

REVIEW ARTICLE

Pain Management in Endodontics

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ABSTRACT

Management of dental pain during and after endodontic treatment remains a big challenge. Dental anxiety can also influence the patient's perception of pain and is known to directly lower the pain threshold. Psychological intervention in acute dental pain may be a very effective noninvasive measure to reduce pain. However, the pulp that has been diagnosed with irreversible pulpitis, with spontaneous, moderate-to-severe pain may not respond to the local anesthetic (LA) enough for the operator to pursue a painless treatment. In this review, pain predisposing factors and pain prevention techniques are evaluated, and various strategies to overcome anesthetic failures are reviewed which will help the practitioner achieve effective pain management.

Keywords: Anesthesia, Irreversible pulpitis, Pain, Root canal, Success.

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INTRODUCTION

Pain has been described as an unpleasant sensation ranging from mild discomfort to agonizing distress which may be associated with real or potential damage to tissue. It is a complex multidimensional and biopsychosocial event, which has individual objective and subjective events, making the perception of pain very different between individuals.¹ Dental pain is one of the main reasons for a patient to visit an endodontist. Management of dental pain with anxiety during and after treatment remains a big challenge. Pain associated with endodontic treatment has always been overestimated. Although endodontic treatment is generally perceived to be painful, a 2008 AAE consumer awareness survey found that patients who have experienced root canal treatment are 6 times more likely to describe it as "painless" than patients who have not had root canal treatment.

PAIN AND ENDODONTIC TREATMENT

Pain in dental therapy may be associated with the procedure as well as with posttreatment pain. Many patients become anxious during root canal treatment as a result of the pain they expect to endure. This anxiety, together with the effects of inflammation, decreases their pain threshold and diminishes the effect of local anesthesia.² Fear of pain during endodontic treatment is usually associated with the procedure itself, not the posttreatment pain. However, the pulp that has been diagnosed with irreversible pulpitis, with spontaneous, moderate-to-severe pain may not respond to the local anesthetic (LA) enough for the operator to pursue a painless treatment. Such a condition is often referred as a "hot tooth," which requires additional strategies to ensure a painless treatment.

PAIN PREVENTIVE STRATEGIES

Pain preventive strategies should be based on a preemptive approach using appropriate local anesthesia, preemptive analgesia, anxiety reduction techniques, and clinical strategies. Successful anesthesia remains a cornerstone for painless endodontic treatment. It will not only keep the patient comfortable but will also allow the operator to perform the procedure at ease. Obtaining complete anesthesia, especially in mandibular posterior teeth with irreversible pulpitis, is much more difficult when compared to teeth with normal uninfamed pulp.³⁻⁵

PREDISPOSING FACTORS FOR PAIN

There are various factors which are known to predispose a patient to pain despite apparently adequate anesthesia. These factors include genetics, psychological state, ethnicity, gender, age, and environment.

Genetics and Gender

Genetics may play a role in predisposing some patients to a variety of complications, including pain, poor healing, and abscess formation. A variety of genetic polymorphisms clearly influence pain perception and behavior in response to pain. There is growing evidence indicating that there are substantial gender differences in experimental and clinical pain responses for women and men. Women are at a substantially greater risk for many clinical pain conditions and numerous reasons for these findings have been given, including hormonal

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and genetically driven sex differences in brain neurochemistry.⁶

Dental Anxiety

Dental anxiety can influence the patient's perception of pain and is known to directly lower the pain threshold. This is a vicious cycle that should be recognized and addressed. It has a physiologic, a cognitive, and a behavioral component. Patients with a high level of anxiety and chronic facial pain may alter patient's pain during endodontic therapy.⁶ An anxious person might get a strong fear reaction when he is reminded of the dental appointment, and just thinking about visiting a dental clinic may feel overwhelming. The prevalence of dental anxiety has been reported to be between 4 and 40%.⁶⁻⁸ Dental anxiety is more common among women than men; the ratio may be as much as 2:1.⁸ A good patient–dentist relationship is mandatory in order to treat an anxious patient. In 1983 Friedman and colleagues described what they called an "iatrosedative technique," a systematic approach aimed at "making the patient calm by the dentist's behavior, attitude, and communicative stance." The steps a dentist can use to achieve this include making effort to avoid pain, a sense of giving the patient full control, and keeping the patient informed of what the dentist is planning to do, and what sensations the patient may experience. Such steps taken can reduce the pain perception in anxious patients.⁹

Preoperative Pain

The amount of preoperative pain can affect the anesthetic success in patients with symptomatic irreversible pulpitis.^{10,11} A possible explanation for the decrease in success rate of inflamed pulp might be the activation of nociceptors during inflammation. The barrage of painful stimuli, along with tissue damage, alters and modulates the peripheral and the central pain pathways. Another explanation for failure is that nerves from inflamed tissue have altered resting potentials and lowered excitability thresholds. Wallace et al¹¹ demonstrated that LA were not sufficient to prevent impulse transmission due to these lowered excitability thresholds.

Previous Difficulty with Anesthesia

It has been reported that patients who had previous difficulty with anesthesia are likely to experience unsuccessful anesthesia.¹² These patients will usually mention "I always require additional injections to get my teeth numbed." These patients can be identified by simply asking whether they have had prior difficulty getting numbness. If they have had these experiences, operator should immediately plan a supplementary anesthesia over and above the primary anesthesia.

PSYCHOLOGICAL MANAGEMENT OF PAIN

The common psychological issues which predispose to pain include dental anxiety, fear of pain, expectation and anticipation of pain, past negative dental experience, attitudes toward the dentist, and attitudes toward the provision of dental care itself. Psychological intervention in acute dental pain is a very effective noninvasive measure to reduce pain induced by the psychological factors mentioned above. Various psychological interventions can be in the form of distraction strategies, sensory information, perceived control, or positive dental experience.¹³ Distraction strategies can be in the form of visually interesting stimulus, music, etc., while sensory information about the procedure and typical sensations to be expected, such as a rotor noise can be explained before the start of the procedure. Perceived control gives an impression to the patient that they have control over the dentist's actions and can stop the operator by arm-raising which is a pause signal. Providing a positive dental experience by discussing about benefits of introduction to the management by the dentist can also boost the confidence on the dentist and thereby a better cooperation.

In an investigation on the effect of different psychological management techniques for anxiety and pain during dental treatment, Wardle concluded that providing sensation information was the most effective technique.¹⁴ In a study by Logan et al, sensory and procedural information reduced pain experience in patients undergoing endodontic treatment.¹⁵ According to Morosko and Simmons on a study on dental students randomly selected from a group of volunteers, audio-analgesia (music and "white noise") raised the pain detection and tolerance thresholds.¹⁶ Overall, various studies have provided conclusive evidence that patients with acute dental pain does benefit from psychological intervention.

PREMEDICATION

Tetrodotoxin-resistant sodium channels may be increased in inflamed pulps and may be resistant to LA. Inflamed pulps also have significantly increased the amount of prostaglandins which can affect tetrodotoxin-resistant receptors and decrease nerve responses to anesthetic agents.⁶ Therefore, using nonsteroidal antiinflammatory drugs (NSAIDs) and corticosteroids as premedications to improve success of anesthesia seems to be an effective step. But, the results of such studies do not provide an agreement regarding the efficacy of premedication on the success of anesthesia.^{3,17,18} However, pretreatment with some types of NSAIDs may have a positive influence on the success of anesthesia when treating irreversible pulpitis, provided that the patient had no spontaneous

pain.¹⁹ Corticosteroid as premedication prior to anesthesia with an inferior alveolar nerve block (IANB) injection showed a significantly higher success rate.²⁰ A study on premedication with alprazolam did not improve the success of the IANB.²¹

TOPICAL ANESTHESIA

Though local anesthesia is a fundamental method of pain control during dental treatment, the pain that accompanies the process of local anesthesia itself frequently causes fear of dental treatment. Though needle insertion can induce a small degree of pain, pain induced during agent injection is higher. Studies have shown contradicting results on the effectiveness of topical anesthetics on reducing pain of injection.^{22,23} According to Walton, the most important aspect of topical anesthesia is not primarily the decrease in mucosal sensitivity but rather the demonstrated concern that everything possible is undertaken to decrease the pain during treatment. A two-minute application of topical anesthetic was found to be effective to reduce the pain of insertion but does not diminish pain from the actual deposition of the anesthetic solution.²⁴

A modification of topical anesthetic is vibratory device aimed at easing the fear of the needle based on the gate control theory of pain management. The theory suggests that pain can be decreased by simultaneous activation of nerve through vibration.²⁵ However, Inui et al have shown that pain reduction due to vibration or non-noxious touch can result from tactile-induced pain inhibition within the cerebral cortex and that the inhibition occurs without any contribution at the spinal level, including descending inhibitory actions on spinal neurons.²⁶ Application of such devices has shown mixed results about the efficacy of the technique.^{27,28}

Apart from the vibratory devices, in a review on the efficacy of different nonpharmacological techniques by Davoudi et al, various techniques, such as cooling the tissue prior to injection, warming the anesthetic solution, buffered LA, computer-aided slow injection devices have been discussed.²⁹ Similar to vibration, cooling the tissue also acts by gate control theory, which claims that applying cold provides a concurrent stimulus and thereby decreases the neural transmission of the unmyelinated nerve fibers. Studies on palatal injection showed that prior palatal cooling is efficient in relieving pain perception. Similarly, warmed local anesthesia would accelerate the onset of sensory block by increasing the passive diffusion across non-neural structures.³⁰ Regarding buffered LA, though various studies have shown decreased injection pain with buffered lignocaine,^{31,32} there were other studies contradicting the claim.^{33,34}

COMPUTER CONTROLLED LOCAL ANESTHETIC DELIVERY SYSTEMS

Computer controlled local anesthetic delivery (CCLAD) systems which were designed for the controlled delivery of local anesthesia have shown efficacy in reducing the pain of LA injections.³⁵ It has two rates of injection, a fast rate (1.4 mL/min) and a slow rate (1.4 mL/4 minutes 45 seconds). The slow rate is used for intraligamentary injection.

Various other steps that can reduce the pain of injection have been studied, which includes type of anesthetic solution, size of needle, speed of injection, etc. Local anesthetics have different pH values and it is thought that lower pH might cause a burning sensation during injection due to the acidic nature of the anesthetic solution. Similarly, the effect of volume on success has also shown contradicting results.³⁶⁻³⁸ The LA solution can also differ in injection pain especially in the presence of vasoconstrictor. Though the presence of vasoconstrictor have shown increase in pain the concentration has not.^{39,40}

It has been shown that the size of the needle (#25 or #27 gauge needles) has no significant effect on pain during IANB, buccal, or palatal injections.⁴¹ It was assumed that a faster injection may expose a longer section of a nerve to the anesthetic solution and there may be a higher rate success of local anesthesia. However, recent studies have shown that it can only induce more pain but has no significant difference on IANB and incisive/mental nerve block success rate.⁴²

COMPARISON BETWEEN DIFFERENT ANESTHETIC SOLUTIONS

Many studies have been done to compare lignocaine and articaine which were evaluated in a recent systematic review and meta-analysis by Kung et al. They concluded that there was no advantage for articaine over lignocaine when used for a mandibular block or maxillary infiltration. However, they also reported that articaine was significantly better than lignocaine when used as a supplementary infiltration after mandibular block anesthesia.⁴³ A study was done to compare different anesthetic solutions on mandibular molar pulpal anesthesia after primary buccal infiltration. Success rate for 4% articaine was 55%, 33% for the 4% lignocaine, and 32% for 4% prilocaine formulation. The highest was with 4% articaine, but 55% success rate was not deemed to be high enough to justify this technique.⁴⁴

OVERCOMING ANESTHETIC FAILURE

Local anesthetic failure is an unavoidable aspect of dental practice. The most common failures were IANBs. The causes of anesthetic failure can be operator dependent

or patient dependent.⁴⁵ From the operator point of view, the first consideration would be to increase the volume of local anesthesia which was already discussed. Next plan would be to change the LA solution but studies do not show superiority of one over the other. By far, lignocaine seems to be the most acceptable choice. Another consideration is the technique and the best way to achieve success with the IANB is to use the direct technique. The common causes of failure are injecting without touching the bone or touching bone too soon. Though Gow-Gates and Vazirani-Akinosi techniques have been tried as an alternative, they have not been proved to be superior.⁴⁶

Among patient-dependent factors, accessory nerve supply is a factor which can lead to failure of anesthesia following both IANB and infiltration. For maxillary molar an accessory innervation from greater palatine can be countered by a palatal block or infiltration. And articaine buccal infiltration has shown to be successful compared to lignocaine buccal infiltration for maxillary molar and similarly for mandibular molar as a sole buccal infiltration.⁴⁷⁻⁴⁹ Similarly for IANB, failure from accessory innervation could be due to long buccal nerve, lingual nerve, or mylohyoid nerve which may require an additional infiltration for these nerves. Inflammation in the region of infiltration is also an important factor for failure because of the change in tissue pH. An increase in the volume could be considered to counter the nullifying effect.⁴⁵ Another patient factor of patient's anxiety has been already discussed. A failure beyond these steps can be managed only through supplementary anesthesia. According to a review by Meechan, 1.5 mL of conventional inferior alveolar and lingual block with lignocaine and adrenaline, followed by 0.2 mL of long buccal nerve block with remainder of cartridge would be a good protocol to follow. A failure after the primary infiltration or block can be overcome by supplementary injection techniques.⁴⁵

Intraligamentary Anesthesia

Local anesthetic solution injected through the periodontal ligament to reach the pulpal nerve supply is termed as intraligamentary anesthesia. Essentially, it is also a form of intraosseus anesthesia. It is recommended that the site of penetration is swabbed with an antiseptic solution prior to the injection. Conventional or specialized syringes may be used but it does not affect the efficacy of anesthesia. The needle is inserted as deep as possible between the root surface and alveolar bone at a 30° angle to the long axis of the tooth at the mesiobuccal aspect. The needle can be inserted with the bevel facing either way and then 0.2 mL of the solution per root should be injected with back-pressure and the needle is maintained in position for about 5 to 10 seconds.⁴⁹ The onset of action is immediate and it generally lasts for about 15 minutes.⁵⁰

Intraosseous Anesthesia

It is more invasive than intraligamentary and needs a specialized equipment, the perforator (e.g., Stabident, X-Tip). The site is in the attached gingiva and usually distal to the root except in the case of second molars where it is mesial. Initially, the gingiva needs to be anesthetized for a painless penetration of the perforator. The perforator is attached to a slow-speed handpiece and advanced through the anesthetized gingiva and bone until the cancellous bone is felt as a sudden dip. The perforator is then removed, and the short 27 gauge needle is inserted through the perforation and around 1 mL solution is injected over a period of 2 minutes. It is one of the most effective supplementary techniques. The onset of intraosseous anesthesia is rapid and it lasts for about 15 to 30 minutes. Both intraligamentary and intraosseus anesthesia should be used with caution in cardiac patients.⁵⁰

Buccal Infiltration

Buccal infiltration (BI) has been used as a supplementary anesthesia for anesthetizing mandibular molar teeth after a failed IANB. Articaine had been especially effective as supplementary or even as a primary BI technique because of its greater bone diffusion compared with lignocaine.^{47,49} A BI of Ketorolac is known to increase the success rate of anesthesia after IANB and BI with articaine in patients with acute irreversible pulpitis.⁵¹

Intrapulpal Injection

Despite the primary injection followed by abovementioned supplementary techniques, approximately 10% of the teeth may not get anesthetized. In such a situation the intrapulpal injection technique should be considered as the last resort as it is invariably a painful technique. Therefore, the patient should be informed of the momentary pain expected during the injection. To perform this technique, an opening into the pulp should be made with a small round bur to enable snug fit of the needle. The anesthetic solution should be injected into the pulp with back-pressure. A back-pressure generally ensures a successful anesthesia but a separate intraradicular injection may be required in multi-rooted teeth.⁵⁰

TIPS FOR EFFECTIVE PAIN MANAGEMENT

- The patients should be free of any anxiety before starting the treatment. Operator should spend sufficient time with the patients explaining the treatment and ensure that all possible steps will be taken to make the treatment painless.

- Anxious patients should be given special care by making sure that no action will take them by surprise which will ensure that patient gets confidence in the operator. Placebo steps can also be undertaken to gain confidence of an anxious patient.
- Patient should always know the amount of pain expected in a procedure. Under-informing the pain induced especially in procedures, such as intrapulpal injection more often has a negative effect.
- Topical anesthesia should always be used (even for IANB as it can act as a placebo) and injection should be given only after 2 minutes after application. Similarly, a waiting period of 10 minutes for infiltration and 15 minutes for IANB should be given before starting the endodontic procedure.
- Infiltration or block anesthesia should be given slowly (1 mL in 1 minute). Operator should ensure the facial muscles are relaxed during injection.
- If the patient gives a history of poor response to LA, longer wait period should be considered and supplementary route should be employed. At no instance patients should be convinced to put up with the pain.
- At the end of the treatment if patient complains of pain, an additional dose of LA should be given as any analgesic will take at least 30 minutes to take effect.

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