

Hot Tooth - A Challenge to Endodontists

Somya Sahu¹, Pooja Kabra², Ekta Choudhary³

Department of Conservative Dentistry and Endodontics, School of Dental Sciences, Sharda University, Greater Noida, Uttar Pradesh, India

Abstract: *The successful management of pain has been one of the keystones of endodontic practice and dentistry worldwide since old time. Achieving profound pulpal anesthesia not only helping hand to patients overcome their fears and irritations towards dentistry but also supports the dentists who will be less worrying about the patient's reaction. But, achieving satisfactory anesthesia in patients with a hot tooth, which is a tooth with irreversible pulpitis, can be a problem. This article describes the hot tooth, causes for anesthetic failure and some of its management techniques.*

Keywords: hot tooth; Anesthesia; supplemental injection; irreversible pulpitis

1. Introduction

Although local anesthetics are very useful in producing anesthesia in normal tissue, local anesthetics commonly fail in endodontic patients with inflamed tissue [1]. For instance, the inferior alveolar nerve (IAN) block is associated with a lapse rate of 15% in patients with normal tissue [2], whereas IAN fails 44-81% of the time in patients with irreversible pulpitis[3]. Similarly, it has been reported that the lapse rate of a maxillary infiltration injection is as high as 30% in teeth with irreversible pulpitis[2]. Failure to achieve anesthesia in patients with irreversible pulpitis remains a remarkable hindrance to successfully treating patients through endodontics. The successful use of local anesthesia has changed the emotional appeal of clinical dentistry from being a painful and frightful experience to being a much less painful and satisfying experience. Moreover, proper pain management results in building up faith and make possible the entire procedure. However, local anesthetics frequently fail in endodontic patients with a hot tooth [4]. The term "hot" tooth generally introduce to a pulp that has been diagnosed with irreversible pulpitis, with spontaneous, moderate-to-severe pain. A typical example of one type of hot tooth is a patient who is sitting in the waiting room, sipping on a large glass of ice water to help control the pain. In endodontic terms, hot tooth definitely does not mean a tooth of excessive attractiveness or even a tooth that is undergoing an exothermic reaction in which its temperature is well above the normal body temperature. But, it normally refers to a pulp that has been diagnosed with irreversible pulpitis (Symptomatic Irreversible Pulpitis) with spontaneous, moderate-to-severe pain [5].

2. Causes for Anaesthetic Failure in Patients With a Hot Tooth

A number of explanations have been present for this-

- 1) Conventional anesthetic techniques do not always give intense pulpal anesthesia, and patients with pre-existing hyperalgesia may be unable to bear any noxious input.[6]
- 2) Inflamed tissue has a lower pH, which bring down the amount of the base form of anesthetic that invade the nerve membrane. Consequently, smaller extent of the ionized form is available in the nerve to attain anesthesia. This explanation however does not important for the mandibular molar with pulpitis that is not easily blocked

by an inferior alveolar injection administered at some distance from the area of inflammation.[5],[6]

- 3) Another theory is that, the nerves arising from the inflamed tissue have a change resting potentials and low thresholds of excitability because of which, the prevention of transmission of nerve impulses by the anesthetic agents is delay.[6], [7],[8], [9]
- 4) Another factor might be the tetrodotoxin resistant (TTX-R) sodium channels. These channels are relatively resistant to local anesthetics,[10],[11] are sensitized by prostaglandins[12] and are more in inflamed dental pulp.[13],[14] They are four times as resistant to close up by lidocaine and their expression is doubled in the presence of prostaglandins E₂ (PGE₂).[15] The sensitization of these channels by prostaglandins propose that, rapid-acting non steroidal anti-inflammatory drugs (NSAIDs) may be useful in pretreatment to upgrade the efficacy of local anesthetics in patients with odontogenic pain.[16],[17]
- 5) Sensitization of TTX-R channels by prostaglandins also reduces the activation threshold of voltagegated sodium channels (VGSCs) and hence raised the amount of sodium ions that flow through the channel.[12],[17]
- 6) Activation of nociceptors in the occurrence of inflammation is one of the strongest theories explaining the lower efficacy of anesthesia.[18], [19] Inflammatory mediators bring down the stimulation threshold in nociceptor neurons to a level at which the small stimulators induce a severe neurogenic response (Goodis et al., 2006). This inflammatory process occurs as a result of the yield of prostaglandins (PGs) as the end point product of the metabolism of arachidonic acid through the cyclooxygenase pathway (COX). Prostaglandins (PGs) then resolving in increased sensation of pain by enhancing the sensitivity of the nerve endings to bradykinin and histamine (Dray, 1995).

How to identify hot tooth?

Most common locations of occurrence in any primary and permanent teeth:

- Sites of recent or faulty restorations
- Sites of recent traumas
- Mandibular molars are more difficult to anesthetize.
- Patients with anxiety about dental treatment or patients who have been in pain for several days usually require a more smart approach.

Table 1: Clinical signs & symptoms to identify hot tooth:

Signs	Symptoms
Deep restorations or caries	Pain when biting and in reaction to percussion test.
Coronal fracture lines	Increased sensitivity to temperature extremes.
Increase in tooth mobility	Earlier presentation: often intense, lingering pain in response to cold. Later presentation: intense pain in response to heat; relieved by cold water.
Thickening of the periodontal ligament	Pain may be impulsive and poorly localized, often radiating from ear to temple for maxillary teeth.
	Pain may wander to opposing arch but never over the midline.

3. Management of Hot Tooth

Prior to procedure for management of hot tooth certain parameters should be monitored:

1) Patient’s education:

Patient should be smart and well-known about the treatment so that he is mentally aware of procedures and the terror of unknown is excluding thus reducing anxiety.

2) Role of premedication

If required anti-inflammatory can be prescribed to be taken as 1 hour before the treatment. Providing sufficient time between anesthetic delivery and beginning of procedure.

3) Management of anxious patient:

- a) Give short morning appointments after good morning breakfast.
- b) Premedication with lorazepam 1 mg (after checking interaction with other drugs) night before sleep followed by 90 minutes before procedure.
- c) No driving & need to be accompanied with friend/relative.
- d) Extremely short in waiting area.
- e) Duration ,only as much as patient can tolerate Making sure patient feels he/she is in order.
- f) Iatrosedation: Vocal sedation- Use of sentences like “I will be careful”, Talk to them during procedure, Avoid use of words like hurt,sharp etc, Music, Aroma, Hypnosis, Acupuncture, Relaxation techniques (deep breathing, guided imagery,progressive relaxation) will be useful.

4) Before initiating access preparation a small test cavity can be made to ensure effectiveness of anesthesia.

5) Additional anesthetic or supplemental injections are necessary to achieve sound anesthesia.

Infiltration: It has shown remarkable increase in duration of pulpal anaesthesia. Other Supplemental intraligamentary or intraosseous injections are most helpful to ensure sound local anesthesia.

Intraosseous technique allows analgesic solution to be accumulated directly into the cancellous bone around the apices of the tooth. It has a fast onset and has shown intensely favorable results when used as a supplemental analgesic for the hot tooth. Special kits have been evolved

that assist drilling a small hole through the mucosa and cortical plate to allow injection of the anesthetic solution into the cancellous bone. X-Tips contain a drill to perforate the cortical plate combined with a guide sleeve. When the drill is pull away the guide sleeve is left in situ. One more system is Stabident Io delivery system.

Intraligamental are used to accumulate analgesic directly into periodontal ligament space. The needle is pushed into the mesial & distal gingival sulcus and in contact with the tooth. The needle is hold up by fingers and positioned with maximal penetration between the root and crestal alveolar bone. Pressure is steadily applied to the syringe handle for 30 seconds. Backpressure has to be progressed for this technique to work and blanching of the soft tissues would be sign of success.

Intrapulpal: Major disadvantage of the intrapulpal injection is the necessity for needle to be pushed into a very sensitive and inflamed pulp. The approach can, therefore, be painful. Additionally, the pulp has to be disclosed to give the injection and analgesic problems may have happened prior to this being achieved. The injection has to be given under sturdy backpressure. In very rare cases anatomic restrictions may be observed which should be take care of accordingly like dense bone or accessory innervation (mylohyoid nerve branch) Importantly, bupivacaine was found to be more strong than lidocaine in blocking TTXr channels and may be the anesthetic of choice when managing the "hot tooth".[6]

Intraseptal anesthesia:

Intraseptal anesthesia can be intended as a supplemental anesthesia technique for minimizing pain in endodontic treatment.

4. Procedure

A 27- gauge short needle is advised for intraseptal anesthesia. Before injection, apply topical anesthetic for about 1 minute. Area of piercing of the injection will be middle of the interdental papilla adjacent to the tooth to be treated. Slowly inject few drops of anesthetic solution as the needle gain access to soft tissue and move forward the needle till it reaches the bone. Implement pressure to the syringe and push the needle into the interdental septum and accumulate 0.2-0.4 ml of local anesthetic solution.

Factors illustrating success of intraseptal injection

- 1. Resistance to the accumulation of solution
- 2. Ischemia of soft tissue next to the injection area [20].

Table 2: Factors influencing efficiency

Anesthetic Solution	The presence of vasoconstrictor like adrenaline exhibits increased efficacy of PDL injections. The combination of lidocaine with adrenaline shows 91.6% success rate for PDL injection whereas without the vasoconstrictor the success rate shows only 42%.
Operative Procedure	The least success rate of PDL injection is for endodontic procedures and the greatest for exodontias.
Type of Tooth	It is reported that type of tooth also determines the efficiency of Intra ligamentary injection. Studies reveals that the least success for pulpal

	anesthesia with mandibular lateral incisors.
Armamentarium for Intraligamentary injection	Traditionally, PDL injections are usually given by using either standard dental anesthetic syringe or a high pressure syringe. Recently, the development of computed controlled localanesthetic delivery system (Milestone Scientific, Livingston, NJ, USA) has been found to be able to deliver a PDL injection.
Intraosseous Injection	Due to the thickness of the cortical plate in posterior mandible, infiltration injection with lidocaine solutions are not effective for posterior mandible. In such situations intraosseous injection is an alternative. The use of intra- osseous anesthesia was described by Lilienthal.
Onset of Anesthesia	Onset of anesthesia is rapid. There is no waiting time required for the onset of anesthesia.
Site of Injection	The injection is recommended to give on distal to the tooth to be anesthetized except for maxillary and mandibular second molars. For maxillary and mandibular second molar, mesial side is favoured.

Change in anesthetic solution

Commonly used anesthetic solutions which aims to provide intense anesthesia to the patient.

1.4% Articaine

Anesthetic potency of 4% articaine with 1:100,000 epinephrine exhibits higher anesthetic efficiency than using 2% lidocaine with 1:100,000 epinephrine when used as buccal infiltration [21], [22], [23], [26]. Mechanism of action is that articaine have a thiophene group, which enhances its lipid solubility. Lipid solubility decides the level of molecules penetration into the nerve membranes. Therefore, articaine spread more effectively through soft tissues than do other anesthetics, thereby causing better anesthesia [23], [24], [25].

Mandibular Buccal infiltration with articaine

Mandibular buccal infiltration with 4% articaine could be intended as a supplemental injection technique. Studies reveals that buccal infiltration of 4% articaine shows higher anesthetic efficiency as compared to 2% lidocaine solution [27], [28], [29], [30].

0.5 M Mannitol

Combination of 0.5 M mannitol and lidocaine with epinephrine in Inferior Alveolar Nerve Blocks exhibits higher anesthetic efficiency compared to lidocaine and epinephrine alone [31], [32].

5. Conclusion

Management of hot tooth in endodontics always faces problems to the clinician. One should have thorough knowledge about the supplemental anesthesia techniques and the technique to use it. Managing hot tooth with different anesthetic solution is also becoming a trend. Still studies are going on relating to this area. Due to the advancements of supplemental injection techniques and

different anesthetic solutions, managing a hot tooth condition is now no longer a challenge to the dentist.

References

- [1] Bigby J, Reader A, Nusstein J, Beck M, Weaver J. Articaine for supplemental intraosseous anesthesia in patients with irreversible pulpitis. *J Endod* 2006; 32(11): 1044-7.
- [2] Ingle JI, Bakland LK. Preparation for Endodontic Treatment. In: *Endodontics*. 5th ed, Hamilton (ON): BC Decker; 2002: 385-8.
- [3] Matthews R, Drum M, Reader A, Nusstein J, Beck M. Articaine for supplemental buccal mandibular infiltration anesthesia in patients with irreversible pulpitis when the inferior alveolar nerve block fails. *J Endod* 2009; 35(3): 343-6.
- [4] Laura Minea, Diane Ricci, Maryam Safaei, Mukarram Khan, Melissa Dent, Sean Tjandra. What is the best approach to achieve anesthesia of a hot tooth? An Evidence Based Report.
- [5] Nusstein JM, Reader A, Drum M. Local anesthesia strategies for the patient with a „hot“ tooth. *Dent Clin North Am* 2010; 54:237–47.
- [6] W.B. Saunders, Philadelphia, . Carr GB: Ch. 20, Local anesthesia in endodontics. In Cohen
- [7] S, Burns RC, editors: *Pathways of the Pulp*, 10th ed., Mosby, St. Louis, pp 696-713 10.
- [8] Wallace J, Michanowicz A, Mundell R, et al. A pilot study of the clinical problem of regionally anesthetizing the pulp of an acutely inflamed mandibular molar. *Oral Surg Oral Med Oral Pathol* 1985;59:517-21.
- [9] Byers M, Taylor P, Khayat B, et al. Effects of injury and inflammation on pulpal and periapical nerves. *J Endod* 1990;16:78-84 12.
- [10] Modaresi J, Dianat O, Soluti A. Effect of pulp inflammation on nerve impulse quality with or without anesthesia. *J Endod* 2008;34:438-41.
- [11] Thangavel Boopathi, Mathew sabeena, Kailasam sivakumar, Jaya kodiharikaran, Kumaravadivel karthick, Aruna Raj. Supplemental pulpal anesthesia for mandibular teeth. *Journal of Pharmacy and Bioallied Sciences*. 2013;5(Supplement 1).
- [12] Reemers T, Glickman G, Spears R, He J: The efficacy of the IntraFlow intraosseous injection as a primary anesthesia technique. *J Endod* 34:280, 2008.
- [13] Gold M, Reichling D, Shuster M, J L: Hyperalgesic agents increase a tetrodotoxin-resistant Na⁺-current in nociceptors. *Proc Natl Acad Sci U S A* 93:1108, 1996.
- [14] Warren CA, Mok L, Gordon S, Fouad AF, Gold MS: Quantification of neural protein in extirpated tooth pulp. *J Endod* 34:7, 2008.
- [15] Wells JE, Bingham V, Rowland KC, Hatton J: Expression of Nav1.9 channels in human dental pulp and trigeminal ganglion. *J Endod* 33:1172, 2007.
- [16] Ianiro SR ,Jeansonne BG ,McNeal SF ,Eleazer PD. Effect of preoperative acetaminophen or a combination of acetaminophen and ibuprofen on the success of inferior alveolar nerve block for teeth with irreversible pulpitis. *J Endod* 2007; 33:11-4.
- [17] Jena A, Shashirekha G. Effect of preoperative medications on the efficacy of inferior alveolar nerve

- block in patients with irreversible pulpitis: A placebo-controlled clinical study. *J Conserv Dent* 2013;16:171-4.
- [18] Modaresi J, Dianat O, Mozayeni MA: The efficacy comparison of ibuprofen, acetaminophencodine, and placebo premedication therapy on the depth of anesthesia during treatment of inflamed teeth. *Oral Surg Oral Med Oral Pathol* 102:399, 2006.
- [19] Sorensen H, Skidmore L, Rzasa D, et al. Comparison of pulpal sodium channel density in normal teeth to diseased teeth with severe spontaneous pain. *J Endod* 2004;30:287-49.
- [20] Stanley F Malamed. *Handbook of Local Anesthesia*. Sixth Edition
- [21] Vivek Aggarwal, Mamta Singla, Abbas Rizvi, Sanjay Miglani. Comparative evaluation of local infiltration of articaine, articaine plus ketorolac, and dexamethasone on anesthetic efficacy of inferior alveolar nerve block with lidocaine in patients with irreversible pulpitis. *Journal of Endodontics*. 2011;37(4).
- [22] Evans G, Nusstein J, Drum M, Reader Al, Beck M. A prospective, randomized, double blind comparison of articaine and lidocaine for maxillary infiltrations. *J Endod*. 2008;34:389-391.
- [23] Deepashri H, Kambalimath RS, Dolas HV. Kambalimath, Agrawal SM. Efficacy of 4% Articaine and 2% Lidocaine: A Clinical Study-*Journal of Maxillofacial and Oral Surgery*. 2013;12,(1):3-10.
- [24] Oertel R, Rahn R, Kirch W. Clinical pharmacokinetics of articaine. *Clin pharmacokinet*. 1997;33:417-25.
- [25] Raymond SA, Steffenson SE, Gugino LD, Strichartz GR. The role of length of nerve expose to local anesthetics in impulse blocking action. *Anesth Analg*. 1989;68:563-70.
- [26] Kanaa M, Whitworth J, Corbett I, et al. Articaine buccal infiltration enhances the effectiveness of lidocaine inferior alveolar nerve block. *Int Endod J*. 2009;42(3):238-46.
- [27] Douglas Robertson, John Nusstein, Mike Beck, Melissa McCartney. Anesthetic efficacy of articaine in buccal infiltration of mandibular posterior teeth. *JADA*. 2007:138;
- [28] Kanaa MD, Whitworth JM, Corbett IP, Meechan JG. Articaine buccal infiltration enhances the effectiveness of lidocaine Inferior Alveolar Nerve Block. *IEJ*. 2009;42;(3):238-246.
- [29] Rachel Mathews, Melissa Drum, Al Reader, John Nusstein, Mike Beck. Articaine for supplemental buccal mandibular infiltration anesthesia in patients with irreversible pulpitis when Inferior Alveolar Nerve Block fails. *JOE*. 2009;35(3):343-346.
- [30] Mohammed Dib Kanaa, John Martin Whitworth, Ian Porter Corbett, John Gerard Meechan-Articaine and lidocaine mandibular buccal infiltration Anesthesia: A Prospective randomized double-blind cross over study. *JOE*. 2006;32(4)296-298.
- [31] Ronald Wolf, Al Reader, Mike Bek. Anesthetic efficacy of combination of 0.5 M mannitol and lidocaine with epinephrine in IANB: A prospective randomized – single blind study. *Anesthetprog* Winter. 2011;58(4):157-165.
- [32] Steven Smith, Al Reader, Melissa Drum. John Nusstein, Mike Beck. Anesthetic efficacy of combination of 0.5 M mannitol plus 127.2 mg of lidocaine with 50 µg Epinephrine in IANB: A prospective randomized , single-blinded study. *Anesthesia Progress: Spring*. 2013;60(1):3-10.