Successful local anesthesia in conservative dentistry and endodontics

PRESENTED BY : DR. ABHISHEK PARMAR

"SOME PULP WILL DIE EVEN IF YOU CROSSLY LOOK AT THEM, WHILE OTHERS CAN'T BE KILLED EVEN WITH AN AXE."

- GROSSMAN

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Introduction

Why do patients avoid going to the dentist?

- According to a survey by the ADA , fear of pain is the greatest factor that prevents patients from visiting their dentist.
- Additional surveys have found that 90% of dentists have some anesthetic difficulties during restorative dentistry procedures.
- Profound pulpal anesthesia is the cornerstone to the delivery of dental care.
- The current technology and drug formulations used for local anesthesia have made it so much easier to treat patients successfully.
- We now have the ability to anesthetize patients initially, provide anesthesia for the full appointment, and reverse some of the effects of soft tissue anesthesia if desired.

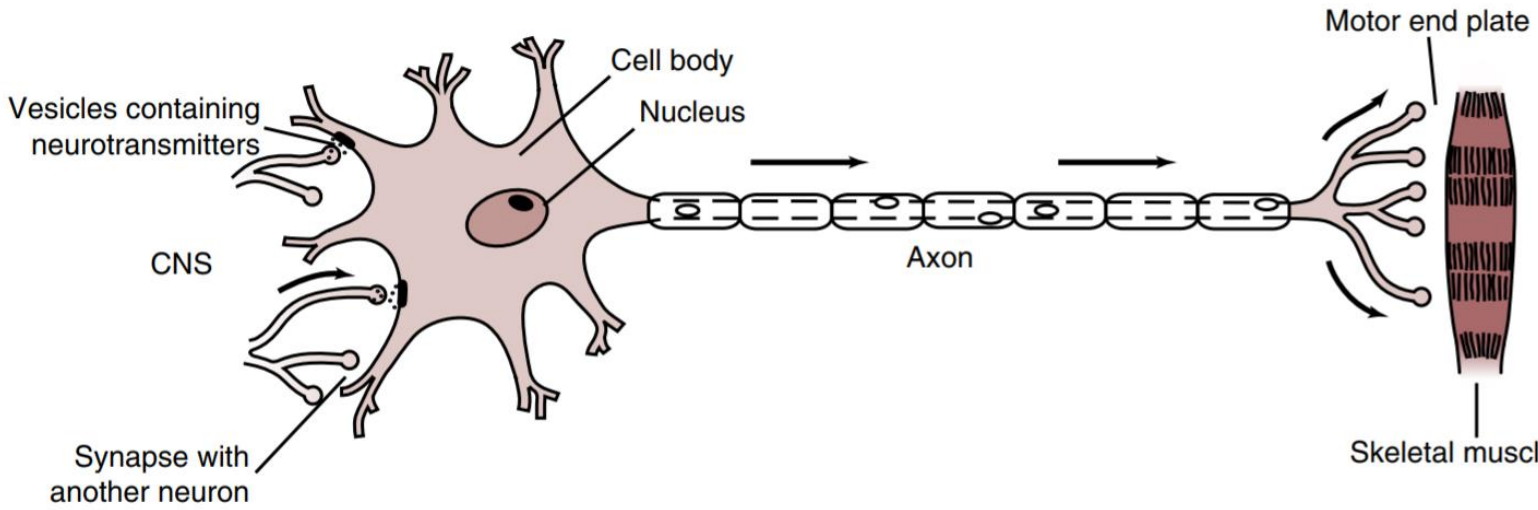
Definition

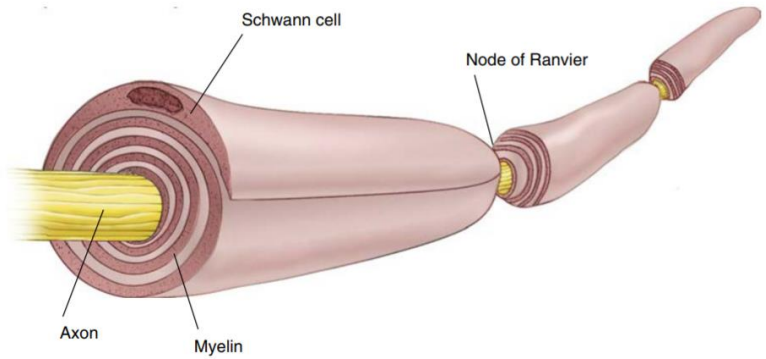
- Local anesthesia has been defined as loss of sensation in a circumscribed area of the body caused by depression of excitation in nerve endings or inhibition of the conduction process in peripheral nerves.

Handbook of local anesthesia (seventh edition) **– Stanley F Malamed**

THE NEURON

The neuron, or nerve cell, is the structural unit of the nervous system.
It is able to transmit messages between the central nervous system (CNS) and all parts of the body.
Basic types of neuron: Sensory (afferent) and Motor (efferent)





• **Fig. 1.5** Structure of a myelinated nerve fiber. (Redrawn from de Jong RH: *Local anesthetics*, St Louis, 1994, Mosby.)

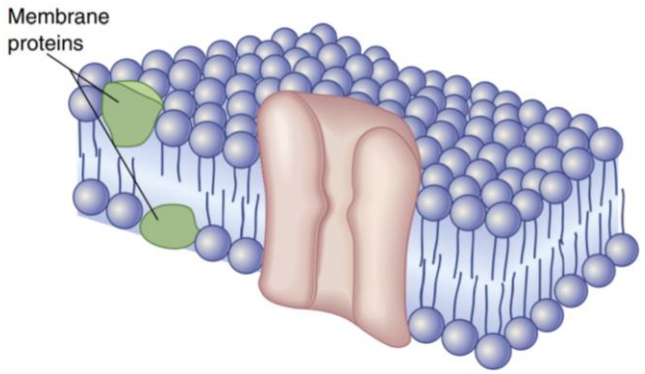
Where Do Local Anesthetics Work?

Nerve fibre

In a single nerve fiber(the axon) cytoplasm (axoplasm) encased in a thin sheath, the nerve membrane, or axolemma

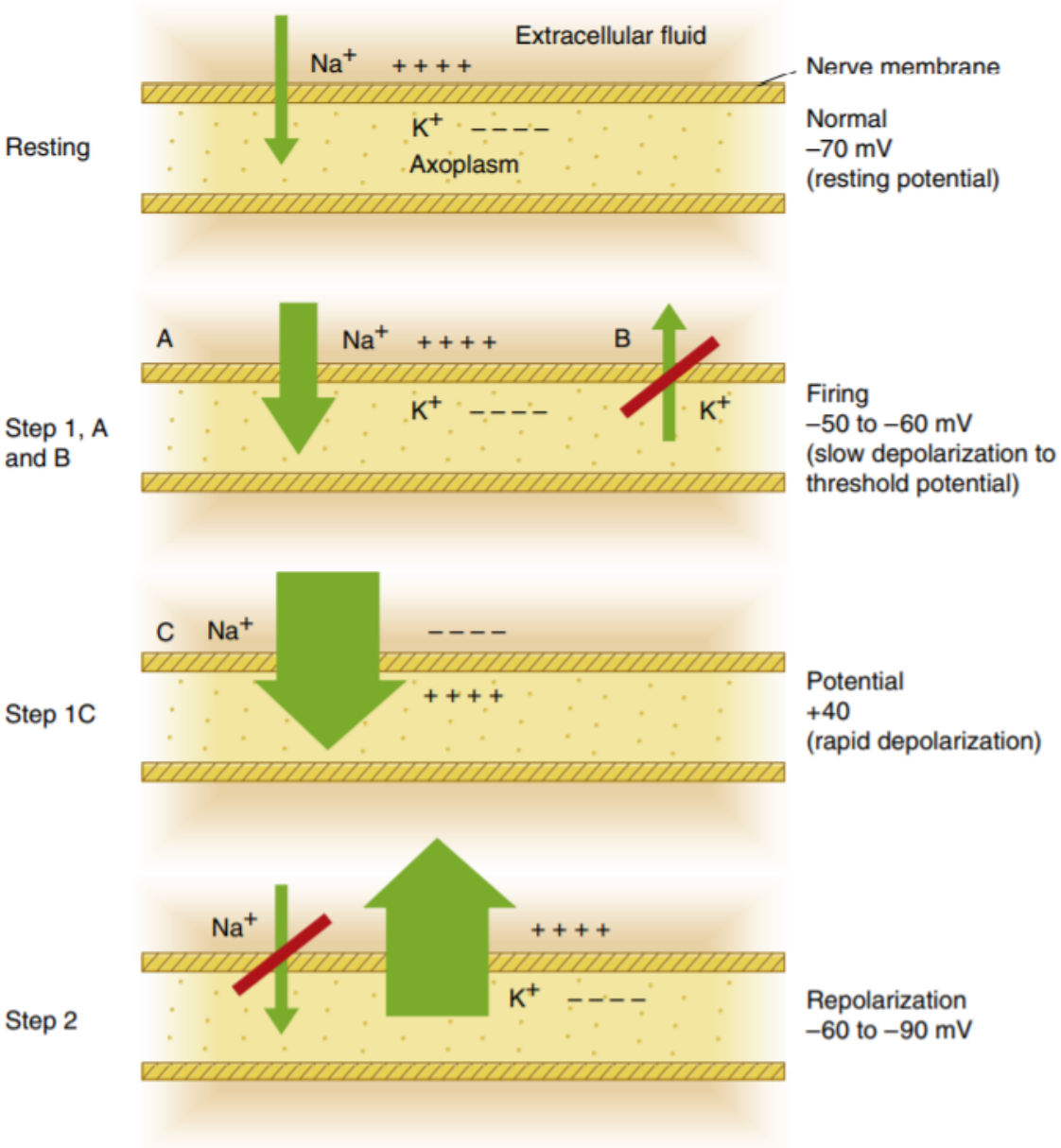
- The nerve (cell) membrane itself is approximately 70 to 80 Å thick.
- The membrane consisting of two layers of lipid molecules (bilipid layer of phospholipids) and associated proteins, lipids, and carbohydrates.
- The lipids are oriented with their hydrophilic (polar) ends facing the outer surface and their hydrophobic (nonpolar) ends projecting to the inner .

- Proteins are the primary organizational elements of membranes.
- Classified as transport proteins (channels, carriers, or pumps) and receptor sites.
- Channel proteins are thought to be continuous pores through the membrane, allowing some ions (Na+, K+, Ca2+) to flow passively, whereas other channels are gated, permitting ion flow only when the gate is open.



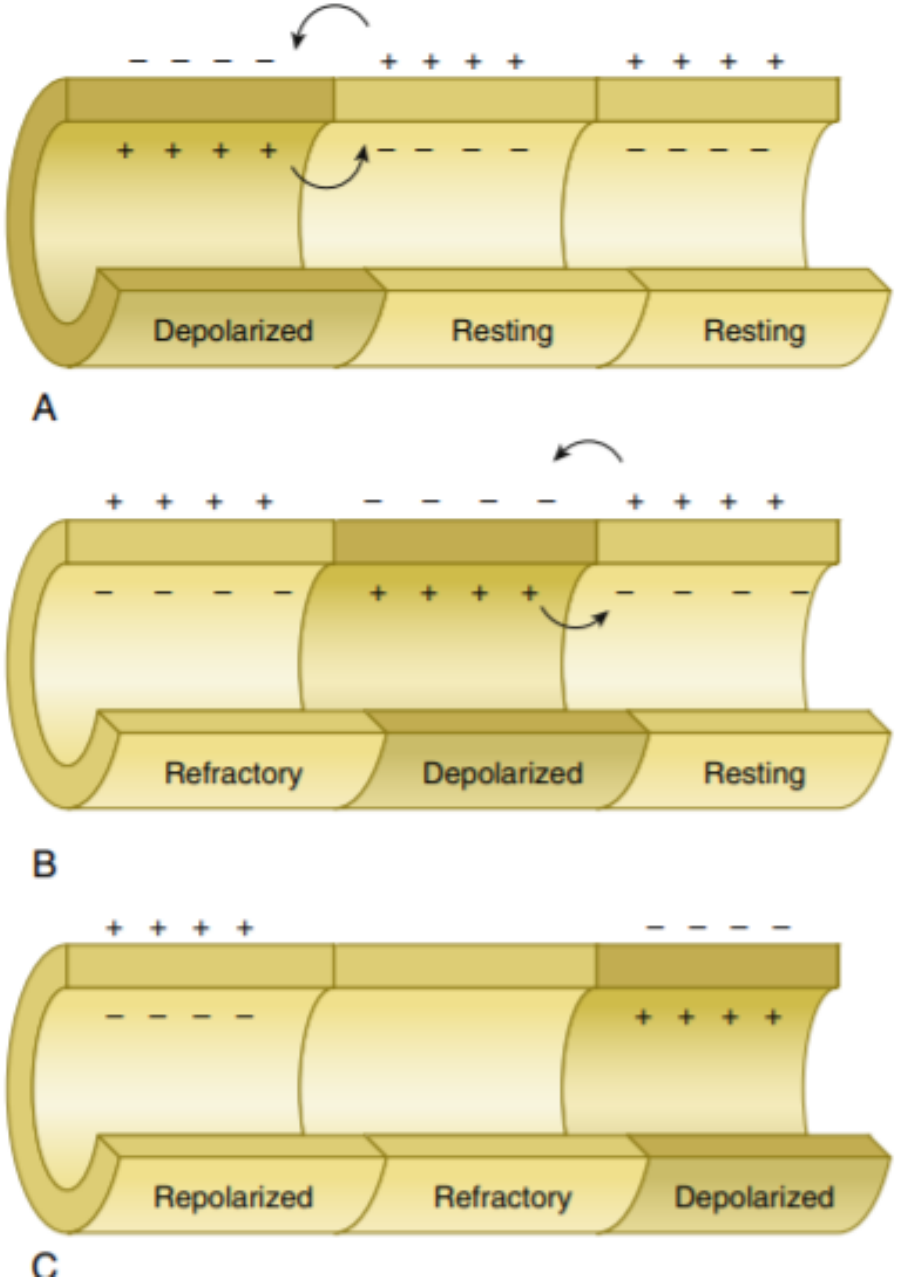
Electrophysiology of Nerve Conduction

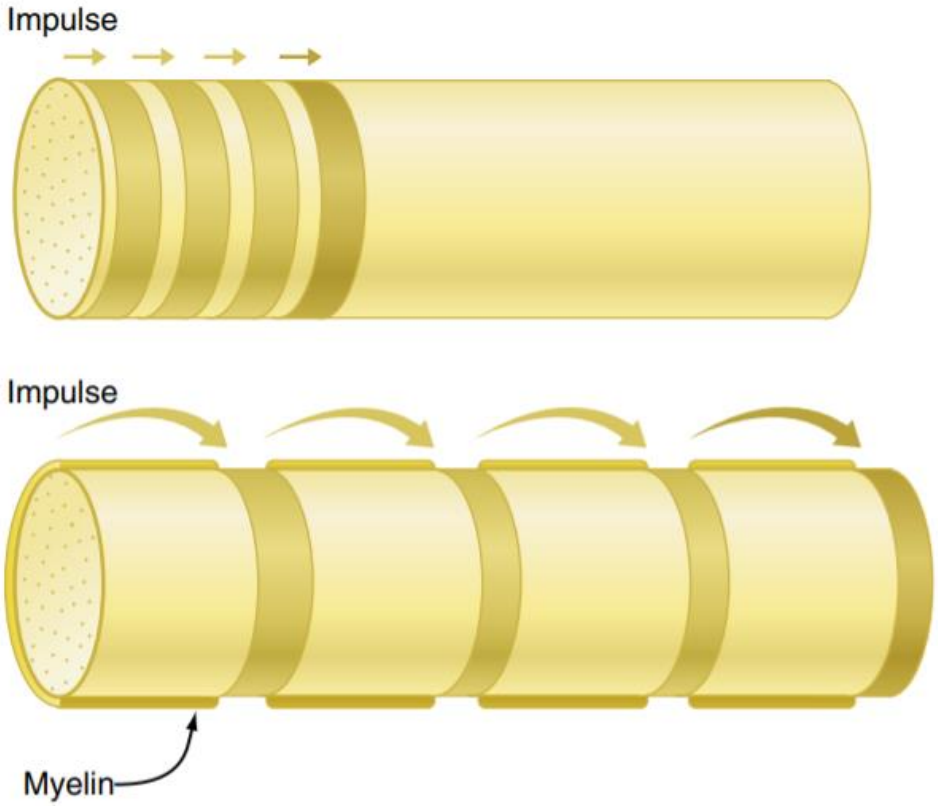
- A nerve possesses a resting potential of – 70 mV across the nerve membrane, produced by differing concentrations of ions on either side of the membrane
- The interior of the nerve is negative relative to the exterior.



• **Fig. 1.7** Resting potential, slow depolarization to threshold (step 1, A and B), rapid depolarization (step 1C), repolarization (step 2).

Impulse propagation





Saltatory propagation: Depolarization in myelinated axons is discontinuous; the impulse leaps forward from node to node.

In nonmyelinated axons, the impulse moves forward by sequential depolarization of short adjoining membrane segments

Mode and Site of Action of Local Anesthetics

- Altering the basic resting potential of the nerve membrane
- Altering the threshold potential (firing level)
- Decreasing the rate of depolarization
- Prolonging the rate of repolarization

Theories to explain mechanism of action of local anesthetics

- **The acetylcholine theory**
- **Calcium displacement theory**
- **Surface charge (Repulsion) theory -** local anesthetics act by binding to the nerve membrane and changing the electrical potential at the membrane surface.

Membrane expansion theory – L A diffuse to the membranes, producing disturbance of the bulk membrane structure, expanding some critical region(s) in the membrane, and preventing an increase in permeability to sodium ions.

Specific receptor theory - Proposes that local anesthetics act by binding to specific receptors on the sodium channel. The action of the drug is direct, not mediated by some change in the general properties of the cell membrane.

Classification

I- Based on the ability to react with specific receptor sites in the sodium channel

1. within the sodium channel (tertiary amine local anesthetics,

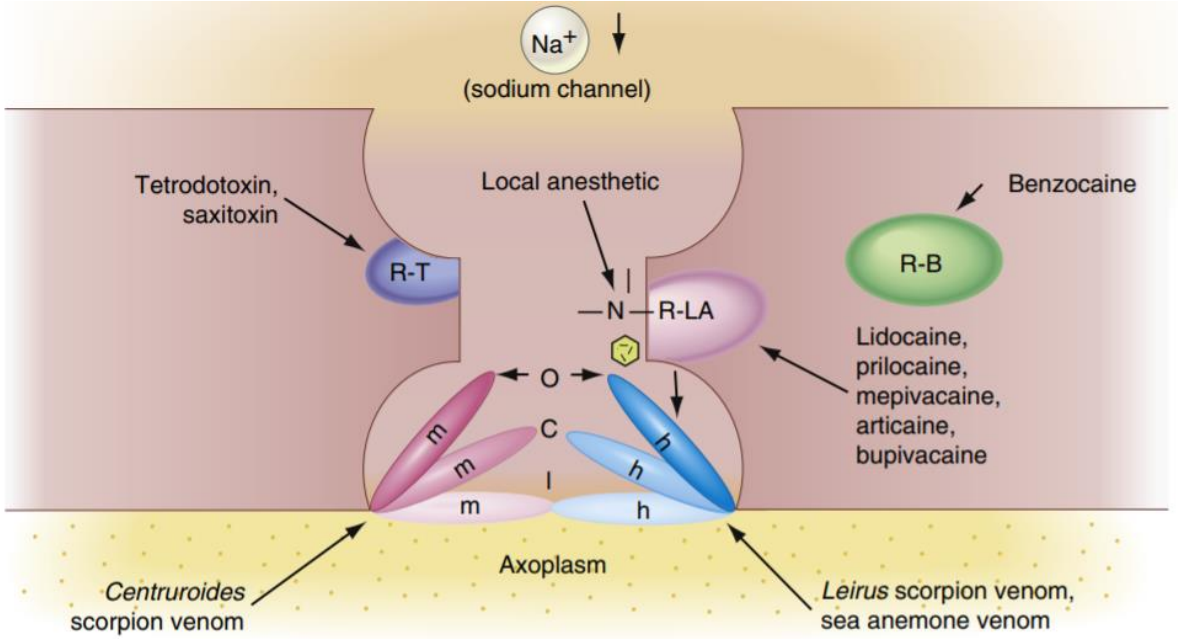
   e.g lidocaine, articaine, mepivacaine, prilocaine, bupivacaine)

2. At the outer surface of the sodium channel (tetrodotoxin, saxitoxin)
3. At the activation gate (scorpion venom)
4. At the inactivation gate (scorpion venom)

II- Classification of Local Anesthetic Substances According to Biological Site and Mode of Action

Class	Definition	Chemical Substance
A	Agents acting at receptor site on external surface of nerve membrane	Biotoxins (e.g., tetrodotoxin, saxitoxin)
B	Agents acting at receptor site on internal surface of nerve membrane	Quaternary ammonium analogues of lidocaine Scorpion venom
C	Agents acting by a receptor-independent physicochemical mechanism	Benzocaine
D	Agents acting by combination of receptor and receptor-independent mechanisms	Most clinically useful local anesthetic agents (e.g., articaine, bupivacaine, lidocaine, mepivacaine, prilocaine)

Modified from Covino BG, Vassallo HG: *Local anesthetics: mechanisms of action and clinical use*, New York, 1976, Grune & Stratton.



• **Fig. 1.14** Tertiary amine local anesthetics inhibit the influx of sodium during nerve conduction by binding to a receptor within the sodium channel (R-LA). This blocks the normal activation mechanism (O gate configuration, depolarization) and also promotes movement of the activation and inactivation gates (m and h) to a position resembling that in the inactivated state (I). Biotoxins (R-T) block the influx of sodium at an outer surface receptor; various venoms do it by altering the activity of the activation and inactivation gates; and benzocaine (R-B) does it by expanding the membrane. *C*, Channel in the closed configuration. (Redrawn from Pallasch TJ: *Dent Drug Serv Newsl* 4:25, 1983.)

III- Based on chemical structure

Esters

Esters of benzoic acid

Butacaine
Cocaine
Ethyl aminobenzoate (benzocaine)
Hexylcaine
Piperocaine
Tetracaine

Esters of *p*-aminobenzoic acid

Chloroprocaine
Procaine
Propoxycaine

Amides

Articaine
Bupivacaine
Dibucaine
Etidocaine
Lidocaine
Mepivacaine
Prilocaine
Ropivacaine

Quinoline

Centbucridine

Dissociation of local anesthetics

- local anesthetics are available as acid salts (usually hydrochloride) for clinical use
- It exists simultaneously as uncharged molecules (RN) - Base, and as positively charged molecules (RNH+), called the cation.
- As the pH of the solution is acidic, hydrogen ions (H+) are also present. $RNH+ \rightleftharpoons RN + H+$
- High concentration of hydrogen ions (low pH), the equilibrium shifts to the left, and most of the local anesthetic solution exists in cationic form: RNH+ >RN + H
- As hydrogen ion concentration decreases (higher pH), the equilibrium shifts toward the free base form: RNH+

$$pH = pK_a + \log \frac{[\text{conjugate base}]}{[\text{acid}]}$$

- **Fig. 1.18** Henderson-Hasselbalch equation.

When the pH of the solution has the same value as the pKa of the local anesthetic, exactly 50% of the drug exists in the RNH+ form and 50% in the RN form

Major factors involved in the action of a local anesthetic :

(1) Diffusion of the drug through the nerve sheath.
(2) Binding at the receptor site in the ion channel.

- The uncharged, lipid-soluble, free base form (RN) of the anesthetic is responsible for diffusion through the nerve sheath.
- A local anesthetic with a high pKa has very few molecules available in the RN form at a tissue pH of 7.4.
- The onset of anesthesia of this drug is slow because too few base molecules are available to diffuse through the nerve membrane (e.g., procaine, with a pKa of 9.1)

Agent	pK_a	Percentage of Base (RN) at pH 7.4	Approximate Onset of Action (min)
Benzocaine	3.5	100	—
Mepivacaine	7.7	33	2-4
Lidocaine	7.7	29	2-4
Prilocaine	7.7	25	2-4
Articaine	7.8	29	2-4
Etidocaine	7.9	25	2-4
Ropivacaine	8.1	17	2-4
Bupivacaine	8.1	17	5-8
Tetracaine	8.6	7	10-15
Cocaine	8.6	7	—
Chloroprocaine	8.7	6	6-12
Propoxycaine	8.9	4	9-14
Procaine	9.1	2	14-18
Procainamide	9.3	1	—

Clinical Implications of pH and Local Anesthetic Activity

- Most commercially prepared solutions of local anesthetics without a vasoconstrictor have a pH between 5.5 and 7.
- When they are injected into tissue, the vast buffering capacity of tissue fluids returns the pH at the injection site to a normal 7.4.
- The pH of a dental cartridge of local anesthetic containing epinephrine may range from 2.8 to 5.5.
- The tissues tends to maintain a normal tissue pH; however, it does require a longer time , resulting in a slower onset of clinical action.

Physical Properties and Clinical Actions

- **Dissociation constant (pKa**) - Drugs with a lower pKa possess a more rapid onset of action than those with a higher pKa.
- **Lipid solubility** : Greater lipid solubility produce more effective conduction blockade at lower concentrations.
- **Protein binding** : Greater degree of protein binding appear to attach more securely to the protein receptor sites and to possess a longer duration of clinical activity.
- **Vasoactivity** : Affects both the anesthetic potency and the duration of anesthesia

Metabolism (De toxification)

Ester Local Anesthetics : Hydrolyzed in the plasma by the enzyme pseudocholinesterase.

- PABA, which is a major metabolic product of many ester local anesthetics- which is excreted unchanged in the urine.
- Allergic reactions that occur (rarely) in response to ester local anesthetics are related to PABA.

Amide Local Anesthetics

- The biotransformation of amide local anesthetics is more complex than that of ester local anesthetics. The primary site of biotransformation of amide local anesthetics is the liver.
- Articaine, a hybrid molecule containing both ester and amide components, undergoes metabolism in both the blood (primarily) and the liver.
- Liver function and perfusion significantly influence the rate of biotransformation of an amide local anesthetic.

Prilocaine and methemoglobinemia

Prilocaine - itself does not produce methemoglobinemia, but orthotoluidine (a primary metabolite of prilocaine) - induce the formation of methemoglobin.

Sedative effect occasionally observed after lidocaine administration
Lidocaine does not produce sedation; however metabolite of lidocaine (monoethylglycinexylidide and glycinexylidide) are thought to be responsible for the sedative effect.

Clinical Factors Related to Local Anesthesia

Confirming Pulpal Anesthesia in Nonpainful Vital Teeth

Lip numbness :

- A traditional method to confirm anesthesia usually involves questioning patients by asking if their lip is numb .
- Although lip numbness can be obtained 100% of the time, pulpal anesthesia may fail in the mandibular first molar in 23% of patients.
- lip numbness does not always indicate pulpal anesthesia.

Soft tissue testing

The lack of patient response to sharp explorer sticks is a poor indicator of pulpal anesthesia

Fig 1-2 Lip numbness does not guarantee pulpal anesthesia.

Fig 1-3 A lack of patient response to mucosal or gingival "sticks" is a poor indicator of pulpal anesthesia.

Commencing with treatment :

- Commencing with treatment without confirming anesthesia may add apprehension for the dentist and patient because neither one knows if the tooth is anesthetized.

Cold refrigerant or electric pulp testing

- Pulp testing with a cold refrigerant or an EPT will indicate if the patient has pulpal anesthesia.
- For anxious patients, pulp testing may need to be postponed until the patient can be conditioned to accept noninvasive diagnostic procedures.

Pulp vitality test

- **Electric pulp testing**: lack of patient response to pulp testing with an EPT will not always indicate that the patient is anesthetized.
- **Cold testing** : A positive response to pulp testing with a cold refrigerant will indicate if the patient is not anesthetized.
- **Pain to cold testing in patients presenting with symptomatic irreversible pulpitis** : patients presenting with symptomatic irreversible pulpitis may experience severe pain and severe reactions to cold testing.
- **Cold testing with crowns** : Teeth with gold crowns, porcelain-fused-to-metal crowns, and full porcelain crowns can be tested with cold.

- **Effect of analgesics on pulp testing** : Generally, preoperative analgesic medication use does not affect pulp testing in patients with irreversible pulpitis.
- **Anesthetic success** :Anesthetic success for a nerve block is by the percentage of patients who have no response to an electric pulp tester (EPT) (two consecutive 80 readings) within 15 minutes of injection and continuously sustain the 80 reading for 60 minutes

Fig 1-4 A cold refrigerant may be used to test for pulpal anesthesia before the start of a clinical procedure. (Courtesy of Coltène/Whaledent.)

Fig 1-5 The cold refrigerant is sprayed on a large cotton pellet.

Fig 1-6 The pellet with the cold refrigerant is applied to the surface of the tooth.

Fig 1-7 An EPT may also be used to test for pulpal anesthesia before a clinical procedure is started. (Courtesy of SybronEndo.)

Fig 1-8 The EPT probe is placed on the surface of the tooth.

Anesthetic agents and dosages

Typical maximum dose

Anesthetic	Vasoconstrictor	Dental cartridge color code[b]	MAD[c]	TMD[c]
2% lidocaine	1:100,000 epinephrine	Red	13	8
2% lidocaine	1:50,000 epinephrine	Green	13	8
2% lidocaine plain	No vasoconstrictor	Light blue	8	8
2% mepivacaine	1:20,000 levonordefrin	Brown	11	8
3% mepivacaine plain	No vasoconstrictor	Tan	7	5½
4% prilocaine	1:200,000 epinephrine	Yellow	5½	5½
4% prilocaine plain	No vasoconstrictor	Black	5½	5½
0.5% bupivacaine	1:200,000 epinephrine	Blue	10	10
4% articaine	1:100,000 epinephrine	Gold	7	7
4% articaine	1:200,000 epinephrine	Silver	7	7

[a]The dosages were adapted from Malamed.[35]
[b]Uniform dental cartridge color codes.
[c]This table provides the maximum dosage in two formats. The maximum allowable dose (MAD) generally is approached only with complex oral and maxillofacial surgical procedures. The typical maximum dose (TMD) is the usual upper limit of drug dosage for most restorative and endodontic dental procedures. Both columns show the number of cartridges that would be required for an adult weighing 150 pounds (67.5 kg).

Maximum allowable dose

Factors influencing local anesthetic effectiveness

Genetics : Genetics may play a role in anesthetic failure

Gender differences : Women try to avoid pain more than men and fear it more.

Catastrophizing : Some patients may have an exaggerated negative mental set that occurs during an actual or anticipated painful experience.

- These patients are already predisposed to have a painful experience during dental treatment.

Pregnancy and breastfeeding : Defer elective treatment for pregnant patients, particularly in the first trimester. However, if treatment involving a painful procedure is required for the pregnant or lactating patient, many of the commonly available local anesthetic agents are safe to use.

Elderly patients : Older patients may tolerate pain better than younger patients.

Alcohol addiction : patients with alcoholism may be more difficult to anesthetize.

Allergies and local anesthetics

- **Local anesthetics** : Patients who have had serious reactions to local anesthetics should be treated in conjunction with a dental anesthesiologist or oral surgeon.
- **Latex in dental cartridges** : Dental cartridges present little risk in latex allergy patients.(Rubber stopper)
- **Sulfites** : Present in small amounts in local anesthetic cartridges. If a patient has a severe sulfite allergy, use an anesthetic solution without a vasoconstrictor.

Reversing soft tissue numbness

OraVerse

- Phentolamine mesylate (0.4 mg in a 1.7-mL cartridge; OraVerse, Septodont) is an agent that shortens the duration of soft tissue anesthesia.
- Is a safe product and would be beneficial for patients who would like to experience a faster return to normal soft tissue function.
- 88-minute decrease in time to return to normal maxillary soft tissue sensation, and a 47-minute decrease in mandibular lip sensation.

Anxiety and Pain

Anxious patients may be harder to anesthetize. However, dentist dedication to preventing pain is the most important behavior to patients

- **Oral conscious sedation** : Oral conscious sedation with triazolam or alprazolam will not reduce pain during dental treatment. Profound local anesthesia is still required.
- **Patient satisfaction with painful treatment** : A dentist's caring manner relates to patient satisfaction even though painful treatment may be involved.

- **Nitrous oxide** : Is very useful for minimal conscious sedation in apprehensive and emergency patients because it has both analgesic and antianxiety effects.
- **Aromatherapy**: Does not improve pain control in anxious patients.

Vaso constrictors

How vasoconstrictors increase anesthetic success ??

- Decreases blood flow (perfusion) to the site of drug administration.
- Absorption of the local anesthetic into the cardiovascular system is slowed.
- Local anesthetic blood levels are lowered, thereby decreasing the risk of local anesthetic toxicity
- More local anesthetic diffuses into the nerve, where it remains longer, thereby increasing the duration of action of most local anesthetics.
- Vasoconstrictors decrease bleeding at the site of administration. Their inclusion in the local anesthetic solution is useful when increased bleeding is anticipated (e.g., during a surgical procedure).

Categories of sympathomimetic amines

Direct Acting	Indirect Acting	Mixed Acting
Epinephrine	Tyramine	Metaraminol
Norepinephrine	Amphetamine	Ephedrine
Levonordefrin	Methamphetamine	
Isoproterenol	Hydroxyamphetamine	
Dopamine		
Methoxamine		
Phenylephrine		

Catecholamines	Noncatecholamines
Epinephrine	Amphetamine
Norepinephrine	Methamphetamine
Levonordefrin	Ephedrine
Isoproterenol	Mephentermine
Dopamine	Hydroxyamphetamine
	Metaraminol
	Methoxamine

Dilutions of Vasoconstrictors

- The dilution of vasoconstrictors is commonly referred to as a ratio (e.g., 1:1000).
- Maximum doses of vasoconstrictors are presented in milligrams, or more commonly today in micrograms.
- A concentration of 1:1000 means that 1 g (1000 mg) of drug is contained in 1000 mL of solution
- A 1:1000 dilution contains 1000 mg in 1000 mL or 1.0 mg per milliliter of solution.

Vasoconstrictors : Cardiovascular reactions

- Using 1.8 mL of L A with vasoconstrictors for infiltrations and nerve blocks generally will not increase heart rate.
- Increasing the volume will increase heart rate.
- Intraosseous injections using local anesthetic agents with vasoconstrictors will almost always increase heart rate.
- **Contraindications** : Serious medical conditions are contraindications to routine dental treatment. (pheochromocytoma , hyperthyroidism)

Considerations in patients with cardiovascular disease :

- **Consultation with the patient's physician** : emphasize our anticipated treatment and the rationale for local anesthesia.
- **Plain anesthetic formulations** : Anesthetic solutions without vasoconstrictors are not safer than anesthetic solutions with vasoconstrictors and should not be given in large amounts.

Drug interactions

We should be cautious about administering a vasoconstrictor, or at least limit the amount of vasoconstrictor, in certain patients taking systemic drugs, including

- Antidepressants
- Beta-blocking agents
- Medicines that treat Parkinson disease
- Cocaine.

Drug	Medical condition suspected
Tricyclic anti depressants (TCA)	Cardiac arrhythmia
Nonselective beta-blocking agents	Increases in blood pressure and Reflex bradycardia
Medicines treating Parkinson disease	Exaggerated effect on blood pressure and heart rate
Cocaine	Dysrhythmias and other serious cardiac problems

Category of drug	Alternative measures can be taken - with L A adrenaline combination
Antidepressants	Serotonin re uptake inhibitors (fluoxetine) MAO
In Parkinson's disease	Reduce cartridges to 2 or 3
Beta blockers	Selective beta blockers

Injection Pain

Injection pain in the maxilla and mandible :

local infiltration in the maxillary anterior region yielded the highest discomfort scores.

- Among the anterior and posterior palate infiltration was more uncomfortable in the anterior palate than posterior palate
- **Needle size** : Needle gauge (25-, 27-, and 30-gauge) does not seem to matter in perception of pain in the oral cavity.

Injection techniques

1. **Slow injection** :

- A slow injection (deposition of anesthetic solution) decreases pressure and patient discomfort during injection.
- CCLAD (computer controlled local anesthetic delivery) system decreases the pain of injection considerably.

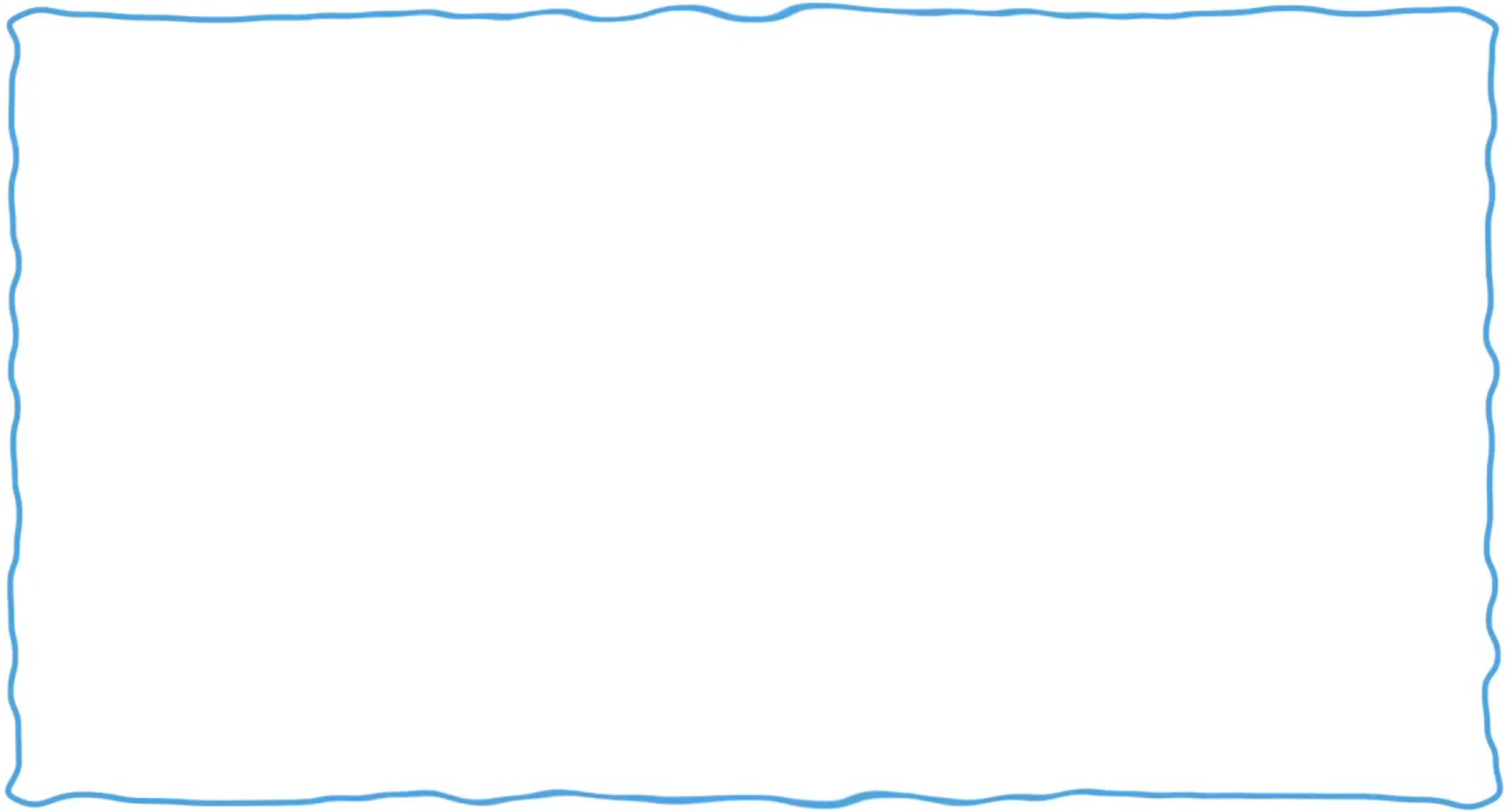
WAND :

Computer-controlled local anesthetic delivery (C-CLAD) technique: Designed to improve on the ergonomics and precision of the dental syringe

WAND STS SYSTEM

Dynamic pressure sensing technology (DPS) – CCLAD

Provides both visual and audible feedback regarding placement of the needle tip during the periodontal ligament (PDL) injection.



Local anesthesia boosting gun

- Slow , medium and fast
- Perfect for block, infiltration and intraligamentary injection

2. Two-stage injection : Initial very slow administration of approximately a quarter cartridge of anesthetic solution just under the mucosal surface Once regional numbness occurs, the remaining anesthetic solution is given to the full depth at the target site. Helpful in reducing the pain of injection.

Topical anesthetics

- Is most effective in the maxillary anterior region for reducing injection pain.
- Should be applied for at least 1 minute and before each injection.

Effective concentrations for injection and topical anesthasia.

Agent	Effective Concentration		Useful as Topical Anesthetic
	Injection (%)	Topical (%)	
Lidocaine	2	2–5	Yes
Mepivacaine	2–3	12–15	No
Procaine	2–4	10–20	No
Tetracaine	0.25–1	0.2–1	Yes

• **Fig. 4.8** 20% benzocaine containing topical anesthetic gels. (A and B) available in a variety of 'flavors.' ([A] Courtesy Beautlich Pharmaceuticals, Waukegan, Illinois, United States, [B] Courtesy of Septodont, Inc., Lancaster, PA.)

• **Fig. 4.9** Cetacaine brand of benzocaine, butamben, and tetracaine hydrochloride. (Courtesy Cetylite Inc., Pennsauken, New Jersey, United States.)

EMLA (Eutectic Mixture of Local Anesthetics)

- Composed of 2.5% lidocaine and 2.5% prilocaine is an emulsion in which the oil phase is a eutectic mixture of lidocaine and prilocaine in a ratio of 1:1 by weight.
- Contraindicated for use in patients with congenital or idiopathic methemoglobinemia, children younger than 12 months who are receiving treatment with methemoglobin inducing agents.
- Not recommended for use on mucous membranes.

Oraqix : The dental formulation of EMLA, Composed of 2.5% lidocaine and 2.5% prilocaine.

- Application of the periodontal gel to periodontal pockets produces an anesthetic effect in 30 seconds.
- The duration of anesthesia is approximately 20 minutes (range 14 to 27 minutes).
- Reapplication may be needed to maintain the anesthetic effect for the duration of the planned procedure

Lidocaine

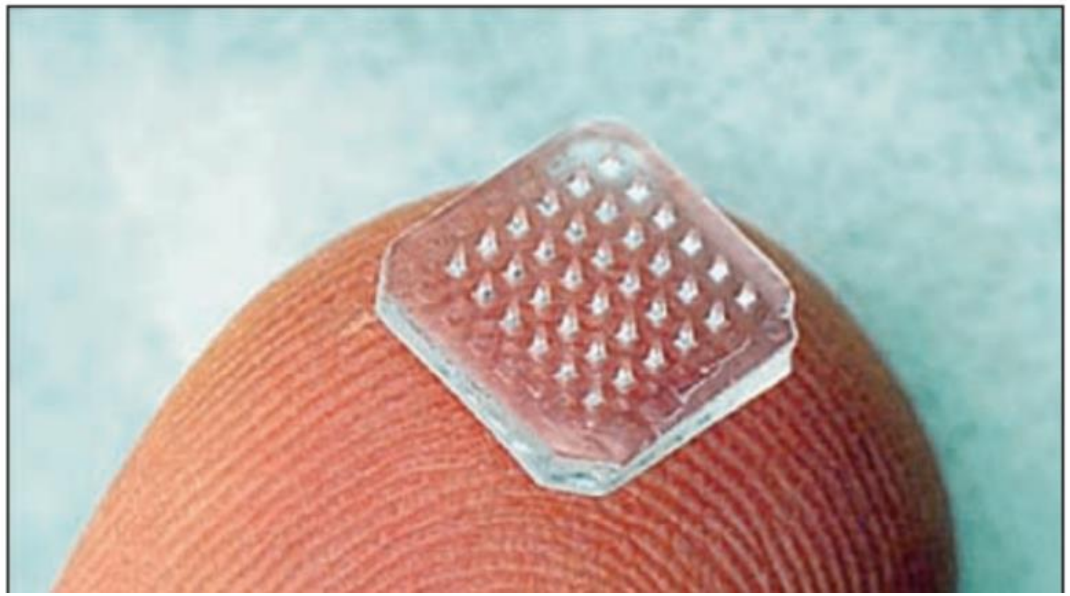
I- **lidocaine base**, which is poorly soluble in water, used as a 5% concentration, is indicated for use on mucous membrane, ulcerated, abraded, or lacerated tissue.

II- **lidocaine hydrochloride** : its water-soluble preparation, which is used as a 2% concentration.

• **Fig. 4.11** Topical anesthetics: lidocaine. (A) Lidocaine ointment. (B) Dentipatch. ([A] Courtesy of Septodont, Inc., Lancaster, PA and [B] Courtesy Noven Pharmaceuticals Inc., Miami, Florida, United States.)

Microneedle-based lidocaine injection :

Microneedles may be used in future for deliver topical anesthetics across mucus membrane surface painlessly



Alternative Modes of Reducing Injection Pain

Warming anesthetic solution : further research is needed on warming anesthetic solution.

Palatal anesthesia with cooling : In pediatric patients, precooling the soft tissues with ice helped to reduce the pain of local anesthetic injection

Using Endo-Ice or prolonged cold application to the palatal mucosa should not be used clinically to achieve anesthesia.

Fig 1-19 Postoperative palatal lesion caused by the application of Endo-Ice.

Sonophoresis : Produces ultrasonic energy that generates microchannels between the keratinized cells of the stratum corneum—allowing topical anesthetic to penetrate this layer.

- The application of sonophoresis/topical lidocaine does not seem to be effective in reducing injection pain.

Jet injection : May be useful for topical anesthesia

- But may not be effective orally and does not provide consistent pulpal anesthesia.

- **Counter stimulation and distraction** : Counter stimulation (Using finger vibration of oral tissue) and distraction (raising the right and left legs) were found to reduce pain reaction in pediatric patients.

Fig 1-21 J-Tip jet injectors inject the local anesthetic under pressure after being loaded with local anesthetic solution.

Fig 1-22 Patient using audio sedation. (Courtesy of b-Calm.)

Vibrating devices and their effect on pain :

- VibraJect , potentially reduce injection pain.
- The DentalVibe : Vibrates, illuminates, and retracts the tissue during a dental injection.

Fig 1-23 VibraJect is a vibrating unit that is attached to a local anesthetic syringe. (Courtesy of Vibraject.)

Fig 1-24 The DentalVibe *(a)* creates vibrations in the tissues around the injection site as well as illumination while anesthesia injections are administered *(b)*. (Courtesy of Bing

Electronic dental anesthesia and transcutaneous electrical nerve stimulation (EDA & TENS)

- Various pediatric studies have found that electronic dental anesthesia (EDA) reduced discomfort during local anesthetic administration in young, sedated dental patients and was effective in pain control.
- EDA and TENS are not totally effective for pain control.

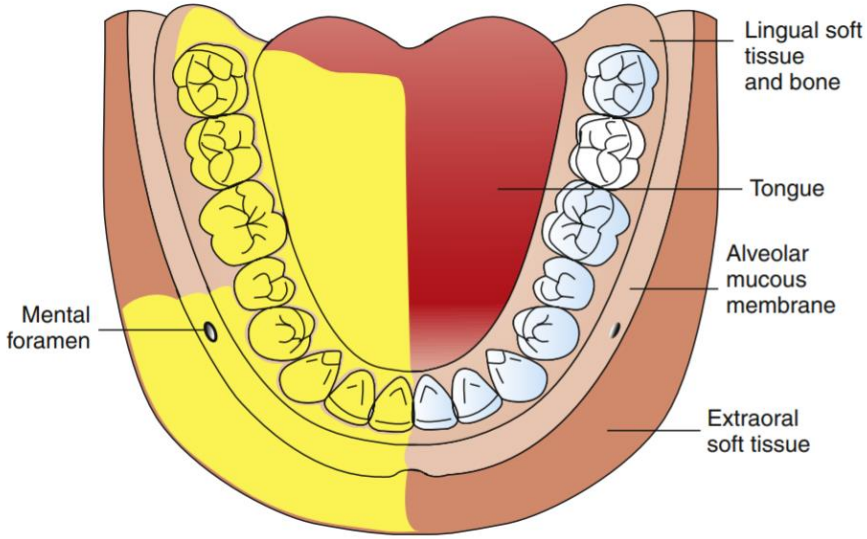
MANDIBULAR ANESTHEASIA

Inferior alveolar nerve block (IANB)

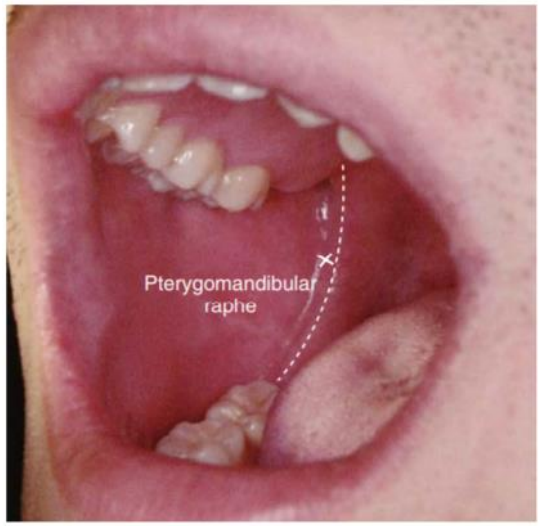
Nerves Anesthetized

- Inferior alveolar nerve, Incisive nerve, Mental nerve and Lingual nerve (commonly)

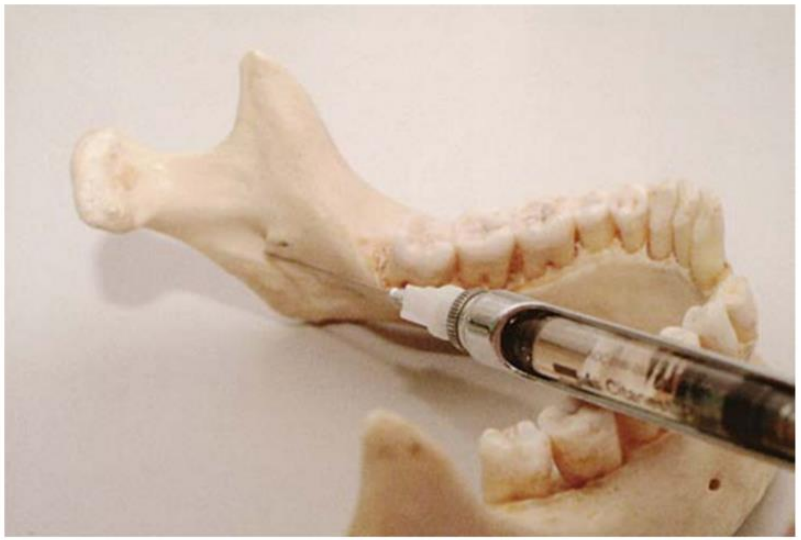
Areas anesthetized .



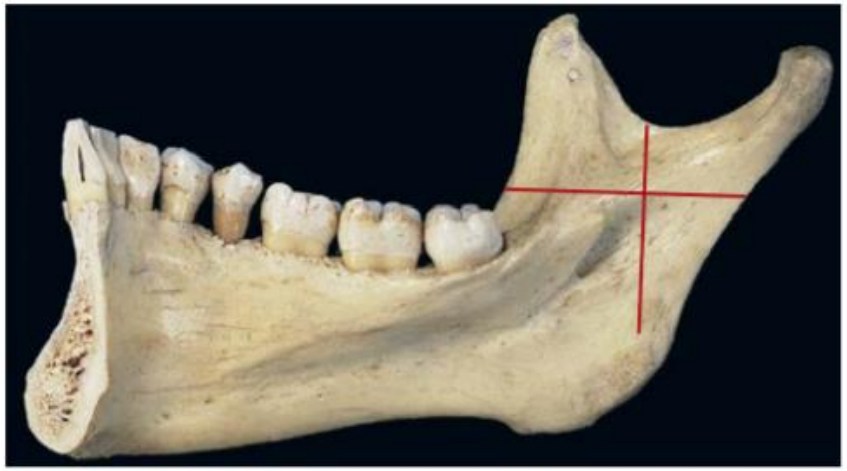
• **Fig. 14.2** Osseous landmarks for inferior alveolar nerve block. *1*, Lingula; *2*, distal border of ramus; *3*, coronoid notch; *4*, coronoid process; *5*, sigmoid (mandibular) notch; *6*, neck of condyle; *7*, head of condyle.



• **Fig. 14.3** The posterior border of the mandibular ramus can b approximated intraorally by use of the pterygomandibular raphe as turns superiorly toward the maxilla.



• **Fig. 14.6** Placement of the needle and syringe for an inferior alveolar nerve block.



• **Fig. 14.7** Needle insertion is at the point of intersection of horizontal and vertical lines

- **Anesthetic success :** varies from 51% in the first molar to 10% in the central incisor even though patients have profound lip numbness.
- **Anesthetic failure** : anesthetic failure varies from 23% in the first molar to 58% in the central incisor even though patients have profound lip numbness.
- **Onset of pulpal anesthesia** : within 5 to 19 minutes.
- **Slow onset** : about 12% to 20% of patients have slow onset of pulpal anesthesia
- **Onset of lip anesthesia**: onset of lip numbness is usually within 4.5 to 6 minutes

- **Noncontinuous anesthesia** : Noncontinuous anesthesia means that the patient does not have a continuous duration of anesthesia during the appointment and reports episodes of anesthesia followed by a lack of pulpal anesthesia.
- **Missed blocks** : Not obtaining profound lip numbness within 15 to 20 minutes after an IANB

The missed block differs from a failed IANB, where lip numbness is achieved but not pulpal anesthesia

- **Buccal nerve anesthesia with an IANB**: buccal soft tissue anesthesia could be obtained in 30% to 63% of the time with only an IANB using 1.8 to 3.6 mL of lidocaine with epinephrine.
- A separate long buccal injection should be given when soft tissue anesthesia is required in the molars.
- **Positive aspirations** : Positive aspirations occur from 10 to 15 % of the time with an IANB. (Highest of all intra oral techniques)
- **Trismus** : 2% to 9%

Alternate Anesthetic Solutions for the IANB

I- Plain solutions: Mepivacaine and prilocaine : 3% mepivacaine plain and 4% prilocaine plain are equivalent to 2% lidocaine with 1:100,000 epinephrine for pulpal anesthesia of approximately 50-minute duration

- Using 3% mepivacaine (Carbocaine) is an excellent alternative for the IANB when medical conditions or drug therapies suggest caution in administering epinephrine-containing solutions.
- **Levonordefrin as a vasoconstrictor**: Less cardiac and central nervous system stimulation than epinephrine.

II- Articaine

Available as a 4% solution with 1:100,000 and 1:200,000 epinephrine.

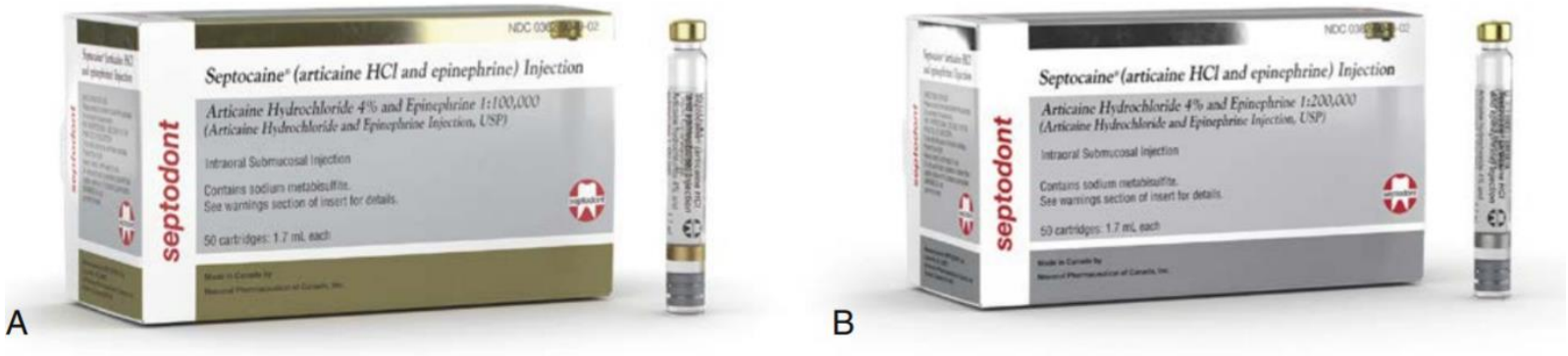
- Contains Thiophene ring : Facilitate better diffusion of the anesthetic solution.
- Faster onset, longer duration
- Higher success rate
- Greater potency (1.5 times)
- Initial stinging pain of injection can be bypassed with articaine because its pH is close to pH of body fluids.
- Shows enhanced anesthetic effects when used as a primary buccal infiltration of the mandibular first molar and as a supplemental buccal infiltration of the first molar following an IANB

Safety : Both lidocaine and articaine have the same maximum dose of 500 mg .

Paresthesia and methemoglobinemia : Articaine , like prilocaine, has the potential to cause methemoglobinemia.

The incidence of neuropathies

Articaine and prilocaine had a higher incidence of paresthesia's.



• **Fig. 4.5** Articaine, 4%, with epinephrine 1:100,000 (A) and 1:200,000 (B). (Courtesy of Septodont, Inc., Lancaster, PA.)

Orabloc articaine formulation

- An articaine local anesthetic containing a vasoconstrictor and is available in two epinephrine formulations—1:200,000 and 1:100,000.
- it is a “purer” form of articaine that has a 24-month shelf life at room temperature and very low manufacture-related degradation .

III- Long-acting anesthetic agents :

Bupivacaine and etidocaine

- Onset 2- 7 minutes , Duration 2-9 hours
- Cardiotoxic
- Combination with lignocaine works better.
- 0.5% bupivacaine with 1:100,000 epinephrine is used .
- Slower onset of pulpal anesthesia and prolongs the duration of pulpal anesthesia when compared with lidocaine.
- Average duration of pulpal anesthesia of 4 hours while the lidocaine formulation averaged 2 hours and 24 minutas.

Other long-acting agents : Ropivacaine.

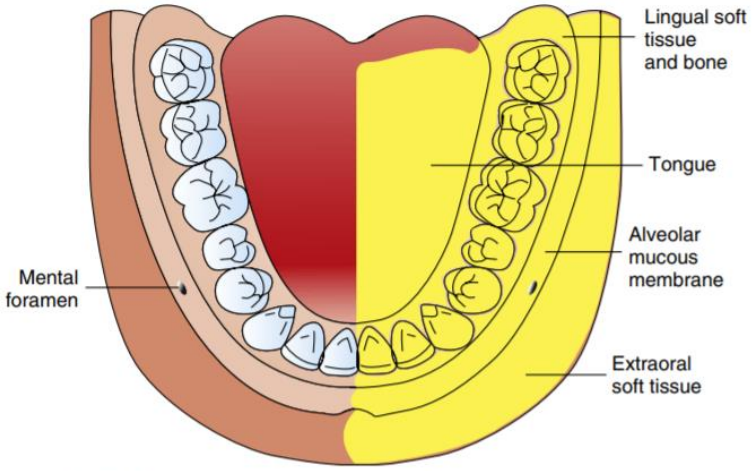
- A number of studies have demonstrated that ropivacaine has a lower potential for central nervous system and cardiovascular toxic effects than bupivacaine.

- Ropivacaine and levobupivacaine have the potential to replace bupivacaine in clinical dental practice due to the decreased potential for cardiac and central nervous system toxicity

Alternative anesthetic techniques

Gow gates technique : The Gow-Gates technique is a true mandibular nerve block because it provides sensory anesthesia of virtually the entire distribution of V3.

- The incidence of unsuccessful anesthesia with Gow-Gates mandibular nerve block may be as high as (if not higher than) that for the IANB until the administrator gains clinical experience with it.
- Following this “learning curve,” success rates greater than 95% are common



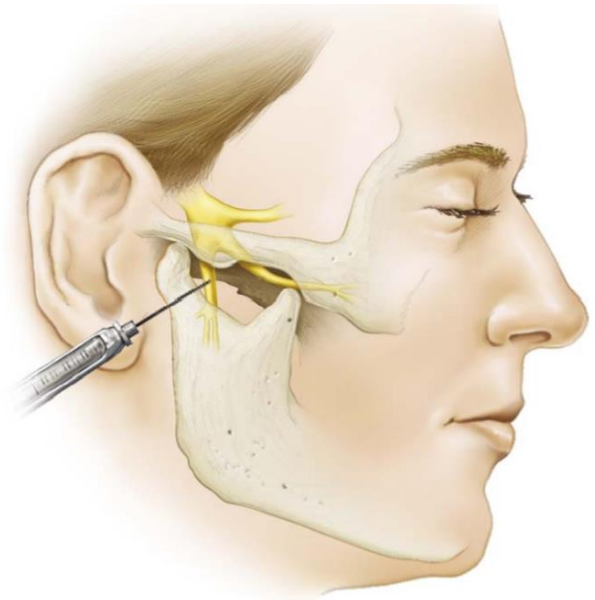
• **Fig. 14.16** Area anesthetized by the Gow-Gates mandibular nerve block.

Extra oral landmarks for gow gates technique :
The lower border of the tragus of the ear and the corner of the mouth

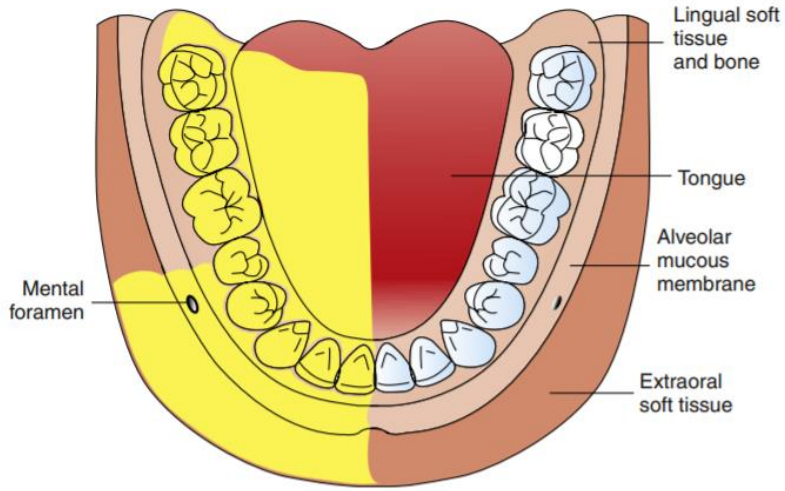
Intra oral landmark :
The neck of the mandibular condyle.

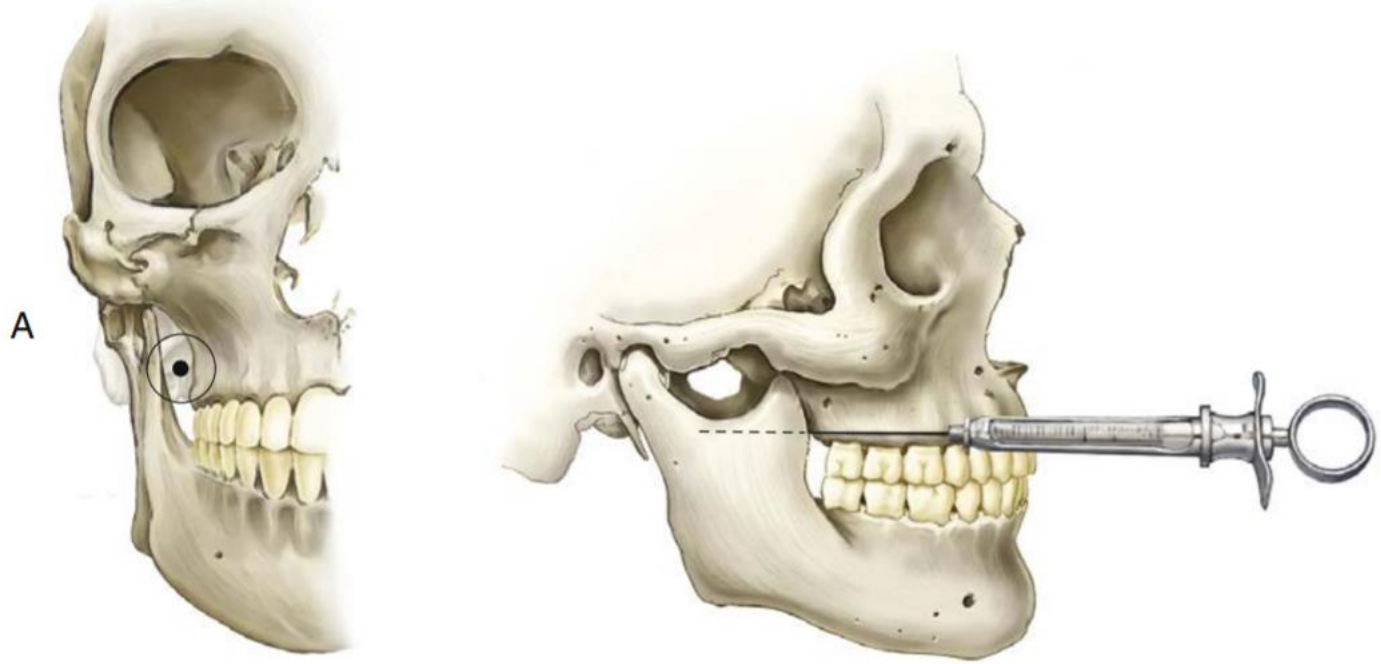
Vazirani-Akinosi Closed - Mouth Mandibular Block

- Indication remains those situations where limited mandibular opening precludes the use of other mandibular injection techniques.
- Used in trismus or limited mouth opening patients



• **Fig. 14.23** Extraoral mandibular block using a lateral approach through the sigmoid notch. (Redrawn from Bennett CR: *Monheim's local anesthesia and pain control in dental practice*, ed 6, St Louis, 1978, Mosby.)





• **Fig. 14.25** (A) Area of needle insertion for a Vazirani-Akinosi closed-mouth mandibular nerve block. (B) Hold the syringe and needle at the height of the mucogingival junction above the maxillary third molar. (Redrawn from Gustainis JF, Peterson LJ: An alternative method of mandibular nerve block, *J Am Dent Assoc* 103:33–36, 1981.)

Vazirani-Akinosi technique. This closed-mouth technique has the landmark for needle insertion on line with the mucogingival junction of the maxillary second molar.

Gow-Gates and Vazirani-Akinosi techniques

- In subjects who achieved lip numbness, the conventional IANB was similar to the Gow-Gates and Vazirani-Akinosi techniques regarding anesthetic success .
- These techniques had a slower onset of pulpal anesthesia when compared with the conventional technique and do not replace the conventional IANB
- Incidence of buccal nerve anesthesia : buccal nerve anesthesia is not complete with the Gow-Gates or Vazirani-Akinosi technique

Evaluating Mechanisms of Failure with the IANB

I- Accessory innervation

Mylohyoid nerve

- Anesthetized using peripheral nerve stimulator
- Mylohyoid injection did not significantly enhance pulpal anesthesia of the IANB
- Therefore Mylohyoid nerve is not a major factor in failure with the IANB.

Anesthetic efficacy of the mylohyoid nerve block and combination inferior alveolar nerve block/mylohyoid nerve block

Stephen Clark, DDS, MS,[a] Al Reader, DDS, MS,[b] Mike Beck, DDS, MA,[c] and William J Meyers, DMD, MEd,[d] Columbus, Ohio
THE OHIO STATE UNIVERSITY

Conclusions. The results of this study suggest that the mylohyoid nerve block does not by itself predictably provide pulpal anesthesia in mandibular teeth and does not significantly enhance pulpal anesthesia when administered in combination with the IAN block.

(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999;87:557-63)

II- Cross innervation : In mandibular central and lateral incisors plays a very small role in failure with the IANB

III- Bifid mandibular canals (0.95% bifid canals)

- More recent studies using cone beam computed tomography have reported an incidence ranging from 16% to 65%.
- While bifid canals have been reported in the mandible, the exact relationship to failure needs further research.

IV- Accuracy of the injection :

Inaccurate injection contributes to inadequate mandibular anesthesia.

Techniques to improve accuracy of injection

- **A medical ultrasound unit to guide needle placement for IANBs**. The transducer probe with attached needle guide used to place the needle next to the neurovascular bundle.
- **Peripheral nerve stimulators :** Used for regional nerve blocks and to assess the degree of neuromuscular blockade achieved.

The use of ultrasound for guiding needle placement for inferior alveolar nerve blocks

Lawrence Hannan, DDS, MS, MS,[a] Al Reader, DDS, MS,[b] Robert Nist, DDS, MS,[c] Mike Beck, DDS, MA,[d] and William J. Meyers, DMD, MEd,[e] Columbus, Ohio
THE OHIO STATE UNIVERSITY

Objective. The degree of pulpal anesthesia obtained with an ultrasound-assisted inferior alveolar nerve block was compared to that obtained with a conventional inferior alveolar nerve block for mandibular teeth to determine whether needle placement assisted by ultrasound results in more successful anesthesia.
Study design. Through use of a repeated-measures design, each of 40 subjects randomly received an ultrasound-assisted inferior alveolar nerve block and a conventional inferior alveolar nerve block at 2 separate appointments. Mandibular anterior and posterior teeth were blindly tested by means of a pulp tester at 4-minute cycles for 60 minutes postinjection. Anesthesia was considered successful when 2 consecutive readings of 80 were obtained.
Results. One hundred percent of the subjects had profound lip numbness with both the ultrasound-assisted inferior alveolar nerve block and the conventional inferior alveolar nerve block. For these 2 techniques, anesthetic success rates for individual teeth ranged from 38% to 92%. There were no significant differences ($P > .05$) between the 2 techniques.
Conclusions. It was concluded that accurate needle placement with ultrasound for the inferior alveolar nerve block did not result in more successful pulpal anesthesia in the mandible. Therefore, accuracy of needle placement is not the primary reason for pulpal anesthetic failure with this block.
(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999;87:658-65)

- Accurate needle location did not guarantee successful anesthesia : 25 % of accurate blocks resulted in anesthetic failure.
- Once lip numbness is achieved, lack of pulpal anesthesia is not due to an inaccurate IANB
- Average needle depth for an IANB - 19 +/- 2.34 mm
- T The best estimate is approximately 19 mm

V- Handling of the anesthetic vials

ORIGINAL ARTICLE

Year : 2017 | **Volume** : 8 | **Issue** : 3 | **Page** : 363-366

Are local anesthesia vials similar to champagne: Do they lose their potency once opened?: An *in vitro* study

PS Gopinath Thilak[1], Sameep S Shetty[2], Jagadeesh Chandra[3], Kavana Gowda[4]

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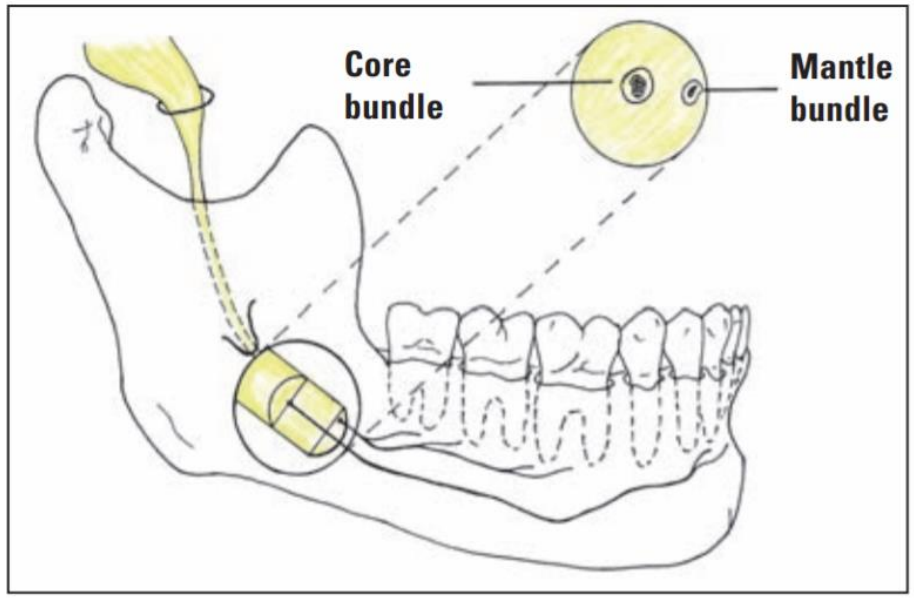
Date of Web Publication 14-Sep-2017

Local anesthetic vials with needle pricked in for a longer duration can alter the pH, concentration of the vasoconstrictor and deteriorate the properties of local anesthetic solution. This can manifest clinically as delayed onset of action, increased burning sensation, and pain on administration. The article aims to adopt the cartridge system, while administering local anaesthesia and necessitates the need to discard the age old practice for a safe and effective delivery of local anaesthesia.

VI- The central core theory:

States that nerves on the outside of the nerve bundle supply molars, while nerves on the inside of the bundle supply anterior teeth

- This theory explains the higher experimental failure rates in anterior teeth with the IANB



The axons in the mantle bundle supply the molars, and those in the core bundle supply the anterior teeth. The extraneural local anesthetic solution diffuses from the mantle to the core.

Attempts to Increase the Success of the IANB in Asymptomatic Patients

- **Increasing the volume - ** Does not increase pulpal anesthesia in an IANB.
- **Increasing the epinephrine concentration** : No advantage to using a higher concentration (1:50,000) of epinephrine in an IANB
- **Combining lidocaine/ hyaluronidase solution :** Resulted in a significant increase in postoperative pain and trismus. adding hyaluronidase to a lidocaine formulation does not increase pulpal anesthesia in an IANB.

0099/2399/89/1501-0006/$02.00/0
JOURNAL OF ENDODONTICS

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An Evaluation of Volumes and Concentrations of Lidocaine in Human Inferior Alveolar Nerve Block

David L. Vreeland, DDS, MS, Al Reader, DDS, MS, Mike Beck, DDS, MA, William Meyers, DMD, MEd, and Joel Weaver, DDS, PhD

The purpose of this study was to evaluate, with the electric pulp tester, the anesthetic efficacy of 1.8 ml of 2% lidocaine with 1:100,000 epinephrine, 3.6 ml of 2% lidocaine with 1:200,000 epinephrine, and 1.8 ml of 4% lidocaine with 1:100,000 epinephrine in human inferior alveolar nerve block. Thirty subjects randomly received each of the solutions at three successive appointments. The first molar, canine, lateral incisor, and contralateral canine were tested with the pulp tester at various time intervals up to 55 min. Complete anesthesia was defined as an 80/80 reading with the pulp tester. No significant differences in anesthetic success or failure were found among the three solutions. Potential anesthetic problems (failure, noncontinuous anesthesia, slow onset, and short duration) occurred in 43 to 57% of the molars, in 43 to 60% of the canines, and in 57 to 80% of the lateral incisors. Complete anesthesia in the mandible is a meaningful clinical problem.

Carbonated anesthetic solutions

- Sodium bicarbonate solution is mixed with a local anesthetic lidocaine with epinephrine.
- A truly carbonated lidocaine solution does not increase pulpal anesthesia in an IANB.

Frequency-dependent conduction blockade of the IANB : Repetitive high frequency electrical stimulation

Did not statistically increase the success rate of pulpal anesthesia for an IANB.

Diphenhydramine as a substitute local anesthetic agent

- Diphenhydramine has been advocated for patients who are allergic to commonly used local anesthetics.
- less effective for pulpal anesthesia than lidocaine with epinephrine for IANBs.
- Is more painful upon injection and had a high incidence of moderate postoperative pain.
- is a poor choice for local anesthesia in patients allergic to common local anesthetic agents.

Methods to Increase the Success of Mandibular Anesthesia in Asymptomatic Patients

I-Buccal infiltration of 1.8 mL of 4% articaine with 1:100,000 epinephrine resulted in a higher success rate (Pulpal anesthesia for 1 hour)

II-Supplemental intraosseous injections : Supplemental intraosseous injections, lidocaine and mepivacaine formulations with vasoconstrictors allow quick onset and increase the success of the IANB for approximately 60 minutes.

Articaine for Supplemental Buccal Mandibular Infiltration Anesthesia in Patients with Irreversible Pulpitis When the Inferior Alveolar Nerve Block Fails

Rachel Matthews, DMD, MS, Melissa Drum, DDS, MS,* Al Reader, DDS, MS,* John Nusstein, DDS, MS,* and Mike Beck, DDS, MA†*

We can conclude that when the IAN block fails to provide profound pulpal anesthesia, the supplemental buccal infiltration injection of a cartridge of 4% articaine with 1:100,000 epinephrine would be successful 58% of the time for mandibular posterior teeth in patients presenting with irreversible pulpitis.

III-Supplemental intraligamentary injection : A supplemental intraligamentary injection of 2% lidocaine with 1:100,000 epinephrine increases the success of the IANB, but the duration is approximately 23 minutes.

IV-Injection speed : A slow IANB (60 seconds) increases success of the IANB in asymptomatic subjects and is less painful.

V-Mannitol with lidocaine : They found that mannitol in combination with lidocaine increased anesthetic success approximately 15% to 20%

- Mannitol increases the success of the IANB by 15% to 20%, but it is not available clinically.

LIGAJECT

Easy intraligamentary anesthesia technique
Ultrashort 30 gauge needle and 1.8 ml cartridge

VI- Use of radiographs for locating anatomical landmarks: Anatomical variations.

- This will definitely help in improving the anesthetic success of IANB

  to locate the mandibular foramen
- Can be used to locate the foramen in both horizontal and vertical planes

Zhonghua Ya Yi Xue Hui Za Zhi. 1990 Sep;9(3):98-103.

[Age Changes in Location of Mandibular Foramen]

[Article in Chinese]
T J Hwang [1], S C Hsu, Q F Huang, M K Guo

In order to understand the changes in location of the mandibular foramen with age in children, lateral cephalometric radiographs from 112 child and adult patients, including both males and females, were randomly selected according to age. The subjects were divided into 6 age-groups; 3, 5, 7, 9, 11 and adult. Certain lines and points were traced on the radiographs used. The location of the mandibular foramen was identified by two persons. The perpendicular distance from the center of the mandibular foramen to the occlusal plane and the location of the mandibular foramen relative to the ramus height , as well as to the ramus width (a-p), were measured. The mandibular foramen was located 4.12 mm below the occlusal plane at the age of 3. It subsequently moved upward with age. By the age of 9, it had reached approximately the same level as the occlusal plane. The foramen continued to move upward to 4.16 mm above the occlusal plane in the adult group. The height percentage averages ranged from the lower 1/3 of the ramus height in the 3 year-old group to the middle of the ramus height in adults.

Three-dimensional anatomic analysis of mandibular foramen with mandibular anatomic landmarks for inferior alveolar nerve block anesthesia

Sang-Hoon Kang, DDS, PhD,[a,b] In-Young Byun, DDS,[a] Jin-Hong Kim, DDS,[a] Hee-Keun Park, DDS,[a] and Moon-Key Kim, DDS, PhD,[a,b] Goyang and Seoul, Republic of Korea
NATIONAL HEALTH INSURENCE CORPORATION, ILSAN HOSPITAL; and YONSEI UNIVERSITY

Objective. We sought to standardize 3-dimensional anatomic positioning of the mandibular foramen (MnF) for inferior alveolar nerve block anesthesia.

Study Design. Three-dimensional mandibular computerized tomography (CT) images were reconstructed from data for 49 patients aged 8-16 years (growth group) and 59 patients aged 18-25 years (adult group). To measure MnF position, we defined 5,6 as the superior contact point between the mandibular first molar and second premolar and 5,6 MnFP as the point on the MnF plane intersecting 5,6 at a right angle. The MnF plane passed through the MnF and parallel to the occlusal plane.

Results. In the growth group, the distance from the MnF to the anterior ramus increased with age, as did distance from the gonion to MnF.

Conclusions. Measurements correlated significantly with age in the growth group. Needle insertion at an obtuse angle in the MnF plane from the contralateral first molar is appropriate for inferior alveolar nerve block anesthesia. (Oral Surg Oral Med Oral Pathol Oral Radiol 2013;115:e17-e23)

Radiographic localization of mandibular anesthesia landmarks

Armaghan Afsar, BSc,[a] Daniel A. Haas, DDS, PhD, FRCD(C),[b] P. Emile Rossouw, BCHD, BCHD(Hons), MCHD, PhD,[c] and Robert E. Wood, DDS, MSc, PhD, FRCD(C),[d]
Toronto, Ontario, Canada
UNIVERSITY OF TORONTO

The objective of this study was to assess whether bony landmarks used for the standard inferior alveolar nerve block can be used to accurately determine the position of the mandibular foramen and whether panoramic radiographs are appropriate for this purpose. A total of 11 landmarks from 79 panoramic radiographs and 70 corresponding cases of oblique (45-degree) cephalometric radiographs were examined. Ten measurements of the distance from each landmark to the mandibular foramen, as well as 6 ratios from these distances, were calculated from all radiographs. The results showed that the position of the mandibular foramen was highly individualistic and not consistently related to traditional clinical landmarks. Panoramic radiographs were as good as oblique cephalometric radiographs for the locating of the mandibular foramen. No age or gender correlations were found. It was concluded that the mandibular foramen can be localized in panoramic radiographs but that its relation to bony landmarks is highly variable. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998;86:234-41)**

Maxillary anesthesia

Infiltration

- **Success using lidocaine with epinephrine** : infiltration injection of 1.8 mL of 2% lidocaine with 1:100,000 epinephrine- Pulpal anesthetic success ranged from 62% to 100%
- May not always be 100% successful due to the individual variations in response to the drug administered, operator differences, and variations of anatomy as well as tooth position.

- **Onset of pulpal anesthesia** : within 5 minutes in the maxilla.
- **Duration of pulpal anesthesia** : Around 30 to 35 minutes in anterior teeth and 45 to 50 minutes in molars.
- **Lip/cheek numbness or dead feeling of the teeth:** lip or cheek numbness or a dead feeling when tapping the teeth together does not always indicate pulpal anesthesia.

Alternate Anesthetic Solutions for Infiltration Injection

Plain solutions:

Plain solutions of 3% mepivacaine and 4% prilocaine are indicated for procedures of short duration.

- Are generally not as safe as solutions with vasoconstrictors if large volumes are administered in an attempt to achieve anesthesia in the maxilla.
- Rapidly absorbed systemically, resulting in excessive plasma concentrations and possible toxic reactions

Prilocaine with epinephrine

- 4% prilocaine with 1:200,000 epinephrine is similar to 2% lidocaine with 1:100,000 epinephrine for infiltration in the maxilla.

Mepivacaine with levonordefrin

- 2% mepivacaine with 1:20,000 levonordefrin is similar to 2% lidocaine with 1:100,000 epinephrine for infiltration in the maxilla.

Articaine with epinephrine: In anterior teeth, 4% articaine with 1:100,000 epinephrine may provide a higher success rate than 2% lidocaine with 1:100,000 epinephrine.

Bupivacaine with epinephrine

- 1.8 mL of 0.5% bupivacaine with 1:200,000 epinephrine has a lower success rate than 1.8 mL of 2% lidocaine with 1:100,000 epinephrine in anterior teeth.
- Soft tissue anesthesia : Bupivacaine provides longer lip numbness when compared with lidocaine.

Attempts for Increasing the Duration of Pulpal Anesthesia for Infiltrations

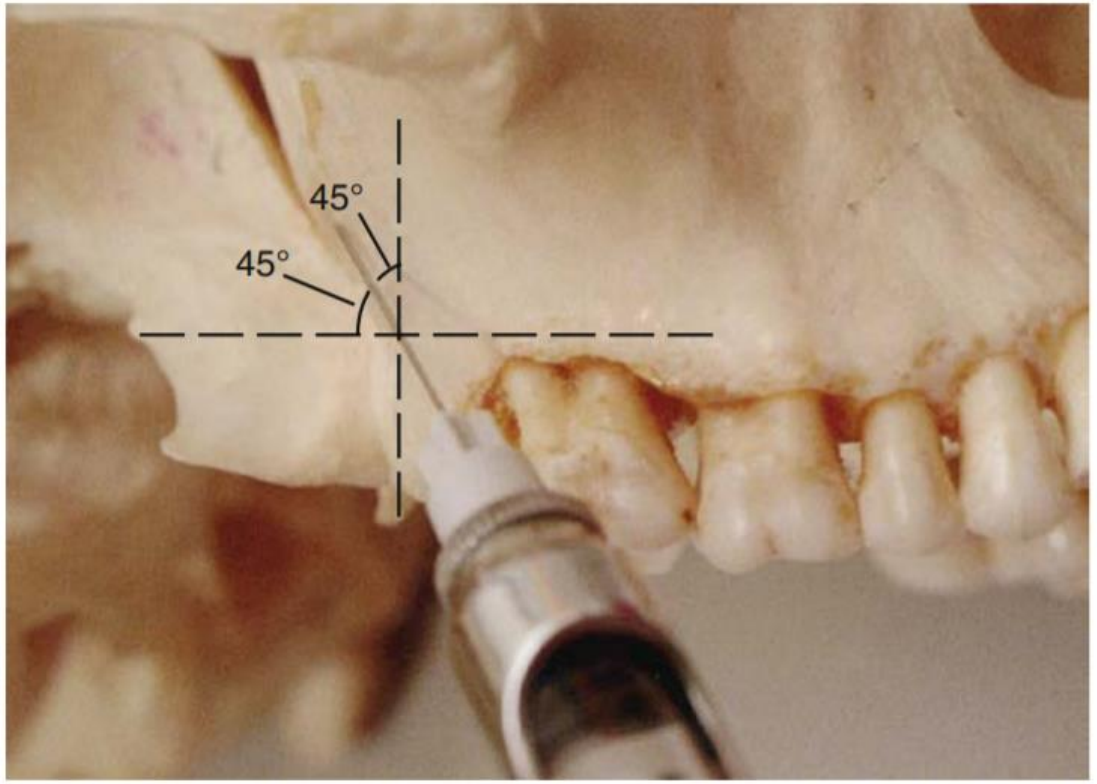
- **Increasing volume of solution** : 3.6 mL of extends duration of pulpal anesthesia when compared with 1.8 mL in maxillary infiltrations.

  However, pulpal anesthesia does not last for 60 minutes
- **Increasing epinephrine concentration** : increasing the epinephrine concentration to 1:50,000 in a 2% lidocaine solution increases the duration of pulpal anesthesia in the lateral incisor but not in the first molar.
- **Repeating an infiltration after 30 minutes** : Giving a cartridge of 2% lidocaine with 1:100,000 epinephrine 30 minutes after giving an initial cartridge of the same anesthetic agent significantly improved pulpal anesthesia.

Alternate Injection Techniques

I- Posterior superior alveolar nerve block (PSA)

- To anesthetize the first, second, and third molars.
- Anesthetic success for the 1.8 mL was 97% for the second molar and 77% for the first molar.
- Positive aspiration – 3.1 %
- To ensure patient comfort for the first molar, an additional buccal infiltration injection after the PSA block may be needed.

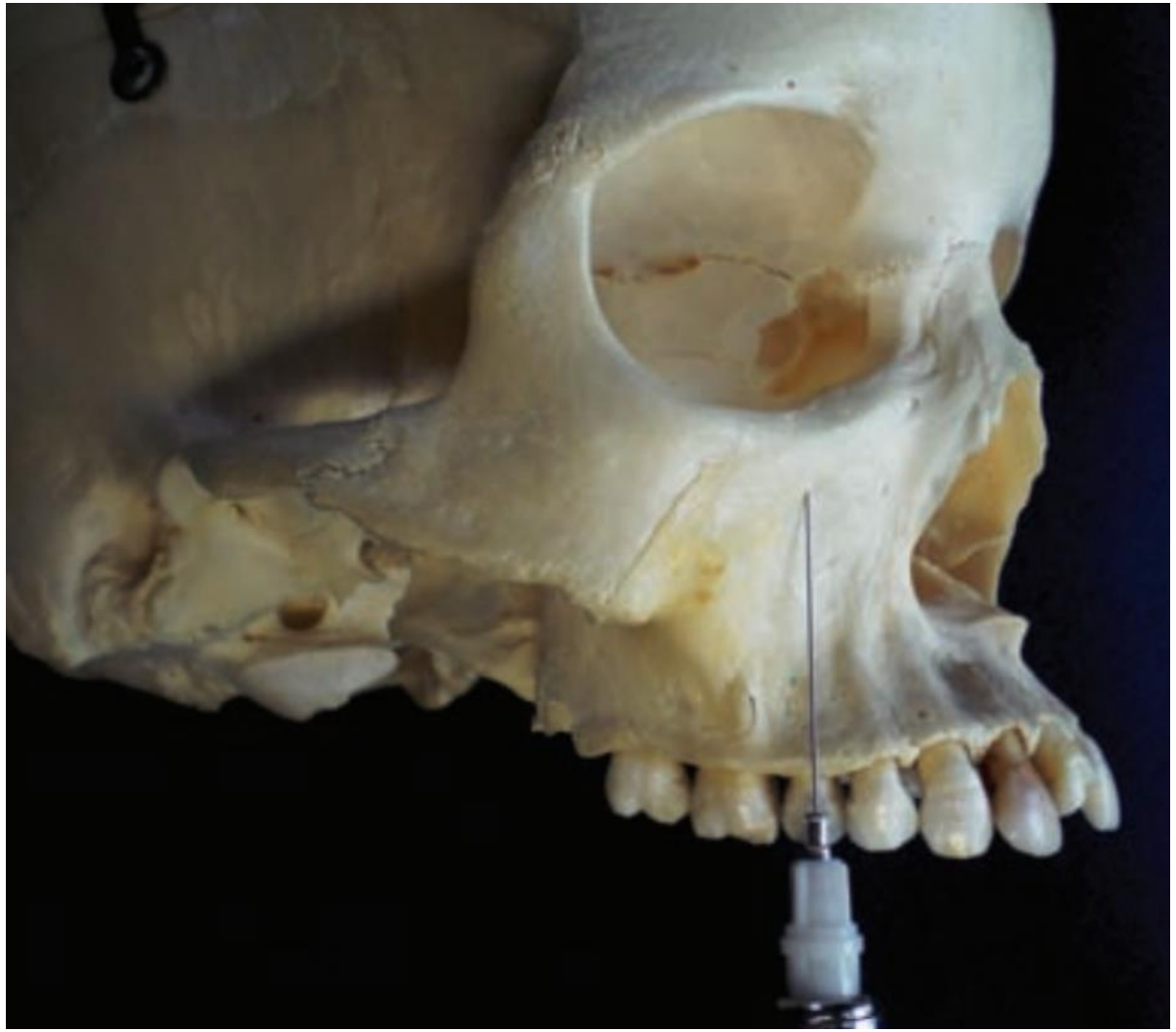


• **Fig. 13.11** Advance the needle upward, inward, and backward.

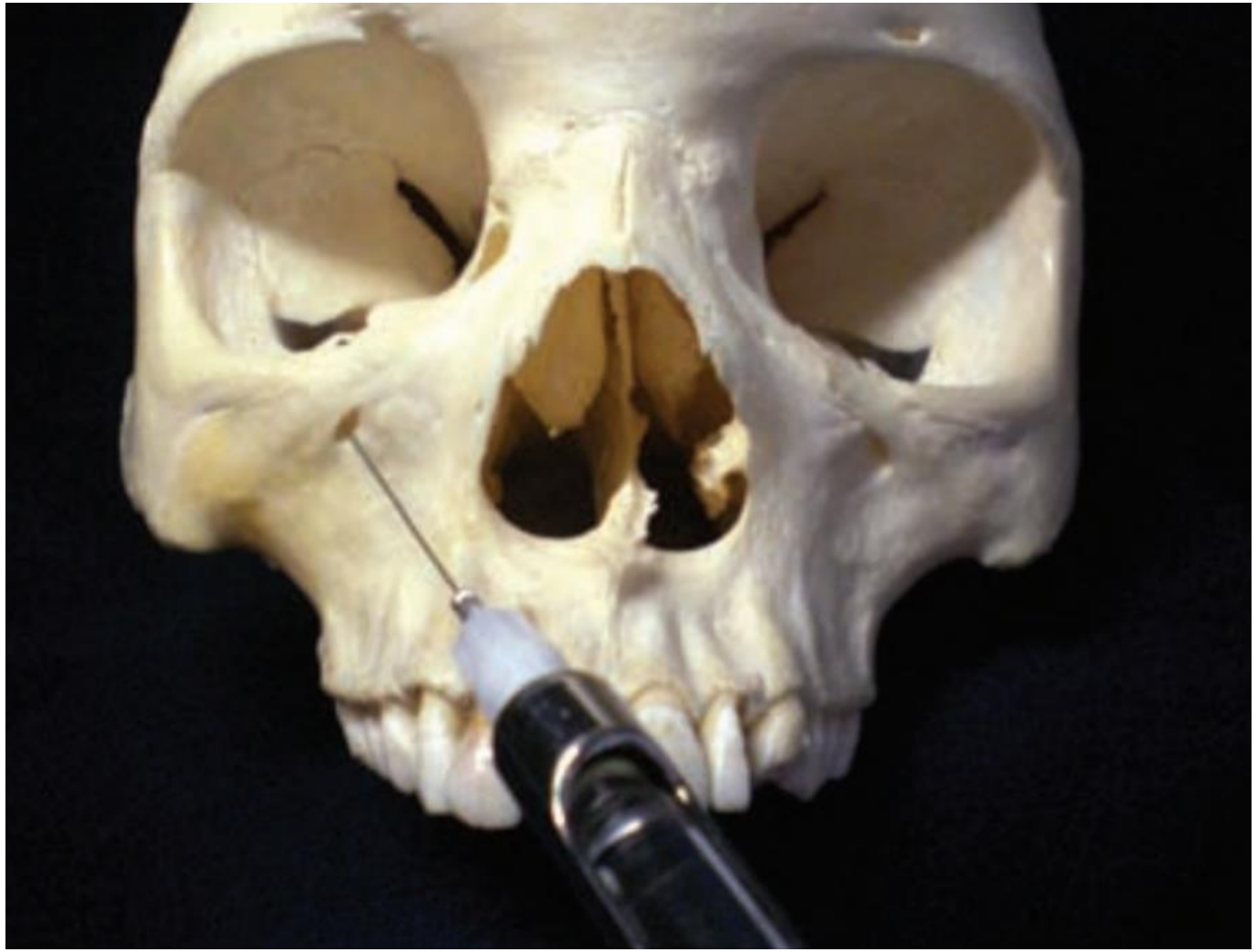
Because of the success rate of infiltration in the molars (see section on maxillary infiltrations), the PSA nerve block is not advocated for routine restorative procedures.

II-Anterior superior alveolar nerve block (ASA) / Infraorbital nerve block

- It is somewhat effective for the canine and premolars, but pulpal anesthesia does not last for 60 minutes.
- Does not provide effective pulpal anesthesia for the central incisor, lateral incisor, or first molar.
- The infiltration in the maxillary teeth, the intraoral infraorbital nerve block is not advocated for routine restorative procedures.



The needle path for the intraoral infraorbital nerve block is parallel to the long axis of the second premolar until it approximates the infraorbital foramen.

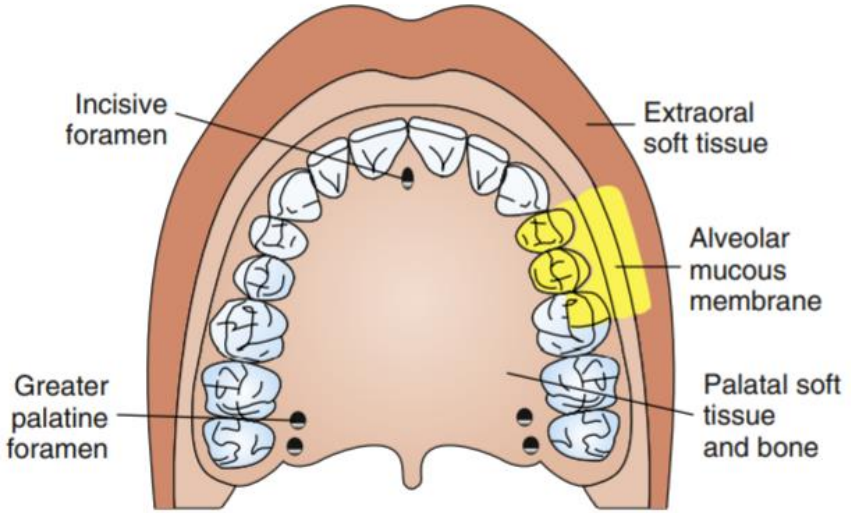


The needle path for the extraoral infraorbital nerve block would be backward, upward, and outward to penetrate the infraorbital canal.

Palatal–ASA nerve block

- Site-specific injection for anesthetizing anterior maxillary teeth
- The P–ASA injection uses a palatal injection into the incisive canal and supposedly anesthetize both the right and left anterior superior alveolar (ASA) nerves
- Has the potential to be a painful injection and does not provide predictable pulpal anesthesia for the maxillary incisors and canines.

Middle superior alveolar nerve block



• **Fig. 13.13** Area anesthetized by a middle superior alveolar nerve block.

- MSA nerve is present in about 28% of the population
- Height of the mucobuccal fold above the maxillary second premolar.
- Target area: Maxillary bone above the apex of the maxillary second premolar

Maxillary nerve block (IInd division) : An effective method of achieving profound anesthesia in the hemimaxilla.

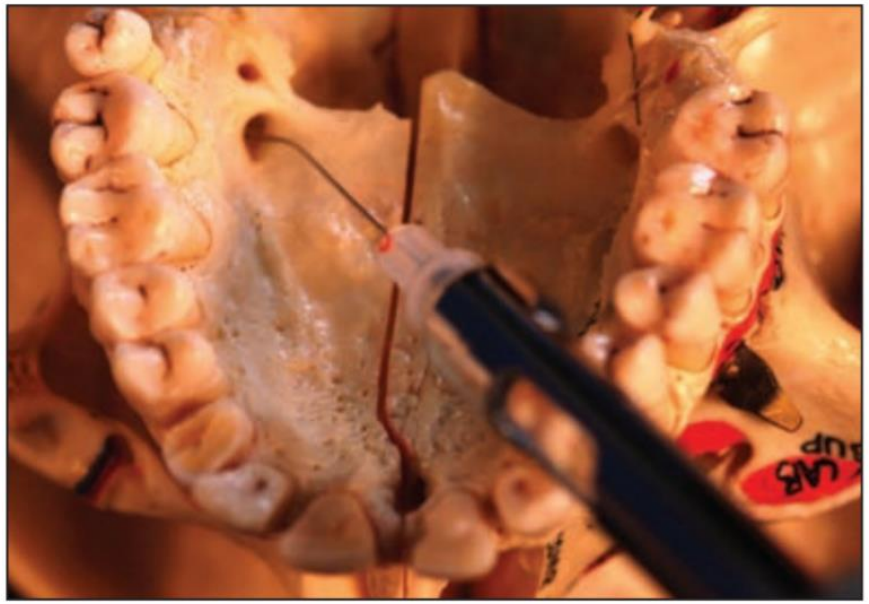


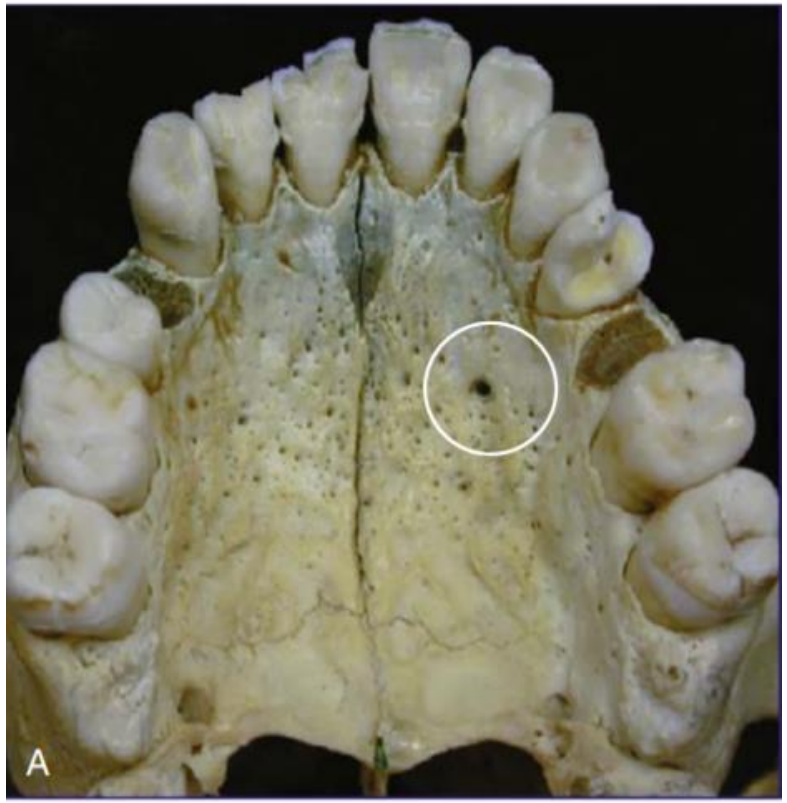
Fig 3-28 The greater palatine approach to the second division nerve block must negotiate the greater palatine canal to the pterygopalatine fossa.

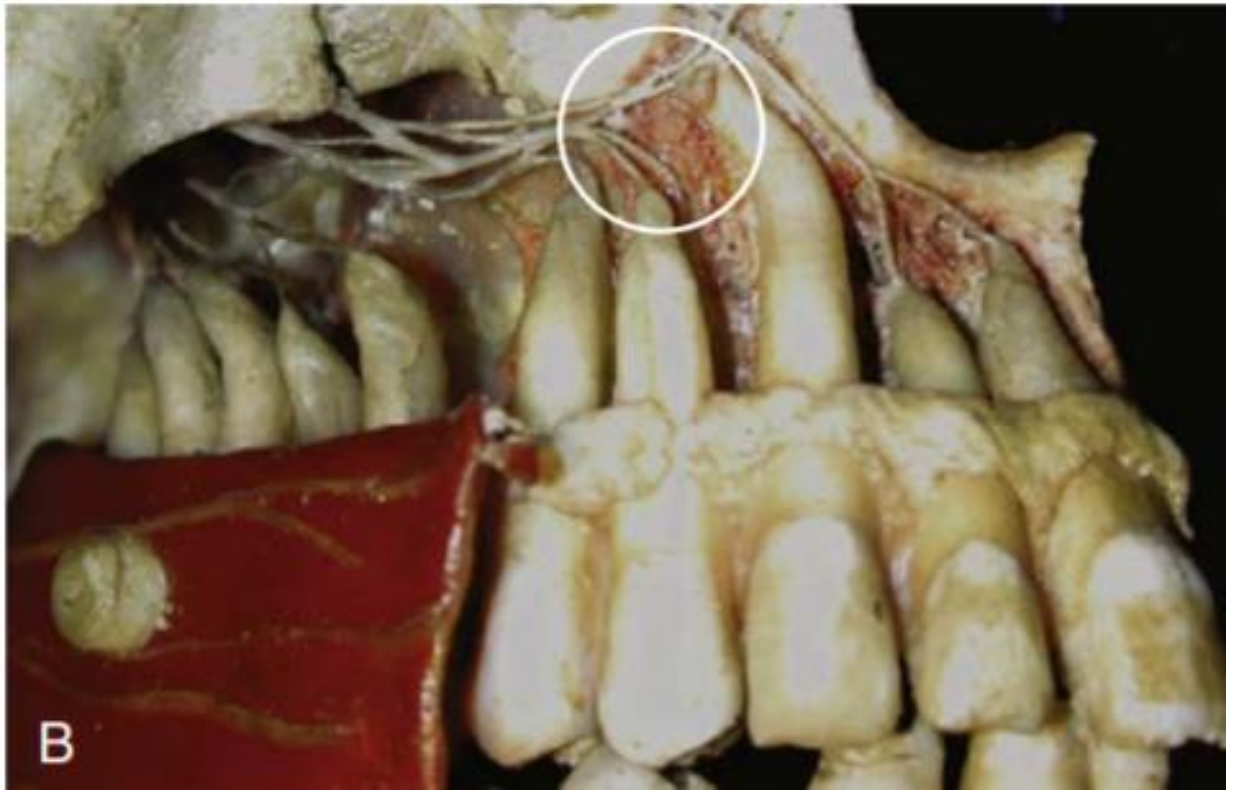
Fig 3-29 The high tuberosity approach to the second division nerve block places the needle around the posterior maxilla until the needle enters the pterygopalatine fossa.

- A second division nerve block does not provide pulpal anesthesia for the central incisor, lateral incisor, canine, or first premolar.
- The blocks are effective for pulpal anesthesia of the molars.
- Because of the success rate of the infiltration over the molars , the second division nerve block is not advocated for routine restorative procedures.

Anterior middle superior alveolar nerve block (AMSA)

- located palatally at a point that bisects the premolars and is approximately halfway between the mid palatine raphe and the crest of the free gingival margin.
- Anesthetize both the ASA and MSA nerves
- Pulpal anesthesia of the maxillary central and lateral incisors, canines, and first and second premolars will be achieved with the AMSA injection
- The AMSA nerve block has the potential to be a painful injection.





injection sites for the AMSA injection.

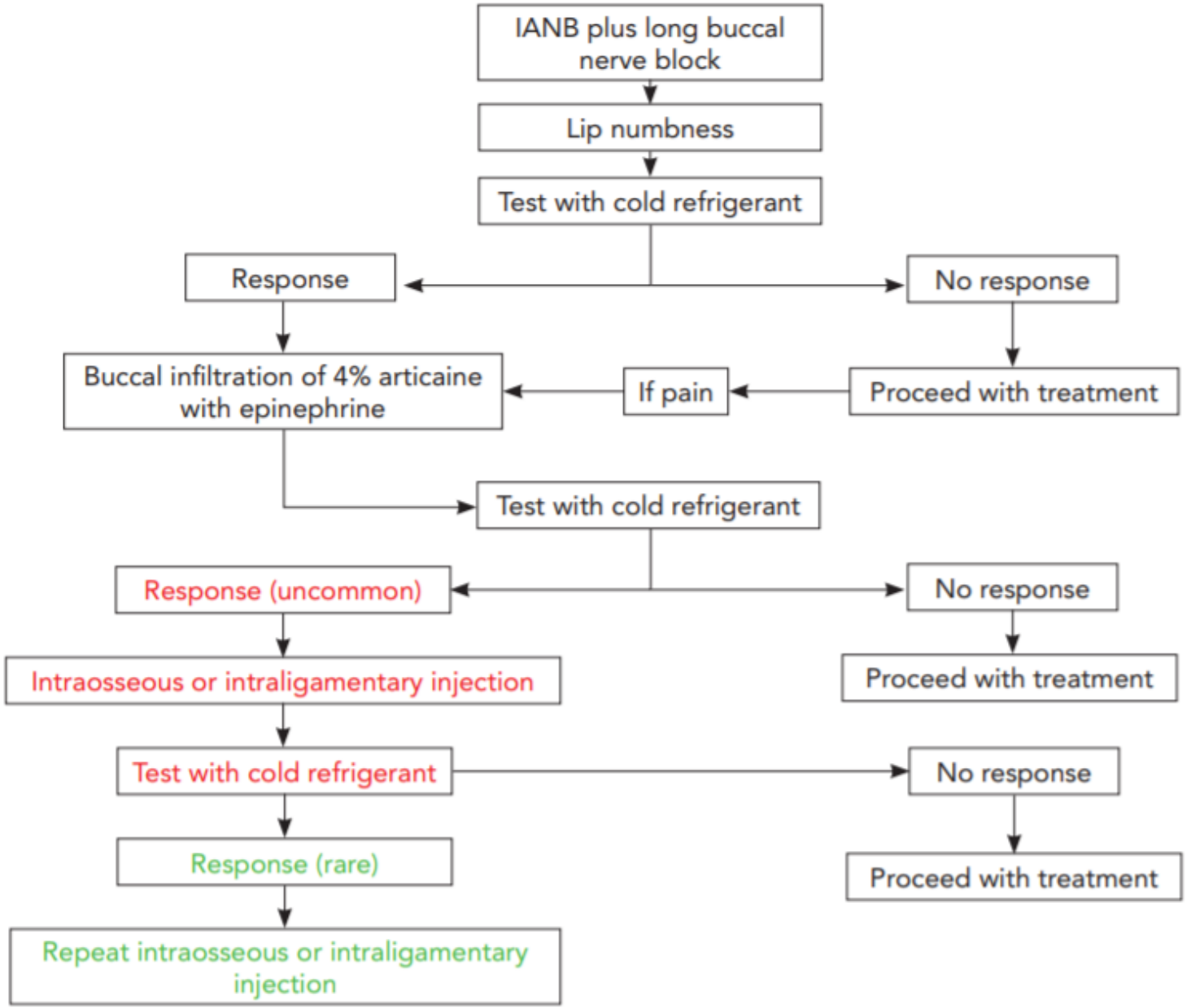
Methods to increase success of maxillary anesthesia

- **Tetracaine nasal spray for maxillary anesthesia**: further research is needed to confirm the efficacy of the combination of tetracaine/oxymetazoline nasal spray for anesthesia of maxillary teeth.
- **Addition of mannitol to lidocaine for maxillary infiltrations** : the addition of mannitol to lidocaine in maxillary infiltration anesthesia does not increase success
- **Buccal and palatal infiltration of the first molar** : the combination buccal plus palatal infiltration increased the incidence of pulpal anesthesia over just a buccal infiltration in the first molar.
- **Soft tissue anesthesia of the palate** : A greater palatine nerve block and a palatal infiltration next to the second premolar provide similar soft tissue anesthesia

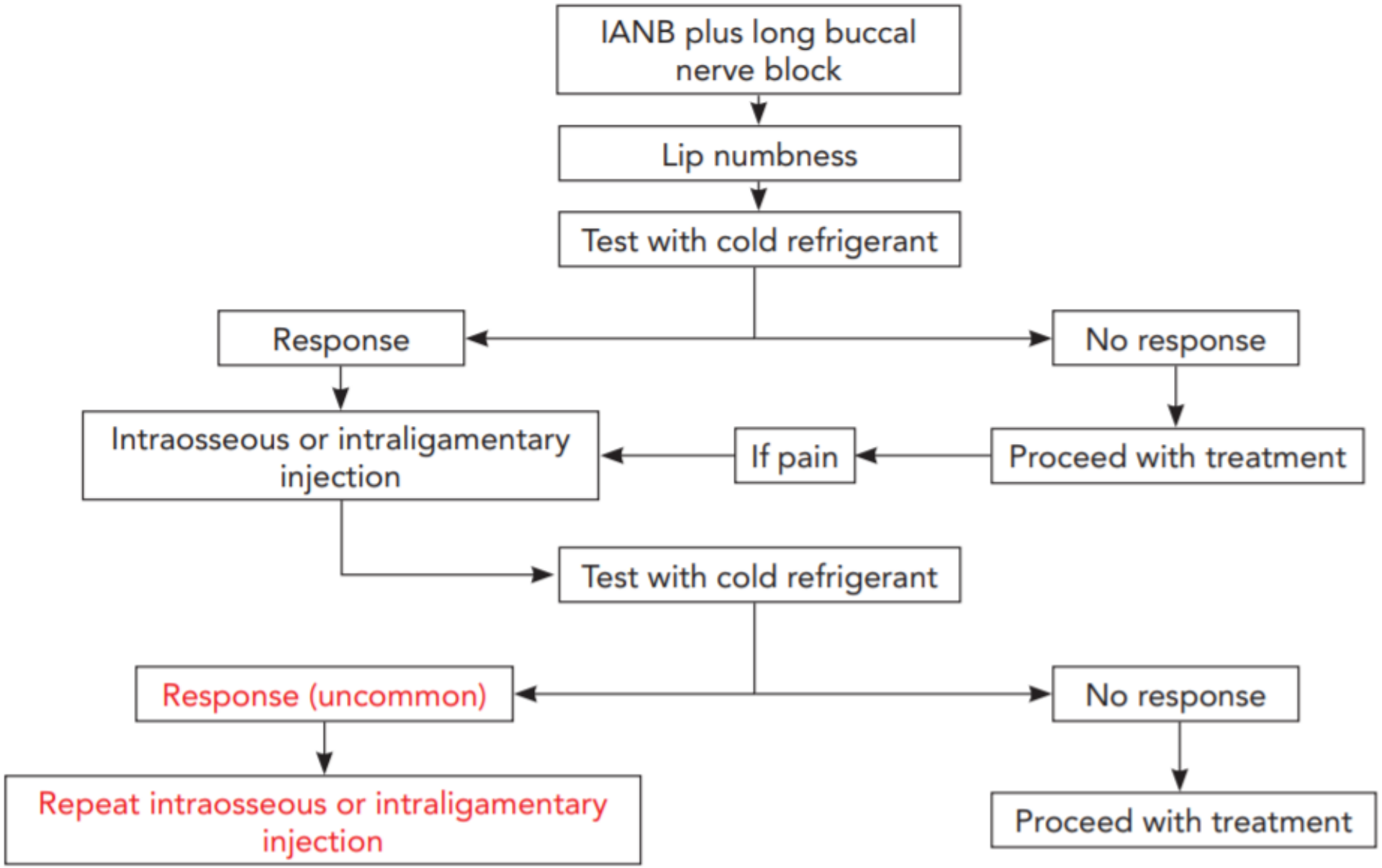
Clinical Tips for Management of Routine Restorative Procedures

For anesthetizing mandibular tooth

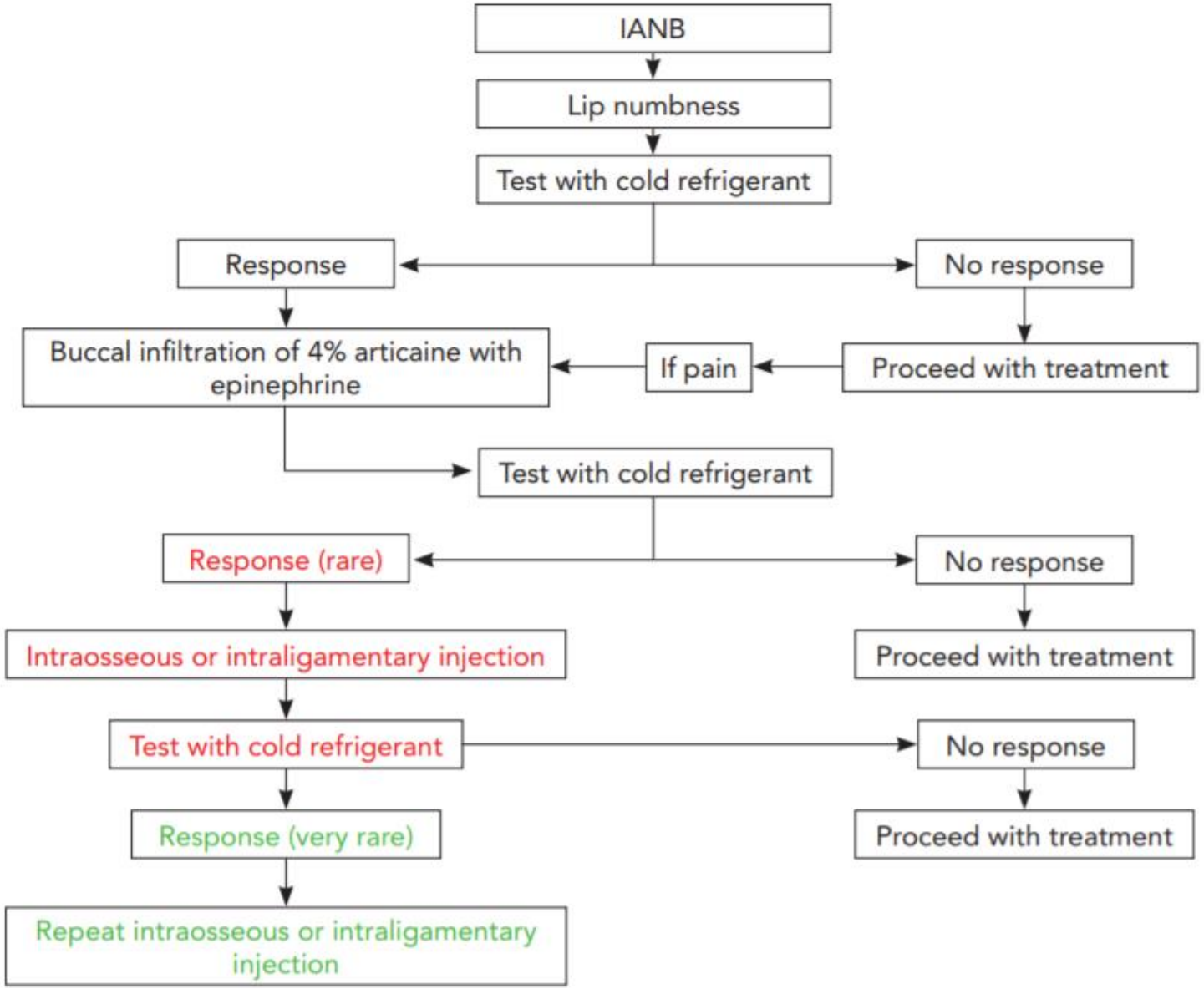
Anesthetizing the mandibular first molar



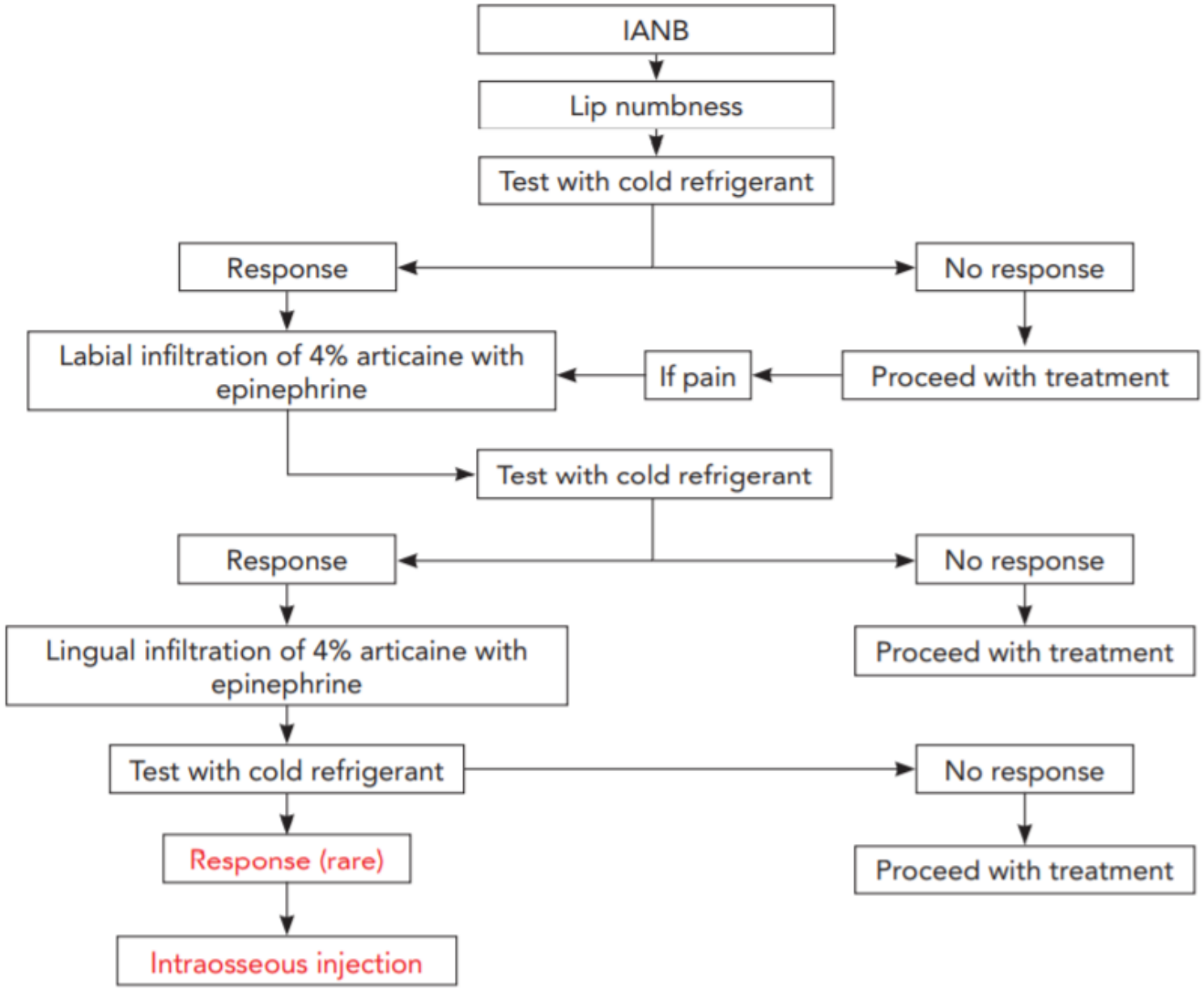
Anesthetizing the mandibular second molar



Anesthetizing the mandibular premolars

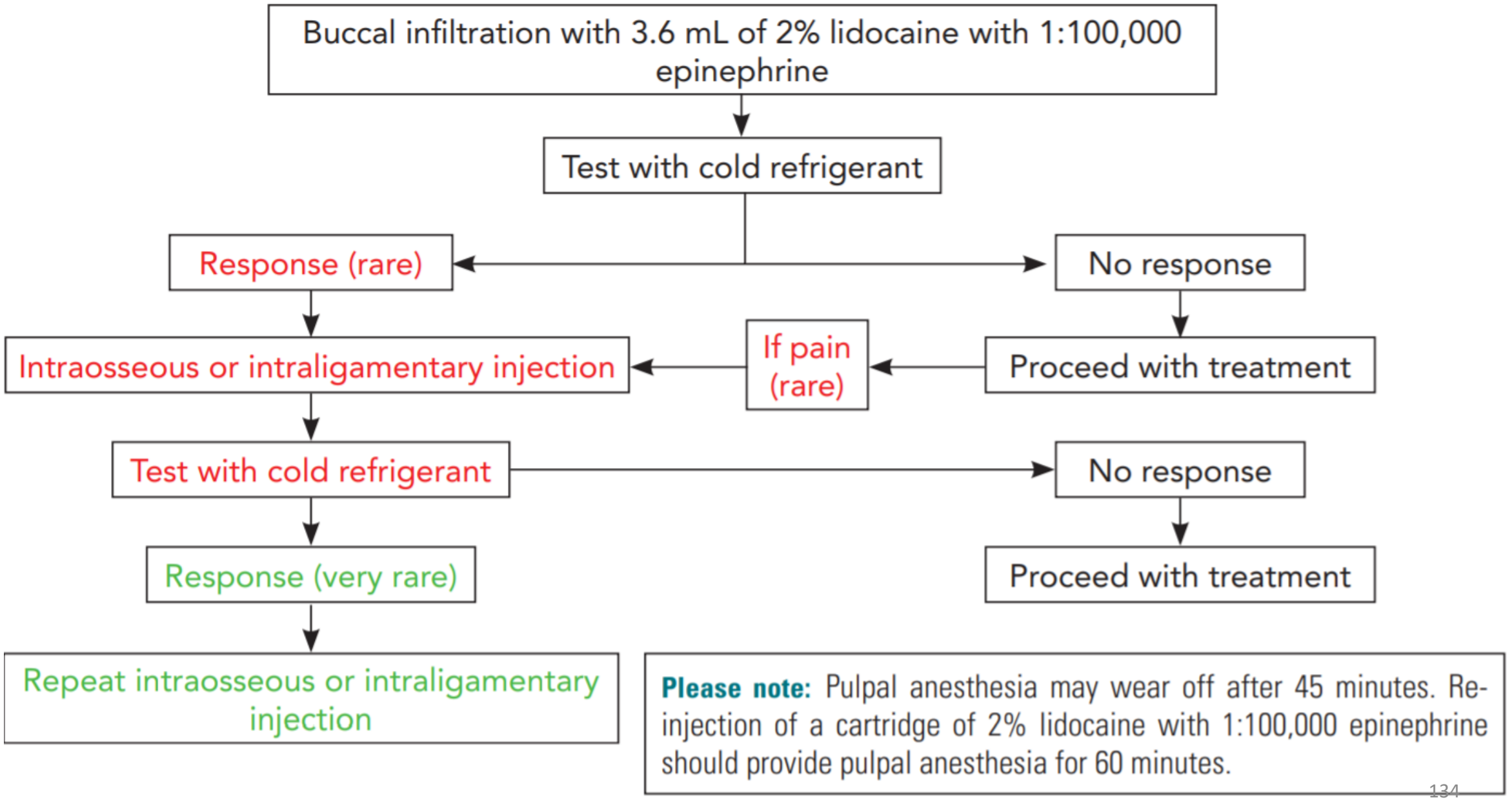


Anesthetizing the mandibular canine and lateral and central incisors

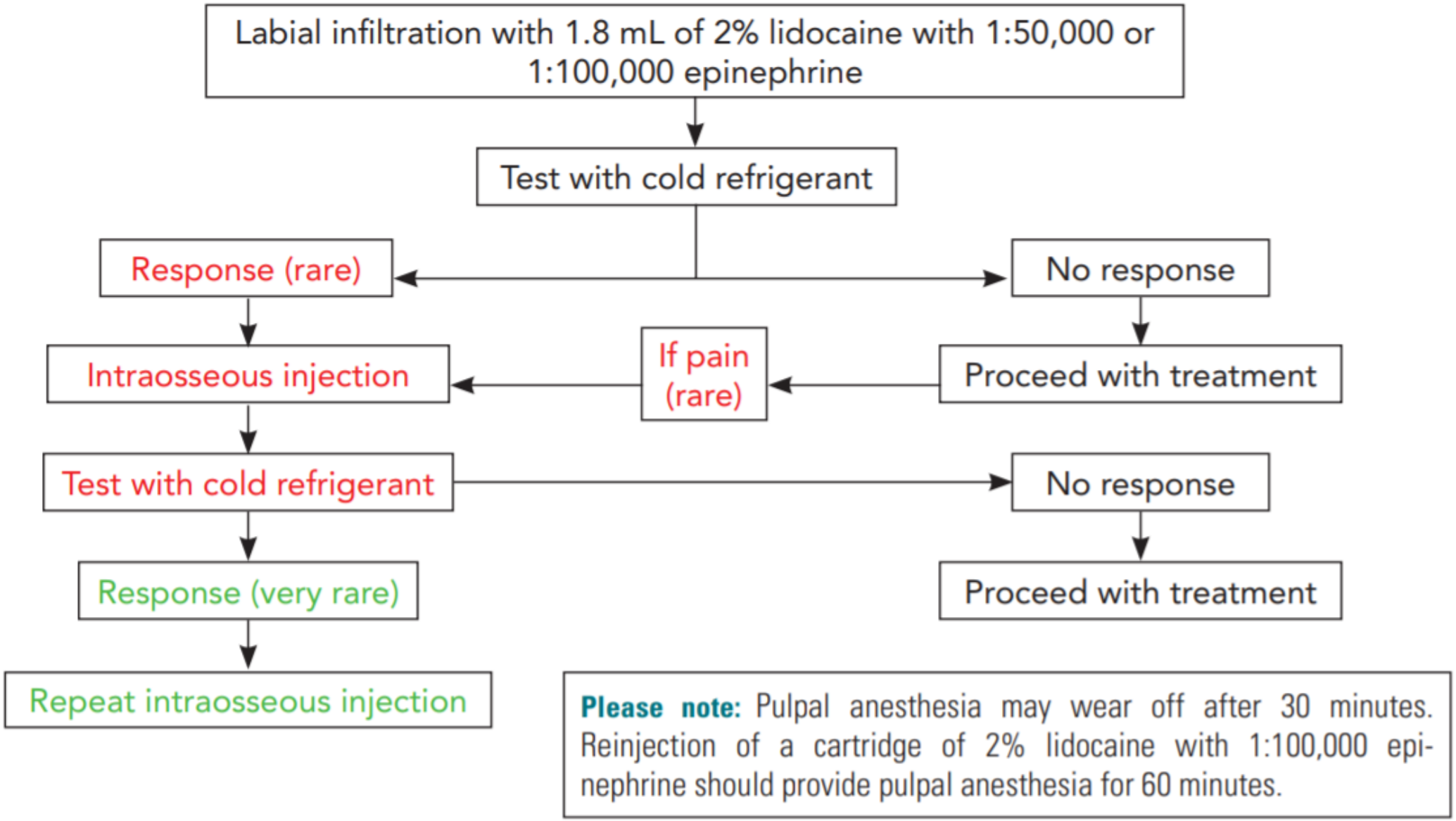


For anesthetizing maxillary tooth

Anesthetizing the maxillary premolars and molars



Anesthetizing the maxillary canine and lateral and central incisors



Please note: Pulpal anesthesia may wear off after 30 minutes. Reinjection of a cartridge of 2% lidocaine with 1:100,000 epinephrine should provide pulpal anesthesia for 60 minutes.

Local anesthesia in endodontics

Success of Local Anesthesia in Patients with Irreversible Pulpitis

IANB

- There will be a clinical difference in success rates of the IANB between patients with SIP and AIP .
- Success rate : AIP- 87%

  SIP- 64%

Clinical effectiveness of articaine for IANBs : Articaine is not better than lidocaine for IANBs in patients presenting with symptomatic irreversible pulpitis.

Gow-Gates & vazirani akinosi technique : Are not superior to the IANB and did not provide adequate pulpal anesthesia for mandibular posterior teeth in patients presenting with symptomatic irreversible pulpitis.

CLINICAL RESEARCH

Anesthetic Efficacy of Articaine for Inferior Alveolar Nerve Blocks in Patients with Irreversible Pulpitis

Elizabeth Claffey, DDS, MS, Al Reader, DDS, MS, John Nusstein, DDS, MS, Mike Beck, DDS, MA, and Joel Weaver, DDS, PhD

The purpose of this prospective, randomized, double-blind study was to compare the anesthetic efficacy of 4% articaine with 1:100,000 epinephrine to 2% lidocaine with 1:100,000 epinephrine for inferior alveolar nerve blocks in patients experiencing irreversible pulpitis in mandibular posterior teeth. Seventy-two emergency patients diagnosed with irreversible pulpitis of a mandibular posterior tooth randomly received, in a double-blind manner, 2.2 ml of 4% articaine with 1:100,000 epinephrine or 2.2 ml of 2% lidocaine with 1:100,000 epinephrine using a conventional inferior alveolar nerve block. Endodontic access was begun 15 min after solution deposition, and all patients were required to have profound lip numbness. Success was defined as none or mild pain (Visual Analogue Scale recordings) on endodontic access or initial instrumentation. The success rate for the inferior alveolar nerve block using articaine was 24% and for the lidocaine solution success was 23%. There was no significant difference ($p = 0.89$) between the articaine and lidocaine solutions. Neither solution resulted in an acceptable rate of anesthetic success in patients with irreversible pulpitis.

Maxillary infiltrations :

Lidocaine : Maxillary posterior buccal infiltration using a one-cartridge or two-cartridge volume of 2% lidocaine with 1:100,000 epinephrine is not completely effective in patients with irreversible pulpitis

- Articaine: maxillary posterior buccal infiltration using 4% articaine with epinephrine is not completely effective in patients with symptomatic irreversible pulpitis.

- Longer roots may be associated with higher rates of failure.

PSA : Will not result in profound pulpal anesthesia in patients presenting with irreversible pulpitis

Why Patients with Irreversible Pulpitis Do Not Achieve Pulpal Anesthesia

I- Lowered pH of inflamed tissue reduces the amount of the base form of anesthetic to penetrate the nerve membrane ,there is less of the ionized form within the nerve to achieve anesthesia.

- Nerves arising from inflamed tissue have altered resting potentials and decreased excitability thresholds.

II-Tetrodotoxin-resistant (TTX-R) class of sodium channels that have been shown to be resistant to the action of local anesthetics.

III- Increased expression of sodium channels in pulps diagnosed with irreversible pulpitis

IV- Patients in pain are often apprehensive, which lowers their pain threshold.

Attempts to Improve the Success of the IANB in Patients with Irreversible Pulpitis

I-Conscious sedation with oral antianxiety drugs : Triazolam and alprazolam : A sublingual triazolam dose of 0.25 mg did not increase the success of the IANB in patients with irreversible pulpitis.

- Even when using conscious sedation, profound local anesthesia is still required to eliminate pain during dental treatment
- Antianxiety agents should not be used as a way to reduce pain during endodontic treatment.

II. Premedication's

Effect of preemptive ibuprofen and acetaminophen/ hydrocodone :

Did not result in a statistically significant increase in IANB success in patients diagnosed with symptomatic irreversible pulpitis.

- **Effect of preemptive ketorolac** : further research is indicated regarding preemptive ketorolac for patients with irreversible pulpitis.
- **Effect of preemptive nitrous oxide**: The administration of 30% to 50% nitrous oxide resulted in a statistically significant increase in success of the IANB.

Effect of Preoperative Ibuprofen on the Success of the Inferior Alveolar Nerve Block in Patients with Irreversible Pulpitis

Mark Oleson, DDS, MS, Melissa Drum, DDS, MS,† Al Reader, DDS, MS,† John Nusstein, DDS, MS,† and Mike Beck, DDS, MA‡*

Results and Conclusions: The success rate for the IAN block was 41% with ibuprofen and 35% with placebo, with no significant difference (P = .57) between the 2 groups. For mandibular posterior teeth, a dose of 800 mg of ibuprofen given 45 minutes before the administration of the IAN block did not result in a statistically significant increase in anesthetic success in patients with irreversible pulpitis. (J Endod 2010;36:379–382)

CONSORT Randomized Clinical Trial

Effect of Combination of Preoperative Ibuprofen/ Acetaminophen on the Success of the Inferior Alveolar Nerve Block in Patients with Symptomatic Irreversible Pulpitis

Michael Simpson, DDS, MS, Melissa Drum, DDS, MS,* John Nusstein, DDS, MS,* Al Reader, DDS, MS,* and Mike Beck, DDS, MA†*

Results and Conclusions: The success rate for the IAN block was 32% for the combination ibuprofen/acetaminophen group and 24% for the placebo, with no significant difference (P = .37) between the 2 groups. For mandibular posterior teeth, a combination dose of 800 mg ibuprofen and 1000 mg acetaminophen given 45 minutes before administration of the IAN block did not result in a statistically significant increase in anesthetic success in patients with symptomatic irreversible pulpitis. (J Endod 2011;37:593–597)

CONSORT Randomized Clinical Trial

The Effect of Premedication with Ibuprofen and Indomethacin on the Success of Inferior Alveolar Nerve Block for Teeth with Irreversible Pulpitis

Masoud Parirokh, DDS, MSc, Rezvan Ashouri, DMD,† Ali Reza Rekabi, DMD,†*
*Nouzar Nakhaee, MD,‡ Abbas Pardakhti, PhD,§ Sara Askarifard, DMD, MS,**
and Paul V. Abbott, DDS, PhD‖

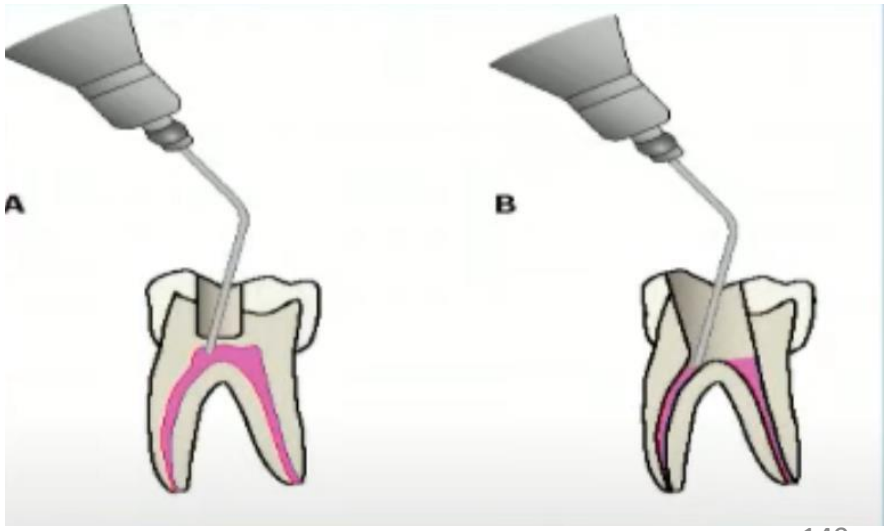
Results: Overall success rates for placebo, ibuprofen, and indomethacin were 32%, 78%, and 62%, respectively ($p < 0.001$). Ibuprofen and indomethacin were significantly better than placebo ($p < 0.01$). There was no difference between ibuprofen and indomethacin ($p = 0.24$).
Conclusions: Premedication with ibuprofen and indomethacin significantly increased the success rates of inferior alveolar nerve block anesthesia for teeth with irreversible pulpitis. (J Endod 2010;36:1450–1454)

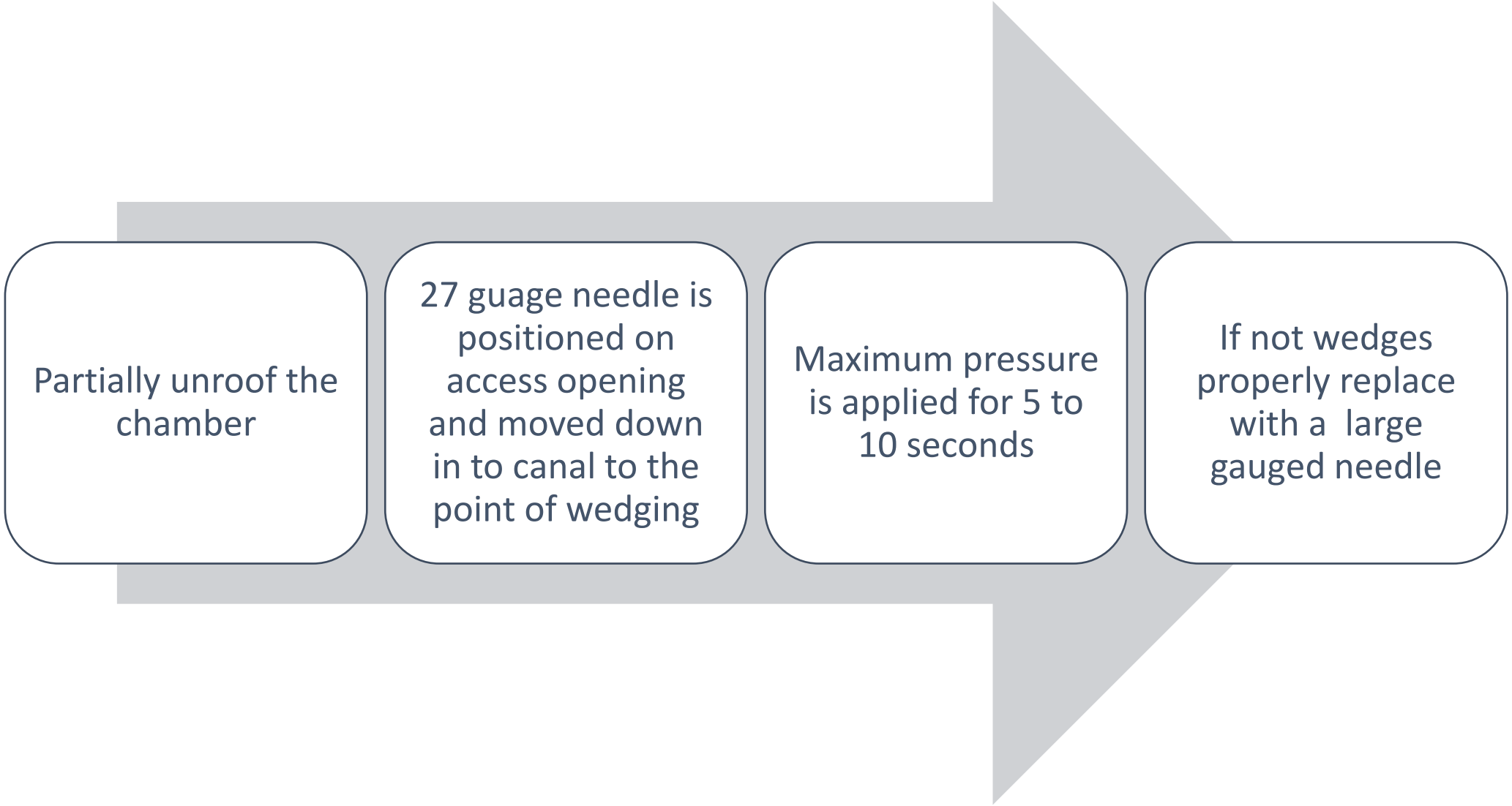
III- Supplemental Infiltration Injections in Patients with Irreversible Pulpitis : A buccal infiltration of articaine following a failed IANB is not reliable for pulpal anesthesia in patients presenting with symptomatic irreversible pulpitis.

Intrapulpal Injection

I- The roof of the pulp chamber penetrated by a half-round bur; the needle then fit snugly in the bur hole.

2- Is an injection into each canal after the chamber is partially unroofed. A standard syringe is usually equipped with a 27-gauge short needle.





Considerations :

- The intra pulpal injection will work if back pressure is achieved
- Intra pulpal injection should only be given after all other supplemental techniques have failed.

Teeth with Necrotic Pulps and Periapical Radiolucency's

- **Asymptomatic teeth** : intraosseous and intraligamentary injections will be successful here.
- **Symptomatic tooth** : Do not use intraosseous injections in painful teeth with necrotic pulps and periapical radiolucency's or teeth exhibiting cellulitis or abscess formation and also in BRONJ Patients

Asymptomatic teeth with total pulpal necrosis and apical pathosis

- Patients presenting with asymptomatic teeth with pulpal necrosis are the easiest to anesthetize
- Usually, the patient is comfortable. On rare occasions, there may be some discomfort during canal preparation requiring an intraosseous or intraligamentary injection.
- In the maxilla, an additional infiltration may be necessary if anesthesia begins to wear off.

Symptomatic teeth with total pulpal necrosis and apical pathosis

Mandibular teeth :

- Topical anesthetic - IANB - Long buccal injection .

Maxillary teeth:

- With no swelling, administer anesthesia with conventional infiltrations.
- If soft tissue swelling (ie, cellulitis or abscess) is present, infiltrate on either side of the swelling or administer a block.
- These injections will provide some degree of bone and soft tissue anesthesia

- Intraosseous injections, intraligamentary injections, or intrapulpal injections should not be used as it would likely be very painful and ineffective for it

- Rather, explain to the patient that he or she does not have profound anesthesia due to the inflammation in the bone surrounding the tooth and use gentle file manipulation.

Incision and drainage

- In the mandible, a conventional IANB injection and long buccal injection (for molars) are administered.
- In the maxilla, infiltrate 1.8 mL of 2% lidocaine with 1:100,000 epinephrine on either side of the labial or buccal swelling.
- For soft tissue anesthesia, the following injections may be used:

  PSA nerve block for molars,

  Second division nerve block for molars and premolars

  Infraorbital injection in anterior teeth.

- For palatal swellings, infiltrate 0.5 mL of 2% lidocaine with 1:100,000 epinephrine over the greater palatine foramen for molars and premolars or the nasopalatine foramen for anterior teeth.
- Do not use these injections if swelling is present over the foramen. Infiltrate on either side of the swelling. The use of the WAND - CCLAD system will reduce the pain of palatal injections.
- Because profound anesthesia is usually difficult to achieve, this should be explained to the patient.
- Buffered solutions gives promising results.

(Addition of sodium bicarbonate)

Why not inject in a swelling?

- Injecting directly into a swelling is contraindicated.
- Possible spread of infection and that the anesthetic solutions would be affected by the lower pH and would be rendered less effective.
- However, a basic science investigation found that local anesthetics may be successful in inflamed tissue, which is acidified.
- Regardless, the basic reasons we do not inject to swellings is that it is very painful and it is relatively ineffective.
- The area of a cellulitis has an increased blood supply. Injecting into this area causes the anesthetic to be carried away into the systemic circulation rather than effectively numbing the area locally. Therefore, the anesthetic effect is diminished when we inject swellings.

Periapical surgery

- In the mandible, IANB and long buccal injections are reasonably effective.
- In the maxilla, infiltration injections are generally effective.
- Larger volumes are necessary to provide anesthesia over the surgical field.
- Maxillary anterior teeth, a cartridge of 2% lidocaine with 1:50,000 epinephrine can be given over the tooth requiring an apicoectomy, and a cartridge of 2% lidocaine with 1:100,000 epinephrine is given over each adjacent tooth.
- Higher concentrations of vasoconstrictors can be used during surgical procedures.

- The effectiveness of surgical anesthesia is decreased by half when compared with anesthesia for nonsurgical procedures.
- This occurs because when reflecting a flap and opening in to bone because the anesthetic solution is diluted by bleeding and is removed by irrigation.
- When surgical anesthesia during the latter part of the surgery is inadequate, giving a palatal infiltration over the surgical site is helpful in the maxilla
- In the mandible, repeating the IANB sometimes helps to restore surgical anesthesia.

- As a prophylactic measure, an intraosseous injection may be administered at the site after routine injections and before the surgery.
- This may enhance depth of anesthesia and may provide better hemostasis.
- Use of a long-acting anesthetic has been advocated for surgery, In the mandible.
- In the maxilla, long-acting agents have a shorter duration of anesthesia .

Future directions

- Capsaicin and transient receptor potential vanilloid-1 (TRPV-1) agonist and antagonists may in the future be used in the clinical management of pain associated with inflammation.
- Considerable ongoing researches are directed at the development of new local anesthetic formulations that allow clinicians to better treat patients in pain.
- Microneedles are a new technology to enhance delivery of drugs.

We can improve success by

- Slow anesthesia
- Use of thinner gauge needles, giving time for pulpal anesthesia
- Buccal articaine along with mandibular anesthesia
- Use of OPG or other radiograph measures for identification anatomical landmarks.
- Learning intrapulpal and intraligamentary injections

Complications of local anesthetic administration

Contents:

Introduction

- Local anesthetics allow dentistry to be practiced without patients discomfort .

- Localized and systemic complications ca occur regardless of appropriate preanesthetic patient assessment, good patient communication , and use of proper technique and procedures, even though vey less.
- Serious complications are rare.
- Systemic toxicity most often involves CNS and / CVS system

Definition

- **Complications** : Any deviations from normally expected pattern during or after securing local analgesia
- **Local complications** : occur in the region of the injection and can be attributed to the anesthetic needle, administration and or the anesthetic drug administered
- **Systemic complications** : occur in the systems of body and are attributed to drug administered such as hypersensitivity and allergy or overdosage toxicity

Classifications

According to bennet

1. Primary or secondary
2. Mild or severe
3. Transient or permanent

Primary or secondary

Primary complication

Experienced by the patient at the time of injection

Secondary complication

Are appeared after the injection is completed
Can occur shortly after injection or later

Mild or severe

Mild complications : Resolve without requiring treatment
Severe complications : Require treatment to resolve complication

Transient or permanent

Transient complications : May appear severe at the time of their appearance but will eventually resolve without any residual effect

Permanent complications : leaves residual effect

Local complications

Local complications

- Pain: During and post injection
- Failure :
  Equipment failure: (Broken needle , Cartridge failure)

  Technique failure
- Trismus
- Hematoma
- Facial nerve paralysis

- Nerve injury - Persistent Paresthesia/Anesthesia)
- Tissue sloughing
- Self- inflicted
- Post Anesthetic Intraoral lesions
- Infection

Pain on injection

Causes :

- pH of LA without vasoconstrictor - 5.5 and 7.
  with vasoconstrictor - 2.8 to 5.5

- Temperature of LA (15 – 37) is not detected by the patient

- Rapid injection technique , faster injection is painful (a rate of 60 sec. per cartridge is ideal)

- Contamination with alcohol

- Touching periosteum
- Intraepithelial injection leading to ballooning
- Subperiosteal injection cause discomfort due to injection into noncompliant tissues
- Careless technique

Prevention

- Careful technique
- Sharp needles
- Topical anesthetic
- Slow injections (a rate of 60 sec per cartridge is ideal)
- Room temperature solutions

Equipment failure : Needle breakage

Causes :

- Unexpected movement by patient
- Needle size (small , short)
- Needle manipulation , i.e. bending the needle
- Defective needle

Prevention of Needle Breakage

Patient communication

→ will help alleviate the patient's fear of the unknown

→ Reduce the possibility of sudden unexpected movements.

Long, large-gauge needle

- Incidences of needle breakage have been reported predominantly when 30- gauge, and occasionally 27-gauge, needles are used.
- Long, 25-gauge needles should be used when penetrating significant soft tissue
- Do not use 30-gauge needles for IANBs in adults or children.

Do not bend needle

All intraoral injections can be performed successfully without bending the needle.

Bending the needle

- Weakens its integrity,
- Increasing the possibility of breakage.
- Prevents the proper recapping of the needle

Advance needle slowly

- Results in gentle contact of the bone, decreasing the possibility of needle breakage.

- In addition,
- Sudden forceful bone contact may startle the patient,

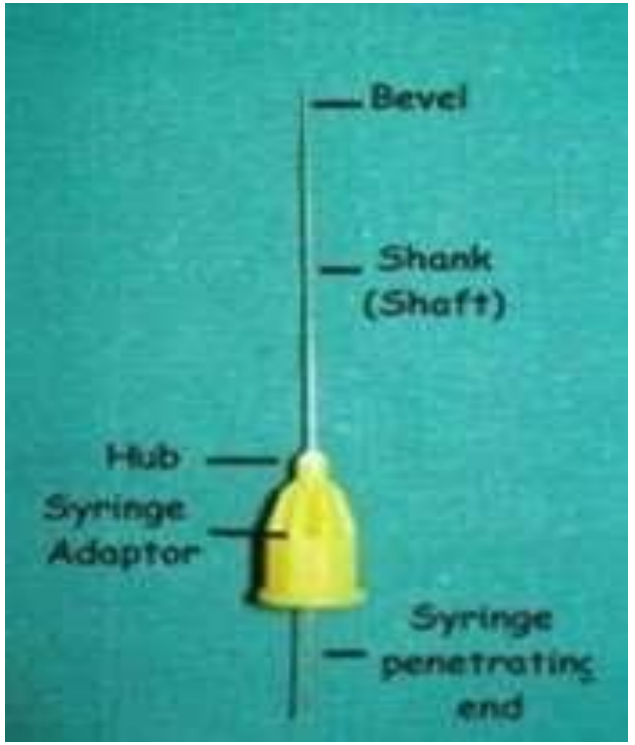
→ causing sudden unexpected movement.

Never force needle

- The needle should never be forced against significant resistance such as bone.

No sudden direction changes

- Changes in needle direction should never be initiated when the needle is inserted deeply in soft tissue.
- The needle should be withdrawn almost completely and then redirected.



Never insert needle to hub

- Most vulnerable part of the needle is at the hub,
- Is the location where most needle breakages are likely to occur.
- Virtually impossible to retrieve the needle if breakage occur in such area
- To increase the chances of retrieving a needle fragment, a portion of the needle's shaft in front of the hub should always be visible during the injection.

Treatment

- If needle breakage occurs and the needle fragment is visible

- The following are recommendations for the dentist to follow:

1. Remain calm

If the patient senses panic, he or she will close the mouth, causing the needle fragment to embed into the tissue.

2.Keep your hands in the patients mouth, and ask the patient to open widely.

3. Attempt to remove it with the hemostat or cotton pliers.

If the needle fragment is not visible and cannot be retrieved,

the following are recommendations for the dentist to follow:

1. Remain calm,

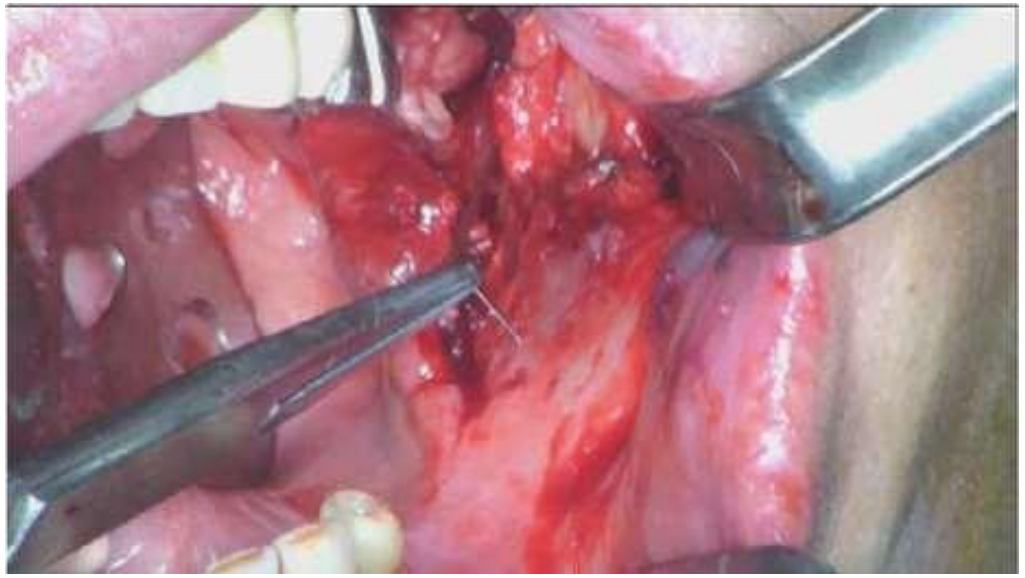
2. Refer the patient to an oral maxillofacial surgeon.

3. Document the incident and sequence of events in the patient's permanent record.

4. Keep the remaining needle fragment for structural evaluation.

5.Surgical procedures are indicated if the needle fragment is not deeply embedded in tissue and easily located by radiographic or clinical examination.

6.If the needle is deeply embedded in tissue, the maxillofacial surgeon may recommend that the needle remain in the tissue without further attempt for removal.

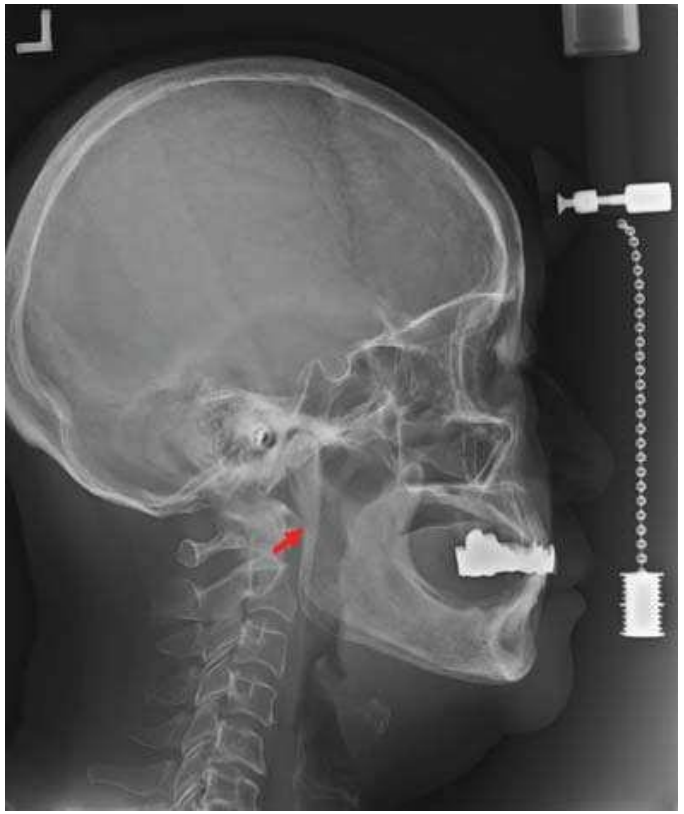


Surgical removal

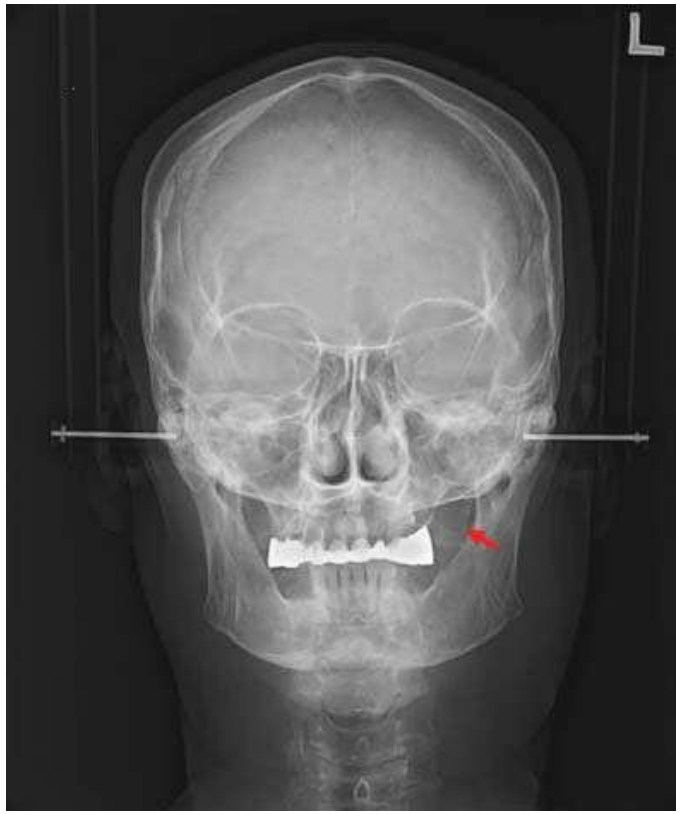
- locating the retained fragment through panoramic and computed tomographic (CT) scanning are often the investigation of choice.
- Plain radiographs taken at right angles to each other are used.
- The most frequent combinations employed are a panoramic radiograph and posterior anterior view of the mandible (P A)

Preoperative radiographic image illustrating the broken needle:

3-D Computerized tomography



(B) lateral skull view



(C) posterior-anterior skull view

(D) panoramic view.

Trismus (limited mouth opening)

Causes

- IM Injection (Med. Pterygoid, temporalis)
- Hemorrhage
- Barbed needle
- Contamination by alcohol
- Bacterial infection from the site of injection

- This happens when the needle is inserted unintentionally through the muscles resulting in its spasm.

- Due to different location of bony landmarks and nerves in individuals, a needle might be inserted through a muscle accidentally.

Trismus Prevention

- Sharp needles
- Proper care and handling of cartridges
- Aseptic technique and clean injection site
- Atraumatic insertion
- Minimal injections and volume

Treatment

- Moist towel 20 mins/hr

Place a hot moist towels at the site for approximately 20 minutes every hour

- Physiotherapy

Patient should gradually open and close the mouth.

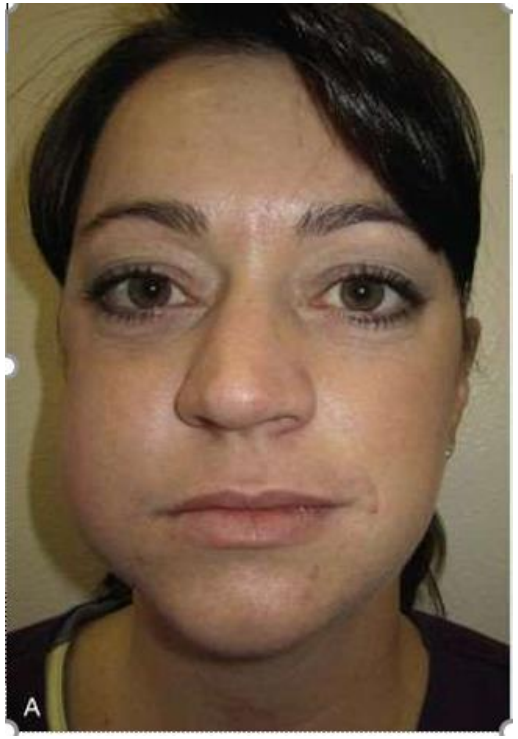
- Muscle relaxants

Analgesics

HEMATOMA

Hematoma develops when a blood vessel, particularly an artery, is punctured or lacerated by the needle.

- This is observed an asymmetrical swelling and discoloration of the tissue resulting from the effusion of blood into extravascular spaces.
- Result after administration of PSA.
- IANB and mental nerve blocks also commonly cause hematomas.



A, Hematoma producing initial swelling from administration of the right posterior superior alveolar nerve block

B, Progression of hematoma one week following initial swelling.

- Although hematomas may appear serious, they are more a cosmetic nuisance. Trismus and mild pain may also occur.

- A hematoma resulting from a PSA block is usually the largest due to the infratemporal fossa being able to accommodate large volumes of blood, and clinically appears as extraoral bruising.

- Hematomas resulting from an IANB block appear as intraoral bruising.

Prevention

1. Know anatomy.
2. Use a short needle.
3. Minimize the number of needle insertions.
4. Follow all recommended injection techniques for all local anesthetic injections.

Management of Hematoma

1. At the first sign of swelling, apply pressure directly to the area for a minimum of 2 minutes.

Because it is difficult to locate the blood vessels for the PSA block, pressure should be applied as far distally as possible without producing a gag reflex.

2. Apply ice to the region of the developing hematoma to reduce the swelling.

- Ice will constrict the blood vessels.
- Analgesic effects for the patient.

3. Inform the patient that soreness and limited movement of their jaw may occur.
4. Instruct the patient to use warm moist towels applied to the region from the next day for 20 minutes every hour to assist in the resorption of blood.

Heat application (>6 hours post injection vasodilatory) should be avoided .

5. Inform the patient that there are no serious complications associated with hematomas, and that swelling and discoloration should disappear after 7–14 days.

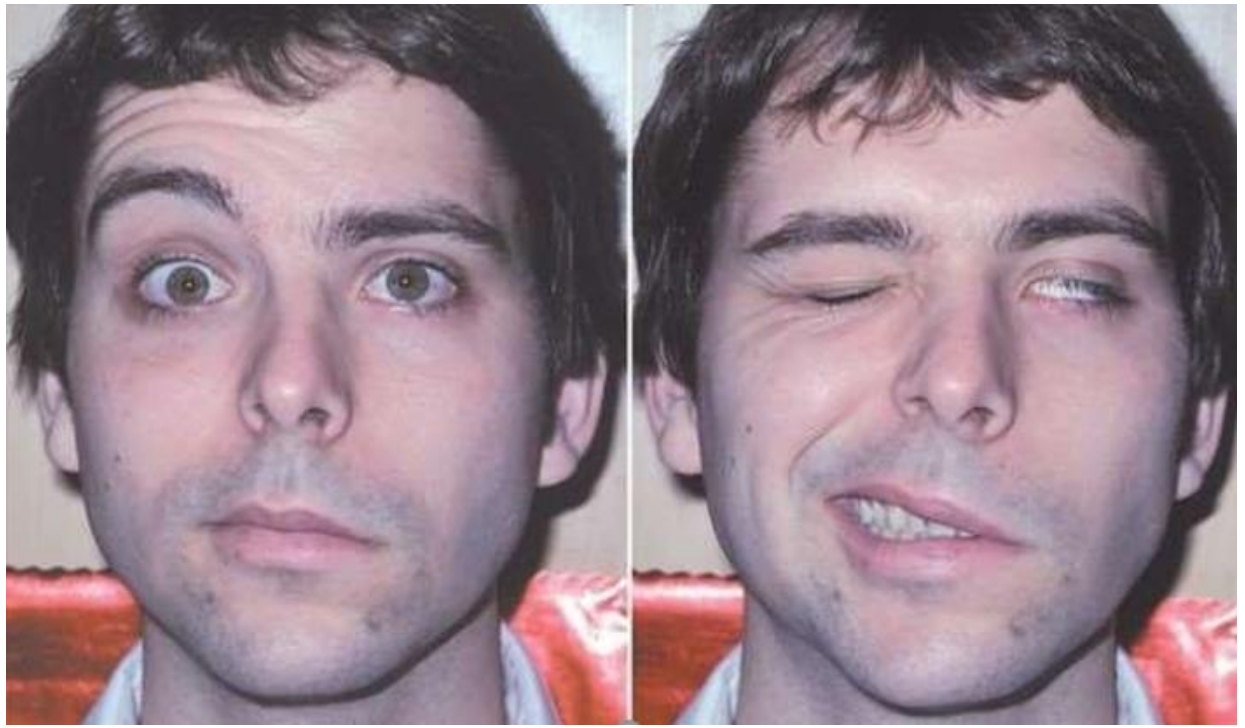
5.Do not dismiss the patient until bleeding has stopped.

6. Document the incident in the patients record including instructions presented to the patient, and the patients response.

7.When hematoma is large prescribe antibiotics to prevent infection

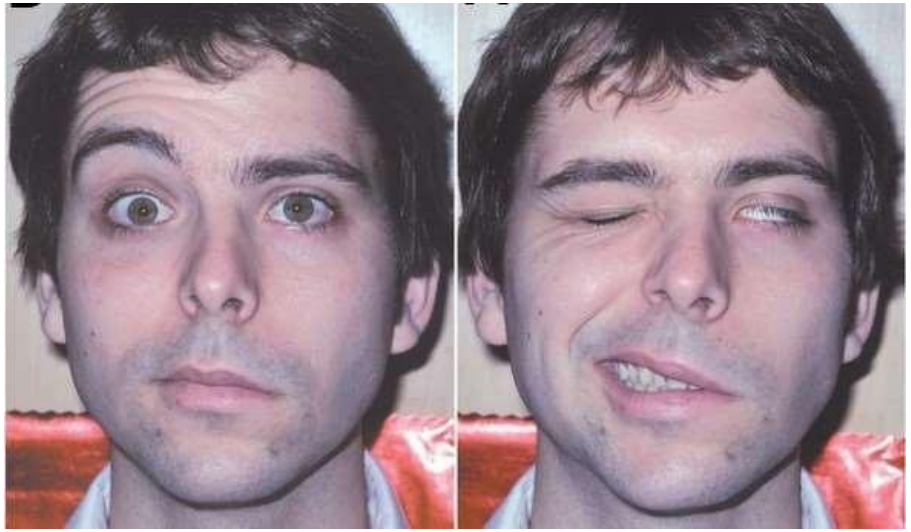
8.Analgesics and follow up as indicated.

Transient facial nerve paralysis



- Caused by the inadvertent deposition of local anesthetic solution during the IANB block into the parotid gland, anesthetizing the facial nerve that runs through the parotid gland

- This produces a unilateral loss of motor function to the facial expression muscles.



A, Inability to close eyelid.

Drooping of lip on affected side (patient’s left).

Treatment

1. Reassure the patient

Explain that weakness in the muscles will resolve as soon as the anesthetic action fades.

2. Protect cornea

- The eye on the affected side should be protected and covered by an eye-shield or eye-pad.
- Drops of sterile paraffin or (Saline Eye Drops) might be administered

3. There are no contraindications to completing the scheduled treatment.
- However, it may be advisable to reschedule treatment for a different time

4. Document the incident.

5. Follow-up as indicated.

Persistent anesthesia or paresthesia

- This happens most frequently where the injection was very accurate and the needle has touched the nerve.

- If the nerve is damaged in any case, the anesthetic effect might persist for weeks or even months or permanent loss of sensation if the impact has resulted in a permanent damage to the nerve

Causes :

1.Trauma to nerve sheath OR Intraneural injection.

Most commonly with the lingual nerve producing a sensation of an electrical shock when it occurs.

2. Hemorrhage around neural sheath

Creating excessive pressure on the nerve

3. Neurolytic agents (alcohol, phenol)

Irritation to the nerve following the administration of a contaminated local anesthetic solution with alcohol or other disinfectants.

To prevent paresthesia

- Cartridges should be stored properly in their original containers.
- Cartridges should never be placed in disinfecting solution.
- Injection techniques should be used as recommended.
- Most paresthesia is not serious and will typically resolve within 8 weeks.

Management

1. Reassure the patient.

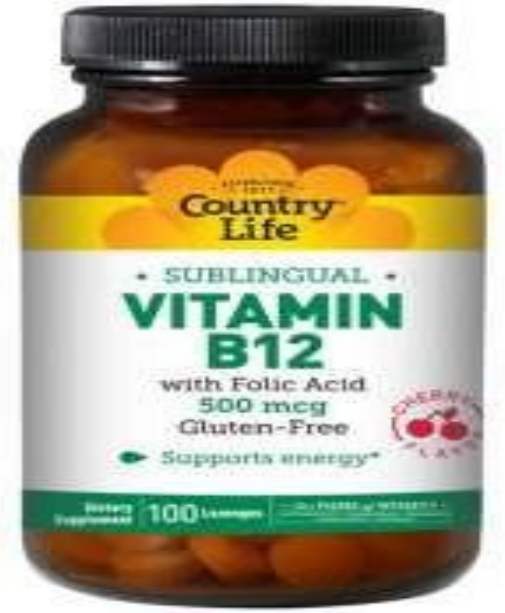
2. Arrange for the patient to be examined to determine extend of paresthesia

Instruct the patient that paresthesia may last up to 2 months and perhaps longer.

- Inform patient of normal signs of nerve recovery

Tingling
Intermittent burning or sharp pain

3. Vitamin B12 complexes might be prescribed to fasten the time of healing.



4. Re-evaluate patient in 2 weeks

5. Document degree and extent

6. The patient should be examined by the dentist every 2 months until normal sensation returns.

7. Avoiding injections to the traumatized nerve.
Alternative pain control measures should be taken.

Self inflicted injuries

- This happens after anesthesia where the patient is not instructed not to bite on his/her lips for 2-3 hours

- Unintentional bite for a long period of time leading to an ulcer

Children are at higher risk

prevention: Use short-acting LA

- Instructions
- Close observation

Treatment

- The ulcer will heal by itself in 10-15 days.
- It might take longer depending on the severity of the ulcer but, in general, it heals by itself

- Analgesics might be prescribed to alleviate pain and inflammation.

Post anesthetic intra oral lesions

- Resemble HSV infection
- Appears after 2 days from LA administration

Causes

- Local tissue trauma/hypoxia/necrosis
- Activation of HSV

Treatment

- Reassure patient

  Self limiting 10-14 day course
- Analgesics

Epithelial desquamation

Cause

- Prolonged use of topical anesthetic
- ❖ Predominantly in palatal mucosa

Treatment

- Resolution in 7-10 days
- Analgesics
- Saline rinses
- Petrolatum can be used to coat the area to minimize discomfort.

Infection

Infection around the area of needle penetration Or deep in the tissue.

Causes :

- Contamination of the anesthetic needle before injection.
- Administration of contaminated solution.
- Administering local anesthetics through areas of dental infection.

Treatment

- Antibiotics should be prescribed
- Analgesics for pain

Complication	Specific management
1. Needle breakage	Visible : Remove with hemostat Not visible (1) Not penetrated deep in to tissues : Surgical removal (2) Penetrated deep in tissue : leave the fragment
2. Trismus	Place Hot moist towel 20 minutes / Hour Physiotherapy Muscle relaxants, analgesics
3. Hematoma	Apply pressure for 2 minutes Apply ice Place Hot moist towel 20 minutes / Hour from next day Antibiotics and analgesics
4. Transient facial palsy	Protect cornea

Complications	Specific management
5.Persistent anesthesia or paresthesia	Vit B12 ,vit C - Supplements Make appointment for patient in interval of 2 weeks
6.Self inflicted injuries	Analgesics Petrolatum
7.Post anesthetic intra oral lesions	Analgesics
8.Epithelial desquamation	Analgesics Saline rinses petrolatum
9.Infection	Antibiotics and analgesics

Systemic complications

Occurs due to

- Inadvertent intravascular injection
- Excessive dose or rate of injection
- Delayed drug clearance

- Systemic toxicity is typically manifested as central nervous system (CNS) toxicity or cardiovascular toxicity
- The dose capable of causing CNS symptoms is typically lower than the dose and concentration result in cardiovascular toxicity.
- Cardiovascular toxicity is more serious and more difficult to treat than CNS toxicity.

These complications may caused by:

I. Direct extension of the usual pharmacological effects of the drugs :

- Side effects
- Overdose
- Local toxic effect

II- By alteration in recipient of the drug

- Disease process (Hepatic dysfunction , CHF, renal dysfunction

III- Genetic aberrations

- Atypical plasma cholinesterase

Predisposing factors

Patient factor

1. Age
2. Weight
3. Other drug
4. Genetics
5. Medical conditions

Drug factor

1. Vasoactivity.
2. Dose
3. Presence of vasoconstrictor
4. Rate of injection

Patients factors

(1) Age - Patients under 6 years and over 65 years of age

Absorption, metabolism, and excretion are not fully developed before age 6, and these functions diminish after age 65.

(2) Patients weight :

- The less an individual weighs and the less muscle mass he has, the lower the tolerance to the drug.

(3) Genetics

Pseudocholinesterase deficiency

- Is an inherited blood plasma enzyme abnormality.
- Metabolism of various local anesthetic agents is affected .
- Muscle relaxants succinylcholine and mivacurium as well as other ester local anesthetics.
- local anesthetics of the ester type (eg, procaine) should be avoided in these patients .

(4) Drug interactions

Local anesthetics with vasoconstrictors can interfere with

- Antidepressants
- Beta-blocking agents
- Medicines that treat Parkinson disease
- Cocaine.

Drug	Medical condition suspected
Tricyclic anti depressants (TCA)	Cardiac arrhythmia
Nonselective beta-blocking agents	Increases in blood pressure and Reflex bradycardia
Medicines treating Parkinson disease	Exaggerated effect on blood pressure and heart rate
Cocaine	Dysrhythmias and other serious cardiac problems

Category of drug	Alternative measures can be taken - with L A adrenaline combination
Antidepressants	Serotonin re uptake inhibitors (fluoxetine) MAO
In Parkinson's disease	Reduce cartridges to 2 or 3
Beta blockers	Selective beta blockers

(5) Medical conditions

l-Liver disorders

Liver damage causes local anesthetic to build up in the blood.

- Patients with reduced hepatic function may exhibit an abnormally decreased rate of metabolism of amide local anesthetics, resulting in potentially toxic blood levels.
- Dosage levels must be reduced for these patients.

II-Cardiovascular disease

Patients with

- Ischemic heart disease (angina , M I)
- Previous cardiac surgery
- Circulatory dysfunctions
- Cardiac failure

- Shows high plasma levels of local anesthetic agent compared to others
- Minimum use is recommended

III- Kidney disorders - If the kidneys can not eliminate the byproducts of local anesthetics, there can be toxic accumulations in the blood.

IV- Pregnancy - During pregnancy, renal function can be disturbed. This can impair excretion and result in an increased blood level of the local anesthetic.

- Bupivacaine has been shown to have increased cardiotoxicity in pregnant women.

V- Acid-base status

Acidosis and hypercarbia

- Amplify the CNS effects and exacerbate cardiotoxicity.
- Hypercarbia enhances cerebral blood flow , consequently more L A is made accessible to the cerebral circulation.
- This also reduces the binding of L A agents by plasma proteins results in increased amount of un bounded local anesthetics in plasma.

Drug factors

(1) Vasoactivity

- Local anesthetics have vasodilating properties, which increase the possibility of overdose.

- For lignocaine the amount of drug given should not be more than 2 mg/ lb (Maximum 300 mg)
- More than that amount increases the chances of toxic overdose.

(2) Rate of injection

A rapid injection (30 seconds or less) causes rapid blood levels, which increases the chance of overdose.

- Injections should be administered slowly

60 seconds or more for administration of a 1.8 mL cartridge

(3) Dose

Anesthetic	Vasoconstrictor	Dental cartridge color code[b]	MAD[c]	TMD[c]
2% lidocaine	1:100,000 epinephrine	Red	13	8
2% lidocaine	1:50,000 epinephrine	Green	13	8
2% lidocaine plain	No vasoconstrictor	Light blue	8	8
2% mepivacaine	1:20,000 levonordefrin	Brown	11	8
3% mepivacaine plain	No vasoconstrictor	Tan	7	5½
4% prilocaine	1:200,000 epinephrine	Yellow	5½	5½
4% prilocaine plain	No vasoconstrictor	Black	5½	5½
0.5% bupivacaine	1:200,000 epinephrine	Blue	10	10
4% articaine	1:100,000 epinephrine	Gold	7	7
4% articaine	1:200,000 epinephrine	Silver	7	7

[a]The dosages were adapted from Malamed.[35]
[b]Uniform dental cartridge color codes.
[c]This table provides the maximum dosage in two formats. The maximum allowable dose (MAD) generally is approached only with complex oral and maxillofacial surgical procedures. The typical maximum dose (TMD) is the usual upper limit of drug dosage for most restorative and endodontic dental procedures. Both columns show the number of cartridges that would be required for an adult weighing 150 pounds (67.5 kg).

The table below lists maximum recommended doses and toxic limits for the most common anesthetics (from Malamed *Handbook of Local Anesthetics)*

Drug Toxic	Limit	Maximum
2% Lidocaine (Xylocaine)	2 mg/lb	300 mg
3% Carbocaine(Mepivacaine)	2 mg/lb	300 mg
4% Citanest (Prilocaine)	2.7 mg/lb	400 mg
1.5% Duranest (Etidocaine)	3.6mg/lb	400 mg
0.5% Marcaine (Bupivacaine)	0.6mg/lb	90 mg

For an adult weighting 150 pounds or 67.5 kg

Dosage guidelines

Use of a reduced dose is indicated in the following patients

- Debilitated or acutely ill patients
- Very young children or geriatric patients
- Patients with liver disease, atherosclerosis, or occlusive arterial disease.

Manifestations of toxicity

Toxicity manifestations can be categorized as

- CNS
- Cardiovascular
- Allergic
- Hematologic
- Ophthalmic
- Syncope
- Hepatic
- Local tissue

I- C N S manifestations

- Typically 1-5 minutes after the injection, but onset may range from 30 seconds to as long as 60 minutes.

I- Patients experience symptoms of Central nervous system (CNS) excitation

- Circumoral and/or tongue numbness
- Metallic taste
- Lightheadedness
- Dizziness
- Visual and auditory disturbances (difficulty focusing and tinnitus)
- Disorientation
- Drowsiness

II-With higher doses, initial CNS excitation is followed by a rapid CNS depression.

- Muscle twitching.
- Convulsions.
- Unconsciousness.
- Coma.
- Respiratory depression and arrest.
- Cardiovascular depression and collapse.

- Large bolus injections may increase peak anesthetic levels to the point where the CNS and cardiovascular system are affected simultaneously

- CNS symptoms may be masked in patients premedicated with anticonvulsants such as benzodiazepines or barbiturates.

- The first sign of toxicity in these premedicated patients may be cardiovascular depression.

II- Cardiovascular manifestations

- Occur at higher concentrations
- Risk of cardiovascular toxicity is somewhat greater with lipophilic local anesthetics such as bupivacaine.
- Risk of cardiac toxicity is greatest in those patients with underlying cardiac illness.

Toxic dose can cause

- Myocardial depression (tetracaine, etidocaine, bupivacaine).
- Cardiac dysrhythmias (bupivacaine)
- Cardiotoxicity in pregnancy.
- Alter vascular tone

The sequence of cardiovascular events is ordinarily as follows

Low blood levels of L A - Small increase in cardiac output, blood pressure, and heart rate (Boost in sympathetic activity and direct vasoconstriction)

As the blood level rises, Hypotension ensues as a result of peripheral vasodilation due to relaxation of the vascular smooth muscles.

Further rise leads to severe hypotension, resulting from the combination of reduced peripheral vascular resistance, reduced cardiac output, and/or malignant arrhythmias.

Cardiac arrest

The range of signs and symptoms of cardiovascular toxicity includes

- Chest pain
- Shortness of breath
- Palpitations
- Lightheadedness
- Sweating
- Hypotension
- Syncope

- Acidosis, hypercapnia, and hypoxia, potentiates cardiac toxicity.

(III)- ALLERGIC REACTIONS

Allergens in LA

Na bisulfite or metabisulfite - Found in anesthetics as perservative for vasoconstrictors.

Methylparaben - No longer used as perservative in dental cartridges.

PABA : Product of metabolism of local anesthetics.

Allergy - Signs/symptoms

Dermatologic:

- Minor rash
- Urticaria - wheals, pruritis
- Angioedema

Respiratory:

- Dyspnea
- Wheezing
- Cyanosis or flushing
- Tachycardia
- Laryngeal edema
- Bronchospasm

Management of Allergic Reactions

Delayed skin reaction

Diphenhydramine - 50 mg I M &Q6H X 3-4 days

Immediate skin reaction Epinephrine 0.3 mg IM or SC

Diphenhydramine - 50 mg IM Observation, medical consultation

Diphenhydramine - 50 mg Q6H X 3-4 days

Anaphylaxis

" A serious, life-threatening generalized or systemic hypersensitivity reaction"

<u>Typical progression</u>

- Skin reactions
- Smooth muscle spasms (GI, respiratory)
- Respiratory distress
- Cardiovascular collapse

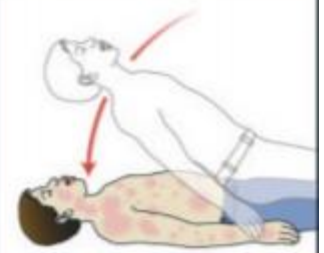
May occur rapidly, with considerable overlap

Anaphylaxis is highly likely when any one of the following three criteria is fulfilled:

1 Sudden onset of an illness (minutes to several hours), with involvement of the skin, mucosal tissue, or both (e.g. generalized hives, itching or flushing, swollen lips-tongue-uvula)

AND AT LEAST ONE OF THE FOLLOWING:

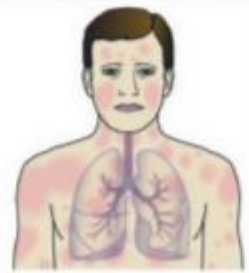
Sudden respiratory symptoms and signs (e.g. shortness of breath, wheeze, cough, stridor, hypoxemia)



Sudden reduced BP or symptoms of end-organ dysfunction (e.g. hypotonia [collapse], incontinence)

OR **2** Two or more of the following that occur suddenly after exposure to a ***likely allergen or other trigger**** ***for that patient*** (minutes to several hours):

Sudden skin or mucosal symptoms and signs (e.g. generalized hives, itch-flush, swollen lips-tongue-uvula)



Sudden respiratory symptoms and signs (e.g. shortness of breath, wheeze, cough, stridor, hypoxemia)

Sudden reduced BP or symptoms of end-organ dysfunction (e.g. hypotonia [collapse], incontinence)

Sudden gastrointestinal symptoms (e.g. crampy abdominal pain, vomiting)

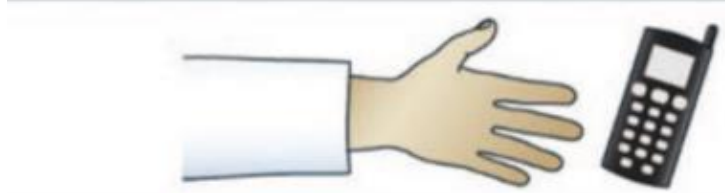
OR **3** Reduced blood pressure (BP) after exposure to a ***known allergen*** ***for that patient*** (minutes to several hours):

Infants and children: low systolic BP (age-specific) or greater than 30% decrease in systolic BP***

Adults: systolic BP of less than 90 mm Hg or greater than 30% decrease from that person's baseline

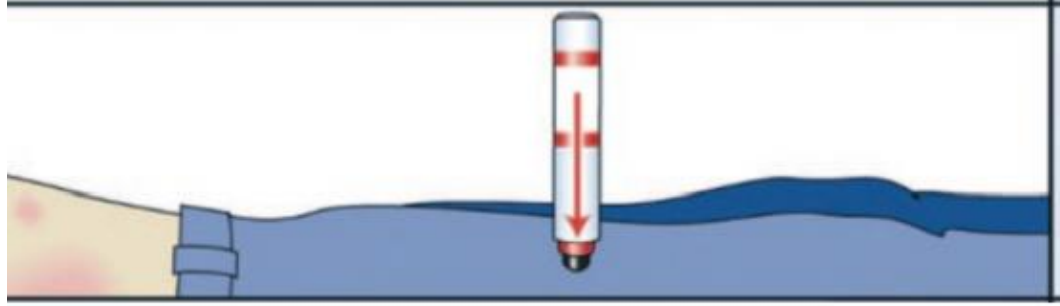
HOW TO MANAGE ??

Assess the patient's circulation, airway, breathing, mental status, skin, and body weight (mass).

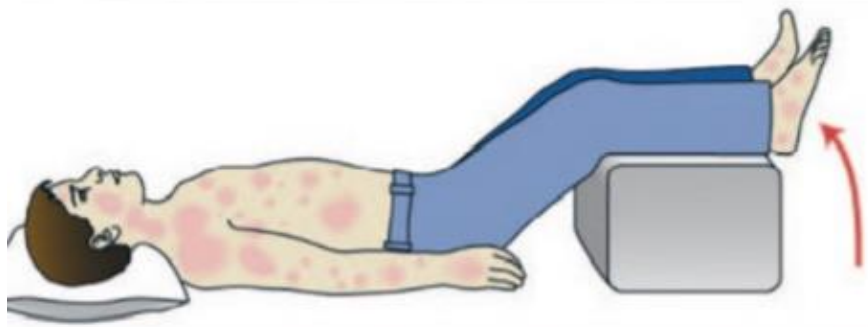


Promptly and simultaneously,

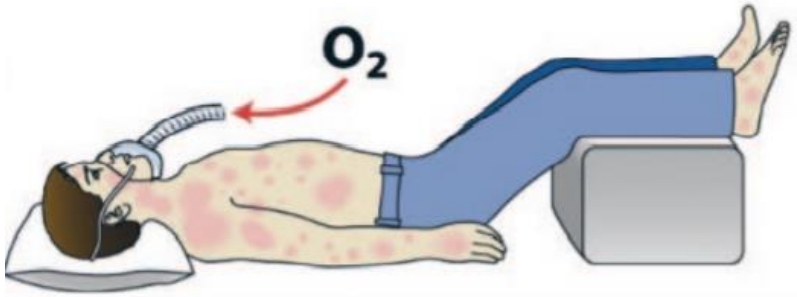
Call for help: resuscitation team (hospital) or emergency medical services (community) if available.



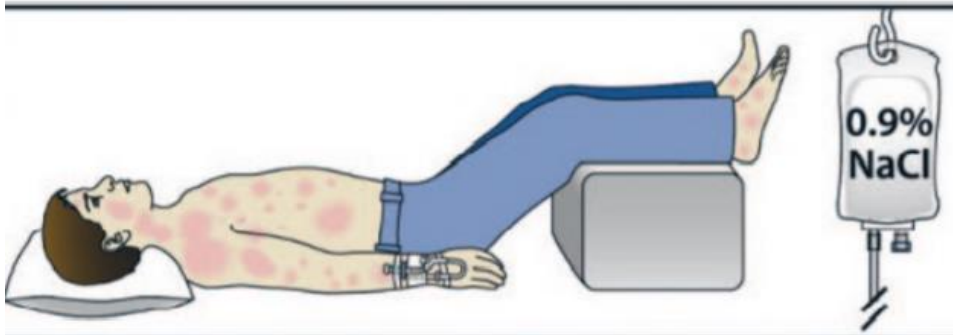
Inject epinephrine (adrenaline) intramuscularly in the mid-anterolateral aspect of the thigh, 0.01 mg/kg of a 1:1,000 (1 mg/mL) solution, maximum of 0.5 mg (adult) or 0.3 mg (child); **record the time of the dose and repeat it** in 5-15 minutes, if needed. Most patients respond to 1 or 2 doses.



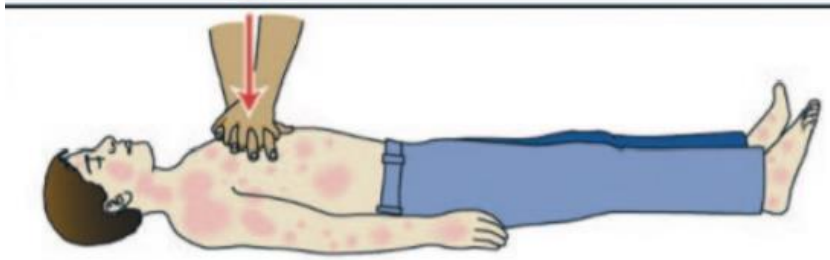
Place patient on the back or in a position of comfort if there is respiratory distress and/or vomiting; **elevate the lower extremities;** fatality can occur within seconds if patient stands or sits suddenly.



When indicated, give high-flow supplemental oxygen (6-8 L/minute), by face mask or oropharyngeal airway.

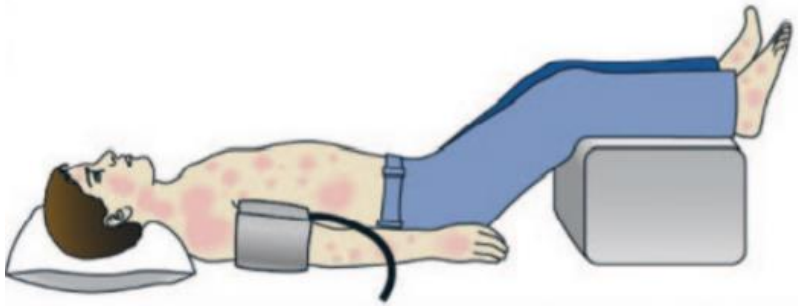


Establish intravenous access using needles or catheters with wide-bore cannulae (14 - 16 gauge). **When indicated, give 1-2 litres of 0.9% (isotonic) saline rapidly** (e.g. 5-10 mL/kg in the first 5-10 minutes to an adult; 10 mL/kg to a child).



When indicated at any time, perform cardiopulmonary resuscitation with continuous chest compressions.

In addition,



At frequent, regular intervals, monitor patient's blood pressure, cardiac rate and function, respiratory status, and oxygenation (monitor continuously, if possible).

- Diphenhydramine (25-50 mg for adults, 1 mg/kg for pediatric patients).

OR

10 mg Chlorpheniramine

- Hydrocortisone 100mg IM/IV

(IV) HEMATOLOGICAL MANIFESTATIONS

- **Methemoglobinemia** is a condition caused by elevated levels of methemoglobin in the blood.
- is a form of hemoglobin that contains the ferric [Fe^{3+}] form of iron.
- The affinity for oxygen of ferric iron is impaired.

- Frequently reported in association with benzocaine use;
- However, lidocaine and prilocaine have also been implicated.
- Can be asymptomatic
- Higher levels (10-40%) may be accompanied by

- Cyanosis
- Tachypnea
- Dyspnea
- Exercise intolerance
- Fatigue
- Dizziness and syncope
- Weakness

(V) SYNCOPE

Syncope or fainting is frequently occurs because of patient is frightened at the thought of receiving an injection.

Predisposing factors:

I- Psychogenic factors:

- Fear
- Anxiety
- Sight of unpleasant object as blood or surgical instrument

II- Non-psychogenic:

- Sudden unexpected pain
- Hunger causing low glucose supply
- Poor physical condition

Clinical features

1 Pre-syncope period :

- The patient feels faint and may feel nauseating.
- Paleness and coldness of hand
- Sweating over the forehead and hands
- Hypotension
- Tachycardia
- Deep irregular respiration
- Loss of consciousness
- Hypotension , bradycardia and shallow irregular respiration

- Tremors or convulsive movements of the extremities.
- Progression may occur into muscular relaxation and apnoea

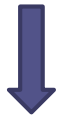
2- Post-syncope period

- After regaining consciousness the patient feels weak, nauseating and mentally confused for few minutes.

Pathophysiology

Stress causes the secretion of adrenalin into the circulation

this cause



Peripheral vascular resistance is reduced and blood flow to the muscle is increased to prepare body to response to this stressful condition

Reduced cerebral perfusion

Management

1 Stop any dental procedure

2 Place patient in supine or trendelenberg position to facilitate venous return to the heart.

3 Maintain patent airway , Respiratory stimulants by aromatic spirit of ammonia

4 Oxygen administration might be needed

5 Keep the patient in this position under observation

6 For persistent bradycardia give atropine 0.4 mg i.v

(VI) Regional or systemic infection

- Infection within the perioral tissues can be potentially spread through planes of the head and neck by passage of a needle through an infected area.
- Endocarditis risk: injections such as the intraligamentary injection can force bacteria into the systemic circulation and cause bacterial endocarditis

(VII) OCULAR MANIFESTATIONS Following PSA

- Paralysis of the extraocular muscles
- Diplopia
- Amaurosis (temporary blindness)
- Blurring of vision

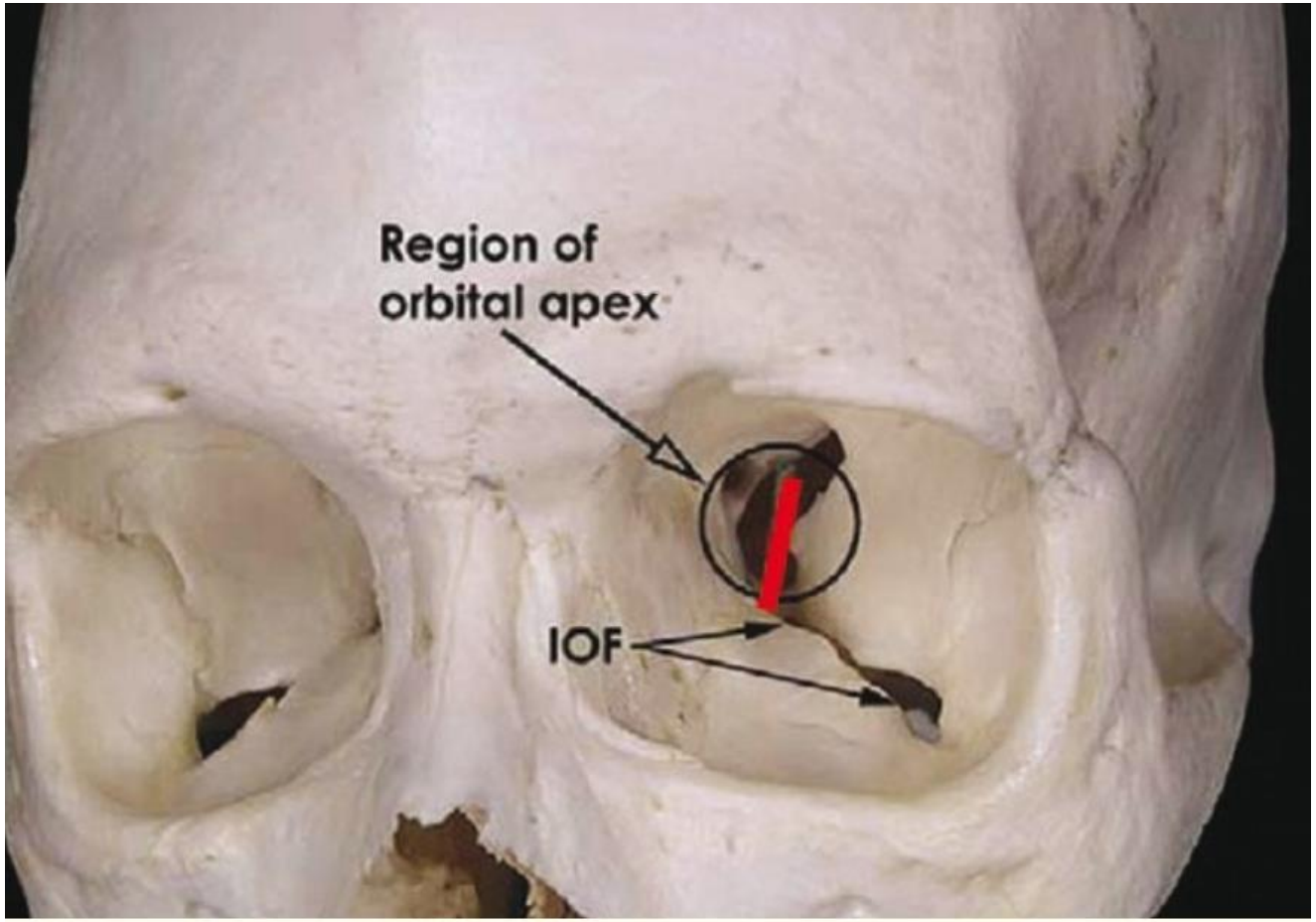
Possible causes

(1) The local anesthetic solution reaches the inferior ophthalmic vein via the pterygoid plexus or its communicating branches.

(2) The inadvertent deposition of results in passage of L A through the inferior orbital fissure to cause direct anesthesia of the abducent nerve.

(3) Deposition of the anesthetic solution within the PSA artery causes a back flow into the connecting maxillary artery and subsequently into the middle meningeal artery.

(4)The local anesthetic solution reaches the abducent nerve within the cavernous sinus.



Abducens nerve normally lies on the deep (intraconal) surface of the lateral rectus muscle

Prevention

- Injections into the vascular system must be avoided.
- Aspiration prior to injection and slow injection are mandatory.
- knowledge of the surgical anatomy with regard to the particular nerve block.
- Follow the accepted techniques and to adhere to all the basic concepts of the accepted procedures.

Management

- Reassure the patient regarding the usually transient nature of the complications.
- Cover the affected eye with a gauze dressing to protect the cornea.
- The patient should be escorted home by a responsible adult.
- If ocular complications last longer than six hours, refer the patient to an ophthalmologist for evaluation.

10.5005/jp-journals-10015-1214

REVIEW ARTICLE

Intraoral Local Anesthesia and Ocular Complications

Kavitha Patil, Karishma Munoli, Vinod Kumar, Kartik Venkataraghavan

ABSTRACT

Background: Ocular complications due to intraoral local anesthesia are rare but most distressing to the dentist and patient. Ocular complications after local anesthetic injections are rarely reported in the literature and these complications include strabismus, ptosis, diplopia, blindness, ophthalmoplegia, loss of accommodation.

due to intraoral local anesthesia, the ocular alterations are quite uncommon, representing approximately 0.1% of the complications.[4]

There are few studies which report various ocular complications. A comprehensive review of literature provides an overview of ocular complications due to local

[Systemic complications and side effects of retrobulbar anesthesia in risk patients]

[Article in German]

B Dick [1], T Kohnen, V Hessemer, K W Jacobi

Affiliations + expand

PMID: 7933904 DOI: 10.1055/s-2008-1045485

Natl J Maxillofac Surg. 2011 Jan-Jun; 2(1): 82–85.
doi: 10.4103/0975-5950.85861

Diplopia with local anesthesia

Michael Pragasm and Anil Managutti

(VIII) HEPATOTOXICITY

Bupivacaine:

Probable cause of clinically apparent liver injury (limited to use of bupivacaine given by infusion or multiple injections over a period of 1 to 3 days)

Management

- The injury was invariably self-limited
- No incidence of acute or chronic liver failure has been linked to bupivacaine or other local anesthetics.

(IX) OVERDOSE

Overdose can be defined as those clinical signs and symptoms that result from an High blood level of the drug in varous target tissue and organs.

CLINICAL MANIFESTAIOTNS OF OVERDOSE

I- Minimal to moderate overdose

Signs

- Talkativeness
- Apprehension
- Slurred speech
- Excitability
- Disorientation
- Euphoria
- Nystagmus
- Muscular twitching / tremors
- Elevated BP
- Elevated heart rate
- Nausea/vomiting
- Elevated resp. rate
- Failure to follow commands

Symptoms

- Restlessness
- Visual disturbances
- Auditory disturbances
- Numbness
- Metallic taste
- Light-headed and dizzy
- Drowsy and disoriented
- Losing consciousness
- Sensation of twitching (before actual twitching is observed)

Moderate to High overdose level :

Generalized tonic-clonic seizure activity

Followed by

- Generalized CNS depression
- Reduced BP, heart rate
- Reduced respiratory rate

Pathophysiology

Local anesthetics cross blood-brain barrier, producing CNS depression as level rises
eg. **LIDOCAINE**

Blood Level	Action Produced
< 0.5 ug/ml	No adverse CNS effects
0.5-4 ug/ml	Agitations , irritability
4.5-7.5 ug/ml	Convulsions
> 7.5 ug/ml	Tonic- clonic seizures

Local anesthetics exert a lesser effect on the cardiovascular system
eg. **LIDOCAINE**

Blood Level	Action Produced
1.8-5 ug/ml	**T**achycardia
5-10 ug/mlx	Cardiac depression
>10 ug/ml	Severe depression , bradycardia, vasodilatation, arrest

Management of overdose

Mild Reaction - Slow onset

- Reassure patient
- Administer O2
- Monitor vital signs
- Consider IV anticonvulsant.
- Get medical consultation.

Severe Reaction - Rapid onset

- Stop all treatment
- Place patient in supine position.
- Establish airway, give O2
- If convulsions, protect patient
- Call for emergency medical help
- Administer anticonvulsant drugs
- Consider vasopressors
- Get medical consultation.

Prevention of local anesthetic toxicity

I - Prior to Treatment

1. Complete review of medical status (including vital signs)
2. Anxiety / Fear should be assessed and managed before administering anesthetic agents.

During administration of Anesthetic

1. Place pt. supine or semi-supine position.
2. Dry site, apply topical anesthetic for 1 min.
3. Select appropriate drug for treatment (time)
4. Vasoconstrictor unless contraindicated.
5. Weakest anesthetic in the minimum volume (compatible with successful anesthesia)
6. Inject slowly (minimum of 60 sec / 1.8 ml)
7. Continually observe –

Never leave patient alone after injection

8. Aspirate in two planes, before injecting.
9. Use sharp, disposable needlesof adequate diameter and length

Conclusion

- Providing clinically adequate anesthesia in the maxilla is rarely a problem.
- Successful mandibular anesthesia is the most challenging to all the practioners .
- The availability of supplemental techniques minimizes the chances of a patient being unable to be treated due to a lack of profound anesthesia
- Prevention of local anesthetic toxicity should always be the primary consideration.

- Although all adverse reactions cannot be anticipated, complications can be minimized by

1. Strict adherence to the guidelines of anesthetic dosing
2. Identification of patients at increased risk
3. Implementation of appropriate anesthetic application techniques to avoid unintentional intravascular injection.

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thank
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