



Pain Correlates in Endodontic Procedures: A Narrative Review Examining the Causative Factors and Clinical Approaches for Management.

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ABSTRACT

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Endodontic treatment, encompassing the diagnosis and management of dental pulp and periapical conditions, is pivotal in preserving dental health. Root canal treatment, a common endodontic procedure, involves the removal, cleaning, and sealing of the tooth's root system to address issues like pain and infections. Patients undergoing endodontic procedures often encounter pain due to the sensitivity of dental pulp nerves to caries, inflammation, infections, or treatment manipulations. The severity of pain is variable and influenced by individual factors such as pain threshold, anxiety levels, gender, and the extent of dental infection.

In conclusion, despite advancements in endodontics, pain management remains a significant concern. The narrative review emphasizes the importance of adopting comprehensive clinical management strategies encompassing the entire treatment process. A thorough assessment of the patient's medical history and dental condition is crucial to identify risk factors for increased pain. Effective communication with patients regarding the procedure and potential discomfort aids in managing expectations and reducing anxiety. Continuous professional development is highlighted as essential for dental professionals to stay abreast of the latest advancements, enabling the implementation of optimal pain management strategies and the delivery of enhanced patient care.

KEYWORDS: dental pain, endodontics, pain, pain management, root canal, root filling

INTRODUCTION

Endodontic treatment plays a vital role in dental care as it focuses on the diagnosis and treatment of the dental pulp and the surrounding periapical area of the tooth¹. It involves the removal of the infected or damaged pulp from the tooth, cleaning and shaping of the root canals, and sealing them to prevent further infection². This procedure, commonly referred to as root canal treatment, is essential for preserving teeth and alleviating pain associated with dental caries, periapical disease, and infections.

The common association of pain with endodontic procedures is a significant aspect that needs to be addressed in dental care. Patients often report pain, or discomfort, pre, intra or

post treatment due to numerous factors³. The dental pulp contains nerves that can be sensitive to caries, inflammation, infections, or manipulation during the treatment process⁴, resulting in pain perception.

The intensity of pain experienced can vary from mild to severe, influenced by individual factors such as pain threshold, anxiety levels, gender, and the extent of the dental infection. Authors have highlighted the prevalence of pain associated with endodontic treatment, such as Siqueira et al. (2002)⁵ reporting mild pain in 10% and severe in 1.9%, whereas Pak and White (2011)⁶ published the range from 81% preoperatively to 40% postoperatively. Moreover, pain during endodontic procedures can significantly impact patients' perception, emotions, and psychological well-being, leading to increased fear and anxiety related to root canal treatment^{7,8}.

The purpose of this essay is to explore the association between pain and endodontic treatment, while also evaluating

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possible reasons behind it and discussing clinical management approaches.

I. Understanding the association between pain and Endodontic treatment

The dental pulp is a very highly innervated and sensitive component of the tooth's structure⁹. When stimulated, the nerve fibres within the pulp initiate conduction velocity, transmitting signals to the central nervous system, ultimately resulting in the perception of pain.

Pain is often a response to acute inflammatory processes, which can be triggered by a range of factors such as trauma, dental caries, or infection. These factors lead to altered pulpal blood flow, affecting sensory nerve activity and initiating pain responses^{10,11}.

Patients undergoing endodontic treatment may experience several types of pain. Acute pain is characterised by sharp, intense, stabbing sensations that are easily localised. This type of pain is typically mediated by A-delta myelinated fibres, that are faster at conducting velocity. On the other hand, chronic pain persists for an extended period and can be associated with persistent inflammation, pulp damage, or infection. It is primarily stimulated by C unmyelinated fibres, which have slower conducting velocity¹². Additionally, patients may experience sensations of pressure or discomfort due to prolonged mouth opening during the procedure⁶.

While as multiple factors contribute to the perception of pain in patients undergoing endodontic treatment, anxiety and fear are known to amplify pain responses, making the overall experience more challenging for patients¹³. Patients with higher levels of anxiety tend to report more pain during dental procedures, including the root canal treatment procedure. Individual factors such as pain threshold, tolerance, and previous experiences can also influence this perception¹⁴, together with what others have told the patient of their own experiences.

It is important to note that dental pain has the potential to induce anxiety, which, in turn, can lead to the development of dental phobia¹⁵. Dental phobia can have long-lasting effects on an individual's willingness to seek dental care in the future¹⁶. Recognising the relationship between pain, anxiety, and dental phobia is crucial in providing appropriate care and ensuring patient comfort during endodontic treatment.

II. Reasons for pain in endodontic treatment

A. Preoperative factors

The perception of pain before endodontic treatment can be influenced by specific pre-existing conditions and patient characteristics. For example, the temporomandibular joint is what connects the mandible (jawbone) to the temporal bone of the skull, and those individuals who have a history of chronic pain conditions, such as temporomandibular disorders (TMD); the most common non-endodontic cause of pain prior to endodontic treatment¹⁷, may enhance increased

sensitivity to pain and demonstrate heightened pain responses during endodontic procedures¹⁸. Additionally, systemic conditions like diabetes or other systemic diseases can also impact pain perception and the healing process, by having a direct impact on the micromolecular level mechanism of tissue repair, therefore preventing, delaying, or impairing tissue ability for healing¹⁹.

Dental anxiety and fear play significant roles in shaping the experience of pain during endodontic treatment. Dental anxiety refers to the apprehension and fear experienced by individuals when faced with dental procedures, particularly those involving root canal treatment²⁰. Factors such as fear of pain, phobia of injections, or negative past dental experiences can contribute to elevated levels of anxiety in patients postoperatively.

B. Intraoperative factors

Pain during endodontic treatment can stem from the occurrence of inflammation within the pulpal and surrounding tissues due to mechanical manipulation, such as instrumentation or chemical stimulation via irrigation. It initiates a cascade of events that generate stimulus signals. This inflammation is associated with the release of inflammatory mediators, such as bradykinin, histamine, cytokines, and prostaglandins, which are chemical substances that facilitate communication between cells and tissues. These inflammatory mediators sensitise the surrounding nerve endings, known as nociceptors, which are specialised receptors leading to the transmission of pain signals through the peripheral nerves to the spinal cord and eventually to the brain^{11,21}. Nerve endings within the dental pulp are highly sensitive to various stimuli encountered during endodontic treatment, such as pressure, heat, cold, and the presence of irritants^{22,23}. The presence of bacterial infection or breakdown of pulp tissue can further activate these nerve fibres initiating acute pain sensations during the procedure²¹.

Additionally, technique-related factors can impact the pain experience during the treatment. Factors such as inadequate and insufficient anaesthesia leading to incomplete pain control, excessive canal preparation or rough filing causing tissue damage and irritating the nerve endings, contributing to pain generation due to delayed healing²⁴, and irrigant extrusion can increase the likelihood of pain and discomfort for patients.

C. Postoperative factors

While the primary goal of root canal treatment is to address the underlying cause of pain and infection, there is a possibility of experiencing flare-ups and increased pain postoperatively. In a study conducted by Pak and White (2011)⁶, a subset of the examined studies (4 out of 12) reported that the immediate postoperative pain levels were slightly elevated compared to the preoperative pain levels.

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In general, these factors can be categorised as microbial, mechanical, and chemical factors²⁵. Postoperative complications arise from the irritation severity of the periapical area lesions, which may include inflammation, swelling, and infections²⁶. Naoum and Chandler (2002)²⁷; Siqueira and Barnett (2004)²⁸; Gondim et al. (2010)²⁹ discussed the various microbial factors that can lead to flare-ups, and it was summarised down to endodontic treatments technique, including inadequate irrigation, carious tissue removal or the use of intra appointment medicaments.

Inflammation can occur as a result of the body's natural healing response to the treatment procedure. Swelling, particularly in cases of periapical abscess or extensive tissue manipulation that can lead to substances extruded past the apex^{6,30}, can also contribute to postoperative pain. Additionally, persistent, or secondary infections, can lead to prolonged delayed healing and in turn result in pain^{6,31}.

The process of administering the local anaesthetic pre and during treatment can cause minor trauma or irritation to the surrounding tissues. Additionally, pressure or gingival trauma from a rubber dam clamp, which is used to isolate the tooth during the procedure, and together with prolonged opening of the tooth during the treatment itself can cause some discomfort or sensitivity. It's important to note that these temporary increases in pain postoperatively are usually short-lived and are outweighed by the overall reduction in pain severity achieved by endodontic treatment⁶.

Some authors studied the impact of different types of intracanal medicaments, irrigation solution strengths and combinations can have postoperatively. Fedorowicz et al. (2012)³² concluded there was no influence on postoperative pain with the use of 5.25% Sodium Hypochlorite (NaOCl), 5.25% NaOCl combined with 3% hydrogen peroxide and 5% of NaOCl used alone or in combination with proteolytic enzyme. Onay et al. (2015)³³ concluded the same with their finding when using NaOCl, Chlorhexidine (CHX), Ethylenediaminetetraacetic acid EDTA solely or in combination. However, Bashetty and Hegde (2010)³⁴ found that 5.25% NaOCl had higher incidence of pain when compared to 2% CHX, Farzaneh et al. (2018)³⁵ concluded that 5.25% NaOCl showed better tolerance than the lower concentration of NaOCl, and Mostafa et al. (2020)³⁶ findings agreed. The idea was that these solutions can initiate some inflammatory response should they reach the periapical tissue surrounding the tooth²⁵.

Interestingly, Aoun et al. (2019)³⁷, highlighted strong association between presence of pain before endodontic treatment and the occurrence after. These findings aligned with what Shresha et al. (2018)³⁸ and Vieyra et al. (2019)³⁹ found.

III. Clinical management of pain in endodontic treatment.

A. Preoperative factors

Patient education and communication are essential components in managing pain expectations and promoting a sense of control and understanding. Providing comprehensive information about the treatment process, potential sensations, and expected outcomes can help patients feel more informed and prepared^{14,40}. By addressing patients' concerns and answering their questions, dental professionals can alleviate anxiety and establish realistic pain expectations. Educating patients about postoperative care instructions and potential discomforts can also contribute to improved pain management during the recovery phase.

The use of local anaesthesia is a cornerstone in minimising pain during endodontic procedures. Local anaesthesia blocks the transmission of pain signals by temporarily numbing the nerve endings in the treatment area⁴¹. It allows for a comfortable and almost pain-free procedure by preventing the activation of nociceptors. Proper administration and technique in delivering local anaesthesia are crucial to ensuring adequate pain control.

Efficacy of local anaesthetics can also have a significant role during treatment. It is thought that mandibular teeth are related to higher incidence of not achieving adequate anaesthesia since mandibular arch exhibits thicker cortical bone in the molar region⁴². Keiser and Hargreaves (2002)⁴³ and Walton (2002)⁴⁴ both supported the use of long-acting anaesthetic to prolong the duration of anaesthesia consequently reducing pain. Therefore, dental professionals should be conscious and consider factors such as the type of anaesthetic agent, dosage, and injection site to achieve effective anaesthesia and enhance patient comfort.

B. Intraoperative factors

The use of appropriate techniques and instruments is essential in minimising pain during endodontic procedures. The selection of instruments with optimal design, such as rotary systems files, can contribute to efficient and less traumatic root canal preparation^{45,46,47}. Proper technique, including gentle and controlled instrumentation, can reduce the likelihood of periapical tissue irritation and postoperative pain.

The decision regarding the number of treatment visits in endodontics should be made on evaluation of the tooth's clinical status and patient factors. However, advancements in techniques and technologies have both provided the opportunity to perform single visit treatment⁴⁸. Literature reviews have studied whether this can have some influence in causing pain. Figini et al. (2008)⁴⁹, Riaz et al. (2018)⁵⁰ and M. Nair et al. (2017)⁵¹ showed no strong correlation whether treatments conducted over a single visit more favourable than multiple visits, attributed potentially to sample size, tooth status and clinicians' technique.

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The use of Ledermix® Paste (Haupt Pharma GmbH, Wolfratshausen, Germany), a corticosteroid based, as an intramedicament was found to be more effective in reducing pain as opposed to the use of Calcium Hydroxide⁵². However, there have been critiques of the use of corticosteroids in endodontic treatment in relation to the repair and healing impairment⁵³ and its use in children⁵⁴.

C. Postoperative factors

Prescribing appropriate analgesics is crucial in postoperative pain management after endodontic treatment. Non-steroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen, are commonly prescribed, where appropriate, to reduce pain and reduce inflammation⁵⁵. These medications inhibit the production of inflammatory mediators, thereby providing relief from pain and discomfort. In cases of severe pain, opioids may be prescribed for a short duration, although caution should be exercised due to their potential side effects and risk of dependency⁵⁶. The choice of analgesic should be based on the severity of pain, patient medical history, and individual response.

In addition to analgesics, the use of antibiotics and anti-inflammatory drugs can contribute to reducing postoperative pain and promoting healing. Antibiotics are only prescribed when there is evidence of infection or risk factors for its development⁵⁷. They help control bacterial growth and prevent the spread of infection, which can be a source of postoperative pain. Anti-inflammatory drugs, such as corticosteroids, may be considered in specific cases where significant inflammation is anticipated⁵⁸. These drugs can help reduce swelling and pain by suppressing the immune response. However, their use should be judicious and based on individual patient needs and considerations.

Patient follow-up and monitoring are essential components of postoperative care in pain management.

CONCLUSION

In conclusion, it is evident that there are often negative connotations and experiences of pain associated with endodontic treatment. The discussion has shed light on several key factors that contribute to pain during endodontic procedures, emphasising the multifactorial nature of this phenomenon. Despite the remarkable advancements in the field of endodontics, pain management remains a significant concern.

To alleviate pain and enhance patient satisfaction, it is crucial to adopt comprehensive clinical management strategies throughout the entire treatment process, including the pre, intra, and postoperative phases.

A thorough assessment of the patient's medical history, dental condition, and pain experience is essential. This allows dental professionals to identify any potential risk factors for increased pain and tailor the treatment accordingly. Effective communication with patients regarding the procedure, its

expected outcomes, and potential discomfort helps manage their overall expectations and reduce or eliminate anxiety.

Furthermore, it is crucial for dental professionals to stay updated with the latest advancements and techniques in endodontics. Continuous professional development enables them to implement the most effective pain management strategies and optimise patient care.

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Conflicts of interest

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Compliance with ethical principles

Ethical approval is not required for review types of studies

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