/or pain in the facial soft tissues and the oral mucosa surrounding the endodontically treated tooth that happens a few hours or days subsequent to the root canal

procedure, the clinical symptom of postoperative pain is (tooth discomfort with biting, chewing, or on its own) are substantially expressed [3].

Different ways to control post-operative pain

- **Nonpharmacological management**
  These techniques encompass pulpectomy and pulpotomy, two prevalent dental procedures for alleviating pain. In situations where time constraints preclude a comprehensive pulpectomy, a pulpotomy is often conducted in response to acute pulpal discomfort. Pulpotomy is advised in emergencies, accompanied by the application of antibacterial dressings and sealing sedative within the pulp chamber. Pulpotomies are commonly employed to address patients exhibiting signs of irreversible pulpitis or necrosis of the pulp, regardless of edema. To avert contaminating from the oral cavity, it is advisable to secure a tight dressing after the pulpectomy [4].
- **Crown-down technique**
  The crown-down technique for shaping and cleaning root canal systems reduces extrusion of the debris via the apical foramen by commencing at the coronal third and progressing towards the apical third. The reduction in discomfort is significant, as extrusion of the periapical debris is an essential factor of pain subsequent to root canal therapy [4].
- **Sodium hypochlorite concentrations**
  In molars of the mandible with nonvital pulp handled over two visits, 1.3% Sodium hypochlorite (NaOCl) resulted in a lesser degree of postendodontic discomfort compared to 5.25% NaOCl. Conversely, within the initial 72 hours following a single visit for root canal therapy of molars in the mandible with irreversible pulpitis, 5.25% NaOCl had been associated with markedly reduced discomfort after the procedure compared to 2.5% NaOCl [4].
- **Endovac irrigation system**
  The Endovac system ensures the secure delivery of irrigants to the apical terminus of root canals. The irrigant is administered into the pulp chamber via a macro- or microcannula connected to the suction apparatus. The substance is thereafter pulled by negative pressure via the canal into the cannula's tip and extracted via a coronally situated suction hose [5].
- **Phototherapy and cryotherapy**
  Phototherapy entails being exposed to particular light wavelengths by lasers, light-emitting diodes, or polychromatic polarized light, in contrast to photodynamic therapies, that employs photosensitizing agents. In the past few years, phototherapy has emerged as an efficient therapeutic modality for various oral conditions in dentistry. Furthermore, phototherapy is employed to alleviate pain, accelerate wound healing by vasodilation, and efficiently regulate inflammatory markers. Phototherapy modifies biological processes including adenosine triphosphate (ATP) production, synthesis of prostaglandin and proteins, neurotransmitter secretion, proliferation and differentiation of the cells, and phagocytosis. Research indicates that phototherapy can effectively alleviate post-extraction discomfort [6].
  Cryotherapy has also been associated with reduced postoperative opioid consumption. This experiment was founded on the work of Vera *et al*., who illustrated that irrigating root canals with a 2.5°C saline solution for 5 minutes decreased the exterior root surface temperature [7].

Pharmacological management

- **Nonsteroidal anti-inflammatory drugs (NSAIDs)**
  The most effective treatments now available for individuals with irreversible necrosis of the pulps or pulpitis are NSAIDs or NSAIDs with acetaminophen given following nonsurgical endodontic therapies, according to very low-to-moderate quality data. This decrease in postoperative pain is clinically significant [8].
- **Pre-emptive analgesia**
  Pre-emptive analgesics is an anti-nociceptive medication that works by blocking the processing of changed afferent input, therefore minimizing postoperative pain. Given that the majority of patients experience pain preoperatively, more released local inflammatory mediators are present. Therefore, central sensitization: a process by which spinal neurons elevate their sensitivity to peripheral nociceptive impulses is inhibited by pretreatment analgesia [9]
- **Analgesic Effects of Piroxicam Contrasted to Ibuprofen on Post-Endodontic Pain:**
  Ibuprofen(400mg) was equally effective at different etoricoxib dosages (60,90,120 mg) and might continue to be the best analgesic for pulpal pain [10].
  Prophylactic intraligamentary administration of piroxicam (Feldene) for the alleviation of post-endodontic discomfort in molar teeth exhibiting irreversible pulpitis: An investigation to assess the analgesic efficacy of piroxicam (feldene), a non-selective NSAID, following endodontic procedures. Prophylactic intraligamentary administration of 8 mg piroxicam is significantly successful in lowering post-endodontic discomfort for vital teeth with irreversible pulpitis within 48 hours. It had been significantly more efficient contrasted to a comparable lidocaine administration in relieving endodontic pain following surgery [11].
- **The Efficiency of Oral and Transdermal Diclofenac for Post-Endodontic Control of Pain:**
  For two days, oral diclofenac (50 mg twice day) and transdermal diclofenac patch (100 mg per day) had been given as post-endodontic analgesia to groups I and II, respectively. A visual analogue scale (VAS) chart had been utilized. The transdermal diclofenac patch had been as efficient as the oral diclofenac tablet and might be utilized as an alternate and efficient analgesia for post-endodontic pain managing, particularly among individuals with gastrointestinal discomfort [12]

Steroid anti-inflammatory drugs

- **Efficacy of corticosteroid premedication on postoperative endodontic pain:**
  Glucocorticoids are hormones secreted by the adrenal glands that possess substantial anti-inflammatory effects. This encompasses the inhibition of arachidonic acid generation from phospholipids of the cell membrane, decreasing vasodilation, polymorphonuclear leukocytes migration, and phagocytosis. The outcomes of systematic analysis revealed that the utilization of glucocorticoids may reduce pain following randomized controlled trial (RCT), with the reduction in pain being considerably more noticeable in the initial 12-48 hours following therapies [13].
- **Effects of pretreatment dexamethasone on post-**

endodontic pain: Evaluating the utilization of a preoperative single oral dosage of dexamethasone (Dex) (4mg) contrasted to placebo. The medications had been supplied one hour before the beginning of endodontic therapy. Postoperative pain had been measured at 4, 12, 24, and 48 hours. Dexamethasone substantially decreased post-endodontic pain in 4 and 12 hours. Nevertheless, no significant variation had been seen at 24 and 48 hrs. The placebo group took more rescue medicines. There were no documented adverse consequences from any of the drugs used [14].

- **Effects of Pretreatment Prednisolone on Post-Endodontic Pain:** Prednisolone substantially decreased post-endodontic pain after 6, 12, and 24 hrs. There were no documented negative impacts from any of the drugs utilized [15].
- **Effects of Dex Intra-ligamentary Injection on Post-Endodontic Pain:** After administering local anaesthesia and prior to treatment, group 1 (control) had a PDL injections with a syringe holding an empty cartridge, whereas groups 2 and 3 received 0.2 mL of 2% lidocaine or Dex (8 mg/2 mL). following 6 and 12 hours, groups 1 and 3 had the greatest and lowest pain values, correspondingly for 6 and 12 h. After 24 and 48 h, no significant variation existed in pain levels among groups 1 and 2 but group 3 experienced decreased levels of pain respectively) [16].
- **Effects of periapical infiltration of injection of Dex, morphine and placebo on postoperative endodontic pain:** Treatment with dexamethasone or morphine was statistically correlated with lower levels and endodontic pain incidence at 4, 8, and 24 hours, but not at 48 hours. Additionally, it was noted that morphine (43.3% no pain) was quite less effective than dexamethasone (56.7% no pain) [17].
- **Effects of supraperiosteal injection of Dex on postoperative pain:** No variation existed between the Dex and placebo groups 48 hours following the initial assessment, dexamethasone was very beneficial in decreasing the level of pain within the first 24 hours [18].
- **Intraosseous Methylprednisolone Injection for Acute Pulpitis Pain:** Evaluation the effectiveness, safety, and efficiency of emergency pulpotomy against local intraosseous methylprednisolone administration in managing of acute pulpitis. Contrasted to the individuals in the pulpotomy group, the methylprednisolone group's patients experienced less severe spontaneous and percussion pain during the period of day 0–day 7. Compared to pulpotomy, methylprednisolone therapy took roughly 7 minutes (4.6–9.3) less to complete (or about half the time). At six months, no apparent variation existed in the therapeutic outcomes among both therapy groups [19].
- **Effects of Premedication with Ibuprofen and Dex on Success Rate of Inferior Alveolar Nerve Block:** [20]
  As regards the sex of the participants in the three groups (lactose powder placebo, 400 mg ibuprofen, or 0.5 mg Dex), no significant variations had been detected. When comparing the Dex group to the placebo group, the rates of success had been noticeably greater. The comparison of the ibuprofen and placebo groups and the ibuprofen and dexamethasone groups did not reveal any significant variations.

The effects of orally administered ketamine on the necessity for anaesthetics and postoperative pain in molar teeth of the mandible exhibiting irreversible pulpitis

The ketamine group used considerably fewer anesthetic cartridges than the control group. Furthermore, the ketamine group experienced substantially less postoperative pain. Furthermore, the quantity of analgesic tablets consumed in the ketamine group had been considerably decreased [21].

- **Effects of Bupivacaine on Postoperative Pain for Inferior Alveolar Nerve Block:** Patients administered bupivacaine as an anaesthetic for single-visit endodontic treatments of irreversible pulpitis in molars of the mandible noted substantially reduced early postoperative discomfort and required decreased analgesics compared to those treated with lidocaine [22].

The association of intracanal medicaments with postoperative discomfort in endodontics: Teeth afflicted with acute apical periodontitis and managed with Ledermix paste experienced reduced pain contrasted to those managed with calcium hydroxide or left undressed. Ledermix is an efficacious intracanal drug for alleviating postoperative pain resulting from acute apical periodontitis, exhibiting a swift onset of analgesic effects [23].

Analgesic Efficacy of Odontopaste and a Composite Intracanal Medicament During Inter-Appointment Periods of Root Canal Therapies: The randomized controlled experiment had been to compare the analgesic efficacy of Odontopaste® and a corticosteroid-containing chemical medicament between root canal therapeutic visits. Following root canal preparation, participants had been allocated at random to one of these groups. Group 1 obtained root canals treated with Odontopaste (a zinc oxide-based root canal paste comprising 5% clindamycin hydrochloride and 1% triamcinolone acetonide), group 2 had been administered a compound intracanal medicine (comprising triamcinolone acetonide and clindamycin hydrochloride), and group 3 was given a placebo [24].

Groups 1 and 2 had lower average spontaneous pain and percussion sensitivity scores 24 hrs following their initial appointment contrasted to group 3, demonstrating a statistically substantial disparity among these groups. Following seven days, no statistically substantial distinction was seen among the groups for spontaneous pain or percussion sensitivity [24].

- **Utilization of antibiotics for the immediate treatment of pulpal and periapical dental discomfort and intraoral swelling:** Antibiotics for the targeted conditions might have very little benefit and may even cause significant harm, according to the evidence. According to the expert panel, Defintive, conservative dental treatment (DCDT) should always come first and antibiotics for target illnesses should only be given if systemic involvement is evident. When patients have fever or malaise as a result of their oral disorders, or when there is a high chance that their conditions will proceed to systemic involvement, they advise using antibiotics [25].
- **Transcranial Direct Current Stimulation (tDCS)**
  tDCS is a passive and contemporary treatment that includes the implementation of a low-intensity sustained electric current to the scalp to activate specific cortical regions of the brain. The stimuli might affect neuronal excitability and either excite or inhibit cortical and subcortical regions, so prompting the release of

endogenous opioids which promote the attenuation of pain [26]. Cathodal stimuli typically reduces excitability of the cortex by neuronal hyperpolarization, whereas anodal stimuli generally enhances cortical excitability via neuronal depolarization. Due to its cost-effectiveness, lack of pain, non-invasive nature, and relative simplicity to utilize [27].

Therapeutic application of tDCS in relation to pain, Parkinson's disease, various movement disorders, post-stroke aphasia, motor stroke, multiple sclerosis, consciousness disorders, epilepsy, Alzheimer's disease, depression, schizophrenia, tinnitus, and addiction. Additionally, it predicted in fibromyalgia (anodal tDCS of the left primary motor cortex (M1) with right orbitofrontal cathode), major depressive episodes without resistance of drugs (anodal tDCS of the left dorsolateral prefrontal cortex (DLPFC) while cathode is positioned on right orbitofrontal cortex), and in addiction. Also, it has been proposed in the case of chronic lower limb neuropathic pain due to lesion of the spinal cord (anodal tDCS of the left M1 (or contralateral to side of the pain) with right orbitofrontal cathode) [28]. tDCS has been shown to effectively alleviate chronic pain. M1 stimulation with tDCS has been proven to relieve pain among individuals with traumatic injuries of the spinal cord and cancer pain [29]. While migraine patients' headache and pain intensity are decreased by tDCS stimuli of either the left M1 or DLPFC [30]. However, other research shown that in individuals with diabetic neuropathy, tDCS over M1 but not DLPFC results in pain alleviation [31]. Subjects who underwent anodal tDCS of the DLPFC also reported higher ratings for other people's pain, which is in line with the prefrontal cortex function in pain empathy [32]. Evidence suggests that endogenous μ-opioids may be involved in the analgesic impacts of M1 tDCS [33].

Anodal stimulation of primary motor cortex increases pain threshold and pain perception while anodal, it has thalamic inhibitory activity. Stimulation of dorsolateral prefrontal cortex raised pain threshold only. Anodal stimulation of M1 and DlPFC can modulate the pain. Occipital cortex and sham stimulations had no impact on pain perception nor threshold. With higher magnitude DIPFC slightly increased pain threshold more than M1. They suggested that DIPFC stimulation has a role in pain emotional perception and it may be the best stimulation site for chronic pain treating [34].

Since the DLPFC is included in control of pain and there is strong evidence that its structure and function reflect chronic pain conditions, following tDCS to the DLPFC, patients with myofascial pain syndrome who experience chronic pain report lower mean visual analog scale scores [35]. can alleviate symptoms in a variety of areas, such as mood, working memory, and pain perception [36, 37]. It is likely that this area of the brain could be a target for therapy. In fact, a number of studies have now revealed that noninvasive brain stimulation of this area can successfully treat pain, whether it be chronic or acute [38-40].

Diverse parameters, including current amplitude, stimulation site, electrode dimensions, duration of stimulus, and current polarity, might elicit varying responses [41]. Multiple factors must be considered before utilizing a tDCS equipment. A neuron membrane will display a negative electrical charge when it is in its typical resting condition and a negative stimulus is applied to the cell membrane. This occurs when the neuron is in its typical resting condition. As a consequence of this, the polarity of the nerve or neuron will be inverted, and activating the neuron will cause it to terminate its polarity state and activate it. This action takes place very quickly, and because tDCS makes use of alternating current, the polarity of the stimulated cell will change very quickly. Afterwards, it will be accessible for another activation upon its availability. Ampere current is the only type of current that can create the requisite electrical stimulation for neural activation. This is the most important aspect. Consequently, the ampere electrical current induces the fast activity of neurons influenced by tDCS [42]. So, the future direction is to use tDCS on postoperative endodontic intensity of pain and more studies are needed in dentistry to fill the gap of knowlage in this part.

Conflict of Interest
Not available

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