

A new approach to intraosseous anesthesia: the Intraflow™ HTP Anesthesia System

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_The problem

Achieving profound anesthesia in a patient with irreversible pulpitis, especially in mandibular molars, can be challenging. Dentists and supposed experts have generally blamed failure to achieve profound local anesthesia on poor technique or aberrant anatomy. The reality is that a conventional mandibular block will achieve profound pulpal anesthesia only 19–56% of the time in a mandibular molar with irreversible pulpitis.^{1–4}

What is anesthetic failure? Clinically it is when a patient responds to an instrument or needle stick before the procedure starts or when the patient experiences pain during the dental procedure.

More objective methods can be used to test whether a patient has attained pulpal, rather than merely soft tissue anesthesia prior to starting a dental procedure. Methods that can be used in your office include the use of the electric pulp tester (EPT, Analytic technology, Redmond, WA, U.S.A.) or the application of cold such as Endo-Ice™ (Hygenic Co., Akron, OH, U.S.A.).^{2,5}

Why doesn't the conventional mandibular block work reliably in patients with irreversible pulpitis? The reasons for failure of the local anesthetic are often related to physiology, not just anatomy. Some reasons include, but are not limited to the action of inflammatory mediators (ie, prostaglandin) that create altered resting potentials and decreased excitability thresholds on nerves, and the role of increased anxiety in those patients in pain.^{6,7}

The often-cited effect of lowered pH in inflamed tissues on the anesthetic itself has proba-



Fig. 1

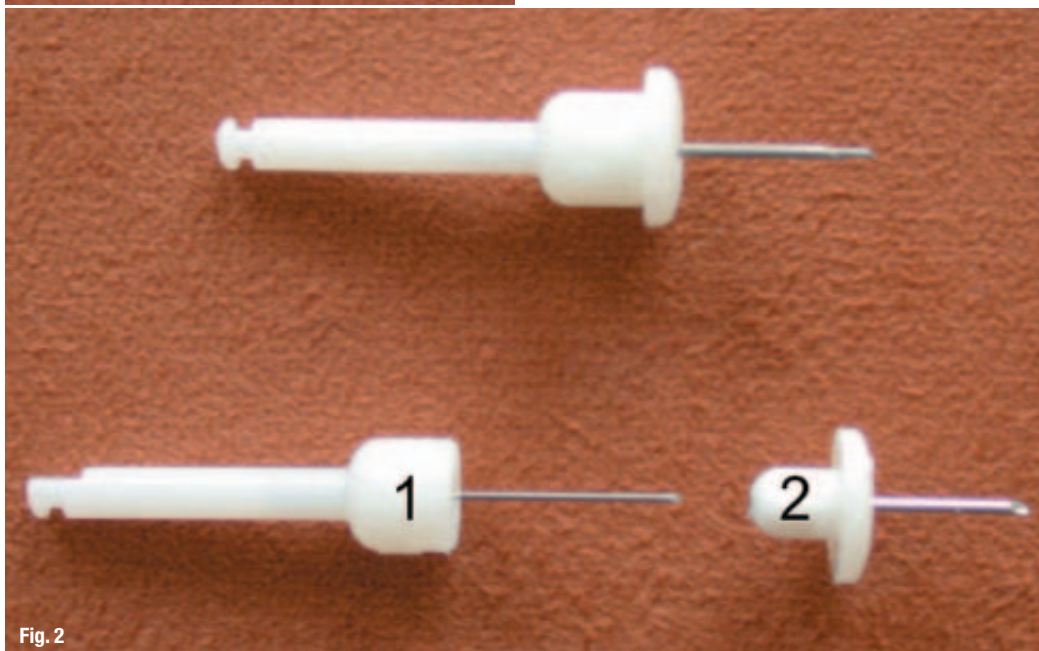


Fig. 2

bly been overstated as the mandibular block is not placed in the area of infection.⁸ Another possibility is that the nerves on the outside of the nerve bundle that supply the anterior teeth receive higher concentrations of local anesthetic than those nerve fibers on the inside of the nerve bundle that innervate the molar teeth. This has been referred to as central core theory.⁸

So how can a clinician achieve profound anesthesia in a patient with irreversible pulpitis prior to beginning the procedure? In addition to pharmacologic strategies to increase anesthetic efficacy, such as preoperative oral administration of a nonsteroidal analgesic (ie, 800 mg of ibuprofen gel caps one hour before the procedure) and a good chairside manner, the practitioner should seriously consider intraosseous anesthesia as a primary or supplemental technique.⁹

As previously stated, we can expect that a mandibular block will only provide adequate anesthesia in a lower molar with irreversible pulpitis less than half of the time!¹⁻⁴ Using intraosseous anesthesia, this success rate can be in-

creased to approximately 88–89% if local anesthetic is delivered adequately to the cancellous bone distal to the tooth being worked on.^{3,4}

This leads to the question: Why don't the majority of clinicians use intraosseous anesthesia routinely in patients with irreversible pulpitis? Since the techniques were developed after many practitioners left dental school, and since these techniques are still not often taught in dental schools today, many clinicians have not learned the advantages of intraosseous anesthesia or how to use it.

_Solution to the problem

Three types of intraosseous anesthesia that are presently available are Stabident™ (Fairfax Dental, Wimbledon, U.K.) (Fig. 1), X-tip™ (X-tip technologies, Lakewood, NJ) (Fig. 2) and the Intraflow HTP Anesthesia System (Pro-Dex/Micro Motors, Santa Ana, CA) (Figs. 3–5).

Another way to deliver supplemental anesthetic is through the periodontal ligament (PDL) to cancellous bone using the Wand™ device (CompuDent),



Fig. 3

Table 1_Pros and cons of Stabident, X-tip and Intraflow HTP Anesthesia System.

	Pros	Cons
Stabident	Inexpensive start up costs. Inexpensive disposable costs. Most supported by peer-reviewed research as effective.	Sometimes difficult to find perforation site with injection needle. Sometimes second perforation is required. Can take more time if difficulties are experienced locating perforation site. Sometimes needle has to be bent for ideal path of insertion in posterior areas.
X-tip	Guide sleeve is left in perforation site, increasing ease of needle placement compared to Stabident. Works in areas that lack attached gingiva or that lack easily visible access. Inexpensive start-up costs. Supported by peer-reviewed research as effective.	Can be difficult to separate the drill from the guide sleeve (sometimes use of a hemostat is necessary). Larger diameter guide sleeve can generate increased difficulty of cortical plate perforation and generate higher temperatures during perforation of thicker or denser bone. More postoperative problems from day 1–3 than Stabident (Intraflow data not available).
Intraflow HTP Anesthesia System	Creates perforation site, injection and withdrawal (three separate tasks) in one continuous step. Works in difficult access areas such as posterior, lingual approach, or areas that are not localized to attached gingiva. Can save time and effort of not having to relocate the perforation site. No separate injection needle pass is required.	Increased start-up costs and disposable items (transfuser) costs. Transfuser Assembly can sometimes leak anesthetic if not properly assembled. Efficacy not yet supported by peer-reviewed research (studies are ongoing).

the Comfort Control Syringe™ (Dentsply) or the N-Tralig PDL injection syringe, however, these devices will not be discussed here. The Hypo Intraosseous Needle™ (MPL Technologies, Inc., Franklin Park, Ill.) was also marketed as an intraosseous device; however, it does not appear to be readily available.

The purpose of this article is to discuss the advantages and disadvantages of each of the three

intraosseous products listed, and to introduce the latest product on the market, the Intraflow HTP Anesthesia Delivery System.

The most widely used commercial device for intraosseous anesthesia at present is the Stabident system (Fig. 1). This device consists of two components, the perforator (shank with perforator needle) and the short injection needle.



Fig. 4



Fig. 5

The Stabident system has been shown to be safe and effective when used as directed in numerous studies.^{3,4,8} The advantages of the product are that it is relatively inexpensive and can be used with equipment already existing in a dental office: a slow speed handpiece with a latch contra angle for the perforator and a standard dental anesthetic syringe for the needle.

The main disadvantage of the device is that the perforation needs to be made in a reasonably accessible and visible location in the attached gingiva distal to the tooth to be anesthetized. If the clinician takes his or her eye off the perforation site, or if the penetration zone is located in alveolar mucosa that moves once the perforator is withdrawn, it can be extremely difficult to locate the perforation site with the anesthetic needle. If the clinician is unable to find the perforation site, a second or even third perforation may be necessary. Posterior teeth often require that the 9 mm long needle be bent at a 45-degree angle at the hub in order to obtain a comfortable path of insertion. It is beneficial to hold the syringe using a pen grasp for increased control.

In situations where there is horizontal bone loss or lack of keratinized gingiva, use of the Intraflow HTP Anesthesia system or the X-tip may be advantageous as both of these systems can be used satisfactorily in alveolar mucosa, unlike the Stabident system.

A second intraosseous device is the X-tip (Fig. 2). The X-tip is composed of two parts, the drill (a beveled piece of stainless steel within a shank) and the guide sleeve, a special hollow needle that remains in the bone after perforation to facilitate injection needle placement. The injection needle used is 27 gauge and 0.4 mm diameter.

The advantages of the system are that it works well in alveolar mucosa because the guide sleeve remains to identify the perforation location for needle placement. In cases with limited attached gingiva or with severe periodontitis and horizontal bone loss, the X-tip allows the perforation site to be located in a more apical position, distal to a tooth or between two teeth.

Like the Stabident system, the X-tip also does not require additional specialized equipment and has been comparably effective in providing profound anesthesia.¹⁰ Disadvantages of the X-tip are that the drill and guide sleeve occasionally remain "stuck" together with one another after perforation, requiring that they be pulled

* Anatomic:	Physical Structures Sinus (pneumatized from missing molar) Mental foramen Between the central incisors (the midline lacks cancellous bone) Graft areas (avoid) Extremely thick or dense cortical plate
* Mixed dentition (avoid developing tooth bud as injury to developing crown could take place)	
* Areas of acute infection	
* Area of gross periodontal disease (place perforation site more apically)	

Table 2

Table 2. Contraindications to Intraosseous Anesthesia Technique.

apart with a hemostat while trying not to pull the guide sleeve out of the perforation site. Additionally, it is sometimes more difficult to perforate thick or dense bone in the posterior mandible with the X-tip than with the Stabident perforator.

The X-tip has been reported to have more post-operative pain in males, one to three days after the procedure, which may be contributed to increased heat formation during perforation because of the X-tip's wider diameter of the drill and guide sleeve.¹⁰ The manufacturer recommends a forward and neutral motion pressure, rather than continuous pressure, to reduce heat during perforation. The manufacturer also suggests that if it takes longer than two to four seconds to perforate into bone, this indicates the bone is too thick, and directs the clinician to select a different perforation site. Backflow of anesthetic through the guide sleeve can be experienced on occasion, which can necessitate a second perforation in a different location.

The third intraosseous device is the Intraflow HTP Anesthesia System (Figs. 3–5). The Intraflow Anesthesia system is an improvement in design over its predecessor, the Cyberjet System™ (Cyberdent Inc., Novato, CA), which is no longer manufactured. The Intraflow Anesthesia System is composed of four core components which are:

If the following presents:	Then use:
Easy access and visibility	Intraflow HTP Anesthesia System or Stabident
Moderate difficulty of access, narrow band of keratinized gingiva or horizontal bone loss	Intraflow HTP Anesthesia System or X-tip
Limited access and visibility	Intraflow HTP Anesthesia System

Table 3

Table 3. Which intraosseous product to use?

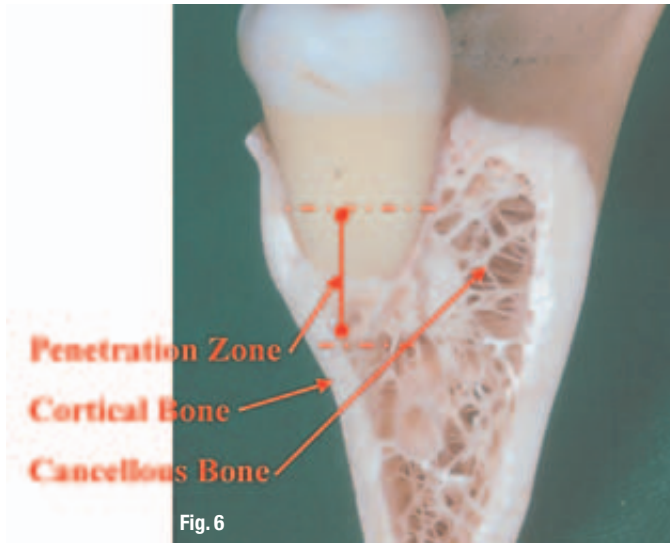


Fig. 6

- 1) the handpiece and quick disconnect,
- 2) the head attachment,
- 3) the perforator, and
- 4) the transfuser.

The device requires five sequential steps for successful assembly for use, and these steps are covered in the System Instruction Guide.

Using the IntraFlow HTP Anesthesia System

Using the Intraflow requires: 1) site selection, 2) site preparation (pre-numbing of the penetration site) and 3) perforation and anesthetic injection. As with all intraosseous anesthesia tech-

niques, the key to successful anesthesia is placement, without backflow of the anesthetic into the medullary space.⁸ It is usually recommended to infuse distally to the desired tooth to be anesthetized, unless anatomic factors (root proximity, thickness of bone, etc.) dictate otherwise.

Picking the right site is an important first step. The preoperative radiograph is used to determine the target area for the intraosseous injection (Fig. 6). It is recommended to infuse distally to the tooth anesthetized. Check the radiograph for root proximity and angulation.

The desired penetration zone is the cancellous bone apical to the alveolar crest, adjacent to the middle third of the root (Fig. 7). The target site can also be described along a line that bisects the interdental papilla, just coronal to the mucogingival junction, distal to the tooth being anesthetized (Fig. 8).

In areas where there is close root proximity, it can be advantageous to choose a different perforation site. Edentulous areas are good targets, as well as the retromolar pad area. In areas where there is thick bone, such as the buccal shelf near the mandibular molars, a lingual approach can also be used.⁸

Site preparation, perforation and injection are described in detail in the System Instruction Guide. The author provides conventional

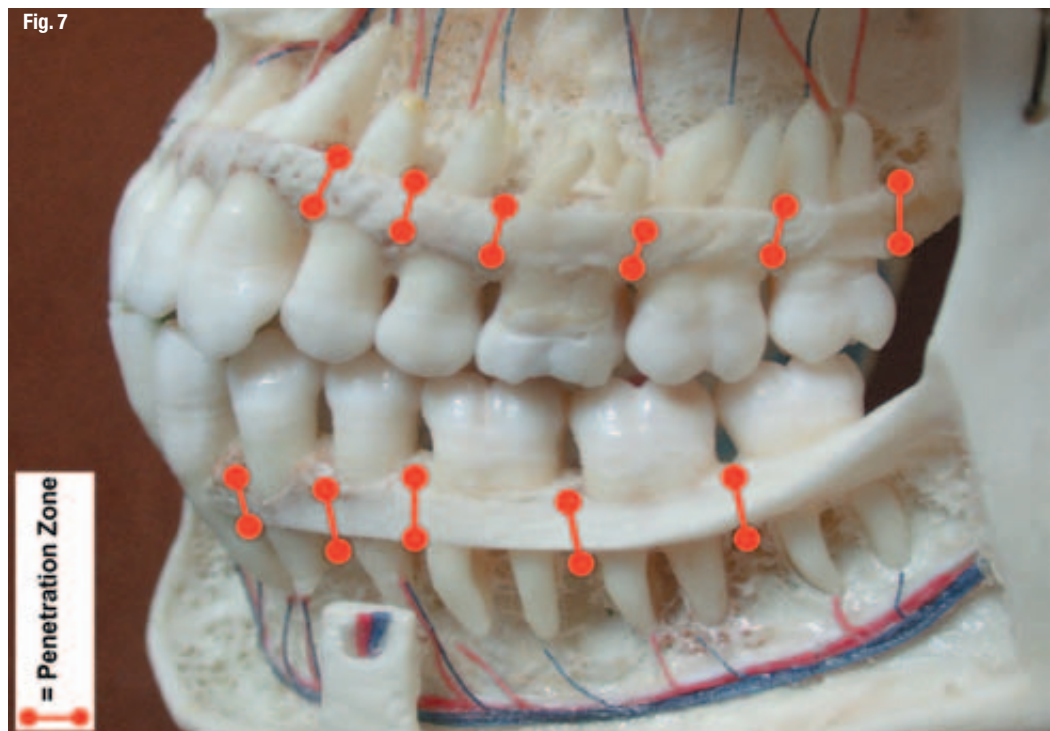


Fig. 7

mandibular block and infiltration to all site preparation areas prior to perforation. The patient should be numb very quickly (in approximately 40 seconds) after the intraosseous injection. As with all intraosseous techniques, the patient should be warned of an increased heart rate or strong heart beat that many patients will feel if you are using anesthetic with a vasoconstrictor present.^{11,12}

The biggest advantage of the Intraflow Anesthesia System is that it allows entry into the penetration zone, injection and withdrawal in one continuous step, without the need to relocate the perforation site. This can be helpful in penetration zones that are difficult to visualize or access, such as the second and sometimes the first molar areas, or where there is horizontal bone loss or a limited band of attached gingiva in the desired penetration zone.

Disadvantages of the Intraflow Anesthesia System are start-up and maintenance costs, and that the device can occasionally leak anesthetic, especially if not assembled properly by staff. The efficacy of this device has not yet been supported by peer-reviewed research; however, studies are presently in progress.

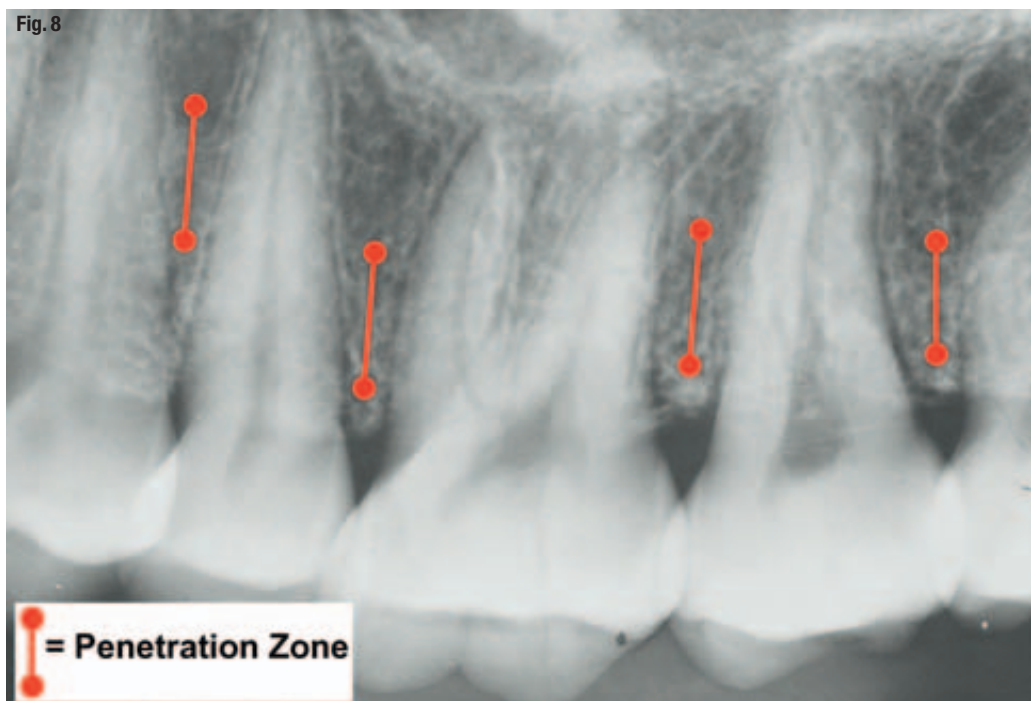
Limitations, contraindications and other considerations

In approximately 5–10% of patients with irreversible pulpitis in mandibular molars, intraosseous anesthesia will not produce profound

pulpal anesthesia even with repeated attempts.⁸ It has been suggested that backflow of anesthetic is a potential problem for all three intraosseous products discussed, possibly related to anatomic factors such as lack of a medullary space or a thick cortical plate in the available perforation zones of some patients.

Failure of conventional block and intraosseous methods are indications for intrapulpal injection. Since this injection depends on pressure within the pulp rather than the action of the anesthetic itself, it cannot be used well once the chamber is unroofed. Therefore, a good rule of thumb is to give a pulpal injection "just in case" when the pulp is first exposed prior to unroofing it. This will avoid encountering sensitive pulp when files are placed into the root canals. Intrapulpal anesthesia can be a painful experience, so it goes without saying that it should not be used as a substitute for a good block or intraosseous anesthetic technique. Intraosseous anesthesia in mandibular molars is of shorter duration than conventional mandibular block anesthesia and is not prolonged by use of "long acting" anesthetics such as bupivacaine.⁸ The duration of anesthesia can be increased from roughly fifteen minutes when using 3% mepivacaine to approximately one hour by using an anesthetic with a vasoconstrictor present.

Patients may experience an increase in heart rate for approximately four to five minutes when using anesthetics with vasoconstrictors.¹¹ Intraosseous anesthesia is generally not recom-



mended in children because they are in the mixed dentition stage, which puts the developing crowns at risk for injury. Contraindications for sites of intraosseous anesthesia are listed in Table 2.


_Which intraosseous product to use?

The choice of which intraosseous anesthesia product to use is up to each clinician. Table 3 describes some pros and cons of each device and how a clinician can use that information to select his or her device. The main predictor for success with all three intraosseous systems is lack of anesthetic back flow and placement of anesthetic into the medullary space during the intraosseous injection.²

_Literature

1. Reisman D, Reader A, Nist R, Beck M, Weaver J. Anesthetic efficacy of the supplemental intraosseous injection of 3% mepivacaine in irreversible pulpitis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1997 Dec; 84(6):676–82.
2. Nusstein J, Reader A, Nist R, Beck M, Meyers WJ. Anesthetic efficacy of the supplemental intraosseous injection of 2% lidocaine with 1:100,000 epinephrine in irreversible pulpitis. *J Endod.* 1998 Jul; 24(7):487–91.
3. Parente SA, Anderson RW, Herman WW, Kimbrough WF, Weller RN. Anesthetic efficacy of the supplemental intraosseous injection for teeth with irreversible pulpitis. *J Endod.* 1998 Dec; 24(12):826–8.
4. Nusstein J, Reader A, Beck FM. Anesthetic efficacy of different volumes of lidocaine with epinephrine for inferior alveolar nerve blocks. *Gen Dent.* 2002 Jul-Aug; 50(4):372-5; quiz 376–7.
5. Certosimo AJ, Archer RD. A clinical evaluation of the electric pulp tester as an indicator of local anesthesia. *Oper Dent.* 1996 Jan-Feb; 21(1):25–30.
6. Wallace JA, Michanowicz AE, Mundell RD, Wilson EG. 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 May; 59(5):517–21.

7. Roy ML, Narahashi T. Differential properties of tetrodotoxin-sensitive and tetrodotoxin-resistant sodium channels in rat dorsal root ganglion neurons. *J Neurosci.* 1992 Jun; 12(6):2104–11.
8. Reader A, Nusstein L. Local anesthesia for endodontic pain. *Endod Topics.* 2002 Nov; (3):14–30.
9. Gallatin J, Reader A, Nusstein J, Beck M, Weaver J. A comparison of two intraosseous anesthetic techniques in mandibular posterior teeth. *J Am Dent Assoc.* 2003 Nov; 134(11):1476–84.
10. Guglielmo A, Reader A, Nist R, Beck M, Weaver J. Anesthetic efficacy and heart rate effects of the supplemental intraosseous injection of 2% mepivacaine with 1:20,000 levonordefrin. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1999 Mar; 87(3):284–93.
11. Stabile P, Reader A, Gallatin E, Beck M, Weaver J. Anesthetic efficacy and heart rate effects of the intraosseous injection of 1.5% etidocaine (1:200,000 epinephrine) after an inferior alveolar nerve block. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2000 Apr; 89(4):407–11.

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