

Local anesthesia in endodontics

Paul A. Rosenberg¹

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Abstract Complete pulpal anesthesia is critical during endodontic treatment. The clinical goal is for patients to have a pain-free endodontic experience. Despite clinical signs indicating complete local anesthesia, patients may still experience pain. This clinical challenge often requires the use of supplemental injections. This review describes the indications, limitations, and advantages of each type of supplemental injection, thus serving as a useful clinician's guide to management of the patient with incomplete anesthesia.

Keywords Profound local anesthesia · Supplemental injection · Duration

Quick reference/description

Profound local anesthesia is required to prevent pain during endodontic treatment of teeth with vital pulps. It is especially challenging to anesthetize mandibular posterior teeth with a history of pain and a diagnosis of irreversible pulpitis [1]. Incomplete anesthesia results in pain and increases the patient's anxiety, with a concomitant drop in their pain threshold. Procedures should be initiated only after profound anesthesia is achieved.

Overview

A variety of supplemental injections are available for use by the clinician. The clinical situation and the clinician's experience dictate the selection of the supplemental injection. Supplemental injections are most often required during the

✉ Paul A. Rosenberg
par1@nyu.edu

¹ New York University, New York, NY, USA

treatment of mandibular molars with symptomatic irreversible pulpitis. A supplemental injection of local anesthetic may also be useful if the duration of a maxillary infiltration is insufficient to complete the procedure (Table 1).

Procedure

A profoundly numb lip is an inadequate indicator of complete pulpal anesthesia. Use of a cold test following an inferior alveolar nerve block (IANB) and a numb lip substantially increases the likelihood of a pain-free experience for the patient. If the patient experiences pain from the cold test despite a numb lip, it is an indication that a supplemental injection of anesthetic is required. When lip numbness does not occur following an IANB, it is an indication that another IANB is required. If there are no lip symptoms following the IANB, repeat the IANB.

Please note that the duration of anesthesia using an IANB with 1.8 ml of 2% lidocaine with 1:100,000 epinephrine is approximately 80–90 min and for 4% articaine with 1:200,000 epinephrine is approximately 120 min and should be sufficient to completely remove the pulp [2]. An absence of back pressure often leads to failure of the injection.

Supplemental injections provide a shorter working time and may have to be repeated. Caution must be taken with repeated injections when epinephrine is used, especially if patients have a significant medical history.

Supplemental injections are often required, especially after the use of an IANB for mandibular posterior teeth with symptomatic irreversible pulpitis.

Buccal infiltration

It has been found that neither a buccal infiltration of 2% lidocaine with 1:80,000 epinephrine nor articaine following a failed IANB is reliable in patients presenting with irreversible pulpitis. An intraosseous injection is a more predictable procedure. However, in asymptomatic teeth, a buccal infiltration of one cartridge of 4% articaine with 1:100,00 epinephrine following an IANB was successful 88% of the time.

Intraligamental (PDL) injection

In intraligamentary injection, anesthetic solution is forced through the cribriform plate into the marrow spaces around the tooth.

As the primary route is not through the periodontal ligament, the injection may be considered a type of intraosseous injection rather than a pressure injection (Fig. 1).

Intraosseous injection

The intraosseous injection delivers a local anesthetic solution directly into the cancellous bone adjacent to the tooth to be anesthetized.

Table 1 Types of supplemental injections

Type	Indications	Limitations/disadvantages	Treatment	Teeth or region anesthetized	Important factors for consideration
Buccal infiltration	A basic supplemental injection used in posterior teeth when some pain occurs during treatment	Insufficient for endodontic treatment	One cartridge of 4% articaine with 1:100,000 epinephrine	Mandibular first molars and mandibular second molars	Thick buccal bone in the area of the mandibular second molar may interfere with diffusion of anesthetic during buccal infiltration injections. Only modest success rates have been reported with supplemental buccal infiltration
Intraligamental (PDL) injection	For posterior teeth after an inferior alveolar nerve block (IANB) that does not provide profound anesthesia	Not recommended in cases of cellulitis or periodontal or endodontic abscesses. Short duration	Special ligamental syringe or conventional syringe with a short needle may be used	Posterior mandibular and maxillary teeth	Postoperative pain at the injection site is common and may be confused with an endodontic complication
Intraosseous injection	For posterior teeth after an inferior alveolar nerve block (IANB) that does not provide profound anesthesia	Transient increase in heart rate when injecting epinephrine and levonordefrin-containing anesthetic solutions	1.8 mL of 2% lidocaine with 1:100,000 epinephrine	Tooth under treatment and the cancellous bone adjacent to the tooth to be anesthetized	Back pressure is important for success. Postoperative pain at the injection site is common and may be confused with an endodontic complication
Intrapulpal anesthesia	Teeth with symptomatic irreversible pulpitis, especially mandibular molars with inadequate anesthesia	Best used in teeth with pulp exposure or near-exposure. Technique-sensitive, and is associated with injection pain	1.8 mL of 2% lidocaine with 1:100,000 epinephrine	Mandibular molars	Back pressure is essential. Use a short needle bent at the hub. In multi-rooted teeth, each canal may require an intrapulpal injection
Nitrous oxide and inferior alveolar nerve block	Supplemental anesthesia for highly anxious patients	Presence of a rubber dam and mask. May require some patient education	Endodontic treatment can be facilitated in the patient with residual pain	Anxiolytic and analgesic properties	Success rate of the IANB in patients with symptomatic irreversible pulpitis is improved when nitrous oxide is administered

Fig. 1 Ligamental injection



Fig. 2 Intraosseous injection.
Dentsply Maillefer X-Tip
intraosseous anaesthesia
delivery system



Adding an intraosseous injection to an inferior alveolar nerve block for the first molar provides a rapid onset and a high incidence of pulpal anesthesia (Fig. 2).

Intrapulpal anesthesia

In cases where there is an anesthesia problem, the intrapulpal injection is a good choice if there is existing pulp exposure or near-exposure.

When a substantial amount of excavation is required prior to the intrapulpal injection, an alternative supplemental injection should be selected (Fig. 3).

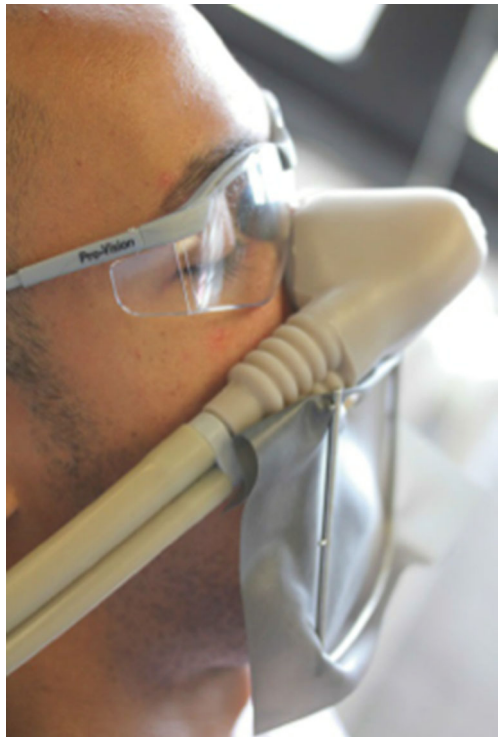
Nitrous oxide and inferior alveolar nerve block

Nitrous oxide has an impressive safety record and is excellent for minimal sedation in apprehensive patients. It produces an analgesic effect and decreases the pain of the initial IANB. Nitrous oxide is administered through the inhalation route, keeping the rubber dam in place (Fig. 4).

Fig. 3 Intrapulpal injection (courtesy of Dr. Katsushi Okazaki)



Fig. 4 Patient receiving nitrous oxide with the rubber dam in place



Pitfalls and complications

Anesthesia and irreversible pulpitis

Profound anesthesia is often difficult to achieve in patients with irreversible pulpitis using only the inferior alveolar nerve block.

Anesthetic failure

Causes of anesthetic failure:

- Failure of anesthetic solution to penetrate the sensory nerves, innervating the pulp, especially in the mandible.
- Anesthetic solution may not diffuse adequately into the nerve trunk to produce an adequate block.
- Long-term low-level pain may sensitize nociceptors, resulting in a lower pain threshold (allodynia) associated with an exaggerated response to stimuli (hyperalgesia).
- The lowered pH of inflamed tissues reduces the amount of the base form of anesthetic available to penetrate a nerve's membrane. Consequently, there is less of the ionized form within the nerve to achieve anesthesia.
- Patients in pain are often apprehensive, which can lower their pain threshold. A negative cycle may occur, with initial apprehension leading to a reduced pain threshold, a complication with the anesthesia, and thus increased apprehension.
- Inadequate time is given for the anesthetic to diffuse. The onset of complete anesthesia may be slow, particularly with the inferior alveolar block.

A “hot tooth”

The term “hot tooth” refers to a tooth that remains severely painful as the endodontic procedure is initiated, even though all the clinical signs of profound anesthesia are present. In such cases, the patient may have a numb lip and no reaction to an electric pulp tester or to a cold stimulus, but severe pain starts with the access preparation.

Treatment of a hot tooth

Once access preparation is done, it is important to completely remove all tissue from the canal(s). Supplemental anesthetic techniques are often necessary when treating a hot tooth.

Administration of nitrous oxide can be particularly helpful.

Table 2 Numb lip and negative (painless) response/positive (painful) response to provoking stimuli

Clinical situation	Clinical decision
Following an inferior alveolar nerve block, profound lip numbness occurs with negative responses to provoking stimuli (cold, percussion, electricity), but acute pain is experienced when access preparation is started	Supplemental injection should be selected based on the specific clinical situation
Following an inferior alveolar nerve block, profound anesthesia occurs with painful responses to provoking stimuli	Patient requires supplemental anesthesia prior to initiating treatment
Anesthesia not achieved	Patient requires another inferior alveolar nerve block

Emergency care

When time does not permit pulpectomy, a pulpotomy—removal of the pulp from the pulp chamber without entering the canal(s)—is a highly predictable approach to alleviating pain at an emergency visit (Table 2).

References

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