



New Advances in Local Anesthesia

Panelists



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The administration of local anesthetic is a skill that must be mastered and used regularly by dentists. For many patients, the thought of an intraoral injection can elicit feelings of considerable anxiety.¹⁻⁶ This may be related to the pain they associate with injections or it may be a learned response developed for a variety of complex reasons.⁷ Because injections are typically administered at the beginning of a dental visit, they represent the pinnacle of stress for the anxious patient and can pose a challenge for the dentist.

In private practice, there are increasing economic pressures to perform dental procedures more efficiently within specified time parameters. Every dentist can relate to instances when achieving an adequate level of anesthesia met with failure. Such experiences are stressful for the patient, dentist, and staff.

One study reported that nearly 20% of dentists surveyed related that there were occasions when the difficulties encountered with local anesthesia made them seriously reconsider their career choice.⁸ Even when local anesthetic administration does not present any specific difficulty, questions remain. Will an adequate level of anesthesia be achieved? Will the level of anesthesia be adequate to maintain patient comfort throughout the procedure, even if the procedure takes longer than antic-



Stanley F. Malamed, DDS, joined the faculty at the University of Southern California School of Dentistry in Los Angeles in 1973, where today he is Professor and Chair of the Section of Anesthesia and Medicine. Dr. Malamed is also a Diplomate of the American Dental Board of Anesthesiology, as well as a 1996 recipient of the Heidebrink Award from the American Dental Society of Anesthesiology and the Horace Wells Award (1997) from the International Federation of Dental Anesthesia Societies. Dr. Malamed has authored more than 85 scientific papers and 16 chapters in various medical and dental journals.

and Professor of Anesthesiology at the UCLA School of Medicine. He is President of the American Society of Dentist Anesthesiologists and a Director of the American Dental Board of Anesthesiology. He is also editor of *The Pulse*, the Newsletter of the American Dental Society of Anesthesiology. Dr. Yagiela is coeditor of the textbook *Pharmacology and Therapeutics for Dentistry* and coauthor of *Local Anesthesia of the Oral Cavity*.



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Dr. Friedman is a graduate of the University of Southern California School of Dentistry, where he is a Professor of Clinical Dentistry. He is an author and lecturer on esthetic restorative dentistry and is President of the American Academy of Esthetic Dentistry. A Fellow of the American and International College of Dentists and the Clinical Director for Milestone Scientific, he maintains a private practice at the Center for Dental Aesthetics in Encino, California.

ipated? Regardless of the potential difficulties, local pain management through various injection techniques remains a cornerstone of clinical practice. Recently, new technologies have been introduced to the marketplace accompanied with a variety of claims. In an effort to gain a better understanding of these new advances in local anesthesia, I enlisted the assistance of three highly respected authorities in the field of dental local anesthesia: Dr. David Donaldson, Dr. Stanley Malamed, and Dr. John Yagiela.

New Devices

Dr. David Donaldson believes that the past few years have brought some promising new technologies ranging from new intraosseous techniques, such as the Stabident^a and X-Tip^b Systems (Figure 1), to electromechanical devices designed to control the anesthetic flow rate, such as the Wand^{®c} (Figure 2). He is also aware of other devices not yet available in the United States. He has used an electromechanical device manufactured in Japan that is held "like a handgun" to meter the anesthetic during an injection; a motor in the handpiece delivers the anesthetic. He feels that the handpiece of the Wand[®] seems "more sophisticated." He recently received palatal injections administered with the Wand[®] and found them to be "painless" and "very effective." He experienced the anesthesia effect of the new palatal approach to the anterior superior alveolar (P-ASA) block, and was convinced that this injection was effective enough for clinical dentistry. Dr. Stanley Malamed responded that he has been using the new anterior middle superior alveolar (AMSA) block for some time and "loves it." He has been teaching it to the dental and dental hygiene students at the USC School of Dentistry. According to Dr. Malamed, the graduate students are using the AMSA as well and find it to be "a wonderful injection technique."

Dr. Yagiela agrees that new devices and techniques for the administration of local anesthetic are going to impact dentistry. He stated that the Wand[®] is the primary device on the market aimed at decreasing the discomfort associated with dental injections and it also has been used to "expand the types of injec-

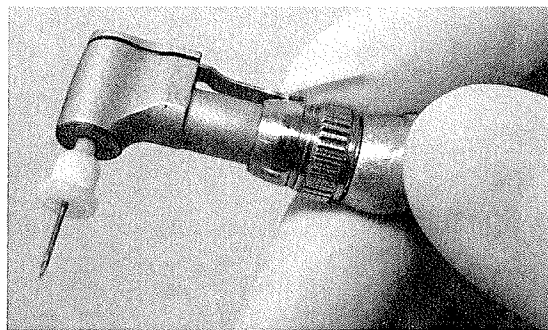


Figure 1—The sterile X-Tip perforator fits a slow-speed dental handpiece and easily penetrates cortical bone. The plastic guide maintains proper orientation to the access hole for the introduction of a 30-gauge needle.



Figure 2—The Wand[®] handpiece is easily maneuvered to any position in the oral cavity. It allows to operator to use finger rests with both hands and improves the ergonomics of injection administration.

tions that can be administered." At the UCLA School of Dentistry, Dr. Yagiela has initiated a clinical investigation on the AMSA and the P-ASA injections. During the next year or so, he believes there will be enough scientific information to make some definitive statements about the effectiveness of these injections compared to other traditional injections for maxillary teeth.

Dr. Yagiela finds the P-ASA block "intriguing" because it is a palatal rather than a facial approach to anesthetizing the maxillary anterior teeth. It involves administering approximately 0.9 mL of anesthetic solution into the incisive canal at a very slow delivery rate (approximately 4 minutes for 1 cartridge). The objective of both the AMSA and the P-ASA injections is to anesthetize portions of the superior dental plexus without collateral anesthesia to the lips and the face.⁹⁻¹¹ He said Fischer had described this general approach to achieving pulpal anesthesia in the early 1900s.¹² It may not have become popular because to deliver the required volume of solution was painful. He adds, "the pressures generated from a manual syringe delivery of such volume could result in a tissue slough." Dr. Yagiela feels that the major advantage of these new palatal injections is that with a controlled delivery device, they can be administered "rather painlessly" and they anesthetize the superior dental plexus and palatal tissue, but

^a Fairfax Dental, Inc, Miami, FL 33133

^b MTI Precision Products, Lakewood, NJ 08701

^c Milestone Scientific, Deerfield, IL 60015

Figure 3—Although practitioners have become accustomed to using a syringe effectively, it requires muscles of the palm, wrist, and forearm to maneuver the needle into position.

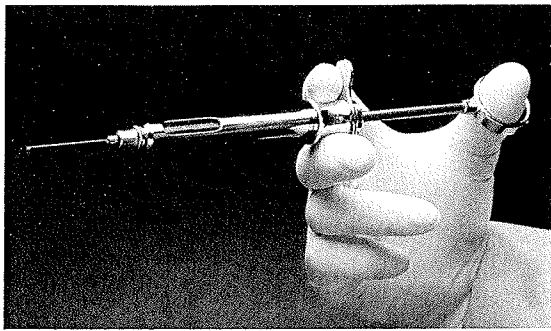


Figure 4—The pen grasp of the Wand® reduces the distance from the needle tip to the fingertips. The ultralight handpiece promotes better tactile feel and control.

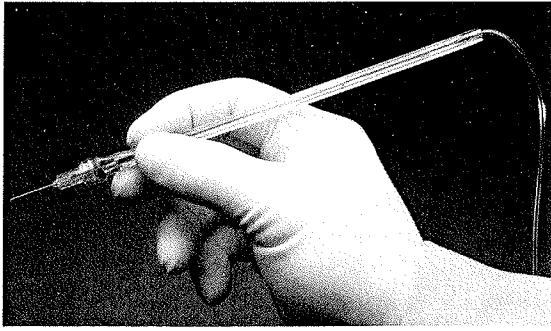
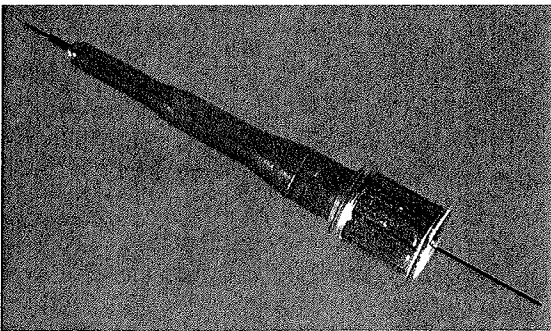


Figure 5—The intraosseous needle is a specially designed combination needle-perforator for intraosseous anesthesia. It fits a traditional syringe and is best suited for children.



maintain normal lip movement. He points out that anesthetizing the teeth and associated soft tissue while sparing the muscles of expression can be beneficial for cosmetic dentistry and certain periodontal procedures. Dr. Donaldson adds that the ergonomics of using the Wand® and holding it like a pen makes “the old syringe look antiquated” (Figures 3 and 4). He feels that the lightweight handpiece is particularly beneficial when doing intraosseous injections.

Intraosseous Anesthesia

Dr. Malamed stated that intraosseous anesthesia is a “great technique,” especially for the “hot tooth” associated with endodontic therapy. He reports that two studies found an 88% and 91% success rate, respectively, in achieving pulpal anesthesia on a “hot mandibular molar” that was unsuccessfully anesthetized with inferior alveolar block attempts.^{13,14} The two systems currently on the market for intraosseous injections are the Stabident and

the X-Tip. Dr. Yagiela adds that additional devices have been introduced. One is an intraosseous needle from Dentsply^d consisting of a specially ground 30-gauge needle stiffened with a surrounding plastic sheath and equipped with a retractable outer sleeve (Figure 5). The needle is designed to penetrate the interproximal bone when inserted with a twisting motion. This intraosseous device works particularly well on children. Because of the density and thickness of the mandibular cortex, it will not be successful for adult mandibular molars.

Another device that Dr. Yagiela has used is the Cyberjet^{™,e}, a dedicated, air-driven handpiece that incorporates an anesthetic cartridge holder and a specially designed needle. The air turbine rotates the needle, allowing it to readily penetrate the bony cortex. The local anesthetic is “infused” through the needle from an anesthetic cartridge contained on the handpiece. A foot rheostat controls the rotation speed and flow of anesthetic like a traditional air turbine. The manufacturer claims that the bone penetration and the injection are performed in one step with one device. However, the device is currently not being sold.

Dr. Yagiela believes that the Stabident and the X-Tip systems will profoundly alter how dentists deal with anesthesia failure. In general, intraosseous anesthesia has been a “lifesaver” for Dr. Yagiela, but there is a small incidence of failure and postoperative infection. At this time he does not recommend these methods as a primary approach to local anesthesia, but rather as a supplement when a traditional approach fails. He thinks a dentist’s armamentarium should include either a trephination approach, such as the Stabident, X-Tip, or Cyberjet, and a non-trephination approach, such as a periodontal ligament (PDL) injection delivered manually or with an electromechanical device.

Dr. Malamed believes that although the intraosseous injections are successful, the duration of anesthesia can be an issue for the dentist. “Because of the small volume used and the vascularity of the area, the duration is going to be limited.” Drugs such as bupivacaine (Marcaine^f) may extend the duration of anesthesia of an intraosseous injection when compared to mepivacaine (Carbocaine^f).

Most intraosseous anesthesia research is

^d DENTSPLY MPL, Franklin Park, IL 60131

^e Cyberdent, Novato, CA 94949

^f Abbott Laboratories; distributed by Eastman Kodak Co, Rochester, NY 14650

based on a clinical model developed by Reader and colleagues at the Ohio State College of Dentistry.¹⁵ Dr. Yagiela says researchers have found that intraosseous injections of local anesthetics without vasoconstrictors provide a short duration when used as a primary means of anesthesia.¹⁶ Even when anesthetics containing epinephrine were used, the duration was only about 30 minutes. By contrast, an intraosseous injection combined with a traditional block could provide an extended duration of action.¹⁷ Dr. Yagiela believes that the concept of the X-Tip might allow for a different approach. The operator can extend the duration of anesthesia by supplementing the dosage with repeated injections of anesthetic with a vasoconstrictor. It may also make it possible to use anesthetics without a vasoconstrictor and still achieve an acceptable level of anesthesia over a longer period.

One concern is pulpal blood flow. Dr. Yagiela points out that both the PDL and the trephinating injections have an effect on pulpal circulation when vasopressor-containing anesthetics are used.¹⁸ Although this is not important for endodontic therapy, it may be an issue in restorative dentistry where maintaining the health of the pulp is an important objective. Dr. Yagiela notes that even an inferior alveolar block can reduce pulpal blood flow.¹⁷

Intraosseous injections with anesthetics containing epinephrine or other vasoconstrictors may also have a systemic effect. The absorption of the drug into the bloodstream is rapid because of the highly vascularized medullary bone. Cardiovascular effects can approach a reaction typically observed with an intravascular injection.¹⁹ "It is important for patients to understand that they may feel a systemic response that may take the form of palpitation or tightness in the chest lasting several minutes as the drug is metabolized." For at-risk patients (ie, with heart disease or high blood pressure) this injection with a vasopressor would be contraindicated. Dr. Malamed agrees that even with anesthetics containing a concentration of 1:200,000 epinephrine, the patient may experience systemic effects. He recommends that the dentist use "plain drug" for endodontic pulp extirpation. It will provide approximately 5 to 10 minutes of anesthesia with no systemic effects.

Using New Technologies

Dr. Donaldson believes that dentists tend to consistently use the same techniques. They

should be encouraged to consider different options depending on the situation. Dr. Malamed agrees that having an array of options will provide the practitioner with the appropriate choice for the specific patient and procedure. One option might be a combination of technologies to gain the best advantages of each. Dr. Yagiela points out there may be an advantage to using an electromechanical device, such as the Wand[®], in combination with a trephinating intraosseous injection, such as the X-Tip. The Wand[®] could precisely control the flow rate and help to maintain a steady concentration of anesthetic in the region to extend the duration of action. In addition, breaking the plastic handle shortens the Wand[®] handpiece resulting in easier manipulation of the needle and it facilitates insertion, especially in the posterior mandible. Future research may show that the needle could be left in place and the Wand[®] could deliver the drug slowly over a prolonged period, much like an epidural infusion.

Dr. Yagiela believes the combination of these two technologies should be looked at more closely. Although clinical investigations need to be performed, it might even be possible to use anesthetics with epinephrine and reduce or eliminate their systemic effects. By introducing the anesthetic solution to the intraosseous space very slowly (possibly one cartridge over 20 minutes), the advantages of intraosseous anesthesia might be realized with less risk of negative sequelae.

New Anesthetics

Articaine (Septocaine[®]), a local anesthetic that has been used in other countries for 30 years, was recently approved for sale in the United States. It has a reputation of providing improved local anesthetic efficacy. Dr. Yagiela has been involved with clinical research comparing various formulations of articaine with lidocaine both with and without a vasoconstrictor, using an electric pulp tester to determine the level of pulpal anesthesia. His data demonstrated that articaine was an effective local anesthetic, but none of the formulations were statistically superior to 2% lidocaine with 1:100,000 epinephrine.²⁰ Even so, articaine is the local anesthetic of choice in Germany and it is very popular in Canada.²¹

Dr. Donaldson also conducted research on

[®] Septodont, Inc, Wilmington, DE 19850

articaine using electric pulp testing. His investigation compared articaine with prilocaine (Citanest^h) because they are both available as a 4% concentration with the same concentration of epinephrine.²² He did not find a statistically significant difference between the two drugs concerning onset or duration, but agrees that Canadian dentists do report articaine works more effectively. In an effort to look more objectively at the efficacy of articaine, he conducted a multi-center investigation in Vancouver and Japan using an *in vitro* approach. His data suggest that articaine was not more efficacious than other anesthetics (Donaldson D, unpublished data).

However, Haas and co-workers have looked at the neurotoxicity and negative tissue reactions associated with articaine and prilocaine and found a higher incidence of paresthesia and tissue damage with these drugs than with lidocaine and mepivacaine.²¹ Dr. Malamed says that this may be related to the 4% concentration of these drugs. In countries that have a 3% concentration of prilocaine, the negative reactions are not observed, according to Dr. Malamed.²³

Irrespective of this, he still finds that "dentists love articaine." The two benefits they report are that "it works faster" and "they miss (block injections) less frequently." Another reason this may be a popular local anesthetic is that the glass cartridges have a "smooth" action during the injection.

Drug Combinations

Some dentists choose a combination of drugs to achieve anesthesia. Dr. Malamed explains that because anesthetics that contain epinephrine are low in pH and cause a burning sensation in the soft tissue, some practitioners will first inject prilocaine plain, mepivacaine plain, or lidocaine plain to anesthetize the injection site, and repeat the injection with an anesthetic containing a vasoconstrictor.

Dr. Yagiela reports that endodontists are often faced with challenging pain management. The patient who is in pain from an inflamed dental pulp can be difficult to anesthetize. He is aware that endodontists may use prilocaine followed by lidocaine with epinephrine. Using prilocaine as the initial drug may in fact be more comfortable for the patient.

The effect of any two cartridges of anes-

^h AstraZeneca, Wilmington, DE 19850

thetic may account for achieving more profound anesthesia than a single cartridge. According to Dr. Yagiela, there is "nothing unusual" about the combination of lidocaine and prilocaine and their effect on nerve conduction. However, an eutectic mixture of local anesthetics (EMLA^h) holds promise as a most effective intraoral topical anesthetic.²⁴ In addition, it can penetrate keratinized tissue and has been successfully used before venipuncture. Dr. Donaldson has conducted research on a new EMLA preparation that is dispensed from a syringe into the periodontal tissues, where it is converted thermally from a solution to a gel and anesthetizes the tissue so the operator can immediately initiate scaling.

Drug Safety

All the panelists agree that lidocaine with epinephrine is considered the "gold standard" in local anesthesia (in most parts of the world). Dr. Yagiela feels it has safety and effectiveness advantages. Of the drugs available to dentists, it has the most liberal recommended dosage limits.

Although the other US Food and Drug Administration-approved drugs are safe systemically when used correctly, dentists should be aware that 4% prilocaine and 4% articaine do pose some increased risk of local tissue damage. Every dentist should have at least one local anesthetic that does not contain a vasoconstrictor. The most common is 3% mepivacaine. These drugs are useful for patients with a known allergy to bisulphites, which are preservatives used to stabilize the vasoconstrictor. They are also useful for some cardiac patients and for short procedures, particularly in the maxilla. In addition, their pH is higher and they do not produce any burning sensation. For longer procedures, formulations such as 0.5% bupivacaine with 1:200,000 epinephrine or 1.5% etidocaine with 1:200,000 epinephrine (Duranest^h) can be used. These will give prolonged anesthetic duration when used for inferior alveolar block or posterior superior alveolar block.

New vs Traditional Options

Additional therapeutic options will benefit any practitioner who takes the time to become familiar with a specific drug or delivery technique. Dr. Yagiela believes that dentists tend to maintain a comfort level when it comes to local anesthesia. One reason for this is that the con-