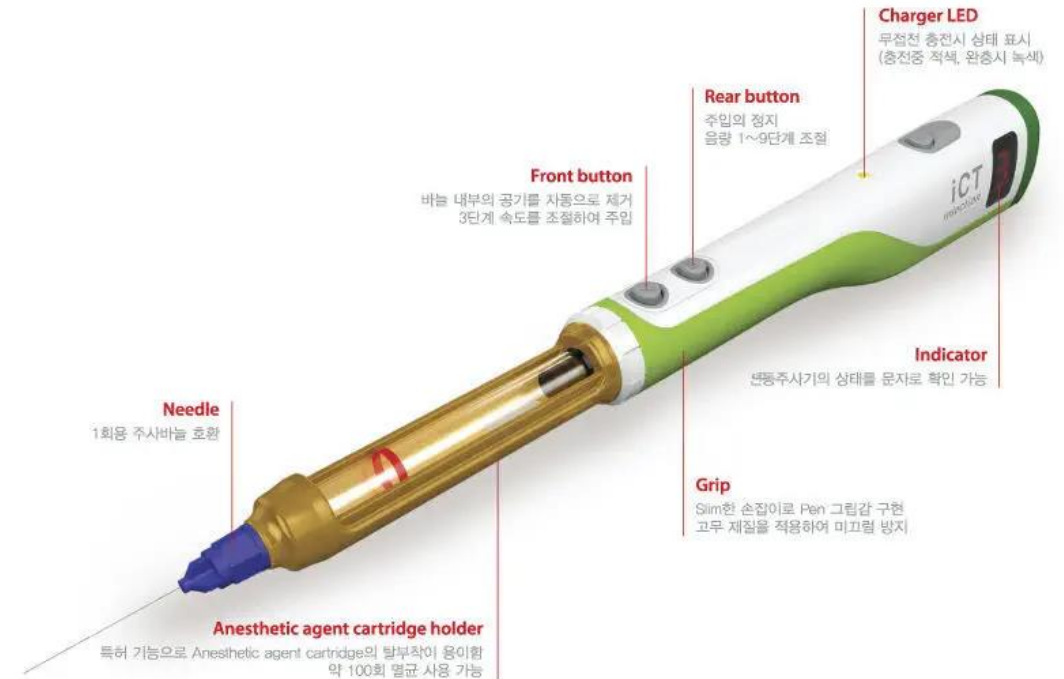
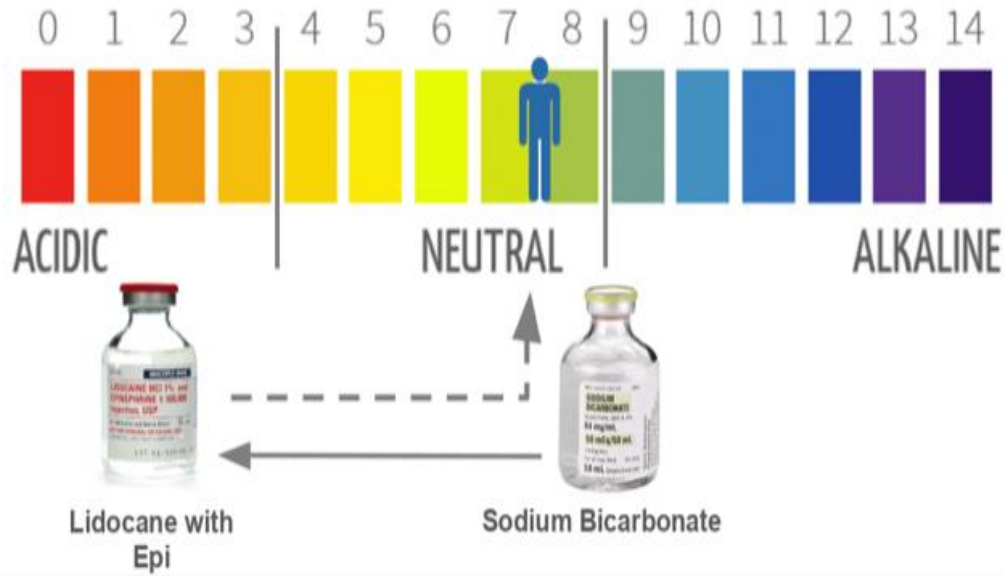


Advances in local anesthesia

Buffered Lidocaine

[Lidocaine with Epi (Acid) + Sodium Bicarbonate (Base)] neutralizes the acid before injection



Although **local anesthesia remains the backbone of pain control** in dentistry, researches are going to seek new and better means of managing the pain.

Most of the researches are focused on improvement in the area of anesthetic agents, delivery devices and technique involved.

Newer technologies have been developed that can assist the dentist in providing enhanced pain relief with reduced injection pain and fewer adverse effects.



Computer-controlled local anesthetic delivery (CCLAD):

Computer-controlled local anesthetic delivery (CCLAD) is one the method to **reduce patient pain during local anesthesia**; it is a device that slowly administers anesthetics by using a computerized device to control the injection speed

Dental fear is the most common reason for patients to avoid visiting the dentist.

Dental fear can occur for a variety of reasons, including noise and vibration from tooth-cutting devices such as dental handpieces, smell of drugs or materials used in dentistry, pain during dental treatment, and irrational fear of local anesthesia. Because dental treatments may be **painful, appropriate local anesthesia is necessary to reduce pain during such treatments.**



from Aseptico
calaject
Electronic Syringe



However, paradoxically, patients often **fear pain caused by anesthetic injections more than pain from dental treatment itself** .

Despite careful anesthetic procedures, **dental local anesthesia can cause pain for various reasons**, including **soft tissue damage during penetration of the oral mucosa**, **pressure from the spread of the anesthetic solution**, **temperature of anesthetic solution**, **low pH of anesthetic solution**, and **pain from the characteristics of the drug**. In order to reduce pain during local anesthesia, **swabbing anesthesia** is often performed on the injection point; **similarly**, local anesthetic techniques that can **anatomically reduce pain**, such as **infiltration anesthesia**, should be used rather than **subperiosteal or intraosseous injections** that **can cause pain**. **In addition**, the anesthetic ampoule must be used **administered at a temperature similar to body temperature**; **sterile local anesthesia should be used**; and **effort should be made to slow the injection speed** .

Although reducing the **injection speed is the most effective method of reducing pain**, **controlling and maintaining the amount or speed of injection in actual clinical settings is difficult**.

Many devices have been introduced that can inject local anesthetic into the tissues at a **set speed**. Collectively, these "**painless anesthetic devices**", are termed "**computer-controlled local anesthetic delivery**" (**CCLAD**) **devices**.

CCLAD also collectively refers to devices that not only **slow** and **maintain the injection speed**, but also **maintain a constant speed while taking into account the anatomical characteristics of the tissues being injected** .

The most widely known devices of this type include the **Wand® (Milestone Scientific, Livingstone, NJ)**, The Wand eliminates the "bee sting" effect - the painful consequence from a surge of fluid into a confined tissue area. Even more, certain injections made possible with the Wand minimize the unnecessary numbness of the tongue, cheek, and face. Imagine leaving the dentist's office without a "fat lip!"

The Wand handpiece provides painless injections for all routine dental treatment including root canals, crowns, fillings, and cleanings.

The Wand's Key Benefits:

Higher Patient Comfort

Reduced Patient Anxiety

Faster numbing onset and sensation recovery

Especially useful for paediatric patients

The Wand's computer-controlled local anesthetic delivery system doesn't look like a syringe. It doesn't feel like a syringe. And, what's more, it works better than a syringe resulting in a more pleasant experience. Ask us about Wand at your next visit. It's the comfortable alternative to the syringe



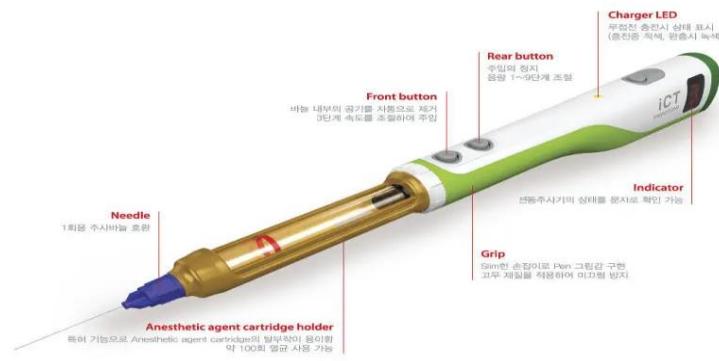
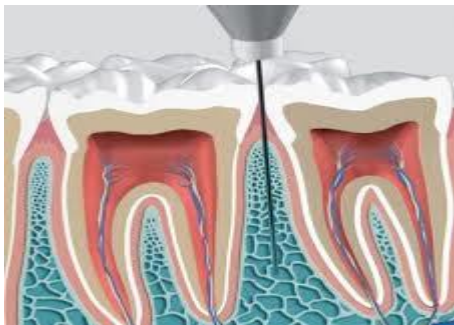
Comfort Control Syringe (CCS; Dentsply, USA),

The Comfort Control™ Syringe (CCS™) is an electronic, pre-programmed delivery system for local anesthesia that dispenses the anesthetic in a slower, more controlled and more consistent manner than a traditional manual syringe.

The Comfort Control™ Syringe has a special delivery system. The injection begins at a slow rate to minimize the discomfort associated with rapid injection.

In short, the Comfort Control™ Syringe can make injections easier for the dental professional and more comfortable for the patient.

QuickSleeper (Dental HiTec, France),



New techniques

Electronic dental anesthesia (EDA):

This technique is based **on the TENS** (transcutaneous electronic nerve stimulation) and the electronic waves are used to disrupt neural pain transmission to the brain. Research on this technique continues for use in the dental field.

Needle-free injection:

The injection system is based on a piston-pressure system and several systems are introduced such as PED-O-JET, SYRIJET and MED-E-JET. These techniques are widely used for **daily injections of insulin in diabetics**. In studies, these systems showed less pain compared to conventional injections with a needle gauge of 25

Computer controlled injection:

In this technique, computer **controls the speed and injection pressure**. C-CLADS (computer controlled local anesthetic delivery system) has less pain and discomfort for patients than conventional syringe injections, **but requires** greater facilities, more space and higher costs



Jet-injection:

In this technique, a small amount of anesthetic drug driven into the submucosa without a needle. The air pressure is used for the infiltration of the drug into the mucosa through tiny pores. This method is particularly useful for topical anesthesia for palatal injection



Vibrajet:

It is a device that provides high frequency vibrations in the dental injection syringe which causes a relative decrease in pain during the injection.

Accupal:

This is a tool to create pressure and vibration at the injection site. These mentioned irritate the larger nerve fibers and cause the lack of sensitivity during the penetration of the needle



TENS (transcutaneous electronic nerve stimulation):

The result of this method in patient comfort and it provides less pain during the injection. This has been demonstrated especially for IAN nerve block techniques, while topical anesthesia does not cause significant changes to reduce pain during the injection. This technique stimulates the nervous system and it starts before injecting and the pulse rate increases to make a good shake to the patient. The needle is inserted at an area between the electrodes of TENS while generated impulses are continuing at the same level. After withdrawing the injection and removing the needle, pulses are **slowly reduced and stopped**.

STA system device:

This is an **auxiliary system** for injection especially made **for PDL injections** where the dynamic pressure sensory system **improves the quality and reduces the side effects of injections**.

Low-pressure dynamic injection in this technique prevents tissue damage and pain during the injection. In addition, the injected anesthetic drug leakage is detected and prevents creation of an unpleasant taste in the patient's mouth. However, this technique requires the computer system tools .

Intranasal local anesthesia:

In the past, the use of nasal mucosa was conventional due to the high blood supply and ability to achieve the systemic effects of drugs.

Nowadays for the nasal mucosa and even upper teeth numbness, anesthetic drugs (**especially tetracaine**) are used on the **nasal mucosa**.

Studies have shown that the use of **intranasal tetracaine with a vasoconstrictor such as oxymetazoline** can provide tooth anesthesia for **the first molar on one side to the first molar on the other side** and dental procedures can be performed for the teeth, **without need to inject anesthetic drugs**



Figure 2—The STA: Intraligamentary Injection uses the STA-System real-time dynamic pressure-sensing technology to guide the needle to the PDL. Accurate and objective feedback is provided to the operator.

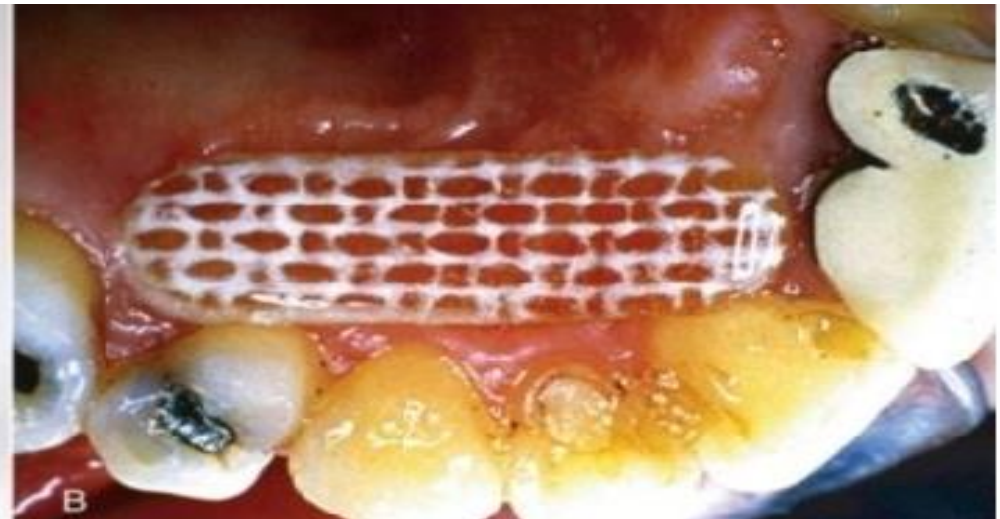
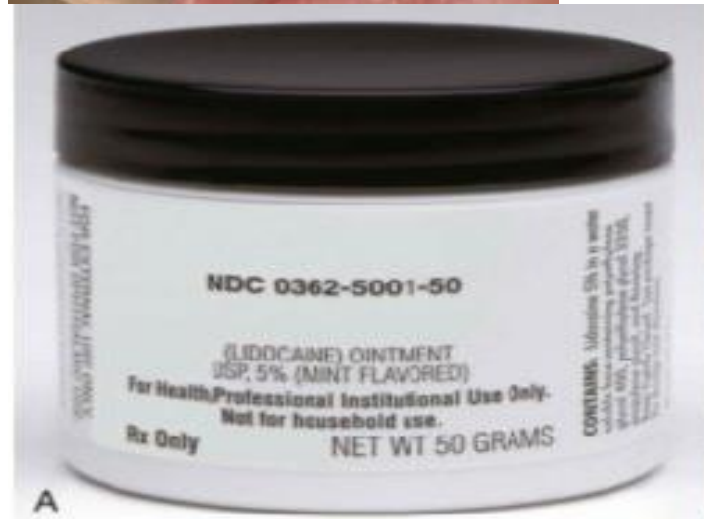
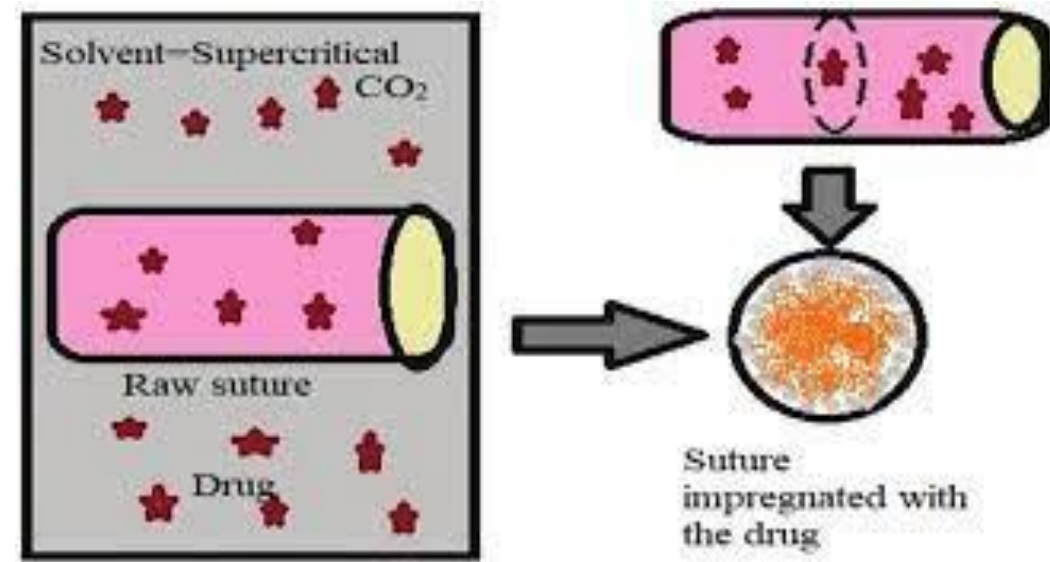


Electrospun drug-eluting suture:

Contains absorbable sutures with PLGA chemical structures that are **combined with bupivacaine**. The sutures can slowly release the drug to the surgical site within 12 days and provide appropriate analgesia. Higher concentrations of the anesthetic drug cause a decrease in the suture tensile strength. The suture tissue reaction is comparable to regular PLGA sutures without the combination of anesthetic drugs

Intraoral lidocaine patch (dentipatch):

This patch contains 10-20% lidocaine which is placed on dry mucosa for **15** minutes and provides suitable anesthesia for the mandible and maxilla



Local anesthesia reversal

Phentolamine mesylate (Oraverse):

Patients can have their dental work performed in a pain-free fashion. Of course, the problem with dental anesthetics is that **for some people**, it takes hours for their mouths to **recover from the numbing effect**. This issue often translates into a **problem for busy working people** who can't afford to **spend half a day feeling numb** in the face. Instead of a quick morning filling appointment being a simple affair, it can **negatively impact a person's work performance** by **impairing speech and impeding a person's ability to present them publicly without humiliation**.

Fortunately, mouth-related numbness doesn't have to be an all-day affair thanks to a new anesthetic reversal agent called *OraVerse*. **OraVerse is the first and only local dental anesthesia reversal agent in the market proven to accelerate the reversal of anaesthetic effect (numbness) after dental procedures.**

To administer OraVerse, dentist will inject it into the area of the patient's mouth that has been worked on and is therefore already numb

The injectable form of **phentolamine (alpha adrenergic receptor antagonist)** can be used to **terminate drug-induced local anesthesia** when it is **not required**.

Especially in high risk populations, where children and the elderly can inadvertently damage the tissues inside the mouth.



Soft tissue numbness causes problems with normal functions such as talking, laughing, eating and drinking and can sometimes cause tissue damage.

To prevent this situation, a 1.7 mL dental cartridge containing 0.4 mg phentolamine mesylate is used. In this way, the approximate time for the return of normal sensation will be about half. For example, the normal sensation of the tongue will return within **60 minutes with phentolamine mesylate and 125 minutes without it**

Children and **adults** have a tendency to bite their lips and even the inside of their cheeks when they are numb from anesthesia. They can't feel themselves biting their lip and so they continue (unfortunately) until they have chewed so hard they have damaged their lips and they have **become swollen and sore**, sometimes to the point of **being cut and bleeding!**

Adults and **young people** become embarrassed being numb because they can't speak clearly, smile or even drink properly they feel uncomfortable and self-conscious. Drooling becomes an issue.

Dental patients were administered a dose of 0.2, 0.4 or 0.8 mg of *OraVerse*. The majority of adverse reactions were mild and resolved within 48 h. There were no serious adverse reactions and no discontinuations due to adverse reactions

Articaine :

mandibular buccal infiltration For a mandibular buccal infiltration of the first molar, **4 percent articaine with 1:100,000 epinephrine will result in a higher success rate than will 2 percent lidocaine with 1:100,000 epinephrine**, but the duration of pulpal anesthesia will decline over 60 minutes with either formulation.

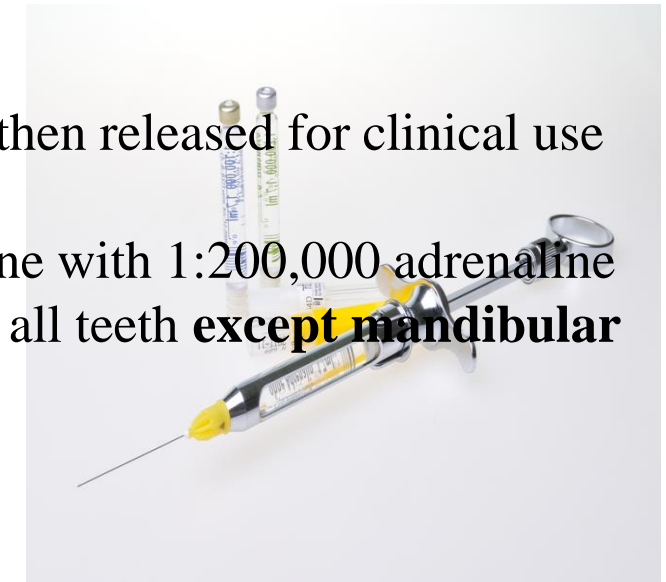


Articaine pharmacology

Articaine, 4-methyl-3[2-(propylamino)-propionamido]-2-thiophene-carboxylic acid, methyl ester hydrochloride, belongs to the amide family of LAs, which also includes **lidocaine, mepivacaine, bupivacaine** and **prilocaine**. **Articaine** is unique amongst the **amide family**, containing an **ester group and having a thiophene instead of a benzene ring**.^{4–6} The **thiophene ring**, an integral feature of articaine's LA potency⁷ increases **articaine's lipid solubility** facilitating more efficient diffusion of the anaesthetic through the **nerve cell lipid membrane and into surrounding**

Articaine was first synthesized in Germany in **1969** under the label, HOE 40-045, and then released for clinical use in **1976** under the name (Carticaine hydrochloride) In 1971 finding that 2% articaine with 1:200,000 adrenaline was superior to 2% lidocaine with 1:200,000 adrenaline in anaesthetic duration and extent, and that articaine produced profound anaesthesia for all teeth **except mandibular molars**.

In 2006, The FDA **approved 4% articaine with 1:200,00 adrenaline**.



Articaine efficacy :

Articaine LA onset takes between **1.5 and 1.8 min** for a maxillary infiltration and **1.5–3.6 min** for mandibular block anaesthesia.

Articaine pulpal anaesthesia lasts between **30 and 120 min**, a duration longer than lidocaine, mepivacaine and prilocaine.

Articaine soft tissue anaesthesia lasts **~2.25 h** for maxillary infiltrations and **4 h** for mandibular blocks.

Articaine safety ,is well-tolerated and safe for use in routine clinical dentistry.

Both anaesthetics are appropriate and effective for clinical use.

Articaine's toxicity is comparable to that of lidocaine, cautioned use of both **lidocaine** and **articaine** in patients with **liver** or **cardiovascular impairment** as amide biotransformation occurs in the liver and the anaesthetics can decrease **myocardial function for patients** with **advanced cardiovascular disease**.

Lidocaine and **articaine** use in dentistry Lidocaine has proven safe and efficacious for routine clinical treatment.

Articaine seems to be the local anesthetic of **first choice in tissues with suppurative inflammation, for adults, children (over 4), elderly, pregnant women, breastfeeding women, patients suffering from hepatic disorders and renal function impairment.**

In Articaine solutions (1: 200,000) epinephrine is in low concentration, thus in patients at high risk adverse responses are **maximally decreased**. In these patients articaine should be used with careful consideration of **risk/benefit ratio**.

Articaine solutions must not be used in persons who are allergic or hypersensitive to sulphite, due to content of

Sodium metabisulfite as vasoconstrictor's antioxidant in it.

Incidence of serious adverse effects related to dental anesthesia with articaine is very low. Toxic reactions are usually due to an **inadvertent intravascular injection** or **use of excessive dose**.

To avoid overdoses maximum recommendation dose (MRD) **must not be exceeded** and **aspiration test always performed prior all LA injections**.

Buffered Local Anesthetic

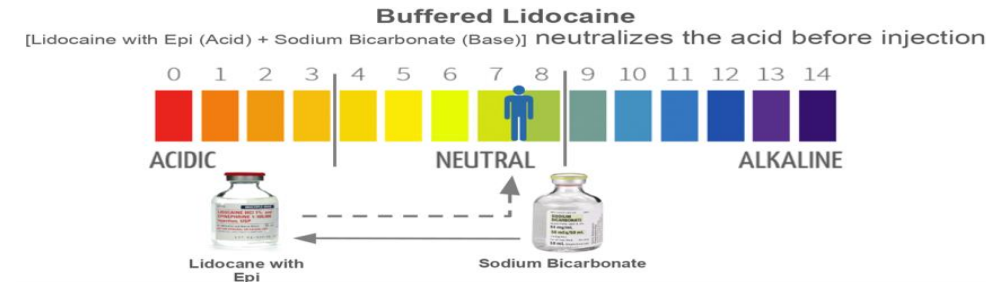
What is Buffered Local Anesthetic?

One downside to a local anesthetic that contains the epinephrine vasoconstrictor is that the pH or “acid-base balance” tends to be more on the acid side of the equation as delivered by the manufacturer. This results in two minor, but manageable problems:

First, as the local anesthetic is initially injected into the patient’s soft tissue, the lower “acid” **pH** results in a **slight stinging effect felt by the patient**. Due to the fast action of most local anesthetics, the surrounding tissue becomes numb quickly and subsequent injections, even at the lower pH are not felt by the patient.

Secondly, also due to the lower **pH**, less number of anesthetic chemical molecules are initially released into the area that is being numbed. **Because of this effect, multiple injections may be required and a time delay of the local anesthetic to profoundly numb an inflamed or infected tooth.**

The human body’s soft tissues eventually **neutralizes or “buffers”** the lower **pH** of the local anesthetic back to a **neutral balance** that gets and keeps a **patient profoundly numb**. The potential benefits of buffering local anesthetic solutions prior to injection, such as decreased injection pain, faster onset, and greater depth of anesthesia, may be particularly advantageous in patients who have difficulty achieving profound anesthesia for clinical dentistry, and for anesthetizing infected areas



Dentists can effectively buffer local anesthetic preparations using commercially available mixing systems or by utilizing a hand-mixing technique. Rather than using a remove and replace technique, practitioners may consider a direct injection technique, adding 0.1 mL of 8.4% sodium bicarbonate directly into any local anesthetic cartridge regardless of local anesthetic concentration.

The Benefits of Buffering:

Since buffered anesthetic can cross the **nerve membrane more readily** than **unbuffered ones**, patients become numb **very quickly** so that the clinician can stay in the operator and begin the procedure **almost immediately**. Using buffered anesthetic can save as much as **17-20 minutes per hour**. Not only do the **dentists and patient** save significant time, **but discomfort is minimized**. Both impact and improve the patient experience. **This combination is priceless**

Predictability: Buffering can **elevate the depth of anesthesia**, increasing the likelihood of patients **getting numb the first time**. It allows dental professionals to give multiple injections without having to **reload the cartridge or risk wasting premixed anesthetic**. *When using this buffering system, 64% of appointments were at least 15 minutes shorter than scheduled.*

Efficiency: Buffered anesthetics can cross the **nerve membrane more readily**, allowing a patient to become numb quickly. *When using this buffering system, 16.7 minutes is the average time saved per appointment (saves 2 hours per day.)*

Reduced Pain: Mixing anesthetic with sodium bicarbonate creates a bi-product of CO₂, which by itself contains the ability to create a numbing effect. A single injection is often sufficient, but when subsequent injections are required, the fast-acting buffered anesthetic is already working and patients don't feel multiple injections. *When using this buffering system, on a scale of 1-10, 1 being no pain and 10 being extreme pain, patients rate their pain experience 1.81 out of 10.*

Reduced Pain: Mixing anesthetic with sodium bicarbonate creates a bi-product of CO₂, which by itself contains the **ability to create a numbing effect**. A single injection is often sufficient, but when subsequent injections are required, the fast-acting buffered anesthetic is already working and patients don't feel multiple injections. *When using this buffering system, on a scale of 1-10, 1 being no pain and 10 being extreme pain, patients rate their pain experience 1.81 out of 10.*

How is the buffering procedure performed?

- 1. A sterile dental anesthetic carpule (1.8cc) is loaded into a standard dental syringe.
- 2. The dentist then extrudes and discards approximately **10% of the solution (0.18cc) out of the anesthetic cartridge**.
- 3. Using a separate sterile plastic syringe and needle, approximately **1cc of 8.4% sterile sodium bicarbonate (an alkaline base solution) is drawn into the 3cc syringe from the bottle of sodium bicarbonate**.
- 4. Remove the needle from the 3cc syringe containing the sterile 8.4% sodium bicarbonate and insert the dental cartridge's anesthetic needle into the open ended syringe of sodium bicarbonate and proceed to aspirate **0.18cc** of sodium bicarbonate back into the dental syringe anesthetic carpule.
5. This process essentially replaces **approximately 10% of the local anesthetic** solution of the anesthetic carpule with the 8.4% sodium bicarbonate. When the **two solutions are mixed together**, the local anesthetic solution (low ph- "acid") + sodium bicarbonate (high ph- "base") **they immediately balance each other out and the final solution becomes a neutral ph=7.0, which is equal to the body's ph of 7.0**. This final, neutralized solution is used to numb the patient's tooth. **Ph paper is used** to verify the correct ph of the final solution: the color of the ph paper will change from yellow (new carpule: ph=3.8) to green (buffered carpule: ph=7.0).

BUFFERING SYSTEM EQUIPMENT





THANK YOU