Methods of administration of local anesthesia

by

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The methods of administration of local anesthesia are sub-divided into three methods: topical, infiltration, and regional techniques.

1. Topical or surface anesthesia: it is obtained by the application of a suitable anesthetic agent to an area of either skin or mucous membrane in which it penetrates to anesthetize superficial nerve endings. It is commonly used to obtain anesthesia of mucosa prior to injection.

2. Sprays containing an appropriate local anesthetic agent are particularly suitable for this purpose because of their rapidity of action.

The active ingredient is 10% lidocaine hydrochloride. The onset time of anesthesia is approximately 1 minute and the duration round about 10 minutes.

3. Ointments containing 5% lidocaine hydrochloride can be used for a similar purpose but take 3-4 minutes to produce surface anesthesia.

Ethyl chloride spray when sprayed on to either skin or mucosa volatilizes so rapidly that it quickly produces anesthesia by refrigeration

This technique is of limited value but is occasionally used to produce surface anesthesia prior to incision of a fluctuant abscesses

Maxilla

The maxilla has thin labial/buccal cortical plate; and moreover shows areas of porosity, and the compact bone presents numerous foramina which aid in absorption of local anesthetic solution. These factors, therefore, make the maxilla more favorable for infiltration anesthesia techniques.

Mandible

The bone is generally dense and has thicker cortical plates than maxilla, particularly in posterior region, more so in the region of external oblique ridge. Only the anterior part of mandible presents sufficient porosity, which is favorable for infiltration techniques.

2. Infiltration anesthesia:

In this method the anesthetic solution deposited near the terminal fibers of any nerve it will infiltrate through the tissues to reach the nerve fibers and thus produce anesthesia of the localized area served by them, this technique is subdivided into:

A. Sub-mucous injection:

in this technique the solution is deposited just beneath the mucous membrane. This technique is unlikely to produce anesthesia of the dental pulp, it is often employed to anesthetize the long buccal nerve prior to the extraction of mandibular molars or for soft tissue surgery

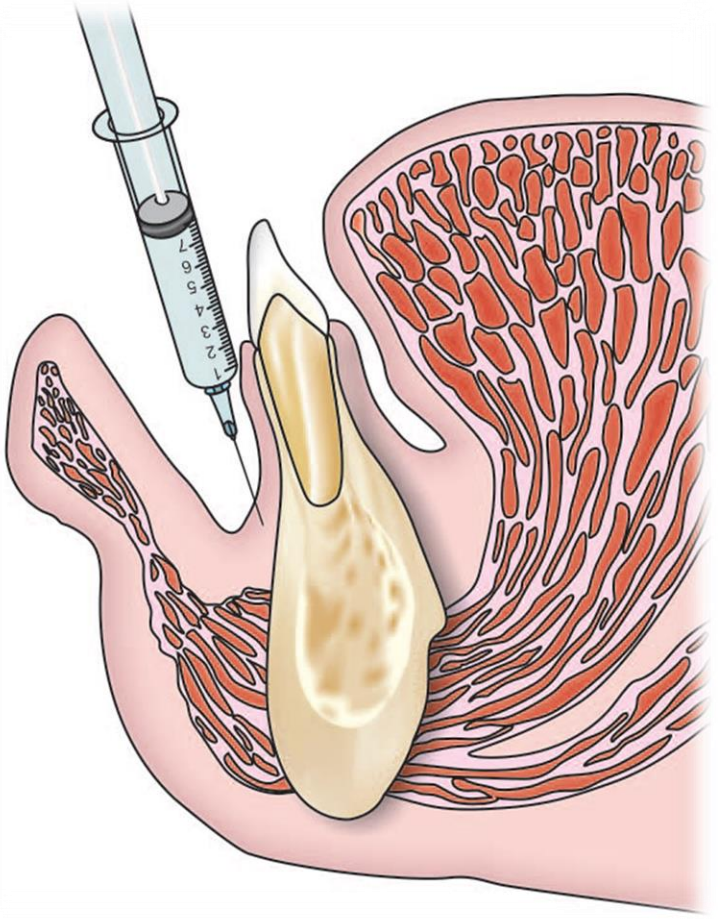


Fig.: Infiltration—submucosal injection—
the position of the point of the needle is in the submucosal layers.

B. Supra-periosteal injection:

- in some sites, such as the maxilla, the outer cortical plate of alveolar bone is thin and perforated by tiny vascular canals.

- In these areas when anesthetic solution is deposited outside the periosteum, it will infiltrate through the periosteum, cortical plate, and medullary bone to the nerve fibers. By this means, anesthesia of the dental pulp can be obtained by injecting alongside the approximate position of the tooth apex.

- The Supra-periosteal injection is the technique most frequently used in dentistry.

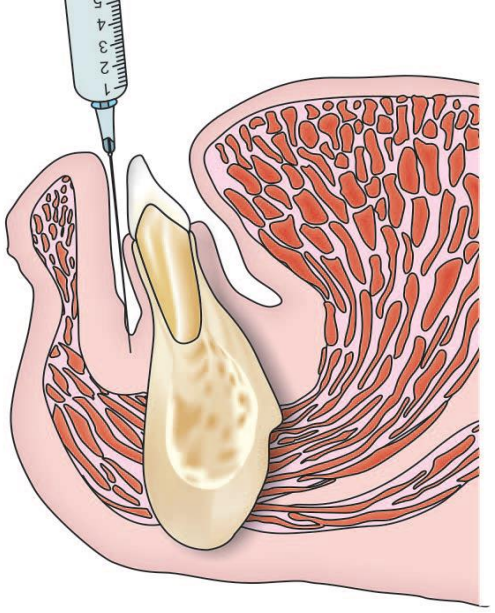


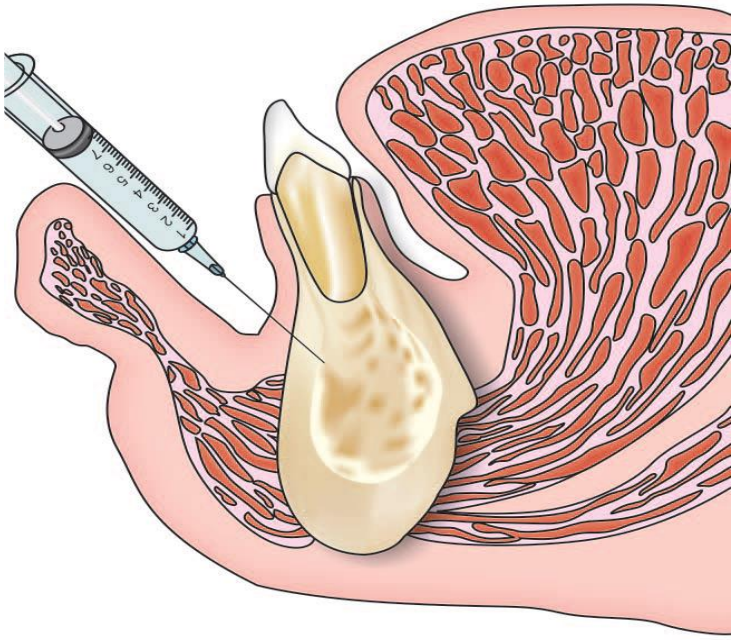
Fig. 2: Infiltration—supraperiosteal injection in anterior maxilla— the position of the point of the needle is at an angle of 45° to the long axis of the tooth.

C. **Sub-periosteal injection:**

in this technique the solution is deposited between the periosteum and the cortical plate. This technique is painful since the periosteum is firmly bound to the cortical plate

Fig.: Infiltration—subperiosteal injection in anterior maxilla—the position of the point of the needle is at an angle of 90° to the long axis of the tooth and the alveolar bone as seen from the side.

D. Intra-osseous injection:



in this technique, the solution is deposited within the medullary bone. The procedure is carried out by the use of bone drills and needles especially designed for this purpose.

In practice, the effectiveness of the anesthetic solution available has reduced considerably the need for intraosseous injection and the technique is seldom used.

E. Intraligamentary (Periodontal or Peridental) Injection

Nerve anesthetized:

Terminal nerve endings at the site of injection at the apex of the tooth.

Area anesthetized:

bone, soft tissue & apical & pulpal tissue in the area of injection.

Indications:

1. **Pulpal anesthesia of one or two teeth.**
2. **Situations in which regional block are contraindicated (e.g.: bleeding disorders).**
3. **Aid in the diagnosis of pulpal discomfort.**
4. **As an adjunctive technique following nerve block if partial anesthesia is present.**

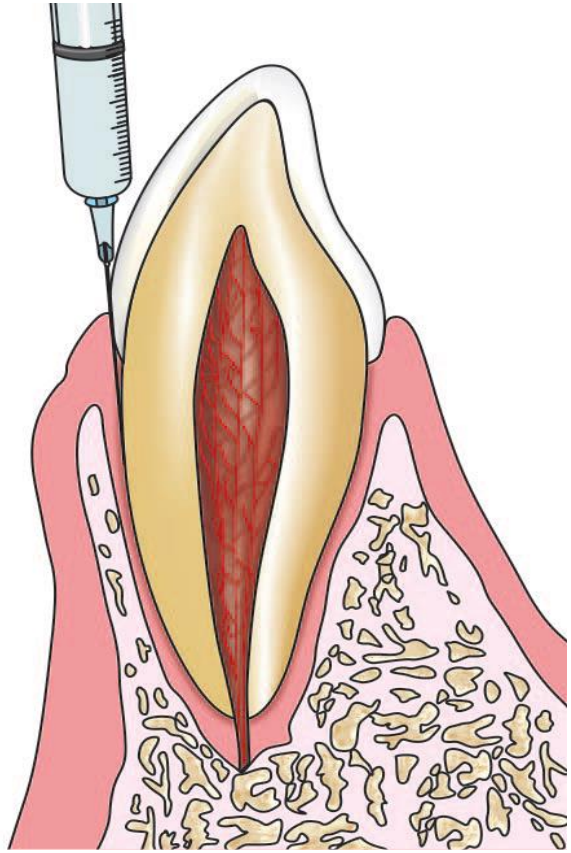


Fig.: Infiltration—intraligamentary injection—the position of the point of the needle is in the periodontal space

Contraindications:

1. Infection or acute inflammation in the area of injection.

2. Patient who requires (numb) sensation for psychological comfort.

Advantages:

1. Avoid anesthesia of the lip, tongue & other soft tissues.

2. Minimum dose of local anesthesia is required.

3. Rapid onset of profound pulpal & soft tissue anesthesia.

4. Less traumatic than conventional block technique.

Disadvantages:

1. Excessive pressure or rapid injection may break the glass cartridge.

2. A special syringe may be required.

3. Excessive pressure can produce focal tissue damage.

Technique:

1. A 27 gauge short needle recommended.

2. Area of insertion; the long axis of the tooth to be treated on its mesial or distal of the root.

3. Target area; is the depth of the gingival sulcus.

Intrapulpal Anesthesia

This technique is indicated for obtaining anesthesia for procedures which require direct instrumentation of the pulpal tissue.

A 25 or 27-gauge needle is inserted directly into the pulp chamber.

The needle should be held firmly or wedged into the pulp chamber or the root canal.

Initially, slight discomfort is felt by the patient which subsequently gets subsided. Sometimes the needle is bent to get a proper angle for good approach

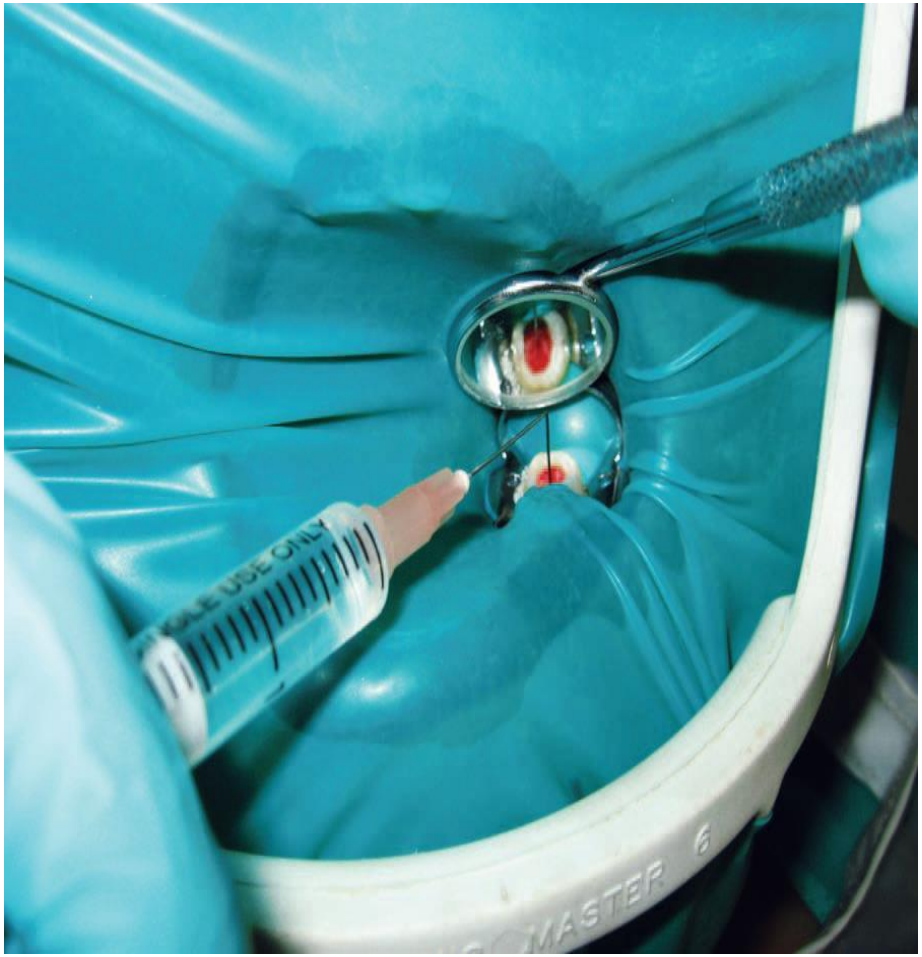


Fig.: Infiltration—intrapulpal injection—the point of the needle is in the pulp chamber (*Courtesy:* Dr Vibha Hegde)

3. Regional (block) anesthesia:

In this technique, the anesthetic solution deposited near a nerve trunk will, by blocking all impulses, produce anesthesia of the area supplied by that nerve.

Although this technique may be used in the maxilla, it is of particular value in dentistry for producing anesthesia in the mandible.

The use of infiltration technique in the mandible is unreliable due to the density of the outer cortical plate of bone.

By placing the anesthetic solution in the pterygomandibular space near the mandibular foramen, regional anesthesia over the whole distribution of the inferior dental nerve on that side is obtained.

Local anesthesia in the maxilla:

Anesthesia of the upper molar teeth:

The pulp of upper third, second, and first molar (with the exception of the mesiobuccal root) are innervated by branches of posterior superior alveolar nerve.

This nerve is also responsible for providing sensory innervation to the buccal gingiva in the molar region and the mucoperiosteal attached to them.

Deposition of the anesthetic solution close to the nerve (posterior superior alveolar nerve) after it leaves its bony canal produces regional anesthesia of the structures it supplies.

This technique is termed posterior superior dental block.

This technique carries the risk of damage to the pterygoid venous plexus so it is of limited use; instead infiltration technique is commonly used.

Technique of posterior superior alveolar nerve block (fig: l):

1. Partially open the patient's mouth, pulling the mandible to the side of injection

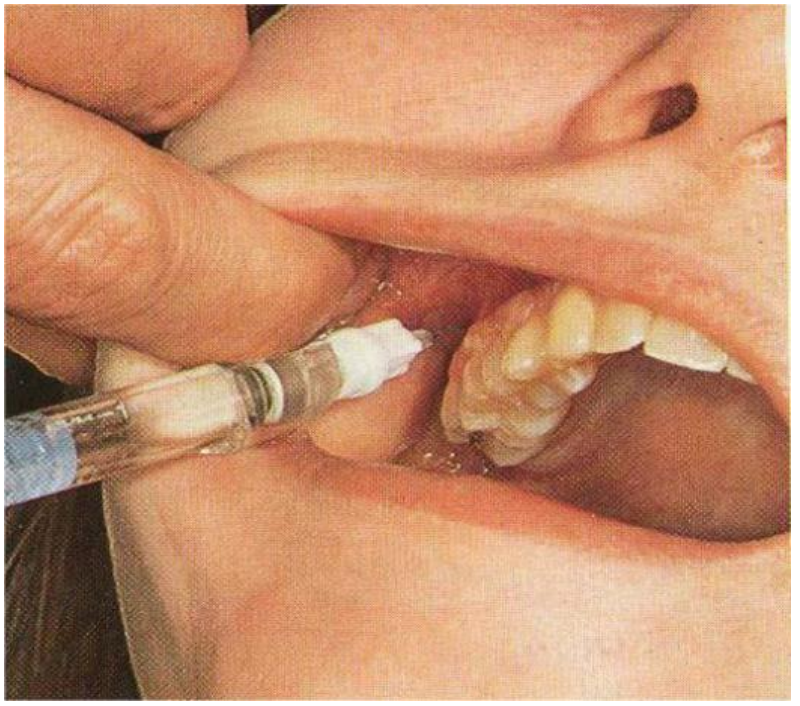
2. Retract the patient's cheek with your finger or mirror (for visibility)

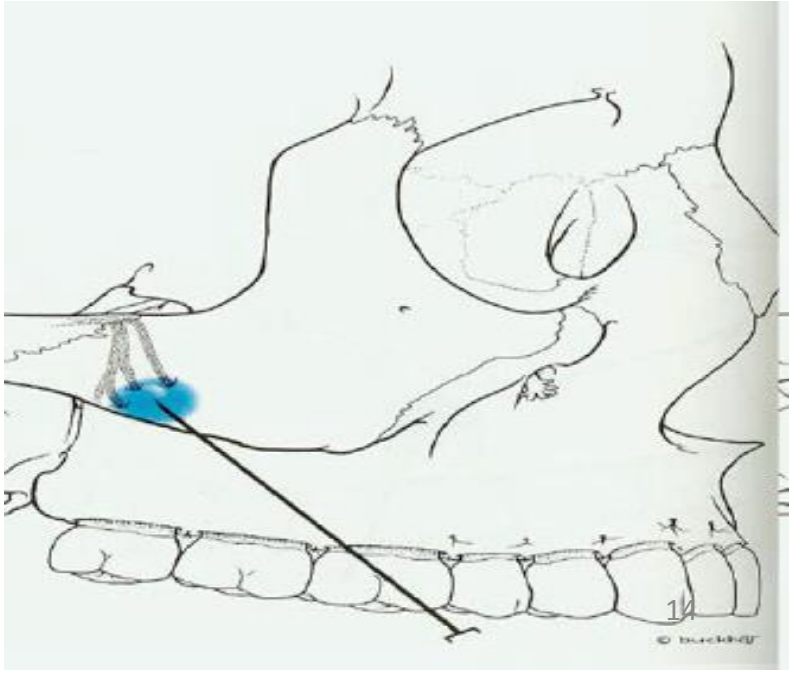
3. Insert the needle into the height of the mucobuccal fold over the second molar.

4. Advance the needle slowly in an upward, inward, and backward direction in one movement

5. Deposit 1 -1.8 ml of the anesthetic solution

6. Slowly withdraw the syringe.





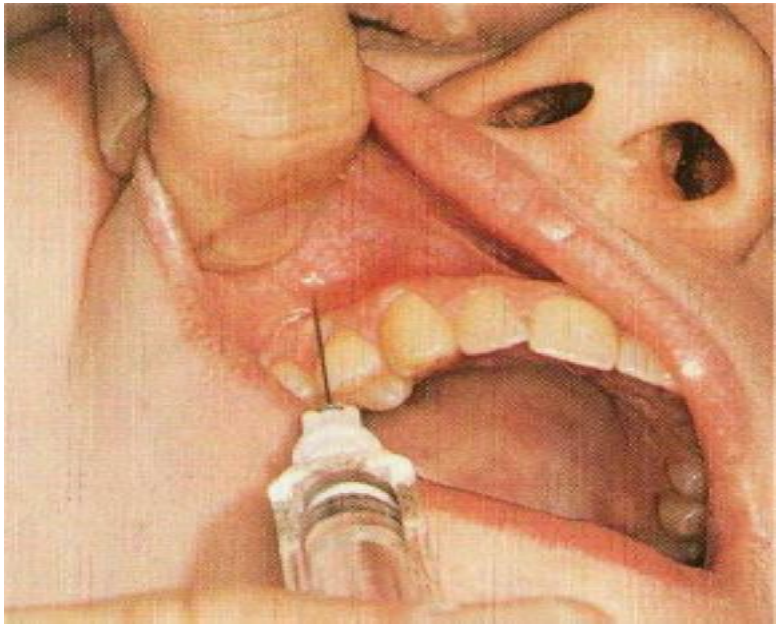
Infiltration technique:

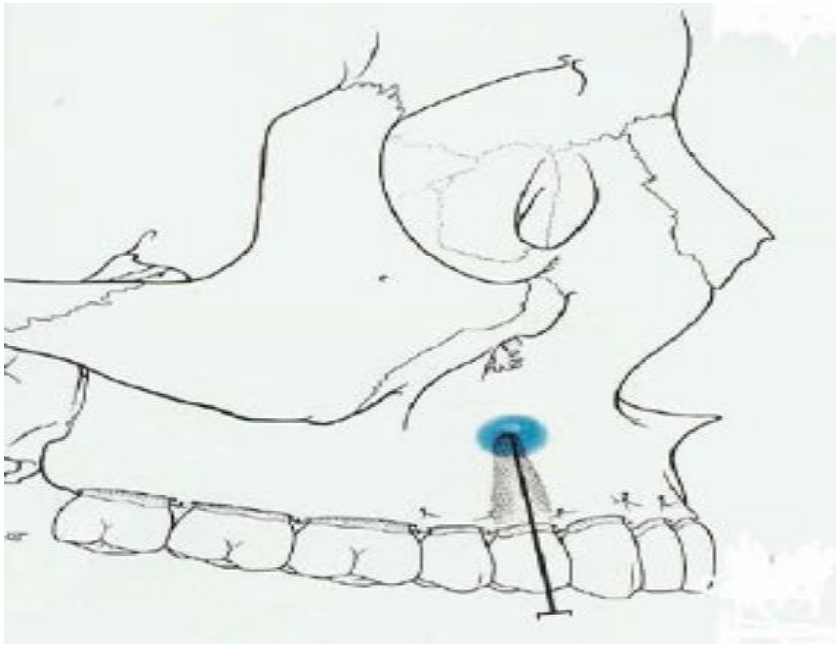
1. Hold the syringe parallel with the long axis of the tooth.
2. Insert the needle into the height of the mucobuccal fold over the target tooth.
3. Advance the needle for a few millimeters.
4. Inject slowly about 0.6 ml (third of a cartridge)
5. Slowly withdraw the syringe.

Note: in the block technique we get anesthesia to the whole area supplied by the nerve (posterior superior dental nerve), while in the infiltration technique, the anesthesia is limited to the specific target tooth.

Anesthesia of the upper premolar teeth

The mesio-buccal root of the upper first molar, both premolars, and buccal supporting tissue and muco-periosteum related to them are innervated via the middle superior alveolar nerve. Infiltration technique is usually employed to anesthetize these structures (same procedure mentioned above).

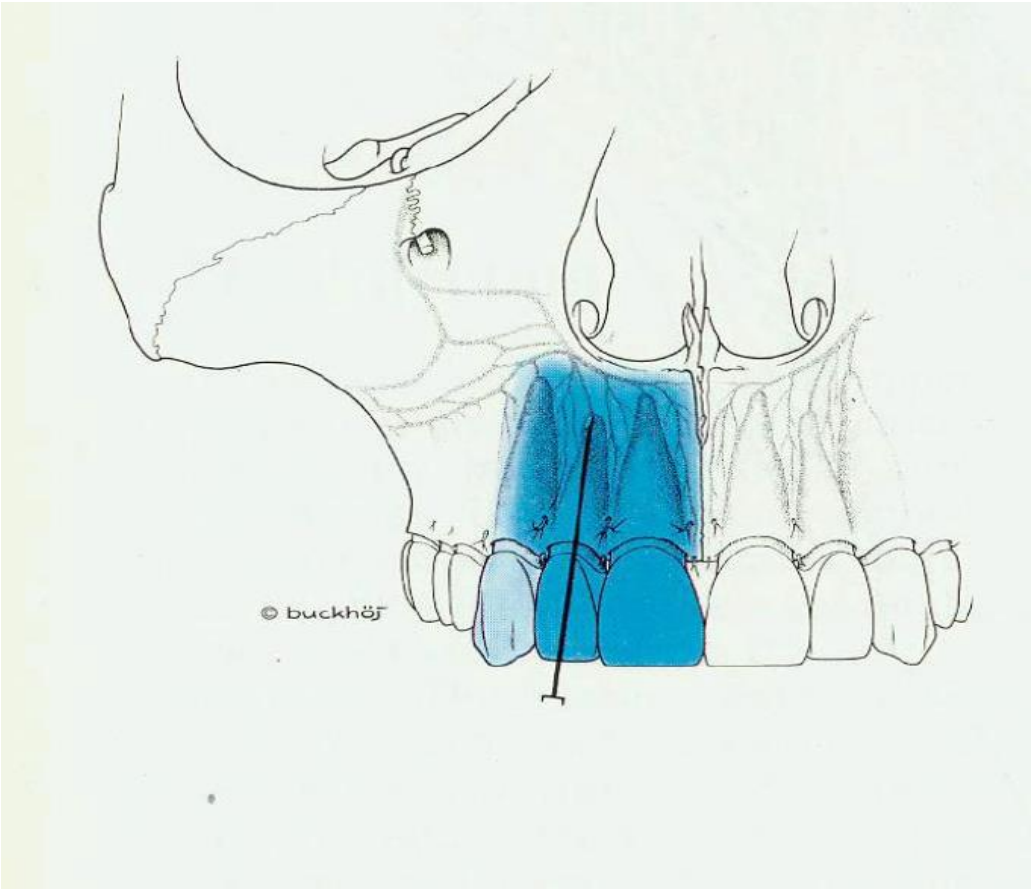




Anesthesia of the upper anterior teeth

The upper central, lateral incisor, and canine teeth and labial supporting tissue and muco-periosteum related to them are innervated via anterior superior dental nerve.

Infiltration technique is usually employed to anesthetize these structures (same procedure mentioned above).



Note: in conservative treatment of a tooth we require anesthesia of the pulp only, while during surgical procedure such as tooth extraction we need anesthesia of the pulp, buccal and lingual gingiva and the associated bone and periosteum.

Palatal anesthesia is necessary for dental procedures involving manipulation of palatal soft or hard tissues (ex: tooth extraction).

The palatal mucopriosteum is firm in consistency and is closely adapted to the bone.

These features make it necessary to inject local anesthetic solutions under greater pressure than is required in other sites.

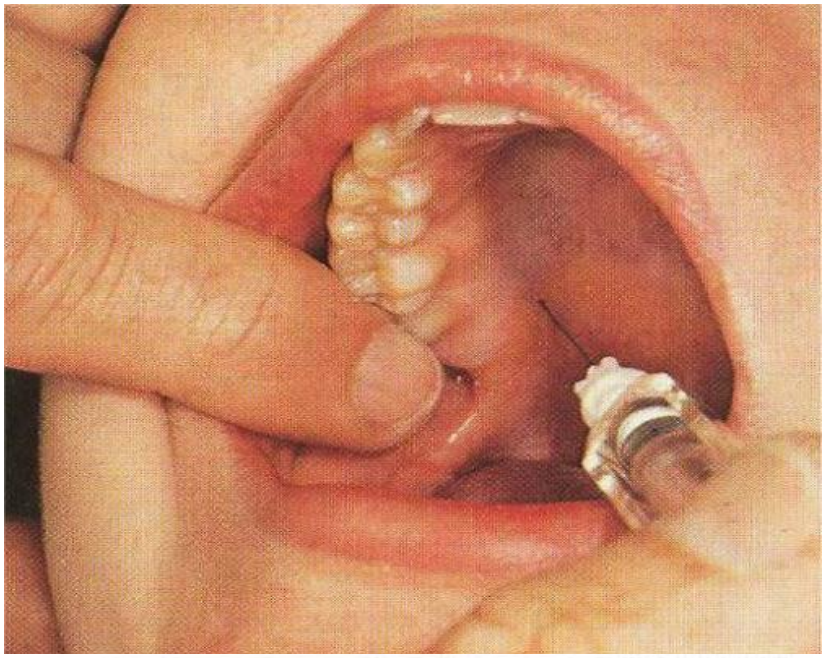
For his reason, patients should be informed prior to injection that palatal injections cause some discomfort or pain. This may be minimized by inserting the needle with the bevel facing the bone and as near as possible at right angel to the vault of the palate.

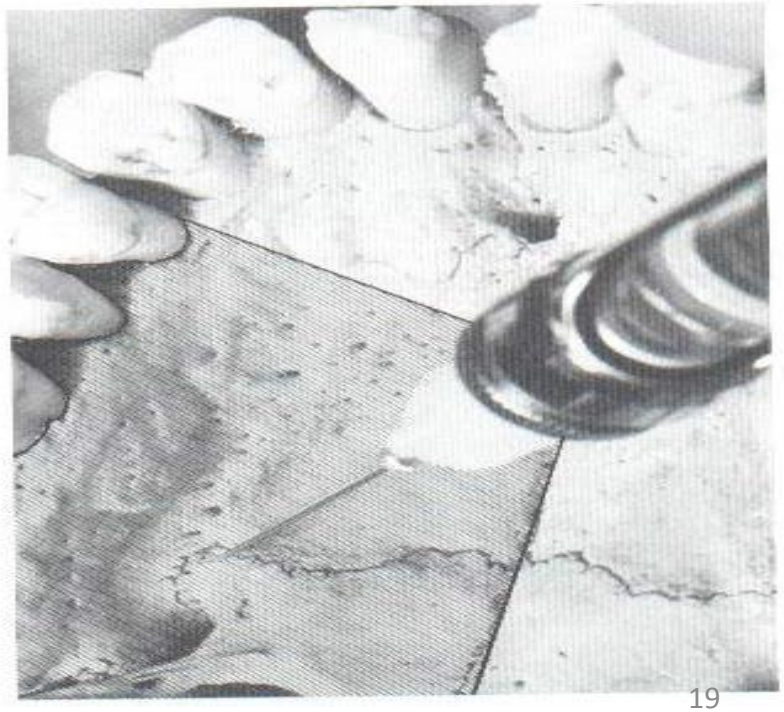
Palatal anesthesia could be achieved by greater palatine nerve block, which provides anesthesia of the posterior portion of the hard palate,

or nasopalatine nerve block, which provides anesthesia of the anterior portion of the hard palate.

Or by infiltration technique in which the solution is deposited in the palatal tissue adjacent to the target tooth.

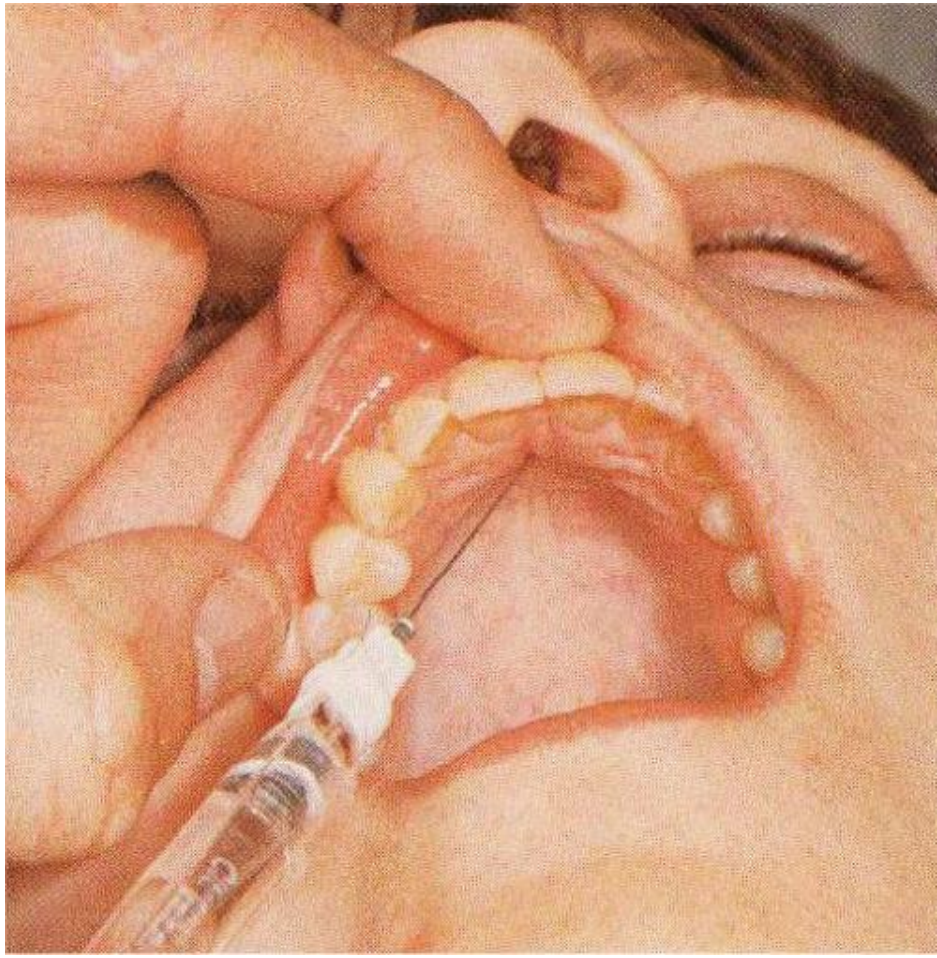
Note: In the greater palatine nerve block (fig.4), the solution is deposited near the greater palatine foramen, which is located just distal to the maxillary second molar about 1 cm toward the midline.





In nasopalatine nerve block (fig:5), the solution is deposited near the incisive foramen, which is located in the midline of the palate about 1cm posterior to the maxillary central incisors.

In the infiltration technique the solution is deposited about half way between the midline and the gingival margin of the target tooth.



Infra- Orbital injection:

This technique is rarely used since the infiltration techniques are so effective in the maxilla, however it may be of value if numerous extractions or extensive surgery are to be undertaken in the maxillary incisor and canine regions.

It may also be employed for anesthetizing an anterior tooth where the use of infiltration technique is precluded by the presence of infection at the site of injection.

This technique is based upon the fact that the solution deposited at the orifice of the infra-orbital foramen passes along the canal to involve both the anterior and middle superior alveolar nerves thus producing anesthesia of the incisor, canine, and premolar teeth and their supporting structures. This block technique could be achieved either by an intra oral or an extra oral approach.

Intra oral approach

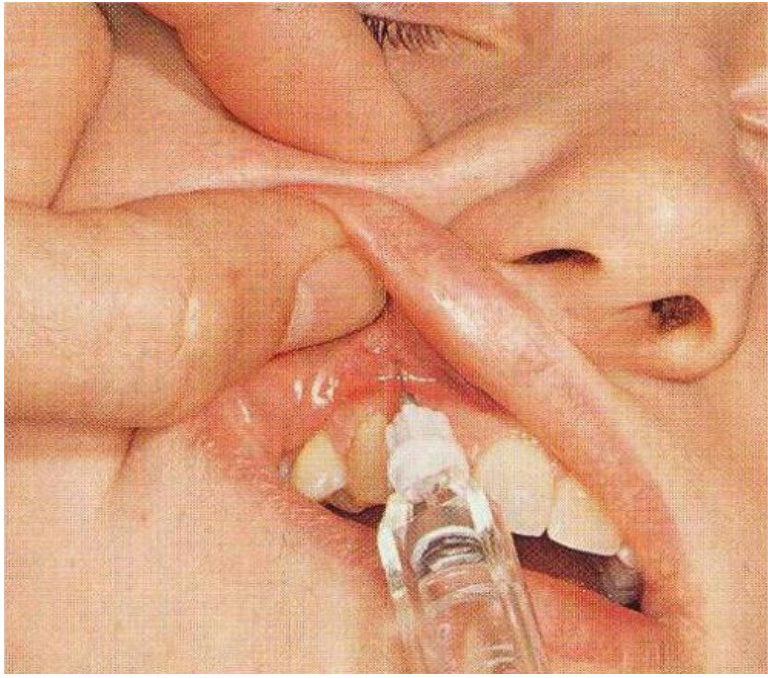
This approach is more popular and allows the needle to be kept out of

the patient's sight.

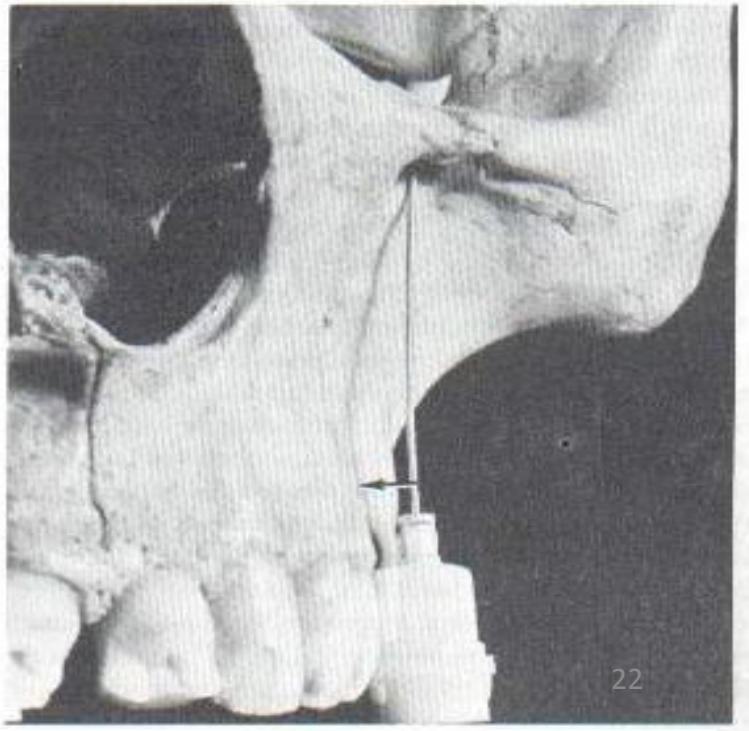
Technique:

The infra-orbital ridge is palpated and the infra-orbital notch located with the tip of the first finger, which is then moved slightly downward to lie directly over the infra-orbital foramen.

With the finger tip maintained in that position the thumb is used to reflect the upper lip and expose the site of injection.



Then the tip of a long needle is inserted into the mucous membrane over the apex of the second premolar. The needle is advanced in line with the long axis of this tooth to a depth of 1.5-2 cm. Then 1 ml of anesthetic solution is given which is enough in most instances.



Extra-oral approach

The infra-orbital foramen is located in the manner previously described, the patient told to close his eyes, then the tip of a short needle is inserted until it lies at the foramen followed by deposition of 1 ml of the solution.

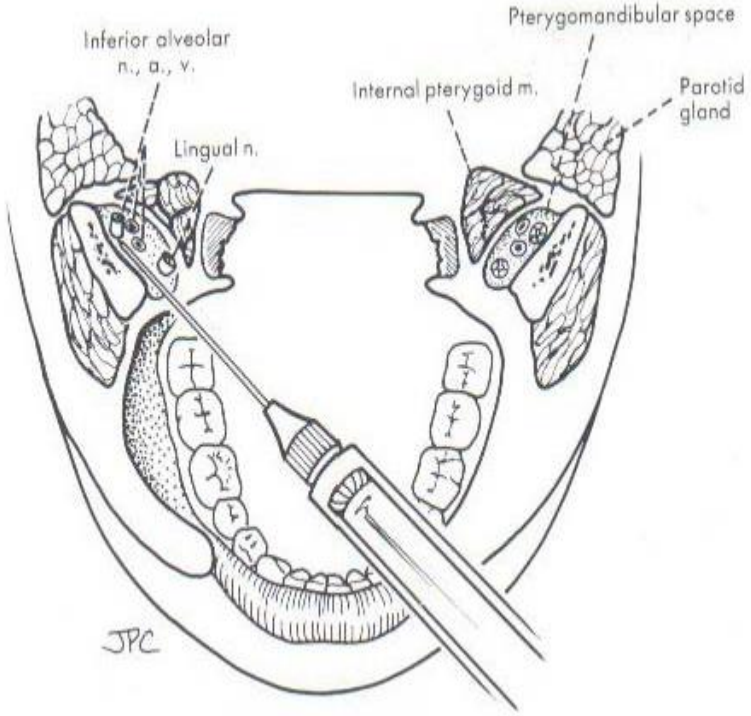
Anesthesia of the upper deciduous teeth:

In children, multiple vascular canals perforate the thin labio-buccal alveolar plate. For this reason, infiltration techniques are highly effective in producing anesthesia of upper deciduous teeth.

Care should be taken to avoid the mistake of misjudging the length of the roots and inserting the needle too deeply into the tissues.

Local anesthesia in the mandible

Due to the density of the buccal bone plate, infiltration techniques are of limited value in the mandible and block anesthesia is most frequently employed. This is achieved by the deposition of solution around the inferior dental nerve in the pterygomandibular space.



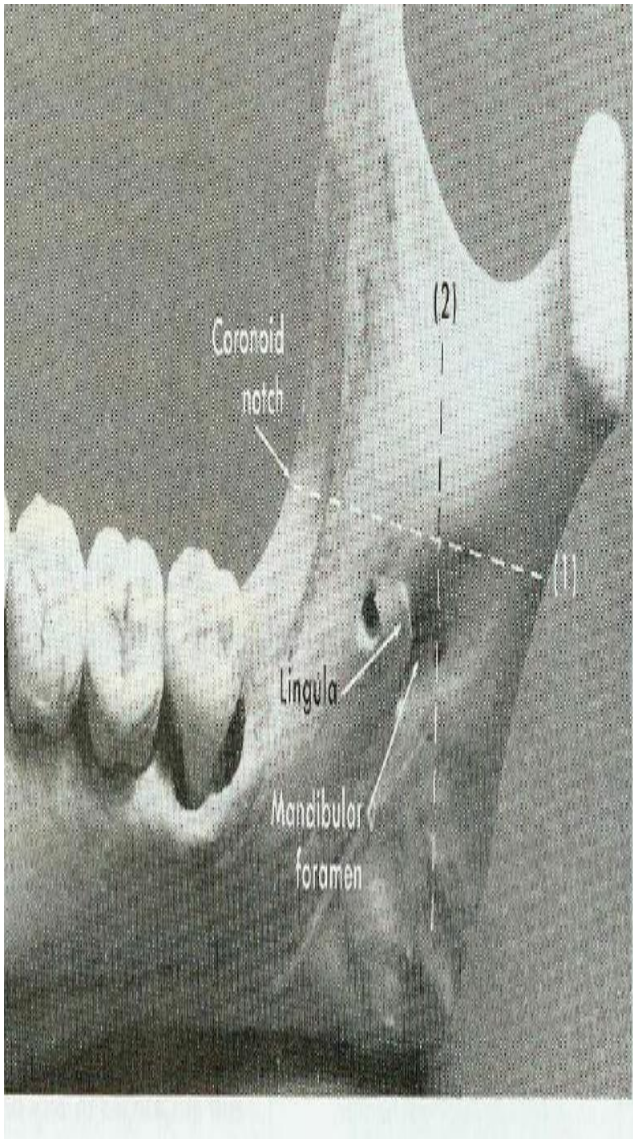
Boundaries of the pterygomandibular space

- **The space is bounded anteriorly by the pterygomandibular raphe and the fibers of superior constrictor and buccinator muscles that are inserted into it.**
- **The posterior boundary is formed by the parotid gland.**
- **The ramus of the mandible forms the lateral wall while the medial pterygoid muscle forms the medial wall; the lateral pterygoid muscle forms the roof of the space.**
- **The lingual nerve ascend diagonally through the space passing just infront of the inferior alveolar nerve as the latter emerges from the mandibular foramen.**
- **A shallow bony depression just above the foramen is the site in which the solution should be deposited for an inferior dental block.**

The inferior dental block (IDB):

The success of this technique is entirely dependent upon the accurate *deposition* of *the* solution; this technique will anesthetize the inferior alveolar nerve and its terminal branches (mental and incisive nerve).

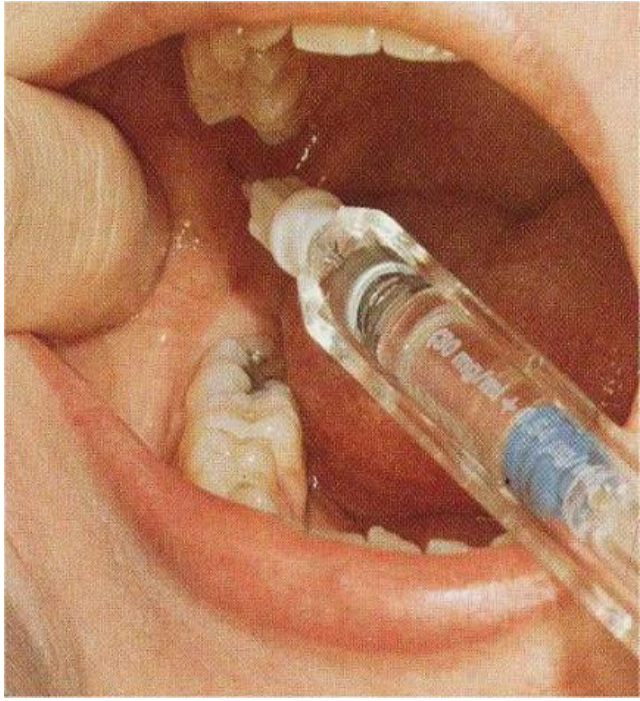
It is accomplished in the following manner: The patient is seated in the chair and the head rest adjusted so that his mandibular occlusal plane is horizontal when the mouth is open.



The dentist should stand in front of his patient for the right IDB and behind the chair for the left IDB (this is for the right handed dentist). Upon intra-oral inspection, two important landmarks should be identified: the retromolar triangle and the pterygomandibular raphe (this structure passes upward and inward from the posterior end of the mylohyoid line of the mandible to the Hamulus of the medial pterygoid plate, the point of insertion of the needle should be lateral to and

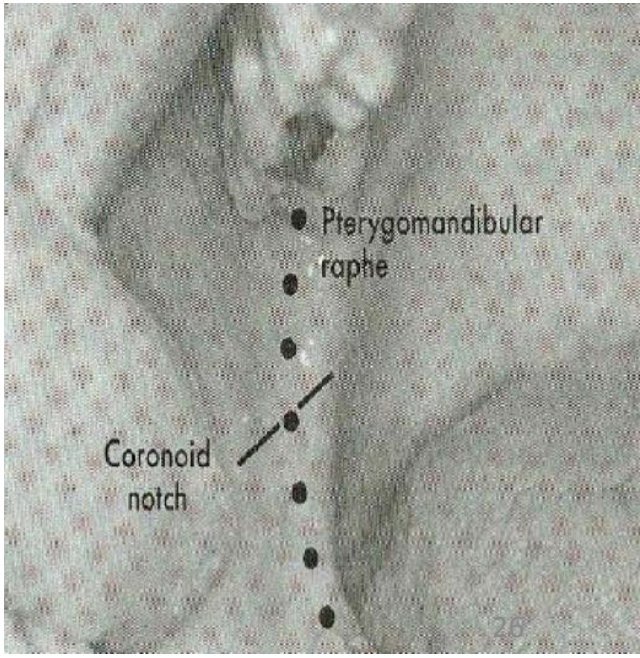
infront of it),

The thumb of the left hand is passed along the buccal surfaces of the lower molar teeth until the external oblique ridge is felt. The tip of the thumb is then passed inward to lie in the retro-molar fossa. The mid point of the nail should lie in the deepest part of the coronoid notch; this position usually coincides with the internal oblique line.



A long needle is inserted at this point. With the barrel of the syringe held parallel to the mandibular occlusal plane and over the second premolar tooth of the opposite side of the mouth, the tip of the needle is inserted for about 2 - 2.5 cm until its tip lightly contact the bone above the mandibular foramen.

When bone is contacted withdraw approximately 1mm to prevent subperiosteal injection and about 1.5 ml of the solution deposited. Then slowly withdraw the syringe and when approximately half its length remains within tissues deposit few drops of the solution to anesthetize the lingual nerve. The onset of anesthesia is signalled by a change of sensation in the lower lip and the tongue when compared with the other side; this may be described as pins and needles, frozen, wooden like, etc...



Note

1. The dimensions and shape of the mandible may vary in patients of differing race, size, and age. Thus the width of the ascending ramus and hence the position of the mandibular foramen may vary between individuals. For this reason it is often helpful to palpate both the anterior and the posterior borders of the ascending ramus by the thumb and the index finger, the needle may then be inserted as previously described and directed midway between the two fingers.

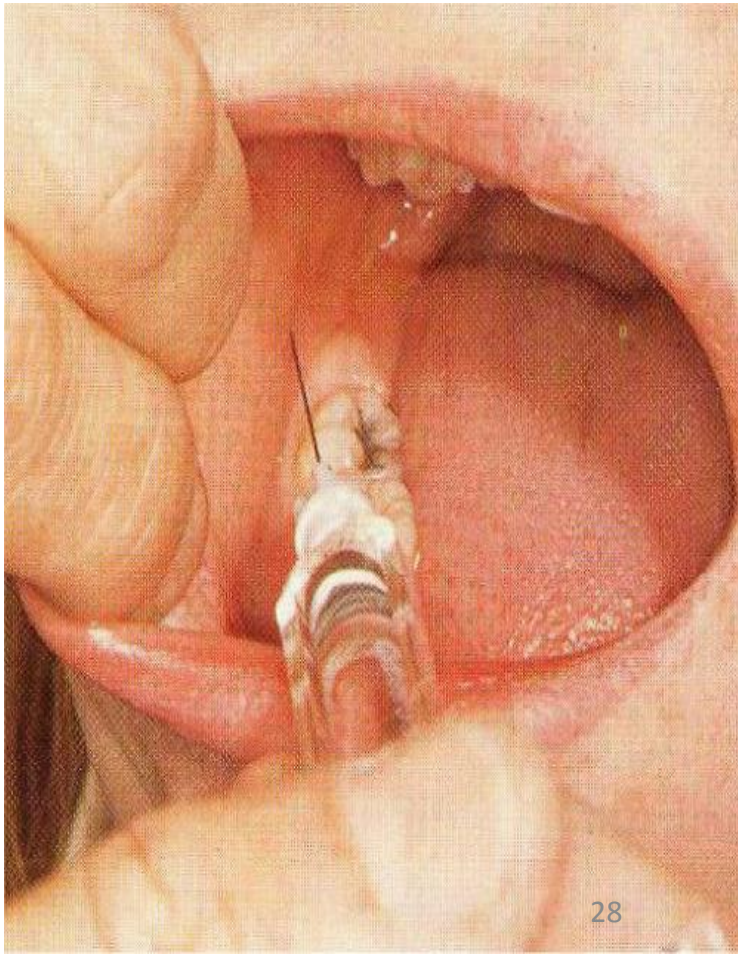
2. Bilateral IDB should be avoided whenever possible since it produces considerable discomfort primarily from the lingual soft tissue anesthesia which usually persist for several hours after injection, in addition, the patient feels unable to swallow and because of lack of sensation he\she is more likely to self injury the anesthetized soft tissue.

3. Lingual nerve also could be anesthetized by infiltration technique, by deposition of about 0.5 ml of the solution in the lingual sulcus adjacent to the target tooth.

Long buccal nerve block (LBB):

The long buccal nerve provides sensory innervation to the buccal soft tissues adjacent to the mandibular molar only (buccal gingiva). The main indication for LBB is during any procedure that involves manipulation of these tissues (ex: during extraction of the molar teeth). LBB is achieved by means of a sub-mucous injection in which the solution is deposited (few drops) just posterior and buccal to the last molar tooth in the arch.

Infiltration technique is achieved by deposition of the solution in the muco-buccal fold adjacent to the target tooth.



Note:

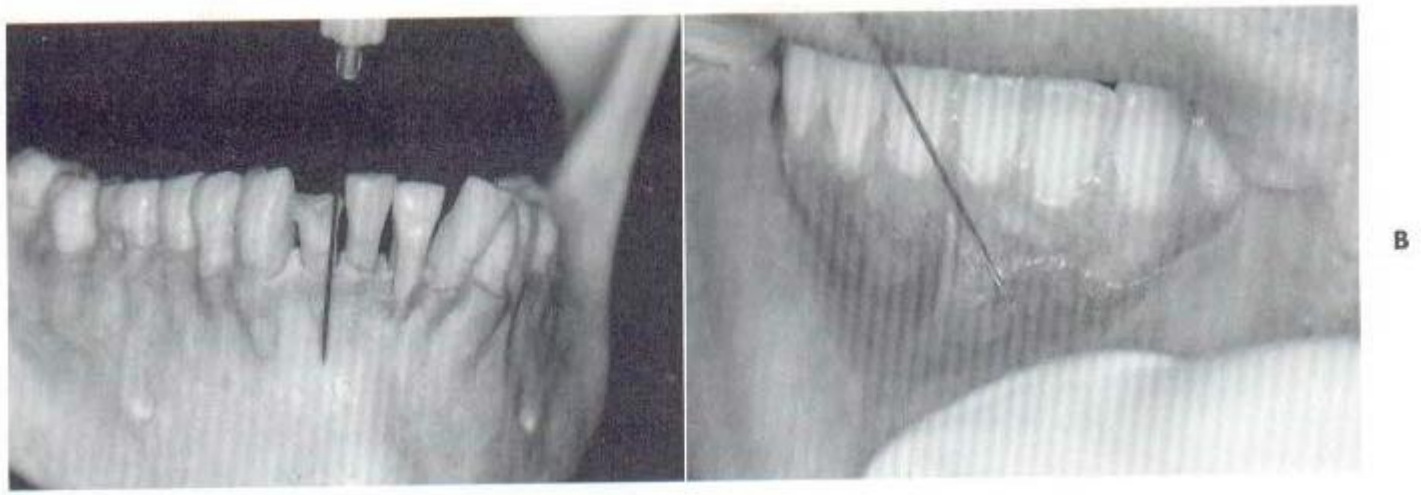
1. When the long buccal nerve anesthetized, the patient rarely experiences any symptoms due to the small size of the anesthetized area.

2. The depth of penetration of the needle is seldom more then 2-4 mm, and usually only 1-2 mm.

Anesthesia of the lower anterior teeth:

- **The lower anterior teeth are supplied by the terminal branch of the inferior dental nerve (incisive nerve).**

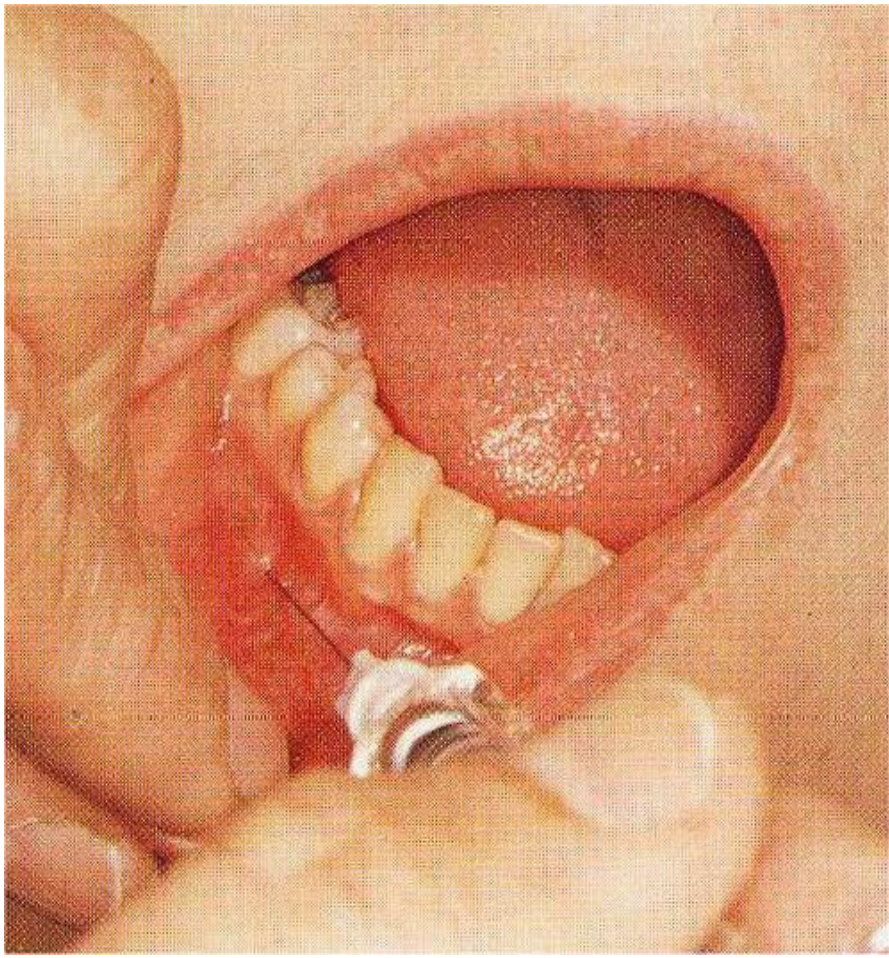
- **In the mid-line of the mandible there is a considerable overlap (anastomosis) between the left and right incisive nerve, and it is this anastomosis that renders an inferior dental block sometimes ineffective in the incisor region.**



- Fortunately the labial alveolar plate in this region is thinner and more porous than elsewhere; accordingly the infiltration technique could be used in this area. This is achieved by deposition of about 1 ml of the solution in the labial sulcus adjacent to the target tooth.

The mental nerve block (MNB):

When the anesthetic solution given near the mental foramen, it will enter the inferior dental canal to produce anesthesia of the premolar, canine, and incisor teeth of that side the mental foramen, which is usually situated between the apices of the premolars, could be determined by an imaginary line passing vertically from the supraorbital notch through the infra-orbital foramen will usually cross the mental foramen when the mouth is closed.



About I ml of the solution should be injected over the foramen.

Anesthesia of the lower deciduous teeth:

In children, multiple vascular canals perforate the labio-buccal alveolar plate, for this reason, infiltration techniques are highly effective in producing anesthesia of lower deciduous teeth. However, inferior alveolar block technique has the advantage of one needle puncture.

Complications of local anesthesia

Introduction:

Administration of local anesthesia is daily routine for most dental practitioners normally no adverse effects are seen. However complications even very serious one can occur in daily practice.

Complications related to local anesthesia can be divided into tow categories:

1. Preoperative (during giving anesthesia) complications.
2. Postoperative complications.

Both can usually be avoided buy using the correct technique and dosage however if complications occur the dentist should know how to manage them.

Each dentist dealing with local anesthesia should know:

1. The possible complications of local anesthesia.
2. The preventive measures of these complications.
3. The treatment possibilities of these complications.

Preoperative complication

1. Pain at injection

Pain during administration of LA solution can be caused by many reasons.

A- Factor depending on the solution:

1-Low PH value; this could irritate the tissue.

2-Temperature of the solution: warmer solution feeling more comfortable than cold. The cartridge can be warmed in the dentist hand or in warm water before the injection.

B- The practitioner related factors:

This is related to the technique used can be avoided by:

1- Fast injection and high injection pressure cause rapid swelling of the tissue & pain. This a slower injection technique.

2- Aggressive insertion of the needle can tear soft tissue, blood vessel, nerve & periosteum & cause more pain & other.

Complications

An inaccurate injection site can lead to an intramuscular or intraneural inj. when the needle penetrates a nerve; the patient feels a sudden (Electrical shock) in the distal area of the nerve. Pain after intramuscular injection is due to fibrosis or inflammation inside the muscle.

2. Lack of effect:

Some time the dentist face a problem, where the patient despite a conventional anesthesia still feels pain during treatment.

The problem is most common with block anesthesia especially in lower jaw.

Reasons behind his failure in LA can be classified as:

1- Anatomical.
2- Pathological.
3- Psychological.
4- Poor inj technique

1- Anatomical reasons include :

- accessory nerve supply
- Abnormal course of he nerves.
- Thick cortical plate of the mandibular alveolus precludes infiltration of anesthesia & therefore infiltration anesthesia is insufficient in the lower jaw.
- Variation in the foramen location.
- Some times the teeth can be innervated by more than one nerve.

2- pathological reasons are :

A- Trismus (limited mouth opening) in these cases it is impossible to use conventional technique of inferior alveolar nerve block. Therefore the so called Akinosi (closed mouth) technique is useful. In these cases there will be an increased possibility of failure of achieving adequate anesthesia.

B- Infection & inflammation: if the pulp is inflamed, the low tissue PH may cause lack of effective anesthesia in that area. However this does not explain failure in block anesthesia, where the solution is inj 4-5 cm from the inflamed area. A possible cause is hyperalgesia; the inflammation makes the nerve more sensitive. A minimal stimulation can cause pain perception. In those patient to obtain sufficient anesthesia more solution has to be injected, for example by combining a block & infiltration anesthesia. Supplemental intra-ligamentary or intra osseous inj can be used if necessary.

C- Previous surgery or trauma.

3- Psychological reasons :

Ex fear & anxiety. They can cause failure in LA, to enable successful anesthesia, relaxation of the patient is some time needed. For this the use of a sedative like benzodiazepine may be helpful

4- Poor technique: Is the most common cause for insufficient anesthesia in inferior alveolar nerve block anesthesia common mistakes are:

A- Injection of anesthesia too soon on the anterior ascending ramus as the needle point touches the lingual cortical bone anterior to lingula

B- Another mistake is to injection inferior to mandibular foramen

C- The solution can directed away from a nerve if it injection too rapidly & forcefully. So when ever possible it is advisable to follow accurate technique to prevent this complication.

3- Fainting & vasovagal attack

Collapse of the patient in the dental clinic may or may not be loss of consciousness. Vasovagal attack is a reflex of nervous system that cause the heart to slow down (bradycardia), at the same time affect he nerves to blood vessel in the legs permitting these vessel to dilate (widen) . As a result the heart ejects less blood so the blood pressure drops. Consequently the circulating blood goes to the legs rather than to the head, so the brain is deprived of 02 & the fainting episode occurs. In an attempt to redistribute the blood to the vital organs.

Note: pain & anxiety are the most important predisposing factor to vasovagal attacks.

Signs and symptoms:

The patients often complain of the following symptoms:

1-Dizziness 2-weakness 3-nausea

& following signs:

I-The skin is pale immediately before the collapse.

2- Cold skin 3- clammy skin 4- weak & slow pulse.

First aide should be taken immediately:

The head should be lowered quickly by adjusting the back of the dental chair so that the patient assume the supine position with legs elevated. Tight collar & belts should be loosened and respiration is stimulated. Spontaneous recovery is usual, but if sign of recovery are not apparent within 30-45 sec of the first aide measure, the collapse probably is not a vasovagal attack & in this case medical emergency team should be asked immediately for help. Meanwhile, we need to maintain a patent air way & supplementary 02 & consider the need for CPR (cardio-pulmonary resuscitation).

4. Hypersensitivity or allergy to LA :

This phenomenon occurs due to sensitivity of some individual to certain substance known as (allergens).

Any LA agent may evoke such a response, but it is more commonly seen with ester type agent (e.g. Procaine) than amide type (e.g. lidocaine) .true allergy to amide type is extremely rare.

Hypersensitivity reaction could be due to:

1- LA agent.

2- Vasoconstrictor.

3- Additives: e.g. bisulphite which used as preservative.

In general hypersensitivity reaction to LA is very rare & represent less than 1% of all complications of LA.

Many of complications suspected to be allergic are actually psychogenic reactions caused by fear of dental treatment.

Other reasons may also be the presence of adrenaline in LA solution which can cause several general symptoms including palpitation, restlessness & nausea.

True allergic response to LA may be localized or generalized & immediate or delayed in onset .they may vary from mild skin irritation or rashes to an anaphylactic reaction. Local reactions are seen more frequently than systemic & usually resolve without active treatment. If any degree of allergic reaction is observed, it is very important to determine the actual cause (allergen). Inadequate diagnosis & treatment can be life threatening to the patient

Anaphylactic shock: It rarely occurs but it is life threatening it is characterized by:

1- Profound fall in blood pressure

2- Dyspnea & respiratory embarrassment

3- Facial & laryngeal edema

4- Loss of consciousness.

5- Urticaria.

It is life threatening condition since it causes air way obstruction in association with laryngeal edema .unless treatment is initiated immediately; the condition may progress to fatal termination.

Management of anaphylaxis:

-If you suspect the anaphylactic reaction occurring, immediately seek medical help. The treatment must begin before BP & breathing problem become life threatening. - epinephrine is the most imp medication for the treatment of anaphylaxis; it is inj into a muscle. Epinephrine works rapidly to make blood vessel contract, preventing them from leaking more fluid. It also relax air way, helping the individual breathe easier, relieves cramping in the GIT & stop itching, rapidly reverse the life threatening symptom of anaphylactic shock, if given in time.

- Even if the individual responds to the epinephrine, it is vitally imp to go to an emergency room immediately.

- 02 & medication may be given to improve breathing.

- IV fluid may be necessary to restore adequate BP.

-additional medication (anti histamine) to contract the effect of histamine & to help in prevention of delayed allergic reaction. -If the victim stops breathing, perform cardio pulmonary resuscitation (CPR) immediately. Continue CPR until the person begins breathing again.

5- *Over dosage & toxicity*

It is relatively rare ,a toxicity reaction can occur when the conc. of LA in circulation increases too rapidly within a short period of time e.g. inj too rapidly into highly vascular area or IV inj .The toxic effect is primarily directed to the CNS & CVS because these tissues are composed of excitable membrane.

Mild over dose sign & symptom:

Restlessness, retention of consciousness talkativeness, & agitation, which may end into convulsion along with increased BP, heart rate, respiratory rate & classified according to the onset.

1- Slow onset <= 5 min following administration of LA (the possible cause rapid absorption & too large total dose).

2- Slower onset >= 15 min following administration of LA (the possible causes are abnormal biotransformation & renal dis.).

We use the following protocol in management of such cases:

Step 1 reassure the patient that every thing will be all right.

Step 2 administer 02 via nasal cannula or nasal hood.

Step 3 monitor vital signs.

Step 4 administer anti convulsants. IV infusion (for diazepam 5mg/ min, for midazolam 1 mg/min).

Step 5 permits the patient to recover as long as necessary; the patient can leave the dental office escorted or unescorted if we believe that full recovery has occurred, if the doubt exist regarding the level of recovery then .

Step 6 seeks medical help.

Step 7 after termination of reaction be sure that the patient be examined by physician to determine the cause of this reaction.

Severe overdose reaction:

Unconsciousness with or without convulsion, vascular collapse, coma, cardiac arrest & respiratory arrest & classified into:

1-Rapid onset (within 1 min) the possible cause is IV inj.

2-slow onset (5 to 15 min) (the possible causes are too large dose, rapid absorption & abnormal biotransformation.

We use the following protocol in management of such cases:

Step 1 terminate dental treatment.

Step 2 if convulsion is present, protect the patient arm, legs & head &loosen the tight clothing and immediately seek emergency medical assistance.

Step 3 provide basic life support (maintenance of adequate air way & oxygenation are of utmost importance during management of LA induced seizures .

Note: seizures cause increase 02 utilization & hyper metabolism, with increased production of C02 & lactic acid & lead to acidosis this in turn lower the seizer threshold & prolongation of reaction. Cerebral blood flow during the seizure also increase this lead to elevation of anesthetic blood level within the CNS.

Step 4 administer anticonvulsant

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Extraoral and Intraoral Examination

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Third Year
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History Taking and Clinical Examination of Patients on a Dental Clinic

History taking: This should include the following:

- Demographic data
- Presenting complaint (the presenting problem, ideally recorded in the patient's own words)
- History of presenting complaint (a detailed history of the complaint and the symptoms associated with it recorded)
- Dental history
- Medical history (current and past)
- Social and family history

Obtaining information

The initial step in any patient contact is to confirm their identity. In addition, the clinician should introduce themselves, in order that the patient knows to whom they are talking, which may help to lessen the patient's anxiety. It is also important to ensure that the person with the presenting problem is allowed to speak for themselves.

Demographic data

Demographic data are necessary to identify the correct patient and corresponding clinical record. The minimum data required include the following:

- Title (Mr, Mrs, Ms, Miss, etc.)
- Name (both forename and surname)
- Marital status
- Date of birth
- Sex
- Occupation
- Current address and contact telephone numbers

Name and contact details of the patient's general medical/dental practitioner. The data obtained must be recorded accurately. Some conditions are correlated with

age, sex, ethnicity or occupation, and demographic data may help to diagnose a presenting condition more easily, for example a heavy metal worker with dark blue staining at the gingival margins.

Preparation for Examination

- Review the patient's histories
- Examine radiographs
- Patient understanding
- Cultural sensitivity

History taking

History taking is a skill that requires practice. Patients respond in different ways to similar lines of questioning, and it may be necessary to modify questioning style or to ask the same question several times but in different ways in order to optimise the information obtained.

Components of the history

Presenting complaint and history of presenting complaint

Patients attending a DC often present complaining of pain. In order to reach a reliable differential diagnosis or diagnosis, it is important to obtain a clear description of the pain. Where possible, use open questions and avoid prompting the patient; for example, 'What does the pain feel like?' is preferable to 'Is the pain sharp or dull?' which restricts and influences the patient response. Once a description of the pain obtained, more specific questions can be used to develop the history further. Basic questions that should be asked are summarised below:

- Site of pain (ask the patient to point with one finger to the place of maximum pain).
- Ask the patient if the pain radiates anywhere.
- Get the patient to describe the pain, e.g. dull ache, sharp, throbbing or shooting.
- Is the pain intermittent or constant? How frequent is it?
- Onset – gradual or sudden?
- Is there anything that makes the pain better or worse?
- What treatments has the patient tried and were they effective?
- Does the pain keep the patient awake at night or wake them from sleep?

- Is the pain affected or initiated by hot or cold stimuli?
- Are there any associated symptoms such as swelling, numbness or pain?

Past and current medical history

The past and current medical history is a description of previous and current medical issues. A systematic approach to data collection is required. It is important to go through the collected information carefully with the patient in order to identify any areas of confusion. The medical history should be carefully recorded.

- Cardiovascular: Myocardial infarction, angina, hypertension
- Respiratory: Asthma, chronic obstructive pulmonary disease.
- Gastrointestinal: Peptic ulceration,
- Hepatic: hepatitis
- Haematological: Blood borne viruses, e.g. hepatitis A/B/C, HIV, clotting disorders, leukaemia, anaemia
- Neurological: Epilepsy, cerebrovascular disease, psychological/psychiatric disorders
- Musculoskeletal: Muscular dystrophy, joint replacements
- Genitourinary and renal: Genitourinary infection, renal disease or failure, renal transplant, etc.
- Drug history: Prescribed, non-prescribed,
- Allergy: Drugs, latex.
- Past hospitalisation: Medical/surgical
- Social history: Occupation
- Smoking habits: duration, frequency and type
- Alcohol consumption: Quantity
- Home and family circumstances

The degree of severity of a medical problem can be judged by asking further questions. For example, in patients with epilepsy, the frequency and severity of the problem should be ascertained using key questions such as: What medications do you take? What symptoms do you get prior to a seizure? When was your last seizure? Have you been treated in an accident and emergency unit or admitted to a hospital following a seizure? If the clinician has this information, a simple risk assessment can be made, and in the event of a seizure, emergency care is facilitated and a specialist's help more easily obtained if required.

A thorough medical history may uncover conditions that are relevant to diagnosis of the presenting complaint, for example oral ulceration in a patient taking the potassium channel activator, or to the subsequent management of the patient, such as alcoholic cirrhosis in a patient requiring extractions. Clearly, patients taking the anticoagulant warfarin require special consideration. It is important to remember that warfarin interacts with patients who have a high alcohol intake may also have problems with coagulation. In such cases, if surgical treatment is considered, blood should be taken for a full blood count (principally to check the platelet count) and a clotting screen.

Patient examination

The examination should start from the moment the patient walks into the dental clinic. The clinician should remember to examine both the normal and affected sides. The examination is divided into an extra-oral examination, followed by intra-oral examination.

Extra-oral examination

The extra-oral examination starts with a visual examination of the head and neck with particular note made of swellings or deformity, asymmetry of the face, abnormal colour or scars on the skin or lips. A clinical photograph is a useful way of recording information.

Sequence of examination

1. Face, Lips, Skin and Eyes
2. Lymph Nodes: a. Occipital b. Auricular c. Superficial Cervical d. Deep Cervical e. Submental f. Submandibular
3. Glands: a. Parotid b. Submandibular c. Sublingual d. Thyroid (Figures 3 and 4)
4. Larynx
5. Hyoid bone
6. Muscles: a. Masseter b. Temporalis c. Sternocleidomastoid d. Mylohyoid

7. Temporomandibular Joint: a. Right b. Left: Figure 2

Inspection:

- Any swelling over the joint region
- Symmetry and extent of movement
- Clicking sound

Palpation: Pre-auricular and intra-auricular

- Extent and symmetry of movement
- Temperature of the overlying skin
- Tenderness Crepitus

Auscultation: Clicking

Inspection: It does detect any unusual changes in the oral cavities, as it's based on vision.

❖ Color changes "pigmentation or caries"
❖ Tooth Fracture and different Lesions.

Palpation: This depends on our sense of touch to feel any abnormalities and to differentiate it from the normal. The types are Bimanual, Bilateral
We can detect the different consistency, temperature, Mobility, in duration.

Percussion: We examine this by striking an object on the tooth and evaluate the produced sound. This technique also helps in detection of tooth mobility.

Probing: This is important technique as it can detect caries and any periodontal diseases.

Auscultation: listen to the normal sounds produced by the Patient

❖ Wheezing: Respiratory disease
❖ TMJ clicking: TMJ disorder

Odor: smelling the patient oral odor can help in the differential diagnosis. Such as Acetone odor= Uncontrolled DM

Intraoral examination

Lips & intraoral mucosa

- View/palpate lips, labial and buccal mucosa, and mucobuccal folds.
- Examine and palpate the tongue
- Mucosa of the floor of the mouth.
- Hard and soft palates, tonsillar areas, and pharynx
- Use a mirror

Oropharynx, nasopharynx, and larynx.
Note: amount and consistency of the saliva and evidence of dry mouth (xerostomia).

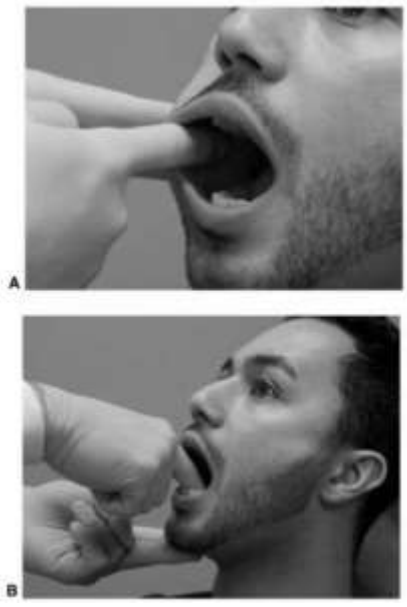

Figure 1: Bimanual Palpation. A: Examination of the buccal mucosa by simultaneous palpation on extraorally and intraorally. B: Examination of the floor of the mouth by simultaneous palpation with fingers of each hand in apposition.

Figure 2: Assessment of the Temporomandibular Joint.

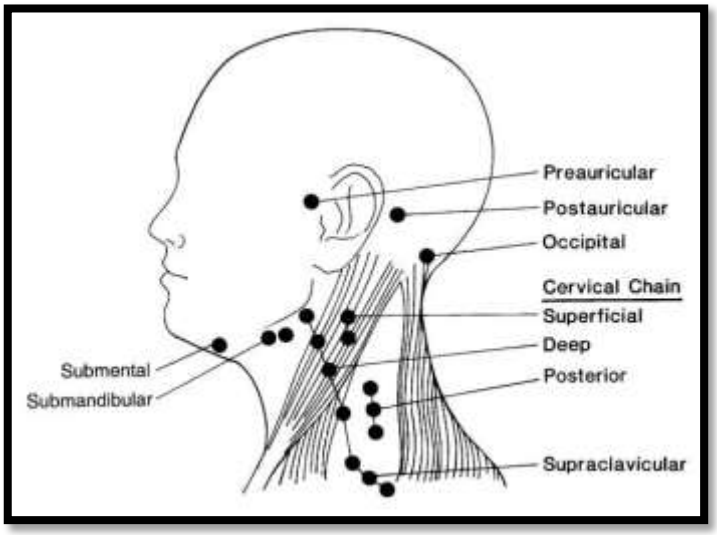

Figure 3: Lymph Nodes.

Figure 4: Lymph Node examination.

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VASOCONSTRICTORS

BY

DR. ELHAM H. ABDULKAREEM

Definition

Vasoconstrictors are the chemical agents or adjuncts added to local anesthetic solutions

(a) to oppose vasodilatation caused by these agents and

(b) to achieve hemostasis.

ACTIONS

The addition of a vasoconstrictor to a local anesthetic agent causes constriction of blood vessels and thereby controls tissue perfusion. The effects caused by addition of vasoconstrictors to local anesthetic agents are:

1. It decreases the blood flow to the site of injection, because of vasoconstriction.

2. It decreases the rate of absorption of local anesthetic agent into cardiovascular system.

3. It lowers the plasma level of local anesthetic agent (Cannall et al, 1975) and Wildsmith et al, 1977), thereby, decreasing the risk of systemic toxicity of local anesthetic agent.

4. Higher volumes of local anesthetic agent remain in and around the nerve for longer periods; thereby increasing the duration of action of most local anesthetic agents (Brown, 1968).

5. It decreases bleeding at the site of injection because of decreased perfusion. This is useful when increased bleeding is expected during a surgical procedure (Carpenter et al, 1989; and Myers and Heckman, (1989).

CLASSIFICATIONS

These drugs can be classified on the basis of mode of action, into the following three categories.

1. **Direct acting drugs: These drugs stimulate or exert their action directly on the adrenergic receptors. For example, epinephrine, norepinephrine, dopamine, levonordefrine and isoproterenol, etc.**

2. Indirect acting drugs: These drugs act by releasing norepinephrine from the adrenergic nerve terminals (from their intraneuronal storage sites), e.g. tyramine, amphetamine, methamphetamine, hydroxyamphetamine.

3. Mixed acting drugs: These drugs have both direct and indirect actions. For example, metaraminol and ephedrine.

ADRENERGIC RECEPTORS

Types

We have 2 types of adrenergic receptors based on their action on smooth muscles.

α *Receptors*

Activation of receptors results in vasoconstriction.

β*Receptors*

β receptors are subcategorised further into β1, β2 and β3 receptors.

1. **β1 receptors are found in the heart and small intestine; and are responsible for: (i) cardiac stimulation (increase in the HR and increase in the strength of contraction) and (ii) renin release.**

2. β2 receptors are found in bronchi, vascular beds, and uterus; and are responsible for:

i. Relaxation of bronchial muscles resulting in bronchodilatation

ii. Relaxation of muscles in the walls of blood vessels, resulting in vasodilatation, and iii. Relaxation of uterus (Lands et al, 1967).

3. β3 receptors are found in brown and white adipose tissue; and are responsible for lipolysis.

DILUTION OF VASOCONSTRICTORS

The dilution of vasoconstrictors is commonly referred to as a ratio (e.g. 1 to 1000; and is written as 1:1000).

- **1:1000 means 1 g or 1000 mg of solute (drug) contained in 1000 ml of solution. Therefore, a 1:1000 dilution contains 1000 mg in 1000 ml or 1.0 mg/ml of solution.**

Vasoconstrictors used in local anesthetic solutions in dentistry are more diluted than 1:1000. Hence, a solution of a dilution 1:10,000 will contain 0.1 mg/ml of solution and 1:100,000 dilution will contain 0.01 mg/ml of solution.

Epinephrine

remains the most commonly used and the most effective vasoconstrictor used in medicine and dentistry.

Proprietary Name: Adrenaline.

Source: It is secreted primarily by adrenal medulla. It is available as a synthetic and is also obtained from the adrenal medulla of animals.

Mode of action: It acts directly on both α and β adrenergic receptors; β effects predominate.

It must be borne in mind that the endogenous release of adrenaline, caused by the stress of going to a Dental Surgeon, sight of dental instruments, and the apprehension of pain caused by the needle-sticks produces effects similar to those produced by excessive exogenous administration of adrenaline.

Maximum Recommended Doses (MRD) of Epinephrine

This drug is potent; and can produce undesirable results

(a) if used in large volumes; or

(b) (b) if inadvertently injected intravascularly. Hence, these drugs should be used with due consideration to their benefits and risks. It is recommended that the least concentrated solution that produces effective pain control should be used.

(c) Lidocaine is available with three dilutions of epinephrine (1:80,000, 1:100,000 and 1:200,000), in many other countries.

(d) recommended that the maximum dose of epinephrine should be limited to 0.2 mg per appointment. The American Heart Association has recommended restriction of epinephrine in local anesthetics when administered to patients with ischemic heart diseases.

A. Normal healthy adult patients (0.2 mg per appointment)

10 ml of a 1: 50,000 dilution (5 cartridges)

16 ml of a 1: 80,000 dilution (8 cartridges)

20 ml of a 1: 100,000 dilution (10 cartridges)

40 ml of a 1: 200,000 dilution (20 cartridges)

B. Patients with clinically significant cardiovascular disease (0.04 mg per appointment) (approximately 1/5th of the dose for normal patients)

2 ml of a 1: 50,000 dilution (1 cartridge)

3.2 ml of a 1: 80,000 dilution (1.6 cartridges)

4 ml of a 1: 100,000 dilution (2 cartridges)

8 ml of a 1: 200,000 dilution (4 cartridges)

Medically Compromised Individuals

The Maximum Recommended Doses (MRD) is 0.04 mg/appointment.

For Hemostasis

Epinephrine is used in local anesthetic solution to minimise bleeding by depositing at the site of surgery via infiltration anesthesia during various surgical procedures. A local anesthetic solution containing 1:50,000 dilution of epinephrine is more effective in minimising bleeding than more dilute solutions such as 1:100,000 or 1:200,000.

Systemic Actions

Cardiovascular System

The overall actions of epinephrine on the heart and cardiovascular system are the result of direct stimulation. If the stimulation of the heart persists for a long time, there will subsequently, be overall decrease in cardiac efficiency. These actions are as follows:

i. Increased stroke volume

ii. Increased heart rate

iii. Increased cardiac output

iv. Increased strength of contraction

v. Increased systolic and diastolic pressures

vi. Increased myocardial oxygen consume

Blood Vessels

1. The primary action of epinephrine is on microcirculation (small arterioles and precapillary sphincters).
2. The blood vessels which supply skin, mucous membranes and kidneys contain primarily α receptors.
3. Epinephrine produces constriction of these blood vessels. The blood vessels supplying skeletal muscles contain both α and β2 receptors, with β2 receptors predominating.
4. Epinephrine in small doses produces dilatation of these vessels as a result of β2 effect.
5. β2 receptors are more sensitive to epinephrine than α receptors.
6. Large doses of epinephrine produce vasoconstriction because of stimulation of α receptors.

Respiratory System

It has a β_2 effect on the smooth muscle of the bronchioles, and hence is a potent dilator. It is a drug of choice in cases of bronchospasm as in bronchial asthma.

Central Nervous System

In therapeutic doses, epinephrine does not stimulate central nervous system. It stimulates central nervous system only if excessive doses are administered.

Metabolism

The actions of epinephrine are terminated by one of the following methods:

i. Primarily, by its reuptake by adrenergic nerves.

ii. Inactivated by the enzymes catechol-O-aminotransferase (COMT), and monoamine oxidase (MAO), both of which are present in liver.

iii. Very small amounts are excreted unchanged in urine.

Overdose

In small amounts commonly used in dentistry, only the arterioles in the immediate area of injection are affected by vasoconstrictors.

The factors that may produce toxic manifestations are:

(i) large volumes, (ii) high concentration of vasoconstrictors;

(ii) and (iii) inadvertent vascular injection of comparatively small amounts of vasoconstrictors. The manifestations can be in the form of tachycardia, hypertension, palpitation, headache, tremors, pallor, and in rare cases, ventricular fibrillation.

- **The systemic effects of vasoconstrictors usually last as long as the blood levels of the drug remain elevated.**

Clinical Applications in Dentistry

It is used along with a local anesthetic agent, as a vasoconstrictor:

(i) for achieving hemostasis,

(ii) to decrease the absorption of local anesthetic agent into cardiovascular system,

(iii) to prolong duration of action.

Availability in Dentistry

Epinephrine is available in the following dilutions: 1:80,000, 1:100,000 and 1:200,000 for use in dentistry.

Norepinephrine (Nor-adrenaline)

It is not commonly used in dentistry.

Felypressin

It is available as a vasoconstrictor, in combination with prilocaine, in dental

local anesthetic cartridges, in many countries (Citanest forte). *Proprietory name:* Octapressin

Chemical structure: It is a non-sympathomimetic amine; and a synthetic analogue of vasopressin.

Mode of action: It acts by directly stimulating vascular smooth muscle. It has little direct effect on the heart or on adrenergic nerve transmission. Its actions are more pronounced on venous rather than on arteriolar microcirculation (Altura, 1965).

Systemic actions:

i. *Myocardium:* No direct effects.

ii. *Coronary arteries:* Doses greater than therapeutic doses, may impair blood flow through coronary arteries.

iii. *Vasculature:* Doses greater than therapeutic doses, cause constriction of cutaneous blood vessels producing facial pallor.

iv. *Uterus:* It has both antidiuretic and oxytocic actions; hence the latter action contraindicates its use in pregnant patients.

v. *Maximum doses:* Patients with clinically significant cardiovascular impairment: Maximum Recommended Dose: 0.27 IU (international units) (that is 9 ml of 0.03 IU/ml or 2 cartridges).

vi. *Side effects and overdose:* Studies have shown a wide margin of safety with felypressin (Klingenstrom et al, 1967).

vii. *Clinical applications*: Used as vasoconstrictor with local anesthetic to decrease their absorption and increase their duration of action.

viii. *Availability:* It is used in dentistry in a dilution of 0.03 IU (international units)/ml with 3% prilocaine.

ix. *Disadvantage:* It acts primarily on venous circulation, hence felypressin is not as effective as conventional vasoconstrictors in providing hemostasis during surgical procedures (McClymont and Crowther, 1988).

x. *Indications:*

a. It may be safely used in patients with medical problems which contraindicate the administration of epinephrine (Anderson and Reagan 1993), which include:

(i) mild to moderate cardiovascular diseases, including hypertension, and (ii) other non-cardiovascular diseases; such as hyperthyroidism.

b. It can be used in patients who are on antidepressant drugs such as tri- or tetracyclic acid antidepressants or monoamine-oxidase inhibitors.

xi. Contraindications:

a. **Local anesthetic containing felypressin is not recommended for use when hemostasis is required because of their predominant effect on venous rather than arteriolar circulation (Newcomb and Wait, 1972).**

b. Pregnancy: It is not recommended for use during pregnancy because of its oxytocic action on Uterus.

SELECTION OF A VASOCONSTRICTOR

The selection of an appropriate vasoconstrictor is based on following factors:

1. Length of the surgical or dental procedure
2. Requirement for hemostasis during the surgical procedure
3. Requirement for postoperative pain control
4. Medical or physical status of the patient and concurrent medications taken.

Length of the Surgical or Dental Procedure

The duration of pulpal and hard tissue anesthesia with 2% lidocaine only lasts for about 10 min.

The addition of epinephrine of 1:50,000 or 1:100,000 dilution prolongs the duration to about 60 min. Hence, for any oral surgical or dental restorative procedure requiring 40-50 minutes, it is difficult to achieve consistent pulpal anesthesia without inclusion of a vasoconstrictor.

Requirement of Hemostasis

Some of the vasoconstrictors are effective in minimising blood loss during surgical procedures. However, most of vasoconstrictors also produce vasodilatation as a result of decline in the tissue levels of epinephrine, which is known as rebound phenomenon.

While using epinephrine as a vasoconstrictor for hemostasis, we must consider that epinephrine is both ⟨ and ® agonist. It possesses both α and β actions; and produces vasoconstriction through it's effect.

However, felypressin stimulates venous circulation more than the arteriolar circulation, and therefore, is of minimal value in achieving hemostasis (Altura et al, 1965).

Requirement for Postoperative Pain Control

Profound pain control of adequate duration by a local anesthetic agent with a vasopressor is used. Plain local anesthetic agent produces pulpal anesthesia of shorter duration that a local anesthetic agent with a vasopressor and is likely to produce stress response.

Medical or Physical Status of the Patient and Medications Concurrently Taken

The benefits and risks of including a vasoconstrictor in a local anesthetic solution in patients who are medically compromised, must be weighed against benefits and risks of using plain local anesthetic solution (Goulet et al, 1992).

Once the medical status of the patient is improved or corrected, dental or surgical procedures requiring administration of local anesthetic agents with vasoconstrictors are indicated.

The groups where inclusion of vasoconstrictor is contraindicated are given below.

1. Patients with significant cardiovascular disease such as (a) ischemic heart disease, (b) hypertension, and (c) cerebral strokes.

2. Patients with certain uncontrolled non-cardiovascular diseases, such as: thyrotoxicosis or hyperthyroid states, and diabetes mellitus.

3. Patients receiving non-specific beta-blockers, monoamine-oxidase inhibitors (MAOIs), tricyclic antidepressants (TCAs) and phenothiazine's.

4. Patients with sulphite sensitivity.

5. Patients who are undergoing general anesthesia with halogenated agents

6. Pregnancy.

1. **Patients with significant cardiovascular disease such as (a) ischemic heart disease, (b) hypertension, and (c) cerebral strokes. Epinephrine and other vasoconstrictors can be used in moderate amounts in patients with mild to moderate cardiovascular disease.**

Felypressin has minimal cardiothoracic stimulatory actions and is nondysrhythmogenic; it is recommended for patients with significant cardiovascular disease. Patients with severe cardiovascular diseases are at too great a risk for elective dental therapy, such as:

a. Ischemic heart disease

i. Patients with history of acute myocardial infarction within last six months.

ii. Patients with history of acute anginal episodes on daily basis or where signs and symptoms are increasing in severity (angina pectoris) (pre-infarction stage or unstable angina).

iii. Patients with cardiac dysrhythmias despite appropriate antiarrhythmic drug therapy (Goulet et al, 1992).

iv. Post-coronary artery bypass surgery, less than six months.

b. Hypertension: Patients with systolic BP greater than 200 mm of Hg and diastolic BP greater than 110 mm of Hg should not receive any dental care unless BP is corrected.

c. Cerebral strokes: Patients with history of less than six months after cerebrovascular accident.

Epinephrine and other vasoconstrictors can be used in moderate amount in patients with mild to moderate cardiovascular disease. Felypressin has minimal cardiovascular stimulatory actions and is non-dysrhythmogenic; it is recommended for significant cardiovascular risk patients.

2. Patients with certain uncontrolled non-cardiovascular diseases, such as: thyrotoxicosis or hyperthyroid states and diabetes mellitus. Medical treatment of the conditions and a consent from the treating physician is

necessary to use vasoconstrictor in such conditions.

a. Thyrotoxicosis or hyperthyroid states: Epinephrine is contraindicated in patients with clinical evidence of hyperthyroid states (Goulet et al, 1992). The signs and symptoms include: Exophthalmos, tremors, hyperhydrosis, increased basal metabolic rate, irritability and nervousness, increased body temperature, inability to tolerate heat, increased HR, and increased BP.

b. Diabetes mellitus: Diabetes is not only a metabolic, and endocrinal disease, but also a vascular one. Microcirculatory changes will result in impaired blood flow to the tissues. The inclusion of a vasoconstrictor in local anesthetic solution may further compromise the inadequate blood supply, and result in local ischemia and tissue sloughing.

3. Patients receiving non-specific beta-blockers, monoamine-oxidase inhibitors (MAOI), tricyclic and tetracyclic antidepressants and phenothiazines for psychiatric ailments.

a. Patients taking monoamine-oxidase inhibitors (MAOI) are not at an increased risk provided the doses used are within the recommended range (Goulet et al, 1992; and Verrill, 1975).

b. Patients receiving tricyclic and tetracyclic antidepressants: Such patients are at a risk of developing dysrhythmias with administration of epinephrine. Hence, its dose should be minimal. The administration of levonordefrin or norepinephrine in patients receiving tricyclic

antidepressants is absolutely contraindicated. Large doses may induce severe (exaggerated) response. Felypressin has minimal cardiothoracic stimulatory actions and is nondysrhythmogenic, and hence can be used. In all the abovementioned conditions felypressin can safely be used.

4. Patients with sulfite sensitivity: Local anesthetic solutions contain an antioxidant, which retards oxidation of the vasoconstrictor. The most commonly used antioxidant in dental cartridges is sodium bisulfite.

5. Patients who are undergoing general anesthesia with halogenated agents: Epinephrine should not be used as a vasoconstrictor during GA when a patient is receiving an inhalational halogenated anesthetic agents such as halothane, methoxyflurane, and ethrane. These vasoconstrictors cause cardiac dysrhythmias. In such situations, felypressin is recommended.

6. Pregnancy: Felypressin is not indicated in pregnant patients because of its potential oxytocic actions.

LOCAL ANESTHETIC CARTRIDGES AND VIALS

It contains primarily the local anesthetic drug, and also the other ingredients, which are as follows:

1. Local anesthetic drug

2. Vasopressor/vasoconstrictor drug

3. Preservative for vasopressor

4. Sodium chloride (NaCl) or Ringer's solution

5. Distilled water

6. General preservatives.

PRESERVATIVE FOR VASOPRESSOR

Local anesthetic solutions containing vasoconstrictors also contain a specific agent, an antioxidant, that acts as a preservative for vasoconstrictors.

- The most frequently used antioxidant is sodium-bisulfite or sodium metabisulfite. It prevents biodegradation of vasopressor by **O_2** which might be present in the cartridge either introduced during manufacture, or which got diffused through semipermeable membrane or the rubber diaphragm after filling at the time of storage of the cartridge.
- Sodium-bisulfite reacts with O_2 before O_2 can destroy vasopressor. Sodium-bisulfite is oxidised to sodium-bisulphate, a chemical with even lower pH (acidic), than before oxidation.
- Local anesthetic solutions without vasoconstrictors have a shelf-life of about 48 months.
- Local anesthetic solutions containing vasoconstrictors have their shelf-life reduced to 18 and 12 months for epinephrine and phenylephrine; and norepinephrine and levonordefrine, respectively. This is so because of the instability of the vasoconstrictors. Hence fresh solutions produce better analgesia and cause less irritation to the tissues.
- Allergy to bisulfites must be considered in pre-anesthetic medical evaluation.

SODIUM CHLORIDE (NaCl) OR RINGER'S SOLUTION

1. It is added to the contents of dental cartridge to make the solution isotonic with the tissues of the body.
2. Hypertonic solution produces tissue edema, paresthesia, sometime lasting for several months following drug administration.

DISTILLED WATER

It is used as a diluent to provide the volume of solution in the dental cartridge.

GENERAL PRESERVATIVES

A number of chemicals are used as general preservatives.

These are added to increase the shelf-life; and include:

(i) Methylparaben, (ii) Thymol,

(ii) i. Methylparaben: It is a bacteristatic and fungistatic agent. It has been excluded from cartridges in USA, from 1st January 1984, following reports of allergy. However, it is still used in multidose vials in some countries including India.

ii. Thymol: It is antiseptic, fungistatic, and antihelminthic.

Surgical Anatomy in Relation to Local Anaesthesia

by
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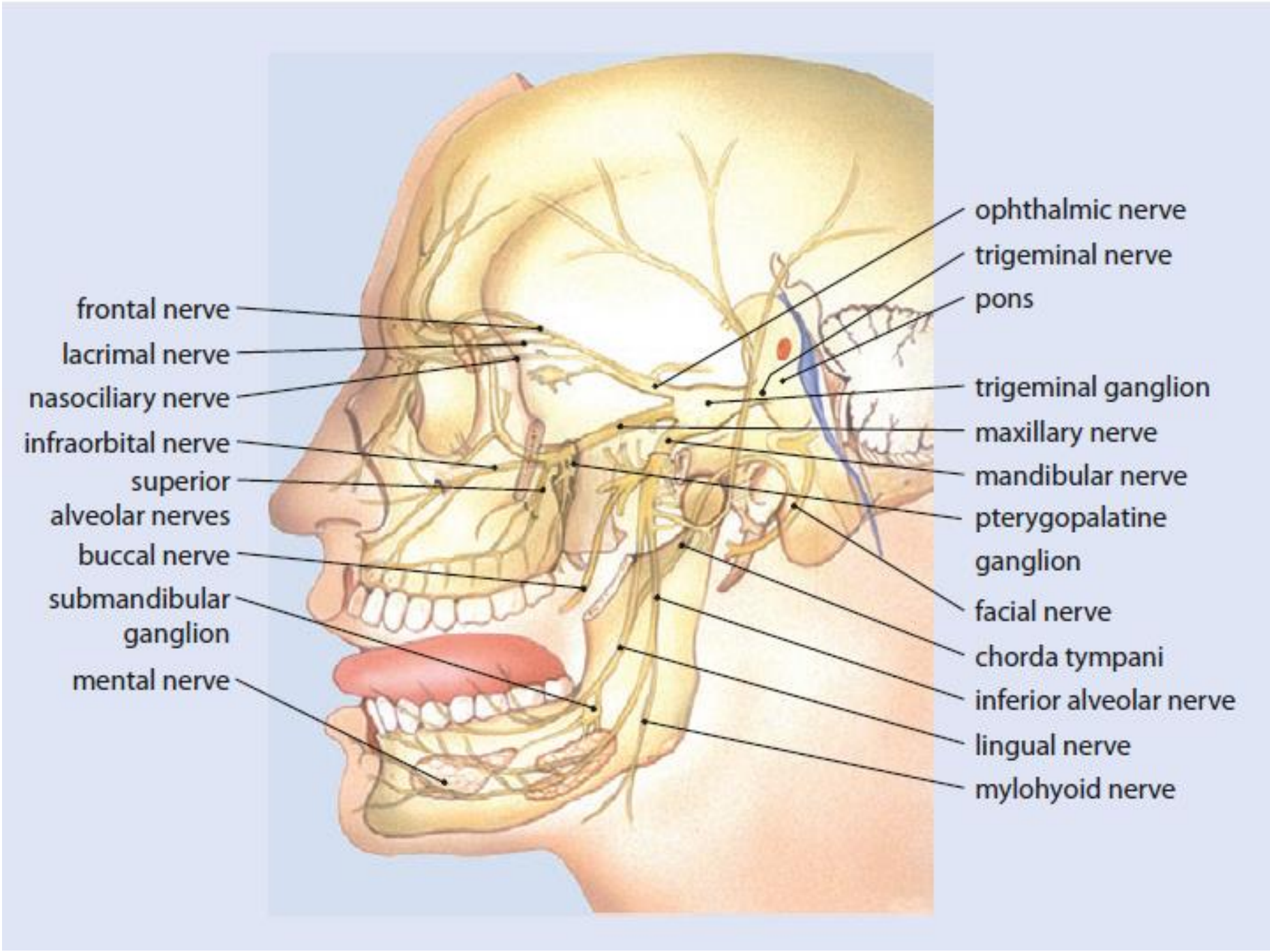
- **The trigeminal nerve contains a large number of sensory (afferent) and motor (efferent) neurons.**
- The trigeminal nerve has a wide innervation area.

- The nerve provides the sensitivity of the dentition, the mucosa of the mouth, nose and paranasal sinuses and the facial skin.
- The nerve also contains motor fibres that innervate, among others, the masticatory muscles.


ophthalmic nerve
trigeminal nerve
pons
frontal nerve
lacrimal nerve
nasociliary nerve
trigeminal ganglion
infraorbital nerve
maxillary nerve
superior alveolar nerves
mandibular nerve
pterygopalatine ganglion
buccal nerve
facial nerve
submandibular ganglion
chorda tympani
mental nerve
inferior alveolar nerve
lingual nerve
mylohyoid nerve

- The trigeminal ganglion is formed by the aggregation of cell bodies of sensory neurons.
- After the ganglion, three branches of the trigeminal nerve can be distinguished: the ophthalmic nerve (n. V1), the maxillary nerve (n. V2) and the mandibular nerve (n. V3).
- The motor root joins the mandibular nerve only, once it has exited the skull via the foramen ovale.

- The sensory areas covered by the three main branches are generally as follows:

- **The ophthalmic nerve** carries sensory information from the skin of the forehead, the upper eyelids and the nose ridge and the mucosa of the nasal septum and some paranasal sinuses.

- **The maxillary nerve** innervates the skin of the middle facial area, the side of the nose and the lower eyelids, the maxillary dentition, the mucosa of the upper lip, the palate, the nasal conchae and the maxillary sinus.

- **The mandibular nerve** innervates the skin of the lower facial area, the mandibular dentition, the mucosa of the lower lip, cheeks and floor of the mouth, part of the tongue and part of the external ear.

Ophthalmic Nerve

The ophthalmic nerve (n. V1) enters the cranial part of the orbit.

This nerve carries only sensory fibres, and, just before leaving the cranial cavity through the superior orbital fissure, it branches off into three:

the nasociliary, frontal and lacrimal nerves.

These nerves run in the roof of the orbit and are involved in the sensory innervation of a large number of structures, such as the mucosa of the frontal,

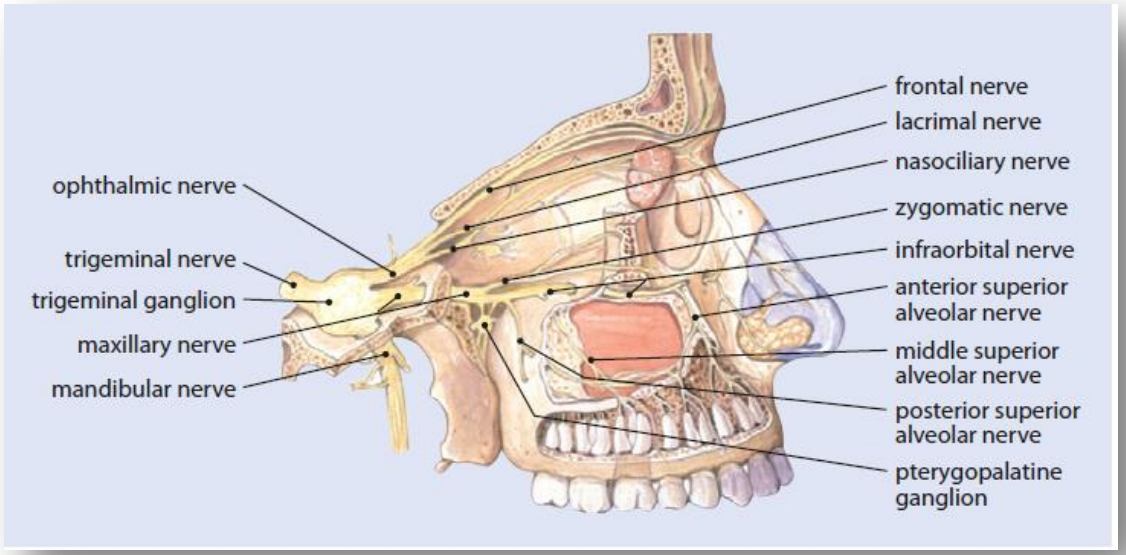
sphenoid and ethmoid sinus,

the mucosa of the nasal cavity and

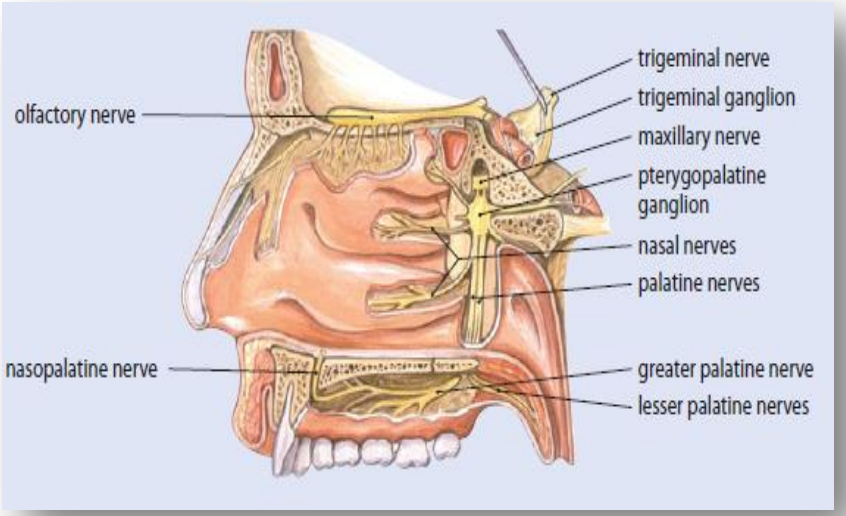
nasal septum,

the skin of the nose ridge,

the upper eyelid and forehead till the hairline and the mucosa that covers the eyeball and inside of the eyelids.

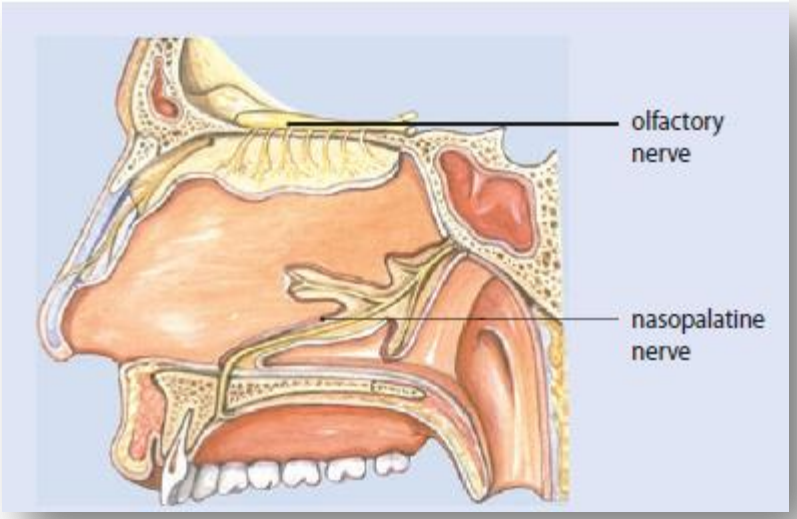


- The maxillary nerve (n. V2), too, is solely sensory.



- It enters the pterygopalatine fossa via the **foramen rotundum** Through the inferior orbital fissure, it reaches the floor of the orbit and proceeds there as the infraorbital nerve, first in the infraorbital sulcus and then in the infraorbital canal. It then reaches the face via the infraorbital foramen.

- Within the pterygopalatine fossa, the maxillary nerve is connected via a number of branches to the upper side of the parasympathetic pterygopalatine ganglion.



- Sensory fibres run through these branches which exit on the lower side of the ganglion and form, among others, the following nerves:

- The nasal nerves and nasopalatine nerve that run through the sphenopalatine foramen to the nasal mucosa.
- The nasal nerves innervate the back part of the nasal mucosa.
- The nasopalatine nerve, which runs forwards along the nasal septum and reaches the oral cavity through the incisive canal, innervates the mucosa and bone of the nasal septum, frontal two-thirds of the palate and the palatal gingiva of the maxillary teeth.
- The greater palatine nerve that runs via the greater palatine canal to the mucosa of the hard palate where it subsequently innervates the palatal gingiva of the maxillary alveolar process and the pulp of the palatal first molar and premolar.

- The lesser palatine nerves that run to the mucosa of the soft palate via the lesser palatine canals Together with the palatine nerves, there are also parasympathetic and orthosympathetic fibres that run from the pterygopalatine ganglion to the salivary glands in the palatal mucosa

- In the pterygopalatine fossa, the maxillary nerve also branches into the **posterior superior alveolar nerve and the zygomatic nerve**

- **The posterior superior alveolar nerve** exits the pterygopalatine fossa through the pterygomaxillary fissure and runs over the maxillary tuberosity.

- The nerve divides into a large number of little branches, **the posterior superior alveolar rami,** which enter the wall of the maxilla through small openings and innervate **the maxillary molars and corresponding buccal gingiva.**

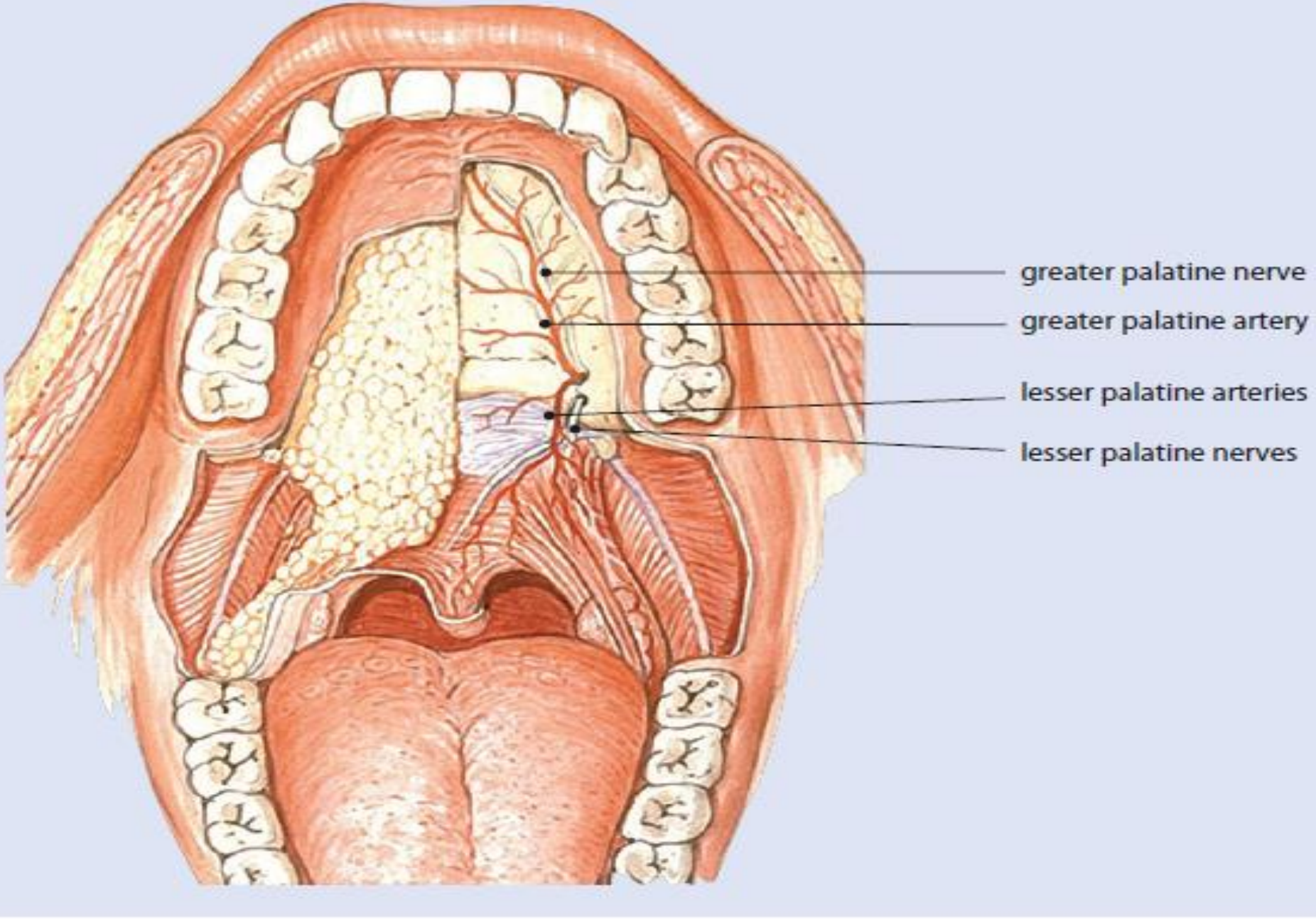


Fig. 2.10 The palate from below

- **The zygomatic nerve** arrives in the orbit via the inferior orbital fissure and branches into the **zygomaticotemporal and zygomaticofacial nerves**.
- These exit the lateral orbital wall through small canals in the zygomatic bone and innervate the **skin** above.
- The zygomatic nerve also contains postganglionic parasympathetic fibres that come from the pterygopalatine ganglion and that join the **lacrimal nerve for the lacrimal gland.**

- As it runs along the orbital floor, **the infraorbital nerve branch**es in two:
- **the middle superior alveolar nerve**, for the innervation of the maxillary premolars and the corresponding buccal gingiva,
- **and the anterior superior alveolar nerve**, for the maxillary canine and incisors and the corresponding buccal gingiva.
- These nerves usually run between the mucosa and outer wall of the maxillary sinus. There they divide into a number of small branches, the medial and anterior superior alveolar that penetrate into the maxillary alveolar process via small openings.
- Inside the bone, they form together with the posterior superior alveolar, right above the apices, an extensive nervous network – the superior alveolar plexus – from which short little branches are sent to the dentition and gingiva.

- Once the infraorbital nerve reaches the face via the infraorbital foramen, it splits into a large number of branches for the sensory innervation of
- **the skin of the lower eyelid,**
- **the infraorbital region,**
- **the side of the nose and the skin and**
- **mucosa of the upper lip**

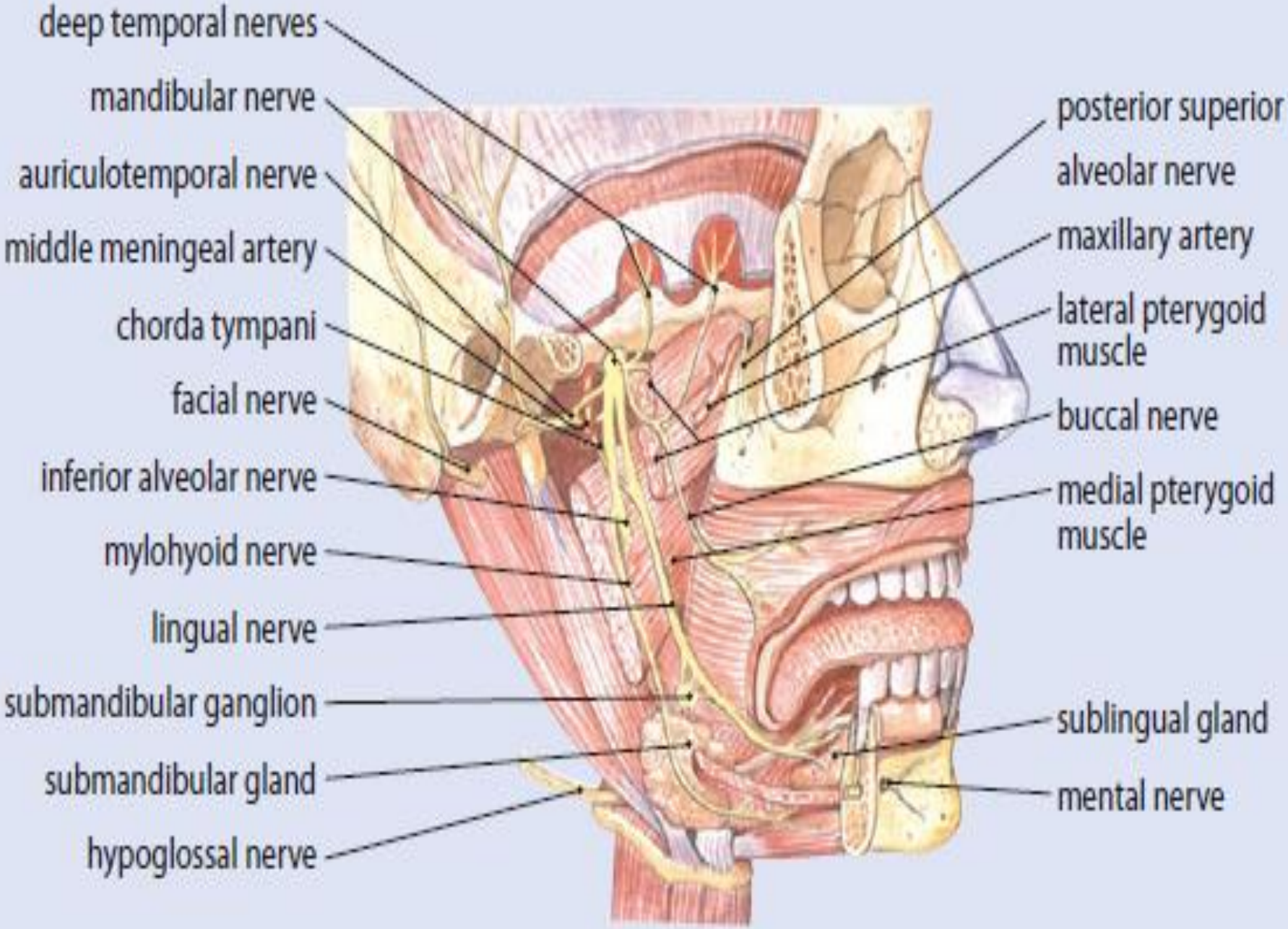
- The mandibular nerve (n. V3) contains both sensory and motor fibres. This nerve exits the skull through the foramen ovale and ends in the infratemporal fossa
- The mandibular nerve is located just below this foramen between the lateral pterygoid muscle and the tensor veli palatini muscle. The nerve sends a motor branch to the latter muscle
- **The mandibular nerve splits into two main branches:**

The anterior and posterior trunks

- from the anterior trunk, a sensory nerve emerges, the buccal nerve and a number of motor nerves, i.e. the pterygoid nerves, the deep temporal nerves and the masseteric nerve.

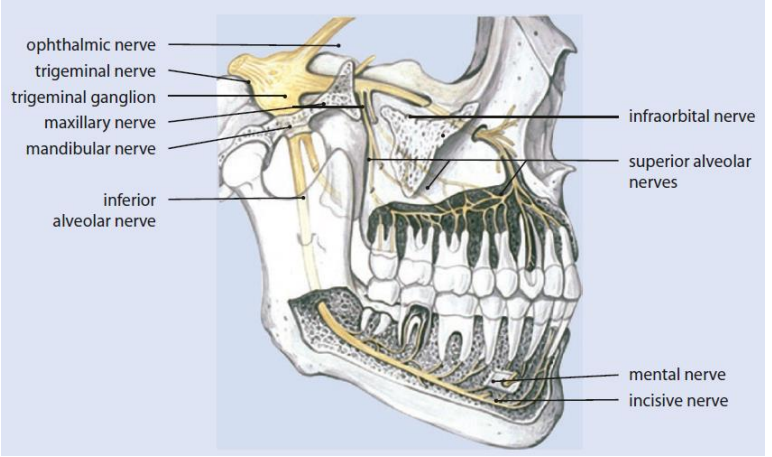
Three branches emerge from the posterior trunk:

- the auriculotemporal nerve (sensory)
- the lingual nerve (sensory)
- the inferior alveolar nerve (mixed sensory and motor)


deep temporal nerves
mandibular nerve
auriculotemporal nerve
middle meningeal artery
chorda tympani
facial nerve
inferior alveolar nerve
mylohyoid nerve
lingual nerve
submandibular ganglion
submandibular gland
hypoglossal nerve
posterior superior alveolar nerve
maxillary artery
lateral pterygoid muscle
buccal nerve
medial pterygoid muscle
sublingual gland
mental nerve

- **The buccal nerve** runs along the medial surface of the upper head of the lateral pterygoid muscle and moves laterally between the muscle. The nerve contains fibres for the salivary glands in the buccal mucosa. The nerve innervates the skin and mucosa of the cheek and the buccal gingiva of the mandibular alveolar process at the level of the molars and premolars.
- **The pterygoid nerves are short motor branches for the medial and lateral pterygoid muscles.**
- **The masseteric nerve** runs laterally along the top of the upper head of the lateral pterygoid muscle and reaches the deep surface of the masseter muscle via the mandibular notch.
- **The deep temporal nerves** also run high along the lateral pterygoid muscle and penetrate the medial side of the temporal muscle.
- **The auriculotemporal nerve** arises as two roots encircling the middle meningeal artery. After the roots have merged to a single nerve, this nerve first runs laterally behind the mandibular neck

- the inferior alveolar nerve contains motor and sensory fibres. It runs deep to the lateral pterygoid muscle. Emerging from beneath this muscle, it directs to the mandibular foramen. Just before it enters the mandibular canal, it gives off its motor mylohyoid branch for the mylohyoid muscle and for the anterior belly of the digastric muscle.

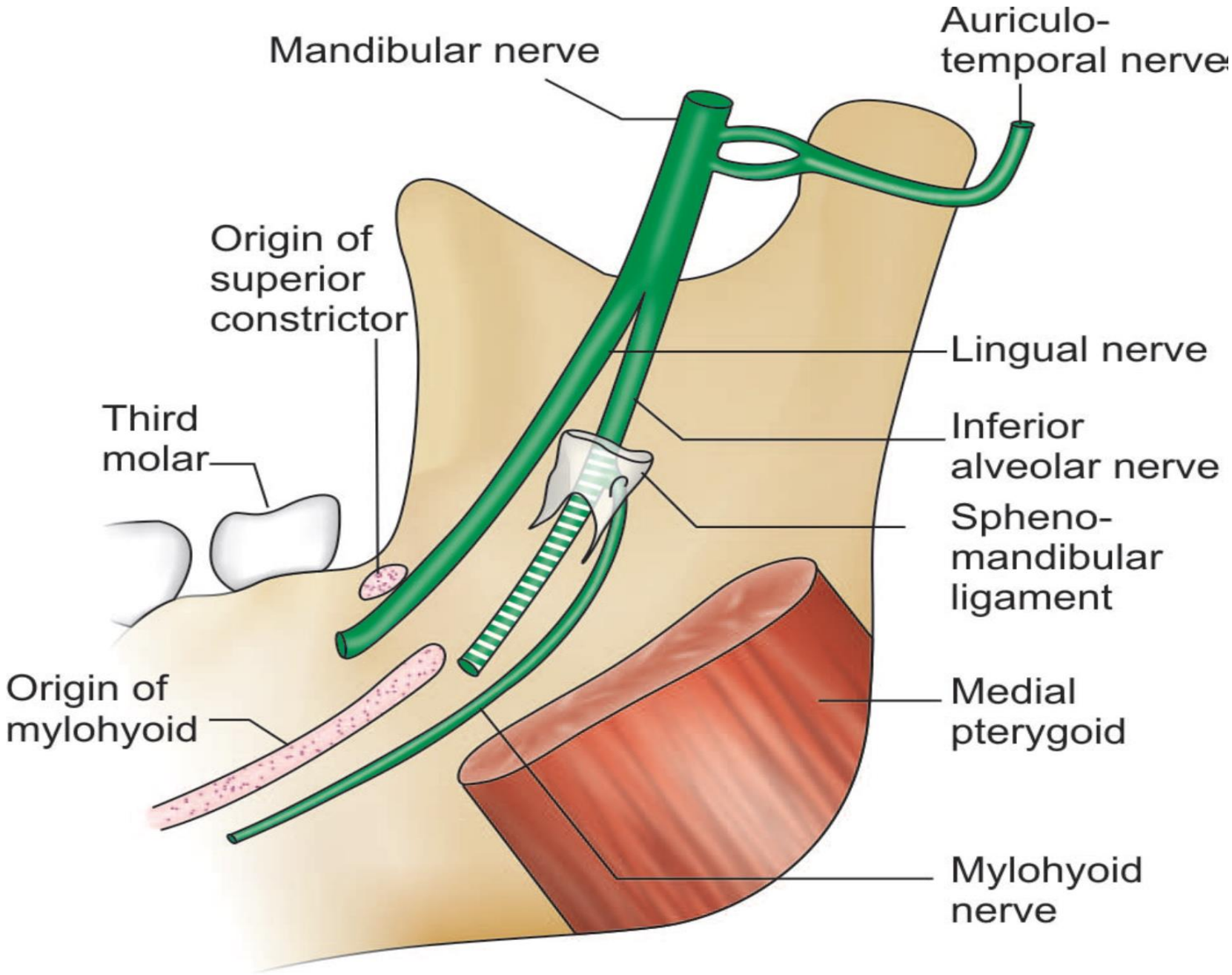


- The nerve, artery and vein travel anteriorly in mandibular canal, as far forward as mental foramen, which is located at a point below and between the roots of the premolars, where the nerve divides into its terminal branches, (i) mental nerve, and (ii) incisive nerve.

- **i. Mental nerve:** It emerges from the mandibular canal through the mental foramen in the form of a major bulk and divides into three branches that innervate (i) skin of chin, (ii) skin and mucous membrane of lower lip, and (iii) buccal mucosa from the incisor to the premolars. It carries a few secretomotor fibers from chorda tympani to labial minor salivary glands.
- ***ii. Incisive nerve:*** It is the smaller terminal branch and the continuation of inferior alveolar nerve, within the substance of the body of the mandible, anterior to the mental foramen. It supplies the pulps of anterior teeth, central and lateral incisors, and canine, and sometimes the first bicuspid, supporting alveolar bone, periodontal ligament, and the overlying soft tissues anterior to the mental foramen.

Innervation of the Tongue

- Various nerves are involved in the sensory and motor innervation of the tongue.
- The general sensitivity (pain, touch, temperature) of the anterior two-thirds of the tongue is supplied by the lingual nerve (branch of the n. V3).
- The specific sensitivity (taste) of the anterior two-thirds is supplied by the chorda tympani (branch of the n. VII) that has joined with the lingual nerve.
- The sensitivity, general and specific, of the posterior third of the tongue is supplied by the glossopharyngeal nerve (n. IX). The motor innervation of the tongue takes place through the hypoglossal nerve (n. XII).


Mandibular nerve
Auriculo-temporal nerve
Origin of superior constrictor
Lingual nerve
Third molar
Inferior alveolar nerve
Spheno-mandibular ligament
Origin of mylohyoid
Medial pterygoid
Mylohyoid nerve

- **The lingual nerve is joined**, directly after its separation of n. V3, by the chorda tympani.
- This is a branch of the facial nerve with preganglionic parasympathetic fibres from the brainstem and sensory nerves for the taste of the anterior two-thirds of the tongue.
- The lingual nerve runs deep to the lateral pterygoid muscle and forwards over the lateral surface of the medial pterygoid muscle. At the level of the apices of the third mandibular molar, it lies immediately beneath the mucosa against the inner side of the mandible.

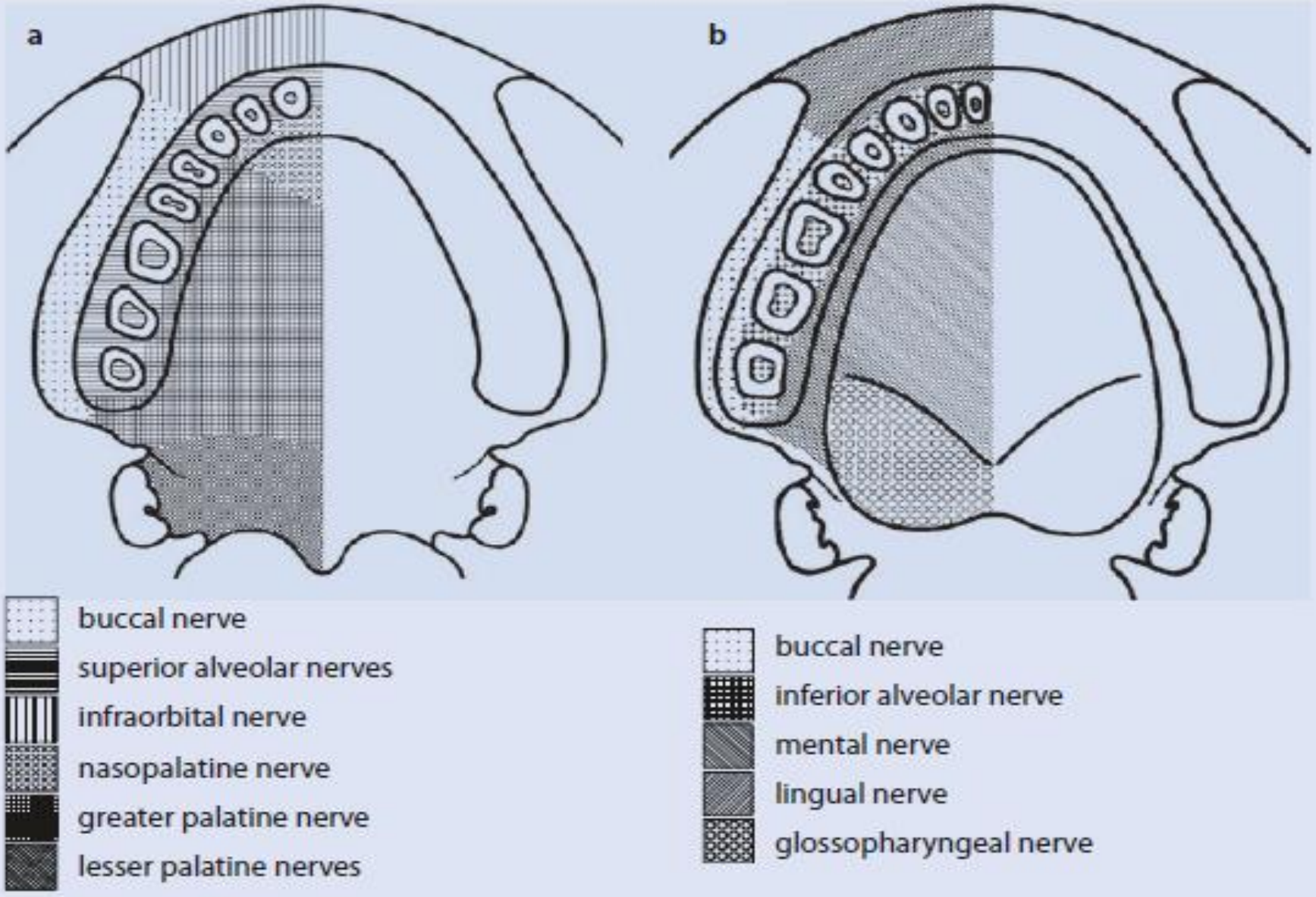


Fig. 2.9 The sensory innervation of the oral cavity. **a** The palate, the superior alveolar process, the cheek and the upper lip. **b** The tongue, the inferior alveolar process, the cheek and the lower lip

- It continues superiorly to the mylohyoid muscle, passing under the submandibular duct, and then ascends in the tongue
- The section of the lingual nerve that comes from n. V3 supplies the general sensitivity (pain, touch, temperature) of the anterior two-thirds of the tongue, the mucosa of the floor of the mouth and the lingual gingiva of the inferior alveolar process
- The postganglionic parasympathetic fibres run to the submandibular and sublingual glands

METHODS OF LOCAL ANESTHESIA

- There are several methods of achieving pain control with local anesthetic agents. The various types of techniques used for deposition of these agents, in dentistry are as follows:

(1) Surface or topical anesthesia,
(2) Infiltration anesthesia,
(3) Field block, and
(4) Nerve block or conduction anesthesia.

The selection of the type of anesthesia depends upon the area and the type of surgery. In general, infiltration anesthesia is adequate for a small isolated area, field block is indicated when two or more teeth are being treated, while a nerve block is indicated for dental or surgical procedure in a quadrant of a jaw.

Surface or Topical Anesthesia

- By this method small terminal nerves in the surface area of the intact mucosa or the skin up to the depth of about 2 mm are anesthetised by application of a local anesthetic agent directly to the area.

Nerves Anesthetised

- Superficial nerve endings.

Indications

- i. Prior to the infiltration injection techniques or nerve blocks for making the insertion of the needle painless
- ii. Prior to carrying out incision and drainage of abscesses
- iii. Prior to removal of sutures.

Forms

I. Spray

I. The active ingredient is a suitable local anesthetic agent, such as 10% or 15% lignocaine hydrochloride in water base. The agent is expelled in small quantities from an aerosol container

II. Advantage: Rapidity of onset. The onset of time of anesthesia is approximately 1 minute and the duration of anesthesia is approximately 10 minutes.

III. Disadvantage: When used as a spray, the solution is spread over more extensive area than desired.

IV. Method of application: It is used as a spray on the area in which the needle penetration is proposed to be made; or it can also be sprayed on a small cotton pellet or roll and then placed on the proposed site of injection for about one minute.

II. Ethyl chloride spray: It produces anesthesia by refrigeration. When sprayed onto either mucous membrane or skin, it gets volatilised rapidly, and produces rapid anesthesia.

- Method of application: The spray is directed over a limited area until "snow" appears.
- Care: Undue inhalation of vapours by the patient should be avoided.
- Use: Occasionally used to produce surface anesthesia prior to taking an incision for fluctuating abscesses.

Ointment

It is used for similar purposes as spray. The active ingredient is a suitable local anesthetic agent, such as 5% lignocaine hydrochloride.

- Time of onset: 3-4 minutes.
- Application: Ointments are used for application over tender and inflamed gingivae prior to deep scaling.

Emulsion

The active ingredient is a suitable local anesthetic agent, such as 2% lignocaine hydrochloride.

- Indications:

i. When full mouth impressions are to be taken in patients who are prone to retching.

ii. Relief of postoperative pain or tenderness following mucogingival surgical procedures such as gingivectomy.

- Method of application: One teaspoonful of the emulsion is swished around in the mouth and oropharynx for 1-2 minutes; and later is spat out immediately prior to taking impressions.

Infiltration Anesthesia or Local Infiltration

- This method is also known as terminal or peripheral anesthesia, as the induction of anesthesia is by the action of anesthetic agents on the terminal nerve fibers.

Maxilla and Mandible

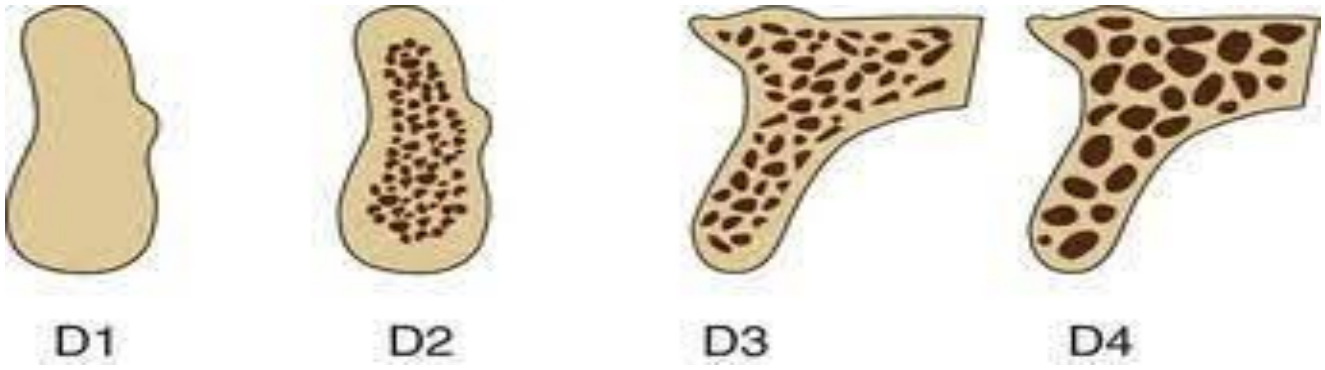
Maxilla

- The maxilla has thin labial/buccal cortical plate; and moreover shows areas of porosity, and the compact bone presents numerous foramina which aid in absorption of local anesthetic solution. These factors, therefore, make the maxilla more favorable for infiltration anesthesia techniques.

Mandible

The bone is generally dense and has thicker cortical plates than maxilla, particularly in posterior region, more so in the region of external oblique ridge. Only the anterior part of mandible presents sufficient porosity, which is favorable for infiltration techniques.

D1	Dense cortical bone	Anterior mandible Posterior mandible
D2	Dense to porous cortical bone surrounding dense trabecular bone	Anterior mandible Posterior mandible Anterior maxilla
D3	Thin porous cortical bone surrounding fine trabecular bone	Anterior maxilla Posterior maxilla
D4	Fine trabecular bone	Posterior maxilla



- Small peripheral terminal branches or free nerve endings in a certain area of oral surgical procedure are anesthetised by deposition of local anesthetic solution in the area. Solution is injected beneath the mucous membrane, or along the periosteum, or beneath the skin.

Complications of local anesthesia

by

Dr. Elham Hazeim Abdulkareem

Introduction:

Administration of local anesthesia is daily routine for most dental practitioners normally no adverse effects are seen. However complications even very serious one can occur in daily practice. Complications related to local anesthesia can ***be divided into two categories:***

1. Preoperative (during giving anesthesia) complications.
2. Postoperative complications.

Both can usually be avoided by the correct technique and dosage however if complications occur the dentist should know how to manage them. ***Each dentist dealing with local anesthesia should know:***

1. The possible complications of local anesthesia.
2. The preventive measures of these complications.
3. The treatment possibilities of these complications.

I-Peroperative complication

1. Pain at injection

Pain during administration of LA solution can be caused by many reasons.

A- Factor depending on the solution:

1-Low PH value; this could irritate the tissue.

2-Temperature of the solution: warmer solution feeling more comfortable than cold. The cartridge can be warmed in the dentist hand or in warm water before the injection.

B- The practitioner related factors: This is related to the technique used can be avoided by:

1 - Fast injection cause rapid swelling of the tissue & pain.

2- Aggressive insertion of the needle can tear soft tissue, blood vessel, nerve & periosteum & cause more pain & others

Complications

An inaccurate injection site can lead to an intramuscular or intraneural inj. when the needle penetrates a nerve; the patient feels a sudden (Electrical shock) in the distal area of the nerve. Pain after intramuscular injection is due to fibrosis or inflammation inside the muscle.

2. Lack of effect.

Sometimes, the dentist face a problem, where the patient despite a conventional anesthesia still feels pain during treatment. The problem is most common with block anesthesia especially in lower jaw. **Reasons behind his failure in LA can be classified as:**

1- Anatomical.

2- Pathological.

3- Psychological.

4- Poor injection technique.

1- Anatomical reasons include :

- accessory nerve supply
- Abnormal course of the nerves.
- Thick cortical plate of the mandibular alveolus precludes infiltration of anesthesia & therefore infiltration anesthesia is insufficient in the lower jaw.
- Variation in the foramen location.
- Some times the teeth can be innervated by more than one nerve.

2- Pathological reasons are:

A- Trismus (limited mouth opening) in these cases it is impossible to use conventional technique of inferior alveolar nerve block. Therefore the so called Akinosi (closed mouth) technique is useful. In these cases there will be an increased possibility of failure of achieving adequate anesthesia.

B- Infection & inflammation: if the pulp is inflamed, the low tissue PH may cause lack of effective anesthesia in that area. However this does not explain failure in block anesthesia, where the solution is injection 4-5 cm from the inflamed area. A possible cause is hyperalgesia; the inflammation makes the nerve more sensitive. A minimal stimulation can cause pain perception. In those patient to obtain sufficient anesthesia more solution has to be injected, for example by combining a block & infiltration anesthesia. Supplemental intra-ligamentary or intra osseous injection can be used if necessary.

C- Previous surgery or trauma.

3- Psychological reasons:

Fear & anxiety. They can cause failure in LA, to enable successful anesthesia, relaxation of the patient is some time needed. For this the use of a sedative like benzodiazepine may be helpful.

4- Poor technique: Is the most common cause for insufficient anesthesia in inferior alveolar nerve block anesthesia .common mistakes are:

A- Injection of anesthesia too soon on the anterior ascending ramus as the needle point touches the lingual cortical bone anterior to lingula .

B- Another mistake is to injection inferior to mandibular foramen.

C- The solution can directed away from a nerve if it injection too rapidly & forcefully. So when ever possible it is advisable to follow accurate technique to prevent this complication.

3- Fainting & vasovagal attack

Collapse of the patient in the dental clinic may or may not be loss of consciousness.

Vasovagal attack is a reflex of nervous system that cause the heart to slow down (bradycardia), at the same time affect the nerves to blood vessel in the legs permitting these vessel to dilate (widen). As a result the heart ejects less blood so the blood pressure drops. Consequently the circulating blood goes to the legs rather than to the head & the fainting episode occurs. In an attempt to redistribute the blood to the vital organs.

Note: pain & anxiety are the most important predisposing factor to vasovagal attacks.

Signs and symptoms:

The patients often complain of the following symptoms:

1-Dizziness

2-weakness

3-nausea

& following signs:

I-The skin is pale immediately before the collapse.

2- Cold skin

3- clammy skin 4- weak & slow pulse.

First aid should be taken immediately:

- The head should be lowered quickly by adjusting the back of the dental chair so that the patient assume the supine position with legs elevated.
- Tight collar & belts should be loosened and respiration is stimulated. Spontaneous recovery is usual, but if sign of recovery are not apparent within 30-45 sec of the first aide measure, the collapse probably is not a vasovagal attack & in this case medical emergency team should be asked immediately for help.
- Meanwhile, we need to maintain a patent air way & supplementary & consider the need for CPR (cardio-pulmonary resuscitation).

4. Hypersensitivity or allergy to LA :

This phenomenon occurs due to sensitivity of some individual to certain substance known as (allergens).

Any LA agent may evoke such a response, but it is more commonly seen with ester type agent (e.g. Procaine) than amide type (e.g. lidocaine).true allergy to amide type is extremely rare.

Hypersensitivity reaction could be due to:

1- LA agent.

2- Vasoconstrictor.

3- Additives: e.g. bisulphite which used as preservative.

- In general hypersensitivity reaction to LA is very rare & represent less than 1% of all complications of LA. Many of complications suspected to be allergic are actually psychogenic reactions caused by fear of dental treatment.

- Other reasons may also be the presence of adrenaline in LA solution which can cause several general symptoms including palpitation, restlessness & nausea. True allergic response to LA may be localized or generalized & immediate or delayed in onset .they may vary from mild skin irritation or rashes to an anaphylactic reaction. Local reactions are seen more frequently than systemic & usually resolve without active treatment. If any degree of allergic reaction is observed, it is very important to determine the actual cause (allergen). Inadequate diagnosis & treatment can be life threatening to the patient.

Anaphylactic shock: It rarely occurs but it is life threatening it is characterized by:

1- Profound fall in blood pressure

2- Dyspnea & respiratory embarrassment

3- Facial & laryngeal edema

4- Loss of consciousness.

5- Urticaria.

It is life threatening condition since it causes air way obstruction in association with laryngeal edema unless treatment is initiated immediately; the condition may progress to fatal termination.

Management of anaphylaxis:

- If you suspect the anaphylactic reaction occurring, immediately seek medical help. The treatment must begin before BP & breathing problem become life threatening.

- epinephrine is the most imp medication for the treatment of anaphylaxis; it is inj into a muscle. Epinephrine works rapidly to make blood vessel contract, preventing them from leaking more fluid.

- It also relax air way, helping the individual breathe easier, relieves cramping in the GIT & stop itching, rapidly reverse the life threatening symptom of anaphylactic shock, if given in time. Even if the individual responds to the epinephrine, it is vitally imp to go to an emergency room immediately & medication may be given to improve breathing.

- IV fluid may be necessary to restore adequate BP. Additional medication (anti histamine) to contract the effect of histamine & to help in prevention of delayed allergic reaction. -If the victim stops breathing, perform cardio pulmonary resuscitation (CPR) immediately. Continue CPR until the person begins breathing again.

5- Over dosage & toxicity

It is relatively rare ,a toxicity reaction can occur when the conc. of LA in circulation increases too rapidly within a short period of time e.g. inj too rapidly into highly vascular area or IV injection. The toxic effect is primarily directed to the CNS & CVS because these tissues are composed of excitable membrane.

Mild over dose sign & symptom:

Restlessness, retention of consciousness talkativeness, & agitation, which may end into convulsion along with increased BP, heart rate, respiratory rate & classified according to the onset.

1- Slow onset <= 5 min following administration of LA (the possible cause rapid absorption & too large total dose).

2- Slower onset >= 15 min following administration of LA (the possible causes are abnormal biotransformation & renal disease).

We use the following protocol in management of such cases:

Step 1 reassure the patient that every thing will be all right.

Step 2 administer via nasal cannula or nasal hood.

Step 3 monitor vital signs.

Step 4 administer anti convulsant. IV infusion (for diazepam 5mg/ min, for midazolam 1mg/min).

Step 5 permits the patient to recover as long as necessary; the patient can leave the dental office escorted or unescorted if we believe that full recovery has occurred, if the doubt exist regarding the level of recovery then .

Step 6 seeks medical help.

Step 7 after termination of reaction be sure that the patient be examined by physician to determine the cause of this reaction.

Severe overdose reaction:

Unconsciousness with or without convulsion, vascular collapse, coma, cardiac arrest & respiratory arrest & classified into:

1-Rapid onset (within 1 min) the possible cause is IV inj.

2-slow onset (5 to 15 min) (the possible causes are too large dose, rapid absorption & abnormal biotransformation.

We use the following protocol in management of such cases:

Step 1 terminate dental treatment.

Step 2 if convulsion is present, protect the patient arm, legs & head &loosen the tight clothing and immediately seek emergency medical assistance.

Step 3 provide basic life support (maintenance of adequate air way & oxygenation are of utmost importance during management of LA induced seizures.

Note: seizures cause increase O2 utilization & hyper metabolism, with increased production of C02 & lactic acid & lead to acidosis this in turn lower the seizer threshold & prolongation of reaction. Cerebral blood flow during the seizure also increase this lead to elevation of anesthetic blood level within the CNS.

Step 4 administer anticonvulsant with good oxygenation & acidosis is not present within 2-3 min seizure will cease. If the seizure is protracted (4-5min with no indication of termination then consider administration of anticonvulsant.

***Step* 5** post seizure CNS depression is usually present & It s intensity equal to that of excitation phase (the patient is drowsy ,or unconscious, breathing may be shallow or absent BP ,HR are depressed so maintenance of patent air way & oxygenation are necessary ,beside administration of IV fluid is initial management of hypotension.

Step 6 allow the patient to rest until recovery

Note: toxicity can also be produced by vasoconstrictor, such as adrenaline in this case the possible symptoms are increase in fear & anxiety, tremor, head ache & palpitation.

To avoid toxicity:

1- Keep in mind the max safe doses of anesthetic. In children & elderly patient, safe level of LA are lower than the remaining population.

2- Use aspirating technique before & during inj. In this manner an IV inj can be avoided.

3- Injection the LA solution slowly.

4- Monitor the patient for possible S.E during injection.

.

6-Drug interaction:

In some patient the administration of 2 drugs will counteract each other, while in other potentiation occurs. In patient under tricyclic antidepressant (TCA) ,variable degrees of potentiation of BP response to catecholamine (adrenaline & noradrenalin)will occur ,even to small doses therefore percussion should be taken during the use of these types of vasoconstrictor with patient taking the TCA . If LA contains felypressin vasoconstrictor, no effect will occur.

7-needle breakage

It is a rare complication in modern dentistry because of the larger awareness of he possible causes & the method for avoiding this complication. The reasons for needle breakage may be:

1- Weakness of the metal of the needle: Metal alloy used nowadays in the needles are flexible, more durable than previously, this lower the number of needle Breakage, but has not entirely solved the problem.

2- re-usage of the needle:

It is not accepted in dentistry nowadays; yet re-usage may happen during the same appointment when giving additional dosage of LA to the same patient. Repeated injection with the same needle cause fatigue of the structure & the risk of needle fracture increases.

3-incorrcct technique: this includes

- Aggressive insertion of the needle in to the tissue.
- Sudden change in the direction inside the tissue.
- Too deep penetration, the needle goes up to it s hub inside the tissue & might fracture at this point. The hub is considered the most common point of needle fracture.

4- Sudden movement of the patient or practitioner.

5. Manufacturing defect

Prevention of needle breakage:

- The dentist should check the inj needles before using them. If there is any suspicion of inadequate product quality a new one should be used.
- Avoid repeated usage of the needle even for the same patient.
- Adequate learning of inj technique for different areas in the mouth.
- Avoid aggressive movement & change of the direction during inj.
- Aggressive insertion can lead to sudden movement of the patient making the dentist unable to control the movement of the needle.

What to do when the needle breaks:

1 -Stay calm & try to localize broken part in the tissue.

2- Tell the patient what has happened & try to relax & comfort him/her.

3- Stabilize the patient jaws in order that the needle stays in place (if the patient move his jaws the tension from the muscle of masticatory system cause the needle to penetrate the tissue &pain).

4- If a portion of the needle is visible, grasp it firmly with a pair of locking forceps & remove it.

5- If you can not remove the broken part yourself, refer the patient to oral & maxillofacial surgeon. In the department of oral & maxillofacial surgery the patient is examined well & the needle is removed surgically UGA ,this will provide complete immobility & muscle relaxation with the aid of some method that are used to localized the needle (ex CT scan , ultrasonography's).

8. Facial nerve paralysis:

This complication arises if the tip of the needle is inserted too far back & behind the ascending ramus of the mandible during inferior alveolar nerve block. The anesthetic agent then deposited in the substance of the parotid gland where it anesthetize the branches of the facial nerve causing paralysis of facial muscles.

Facial nerve paralysis secondary to LA injection is temporary & will last the expected duration of anesthesia of soft tissue of the oral cavity.

Clinically, the patient will immediately complain of transient paralysis of the muscle of the chin, lower lip, upper lip, of eyelid (in ability to close the eye) & in ability to raise the eye brow of the affected side.

Management:

1-reassure the patient of the transient nature of the event & will last for few hours.

2-advice the patient to use an eye patch until motor function return.

3-if contact lenses are worn, they should be removed.

2-post operative complication

I- hematoma

A hematoma is localized mass of extravasated blood that may become clinically noticeable following the injection. It is caused by penetration of the BV with the needle during penetration or withdrawal of the needle in to the tissue leading to bleeding inside the tissue & the formation of a hematoma. The patient will notice development of swelling & discoloration of a bruise lasting I0 days.

Intra orally the vessels most commonly associated with hematoma are:

1- The pterygoid plexus of veins.

2- Posterior superior alveolar vessels.

3- The inferior alveolar vessels in the pterygomandibular space.

4- The mental vessels.

5- The infraorbital vessels.

Prevention:

- Learn anatomical landmark & injection technique.
- Avoid relocating the needle to different sites inside the tissue.

Management:

1- If it is visible immediately following injection, apply direct pressure if possible.

2- Once bleeding has stopped inform the patient of what happened & re-evaluate the possibilities of continuing the treatment.

3- Instruct the patient to avoid application of heat over the area for at least 6 hours.

4- Tell the patient to expect discoloration of the area.

5- Prescribe analgesics & if infection is suspected, suitable antibiotic is given.

6- If it is invisible like in case of pterygomandibular space hematoma, the patient will normally come in the second or third day complaining of trismus. In this case treat the patient as the treatment of trismus.

2- Trismus:

Trismus is defined as limited jaw opening (locked jaw) mainly due to spasm of the muscle of mastication.

The causes of spasm:

1- Penetration of the muscle by needle during administration of LA which might cause bleeding in to the muscle & spasm.

2- Hematoma as a result of damage of blood vessel in the area near one of muscle of mastication.

3- Infection in an area close to one of the muscle of mastication .The most common muscle to be the source of trismus is the medial pterygoid muscle which can be penetrated by the needle during inferior alveolar nerve block.

The main symptom is the limitation of movement of mandible which is often associated with pain, symptoms arise within one to four days of injection, their duration & severity are variable .if properly managed improvement should be noticed within 2-3 days if no improvement is noted, consider other possible cause such as infection &treat accordingly.

Management of trismus:

1- Apply hot moist towel to the site for approximately 20 minute every hour.

2- Use analgesia as required.

3- Instruct the patient to gradually open &close the mouth & use chewing gum as mean of physiotherapy.

3- Infection:

Infection following LA administration is extremely rare nowadays due to the use of disposable needles.

It may occur if the **needle has been contaminated** prior to insertion or if the patient significantly immunocompromised. If an infection does occur, it will likely manifest initially as pain & trismus one day post inj. If these symptoms persist for days & continue to worsen, the possibility of infection should be considered. At this stage, this patient should be examined for other sign & symptom of infection such as swelling, lymphadenopathy & fever & drainage of pus collection should be considered.

When there is an active site of infection such as an abscess, needles should not be inserted because there is a potential for spreading the infection.

4- Prolonged anesthesia & paraesthesia:

Anesthesia, paresthesia, dysesthesia, hyperesthesia; may persist beyond the expected duration of action of a local anesthesia affecting the tongue or lip.

Anesthesia: is a total loss of sensation

Paraesthesia: is an altered sensation, characterized by burning, tingling, pricking sensation experienced by the patient.

Dysesthesia: is an Abnormal, unpleasant sensation experienced by the patient in the absence of stimuli.

Hyperesthesia: is an increased sensitivity to noxious stimuli.

Causes:

1- Direct trauma from the bevel of the needle.

2- injection of the anesthetic solution that is contaminated with a neurotoxic substance such as alcohol.

3- Hemorrhage & infection in close proximity to a nerve: Most of these are transient & resolve within 8 weeks -2 years, but they become irreversible in rare occasions.

Management:

1- Reassurance of the patient that the condition is transient.

2-Note the sign & symptom & follow up of the patient

3- Refer the patient to maxillofacial surgeon if the symptoms persist.

Abbreviations:

Lymphadenopathy: any disease process that cause enlargement of lymph node.

The vital signs (BP, PR, RR, temperature)

BP = blood pressure PR = pulse rate

RR= respiratory rate Temp= temperature

S.E= side effect UGA= under general anesthesia

// = fracture Inj. = injection

Imp.= important LA = local anesthesia

Dis = disease

Classification of nerve fibers:

The fibers of peripheral nerves classified according to the basis of electrophysiological and morphological differences:

Type A ; fiber: largest fibers further divided into four groups :-

1) A- alpha (α): responsible for motor action & muscle properioception.
2) A-beta (β): responsible for motor action & muscle properioception.
3) A-gamma (γ): responsible for motor action & muscle properioception.
4) A- delta (δ): responsible for fast sharp pain, temperatures, touch, & pressure

Type B fibers : preganglionic responsible for sympathetic activity.

Type C fibers : unmyelinated , the most numerous in the peripheral nervous system. Responsible for conduction of dull or burning pain.

Noxious stimuli are transmitted to the CNS by way of Aδ &C fibers. The lightly myelinated Aδ fibers are responsible for conduction of sharp, bright pain while unmyelinated C fibers conduct dull or burning pain.

Requirements of local anesthetic agents:-

- It should not be irritating to the tissue to which it is applied
- It should not, cause any permanent alteration of nerve structure
- Its systemic toxicity should by low
- It must be effective regardless of whether it is injected into the tissue or applied locally to mucous membranes.
- The time of onset of anesthesia should be as short as possible
- The duration of action, must be long enough to permit completion of the procedure.
- It should have potency sufficient to give anesthesia without using harmful concentration
- It should be relatively free from producing allergic reactions
- It should be stable in solution and readily undergo biotransformation in the body
- It should either be sterile or be capable of being sterilized by the heat without deterioration.

Nerve membrane:-

The nerve membrane consists of two layers of lipid molecules (phospholipids) and associated proteins, lipids and carbohydrates (fig: 2). All biologic membranes are organized to

(1) block the diffusion of water soluble molecules.

(2) be selectively permeable to certain molecules via specialized channels and

(3) transduce information by protein receptors responsive to chemical or physical stimulation. Since the nerve membrane exhibits selective permeability, therefore significant differences exist for ions between the intracellular and the extracellular concentrations. Accordingly high concentration of K inside while high concentration of Na and CI outside the nerve membrane.

In some nerves an insulating lipid rich layer of myelin covers this membrane (fig: 3). The outer most layer of myelin consists of the schwann cell cytoplasm and its nucleus. A gap between two adjoining Schwann cells and their myelin spirals called node of Ranvier at these nodes the nerve membrane is exposed directly to the extracellular medium.

1. Ester linked local anesthetic (ex: procaine) are readily hydrolyzed in aqueous solution, while amide linked types (ex: lidocaine) are relatively resistant to hydrolysis.

2. a greater percentage of an amide linked drug is excreted unchanged in the urine than of an ester linked drug.

The ester type includes the following:-

1. procaine
2. chloroprocaine
3. propoxycaine
4. butacaine
5. cocaine
6. benzocaine
7. hexylcaine
8. piperocaine
9. tetracaine

The amide type include the following:-

1. lidocaine
2. prilocaine
3. articaine
4. bupivacaine
5. dibucaine
6. etidocaine
7. mepivacaine

Pharmacokinetic of local anesthetics:-

Distribution:-

Once absorbed into the blood local anesthetics are distributed throughout the body to all tissues. The blood level of local anesthetic is influenced by the following factors:-

1. rate at which the drug is absorbed into the cardiovascular system.
2. rate of distribution of the drug from the vacular compartment to the tissue (more rapid in healthy patients than in those who are medically compromised e.g; congestive heart failure patients).
3. elimination of the drug through the metabolic or excretory pathways.

The last two factors act to decrease the blood level of local anesthetic.

Note:-

All local anesthetics readily cross the blood brain barrier they also readily cross the placenta and enter the circulatory system of the developing fetus.

Dilution of vasoconstrictors'

The di l u t ion of vasoconstrictor is commonly referred to as ratio (1 to 1000, written 1: 1000). This 1:1000 mean that there is I gm (1000 mg) of anesthetic drug contained in 1000 ml of solution.

Therefore a 1:1000 dilution contains 1000 mg in 1000 ml or 1.0 mg/ml of solution. Accordingly 1:10000 dilutions contain 1000 mg in 10000ml or 0.1 mg/ml of solution. & 1:100 000 dilution

contain l000mg in 100 000 ml or 0.01 mg/ml of solution.

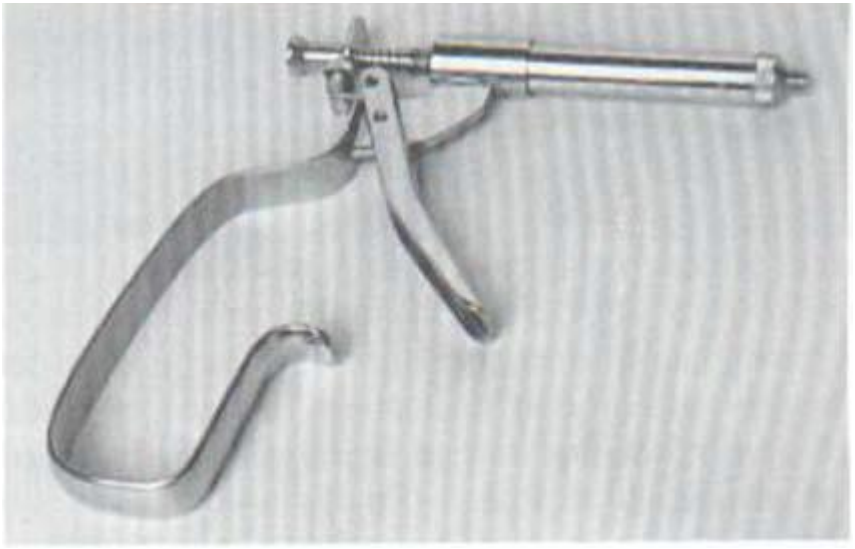
The mg/ml value of the various vasoconstrictors are :

Type	***mg/ml***	***dilution***
Adrenalin	0.02	1:50 000
Adrenalin	0.01	25 1:80 000
Adrenalin	0.01	1:100 000
Adrenalin	0.005	1:200 000
Levonorde frin	0.05	1:20 000
Noradrenalin	0.033	1:30 000

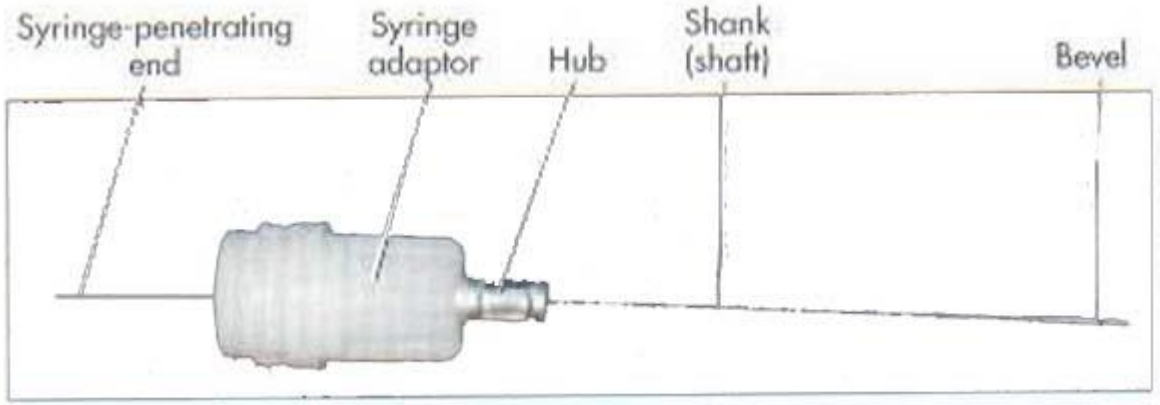
We should remember that the max dose of the vasoconstrictor is 0.2 mg per appointment for adult healthy patient. And 0.04 mg per appointment for patient with clinically significant cardiovascular dis, & should be considered when calculating the max number of cartridge that are allowed to be given to the patient per appointment & according to the type & cone. of the vasoconstrictor.

Type	Pulpal	Soft tissue anesthesia
Lidocaine 2%	5-10 min.	60 min
Prilocaine 4%	5-10 min	90 min
Mepivacaine 3%	20-40 min	120 min
Lidocaine 2%	60 min	180-240 min
Prilocaine 4%	60 min	120 min
Bupivacaine 0.5%	> 90 min	240-540 min

Fig (**2**): dental syringe (top loaded cartridge)



Fig(**3**):pressure syringe (origenal design)


Syringe-penetrating end
Syringe adaptor
Hub
Shank (shaft)
Bevel

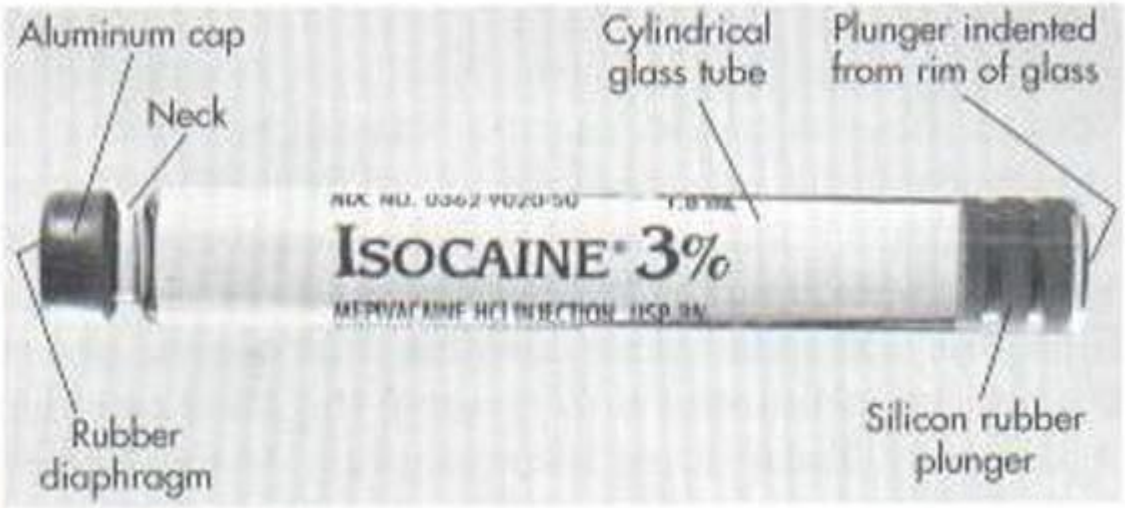


Fig. Components of the glass dental cartridge.

Bent needle

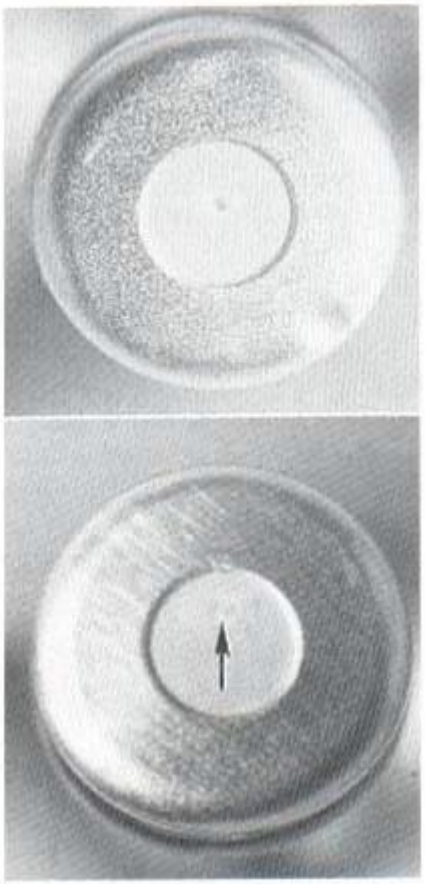
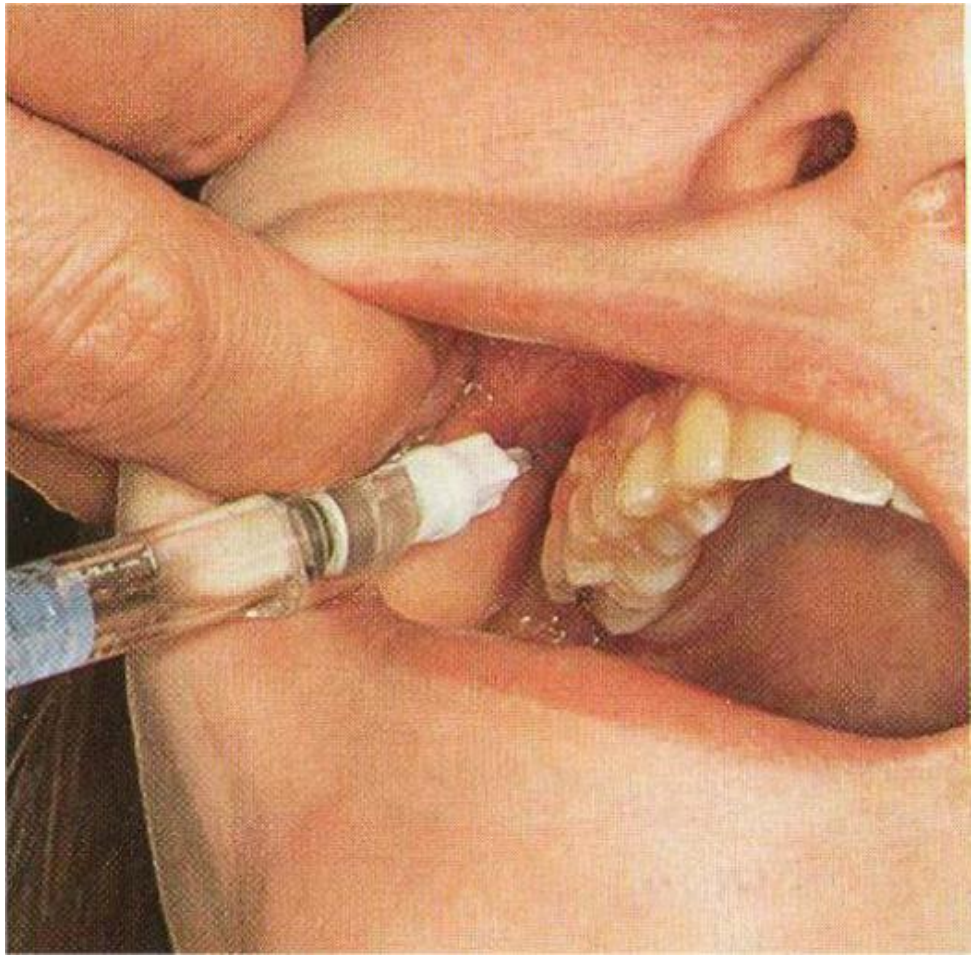
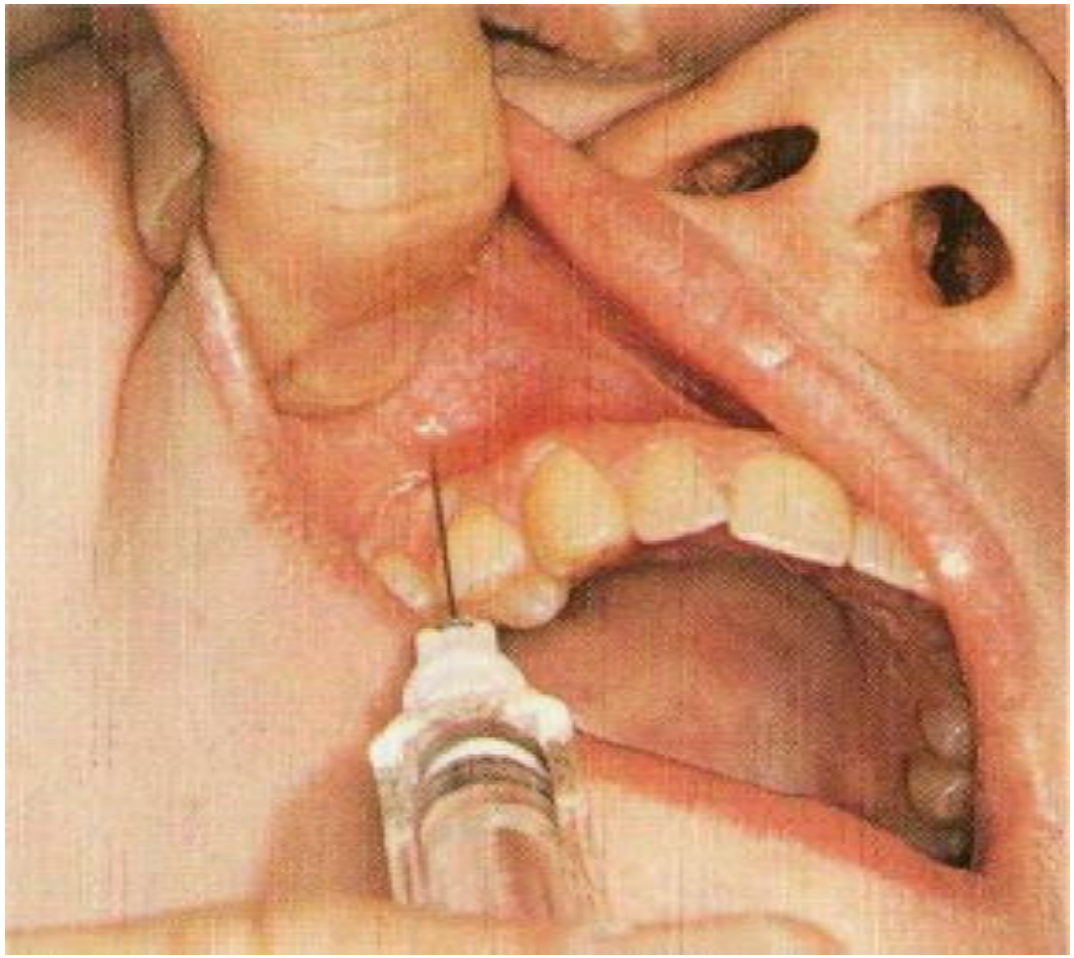
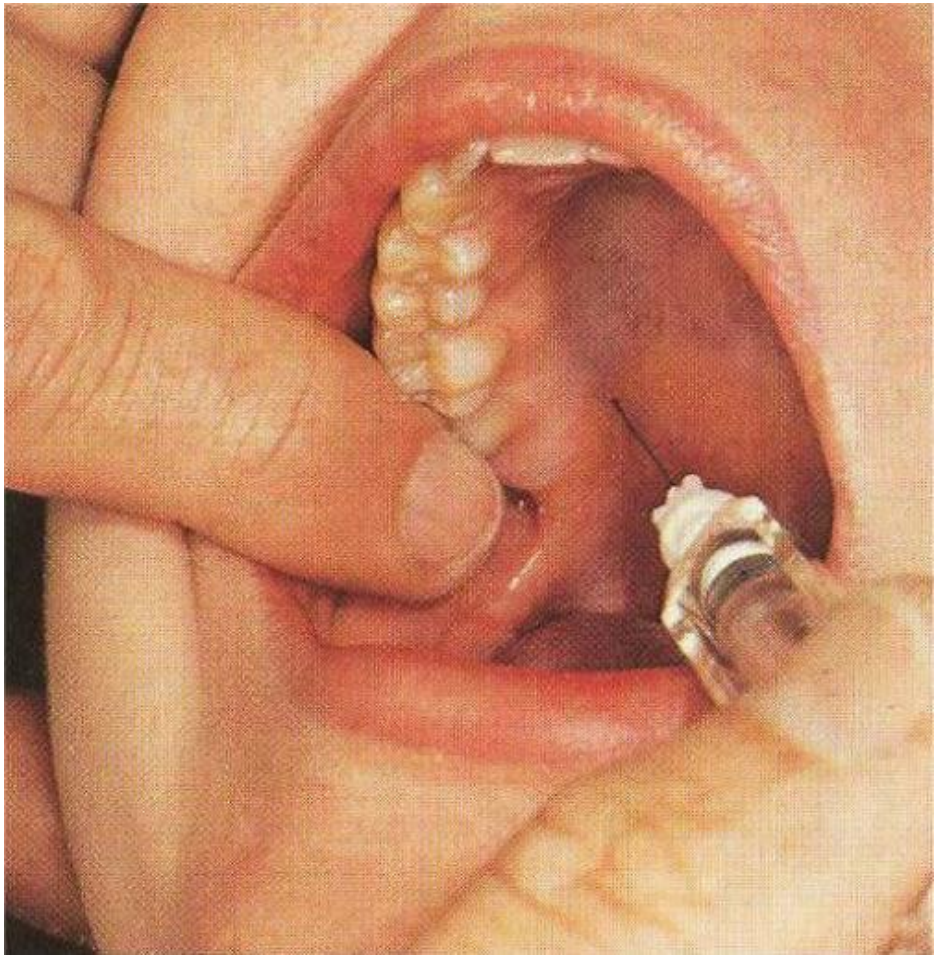
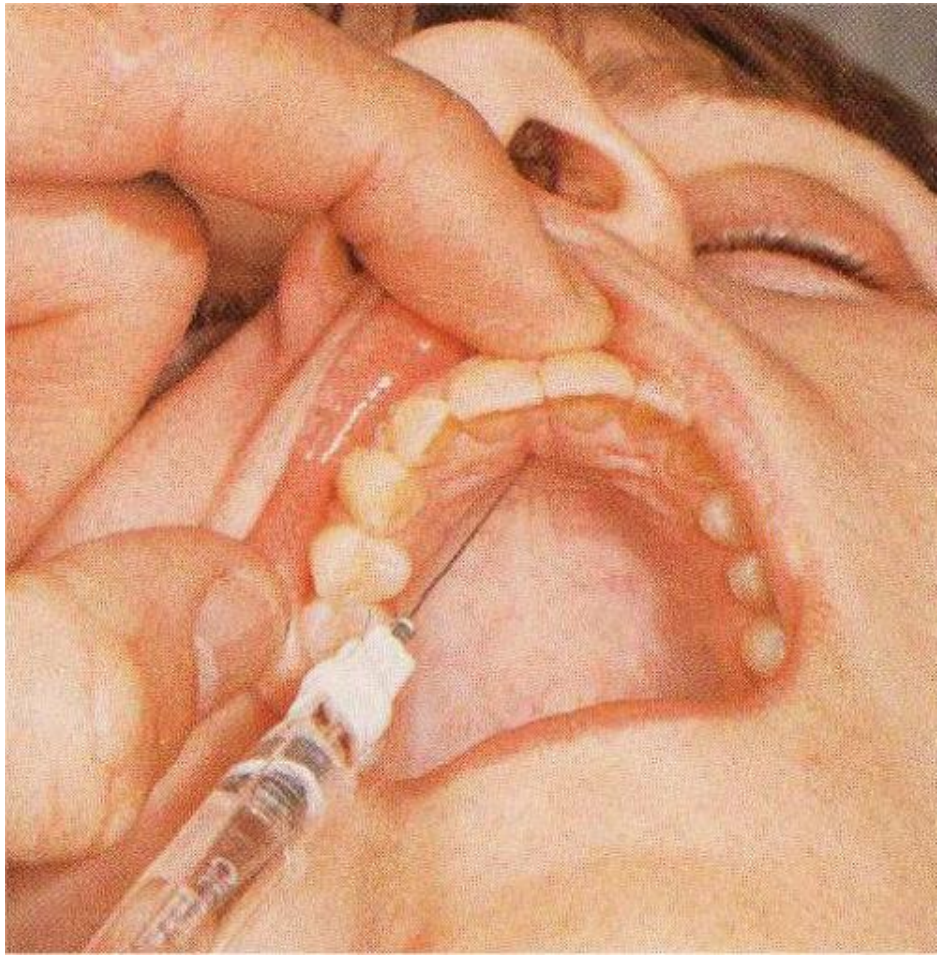


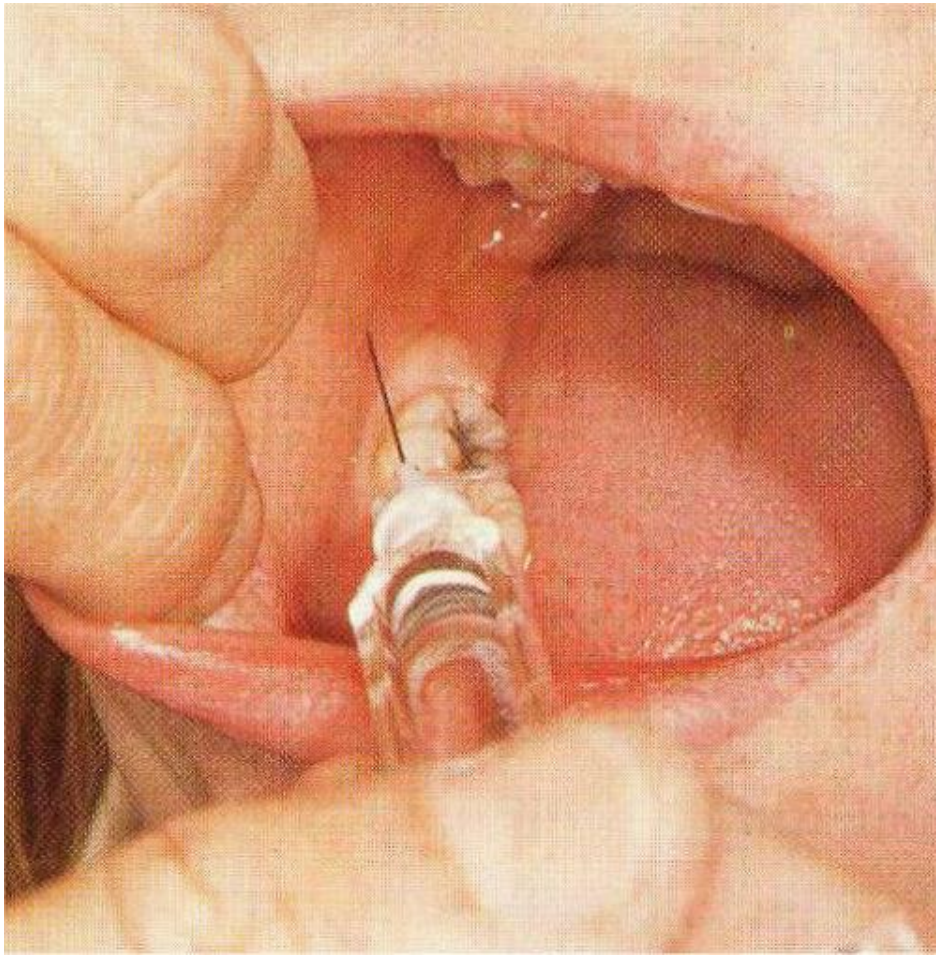
Fig (7):centric and eccentricperforation

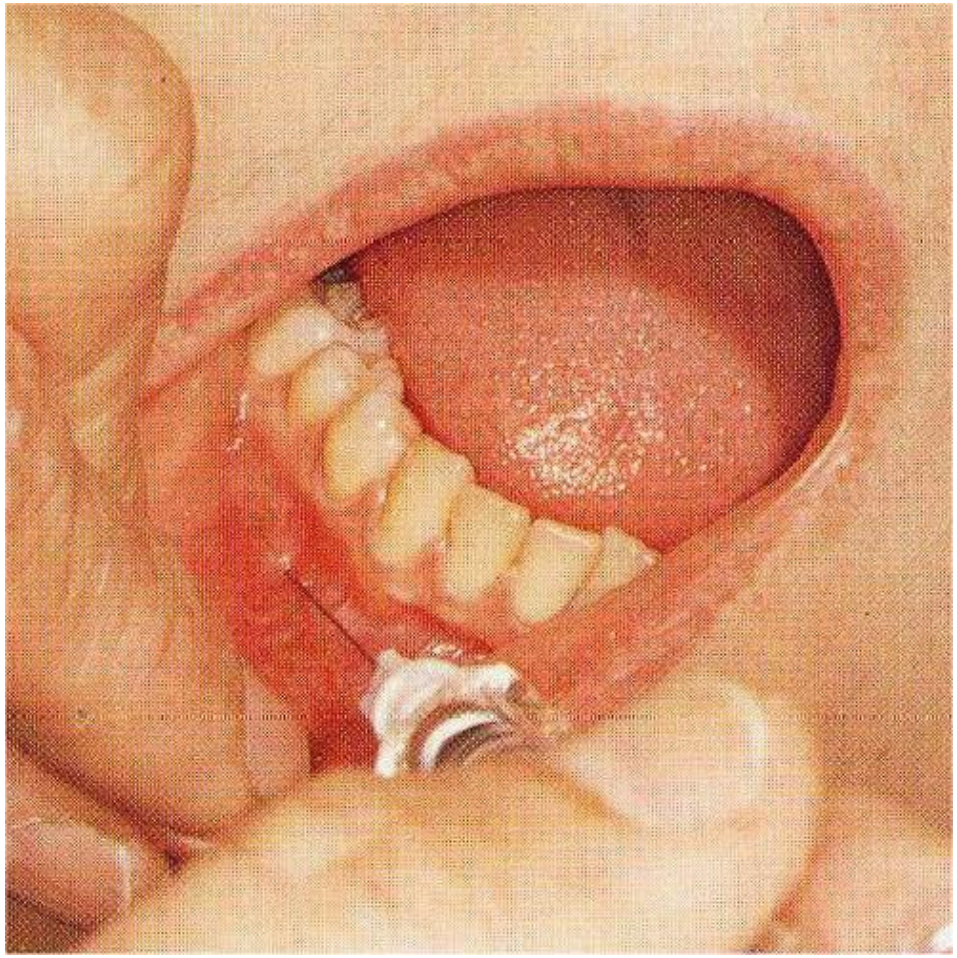












Dental Management of the Medically Compromised Patients

Medical history

A medical history must be taken for every patient who is to receive dental treatment. There are two basic techniques were used to obtain a medical history. The first technique consists of an interview of the patient, in which the interviewer questions the patient and then records a narrative of the patient's verbal responses on a form sheet.
The second technique was used a printed questionnaire that the patient fills out.

1. Cardiovascular Disease

Patients with cardiovascular disease are especially vulnerable to physical or emotional challenges that may be encountered during dental treatment.

2. Heart failure results from an underlying cardiovascular problem such as coronary heart disease or hypertension. Patients with untreated or symptomatic heart failure are at increased risk for myocardial infarction (MI), arrhythmias, acute heart failure, or sudden death, and generally are not candidates for elective dental treatment. Chair position may influence ability to breathe, with some patients unable to tolerate a supine position. Vasoconstrictors should be avoided, if possible, in patients taking digitalis glycosides (digoxin) because the combination can precipitate arrhythmias.

3. Heart Attack

A history of a heart attack (myocardial infarction) within the very recent past may prevent elective dental care, because during the immediate post infarction period, patients are at increased risk for reinfarctions, arrhythmias, and heart failure. Patients may be taking medications such as antianginals, anticoagulants, adrenergic blocking agents, calcium channel blockers, antiarrhythmic agents, or digitalis. Some of these drugs may alter the dental management of patients because of potential interactions with vasoconstrictors in the local anesthetic, adverse side effects, or other Considerations. Stress and anxiety reduction measures may be advisable.

4. Angina Pectoris

is a brief substernal pain results from myocardial ischemia, commonly provoked by physical activity or emotional stress, is a common and significant symptom of coronary heart disease. Patients with angina, especially unstable or severe angina, are at increased risk for

arrhythmias, MI, and sudden death. A variety of vasoactive medications, such as nitroglycerin, β-adrenergic blocking agents, and calcium channel blockers, are used to treat angina. Caution is advised with the use of vasoconstrictors. Stress and anxiety reduction measures may be appropriate. Patients with unstable or progressive angina are not candidates for elective dental care.

5. High Blood Pressure

Patients with hypertension (blood pressure greater than 140/90 mm Hg) should be identified by history and the diagnosis confirmed by blood pressure measurement. Patients with a history of hypertension should be asked if they are taking or are supposed to be taking antihypertensive medication. Failure to take medication often is the cause of elevated blood pressure in a patient who reports being under treatment for hypertension. Current blood pressure readings and any clinical signs and symptoms that may be associated with severe, uncontrolled hypertension, such as visual changes, dizziness, spontaneous nosebleeds, and headaches, should be noted.

Some antihypertensive medications, such as the nonselective β-adrenergic blocking agents, may require caution in the use of vasoconstrictors. The coadministration of calcium channel blockers with macrolide antibiotics (e.g., erythromycin, clarithromycin) can result in excessive hypotension. Stress and anxiety reduction measures also may be appropriate. Elective dental care should be postponed for patients with severe, uncontrolled hypertension (blood pressure of 180/110 mm Hg or higher) until the condition can be brought under control.

6. Artificial Heart Valve

A diseased valve may be replaced with artificial or prosthetic valves. Such replacement valves are associated with a high risk for development of infective endocarditis, with significant morbidity and mortality. Accordingly, the AHA recommends that all patients with a prosthetic heart valve be given prophylactic antibiotics before most dental procedures**.** Patients with an artificial heart valve also may be on anticoagulant medication to prevent blood clots associated with the valve. In such patients, excessive bleeding may be encountered with surgical procedures; it is therefore necessary to determine the level of anticoagulation before any invasive procedure**.**

7. Hemophilia or inherited bleeding disorder

Patients with an inherited bleeding disorder such as hemophilia A or B, or von Willebrand's disease, are at risk for severe bleeding after any type of dental treatment that causes bleeding, including scaling and root planing. These patients must be identified and managed in cooperation with their physician or haematologist. Patients with severe factor deficiency may require factor replacement before invasive treatment, as well as aggressive postoperative measures to maintain hemostasis.

8. Blood Transfusion

Patients with a history of blood transfusions are of concern from two aspects. The underlying problem that necessitated a blood transfusion, such as an inherited or acquired bleeding disorder, must be identified, and alterations in the delivery of dental treatment may have to be made. These patients also may be carriers of hepatitis B or C or may have become infected with the human immunodeficiency virus (HIV) and must be identified. Laboratory screening or medical consultation may be appropriate to determine the status of liver function, and, as always, standard infection control procedures are mandatory.

9. Anemia

A significant reduction in the oxygen-carrying capacity of the red blood cells may result from an underlying pathologic process such as acute or chronic blood loss, decreased production of red blood cells, or haemolysis. Some anaemias, such as glucose-6-phosphate dehydrogenase (G6PD) deficiency and sickle cell disease, require dental management modifications. Oral lesions, infections, delayed wound healing, and adverse responses to hypoxia all are potential matters of concern

10. Leukemia/Lymphoma

Depending on the type of leukemia or lymphoma, status of the disease, and type of treatment, some patients may have bleeding problems or delayed healing, or may be prone to infection. Gingival enlargement can be a sign of leukemia. Some adverse effects can result from the use of chemotherapeutic agents and may require dental management modifications.

11. Epilepsy, Seizures, and Convulsions

A history of epilepsy should be identified, and the degree of seizure control should be determined. Specific triggers of seizures (e.g., odors, bright lights) should be identified and avoided. Some medications used to control seizures may affect dental treatment because of drug actions or adverse side effects. For example, gingival over growth is a well-recognized adverse effect of diphenylhydantoin (Dilantin). Patients may discontinue the use of anticonvulsant medication without their doctor's knowledge and thus may be susceptible to seizures during dental treatment. Therefore, verification of patients' adherence to their medication schedule is important.

12. Psychiatric Patients

Patients with a history of a behavioral disorder or psychiatric illness as well as the nature of the problem need to be identified. This information may help explain patients' unusual such as unexplainable or unusual conditions. Additionally, some psychiatric drugs have the potential to interact adversely with vasoconstrictors in local anesthetics. They also may produce adverse oral effects such as hyposalivation or xerostomia.

Some patients may be excessively anxious or apprehensive about dental treatment, requiring stress reduction measures.

13. Stomach or Intestinal Ulcers, Gastritis, and Colitis

Patients with gastric or intestinal disease should not be given drugs that are directly irritating to the gastrointestinal tract, such as aspirin or nonsteroidal antiinflammatory drugs. Patients with colitis or a history of colitis may not be able to take certain antibiotics. Many antibiotics can cause a particularly severe form of colitis (i.e., pseudomembranous colitis), and elderly persons are more susceptible to this condition. Some drugs used to treat gastric or duodenal ulcers may cause dry mouth.

14. Hepatitis, Liver Disease, Jaundice, and Cirrhosis

Patients who have a history of viral hepatitis are of concern in dentistry because they may be asymptomatic carriers of the disease and can transmit it unknowingly to dental personnel or other patients. Of the several types of viral hepatitis, only hepatitis B, C, and D have carrier stages. The laboratory tests are available to identify affected patients. Standard infection control measures are mandatory. Patients also may have chronic hepatitis (B or C) or cirrhosis, with associated impairment of liver functio may result bleeding and less efficient metabolism of certain drugs, including local anesthetics and analgesics.

15. Allergies or Hives

Patients may be allergic to some drugs or materials used in dentistry. Common drug allergens include antibiotics and analgesics. Latex allergy also is common, and in patients so affected, alternative materials such as vinyl or powderless gloves and vinyl dam material can be used to prevent an adverse reaction. True allergy to amide local anesthetics is uncommon. Dentists should procure a history regarding allergy by specifically asking patients how they react to a particular substance. Symptoms and signs with allergy include itching, urticaria (hives), rash, swelling, wheezing, angioedema, runny nose, and tearing eyes. Isolated signs and symptoms such as nausea, vomiting, heart palpitations, and fainting generally are not of an allergic origin but rather are manifestations of drug intolerance, adverse side effects, or psychogenic reactions.

16. Asthma

The type of asthma should be identified, as should the drugs taken and any precipitating factors or triggers. Stress may be a precipitating factor and should be minimized when possible. It often is helpful to ask whether the patient has visited the emergency room for acute treatment of asthma, because this historical detail would indicate more severe disease. A patient who uses an albuterol inhaler for treatment of acute attacks should be instructed to bring it to the dental appointment.

17. Diabetes

Patients with diabetes mellitus must be identified to determine the type of diabetes, how it is being treated, and how well controlled it is. Patients with type 1 diabetes require insulin, whereas type 2 diabetes usually is controlled through diet and/or oral hypoglycaemic agents; however, some patients with type 2 diabetes eventually also require insulin. Those with type 1 diabetes have a greater number of complications and are of greater concern regarding management than are those with type 2 diabetes. Symptoms and signs of diabetes include excessive thirst and hunger, frequent urination, weight loss, and frequent infections. Long-term complications include blindness, hypertension, and kidney failure, each of which also may affect dental management. Patients with diabetes typically do not handle infection very well and also may have exaggerated periodontal disease. Patients who take insulin are at risk for episodes of hypoglycaemia in the dental office if meals are skipped or if infection is present.

18. Thyroid Disease

Patients with uncontrolled hyperthyroidism are potentially hypersensitive to stress and α1- adrenergic effects of sympathomimetic, so the use of vasoconstrictors generally is contraindicated. In rare cases, infection or surgery can initiate a thyroid crisis—a serious medical emergency. These patients also may be easily upset emotionally and intolerant of heat, and they may exhibit tremors. Exophthalmos may be present. Patients with known hypothyroidism usually are taking a thyroid supplement; this medication regimen generally warrants no concern so long as the thyroid hormone level does not become too high.

19. Kidney Failure

Patients with chronic kidney disease or a kidney transplant must be identified. The potential for abnormal drug metabolism, immunosuppressive drug therapy, bleeding problems, hepatitis, infection, high blood pressure, and heart failure must be considered in management. Certain drugs that are nephrotoxic should be avoided. Patients on hemodialysis do not require antibiotic prophylaxis.

20. Sexually Transmitted Diseases

A variety of sexually transmitted diseases such as syphilis, gonorrhea, human immunodeficiency virus (HIV) infection, as well as AIDS, can have manifestations in the oral cavity because of oral genital contact or secondary to hematogenous dissemination in the blood or immune suppression. The dentist may be the first to identify these conditions. In addition, some sexually transmitted diseases, including HIV infection, hepatitis B and C, and syphilis, can be transmitted to the dentist through direct contact with oral lesions or infectious blood.

21. Tobacco and Alcohol Use

The use of tobacco products is a risk factor that is associated with cancer, cardiovascular disease, pulmonary disease, and periodontal disease. Excessive use of alcohol is a risk factor for malignancy and heart disease, and may lead to liver disease. The combination of excessive alcohol and tobacco use is a significant risk factor for oral cancer.

22. Drug Addiction and Substance Abuse

Patients who have a history of intravenous drug use are at increased risk for infectious diseases such as hepatitis B or C, AIDS, and infective endocarditis. Narcotic and sedative medications should be prescribed with caution, if at all, for these patients, because of the risk of triggering a relapse. This caveat also applies to patients who are recovering alcoholics. Vasoconstrictors should be avoided in patients who are cocaine or methamphetamine users because the combination may precipitate arrhythmias or severe hypertension.

23. Tumors and Cancer

Patients who have had cancer are at risk for recurrence, so they should be closely monitored. Also, cancer treatment regimens including chemotherapeutic agents or radiation therapy may result in infection, gingival bleeding, oral ulcerations, dry mouth, mucositis, and impaired healing after invasive dental treatment, all of which represent significant management considerations. Patients with a history of intravenous bisphosphonate therapy for metastatic bone disease are at risk for osteonecrosis of the jaw, and surgical treatment should be managed cautiously.

24. Radiation Therapy and Chemotherapy

Patients with previous radiation treatment to the head, neck, or jaw must be carefully evaluated, because radiation can permanently destroy the blood supply to the jaws, leading to osteoradionecrosis after extraction or trauma. Irradiation of the head and neck can destroy the salivary glands, resulting in decreased saliva, increased dental caries, and mucositis. Fibrosis of masticatory muscles resulting in limited mouth opening also may occur. Chemotherapy can produce many undesirable adverse effects, most commonly a severe mucositis; however, such changes resolve with cessation of the chemotherapeutic agents.

25. Steroids

Cortisone and prednisone are examples of corticosteroids that are used in the treatment of many diseases. These drugs are important because their use can result in adrenal insufficiency and potentially render the patient unable to mount an adequate response to the stress of an infection or invasive dental procedure such as extractions or periodontal surgery. Generally, however, most routine dental procedures do not require administration of supplemental steroids.

26. Pregnancy

Women who are or may be pregnant may need special consideration in dental management. Caution typically is warranted in the taking of radiographs, administration of drugs, and timing of dental treatment. Prolonged time in the dental chair should be avoided, to prevent the complication of supine hypotension. If supine hypotension develops, rolling the patient onto her left side affords return of circulation to the heart. Good dental hygiene is important to maintain during pregnancy. Preventive plaque control measures should be provided in the first trimester. Extensive reconstruction or significant surgical procedures are best postponed until after delivery. In spite of the safety of dental radiography, ionizing radiation should be avoided. The most important for the pregnant patient are the protective lead apron and the thyroid collar. In addition, the use of digital radiography markedly reduces radiation exposure.

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1. Dental Management of the Medically Compromised Patient ISBN: 978-0-323-08028-6 Copyright © 2013 by Mosby, an imprint of Elsevier Inc. Library of Congress Cataloging-in-Publication Data
2. Dental management of the medically compromised patient / James W. Little … [et al.]. – 8th ed.p. ; Cm.Includesbibliographical references and index.ISBN 978-0-323-08028-6 (pbk. : alk. paper)

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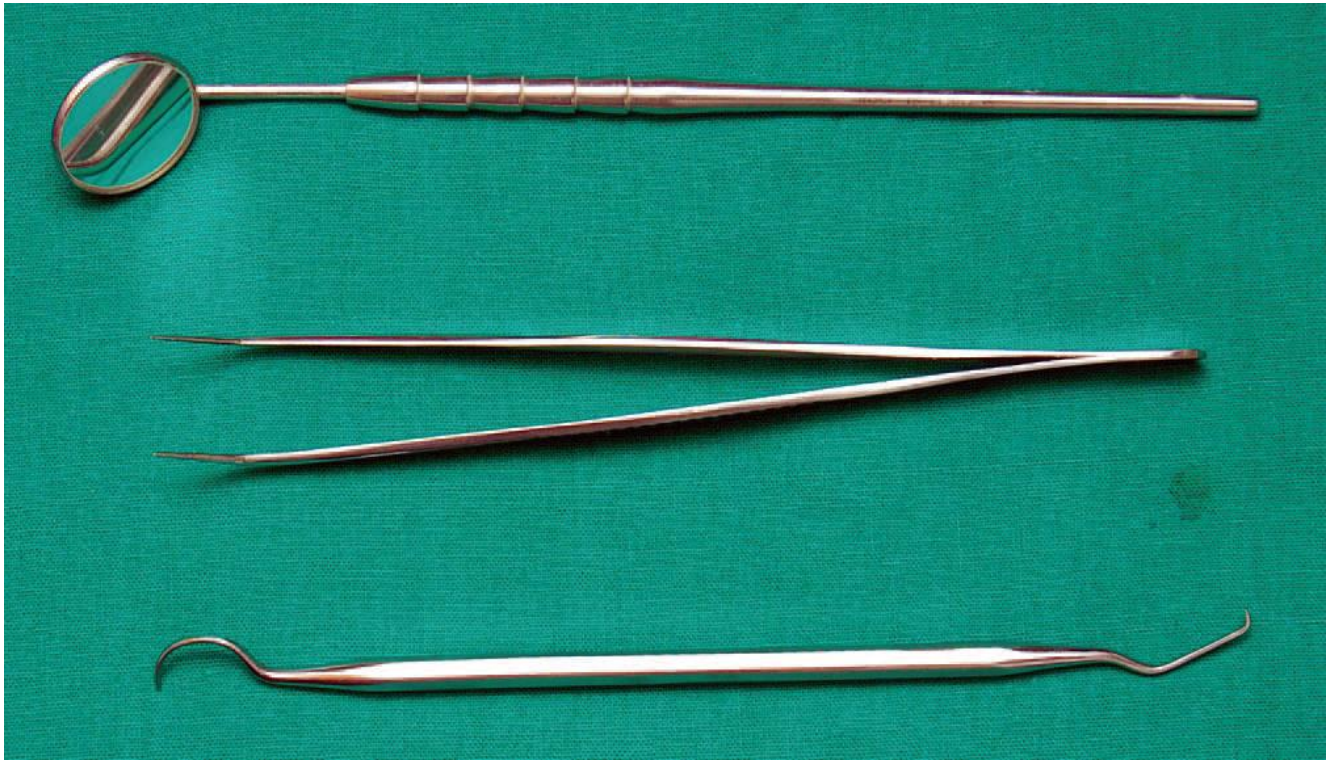
Armamentarium of Local Anaesthesia

By

Dr. Elham H. Abdulkareem

The instruments required for initial examination are shown in Figure.



The armamentarium

The equipment's necessary for the administration of local anaesthetic include:

1. The syringe
2. The needle
3. The local anaesthetic cartridge
4. Additional armamentarium:

a) Topical antiseptic

b) Topical anaesthetic

c) Applicator sticks

d) Cotton gauze (2*2 inches)

e) Haemostate

The syringe

The syringe is the vehicle whereby the contents of the anaesthetic cartridge are delivered through the needle to the patient.

There are 7 types of syringe for local anaesthetic administration in use in dentistry which are:

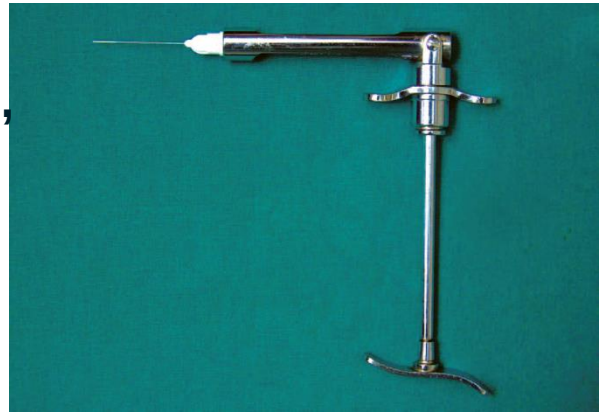
A. Non disposable:

1. Breech-loading metallic cartridge-type aspirating.
2. Breech-loading metallic cartridge-type non-aspirating.
3. Breech-loading plastic cartridge-type aspirating.
4. Breech-loading metallic cartridge-type self-aspirating.
5. Pressure
6. Jet injector

B. Disposable

C. Safety syringes.

Non-aspirating, breech loading cartridge syringe



Various types of aspirating cartridge syringes showing: A diamond, a fishhook, and a harpoon; as seen from above downwards

American dental association criteria for acceptance of local anaesthetic syringes include the following:

- ✓ They must be durable and able to withstand repeated sterilization without damage.
- ✓ They should be capable of accepting a wide variety of cartridges and needles.
- ✓ They should be permit repeated use.
- ✓ They should be inexpensive, self-contained, light weight, and simple to use with one hand.
- ✓ They should provide for effective aspiration and be constructed so that blood may be easily observed in the cartridge.

Breech-loading metallic cartridge-type aspirating syringe is the most commonly used.

The term breech-loading implies that the cartridge is inserted into the syringe from the side. Barrel.

The syringe consists of:

- ☆ Metal barrel
- ☆ Plunger united (piston)

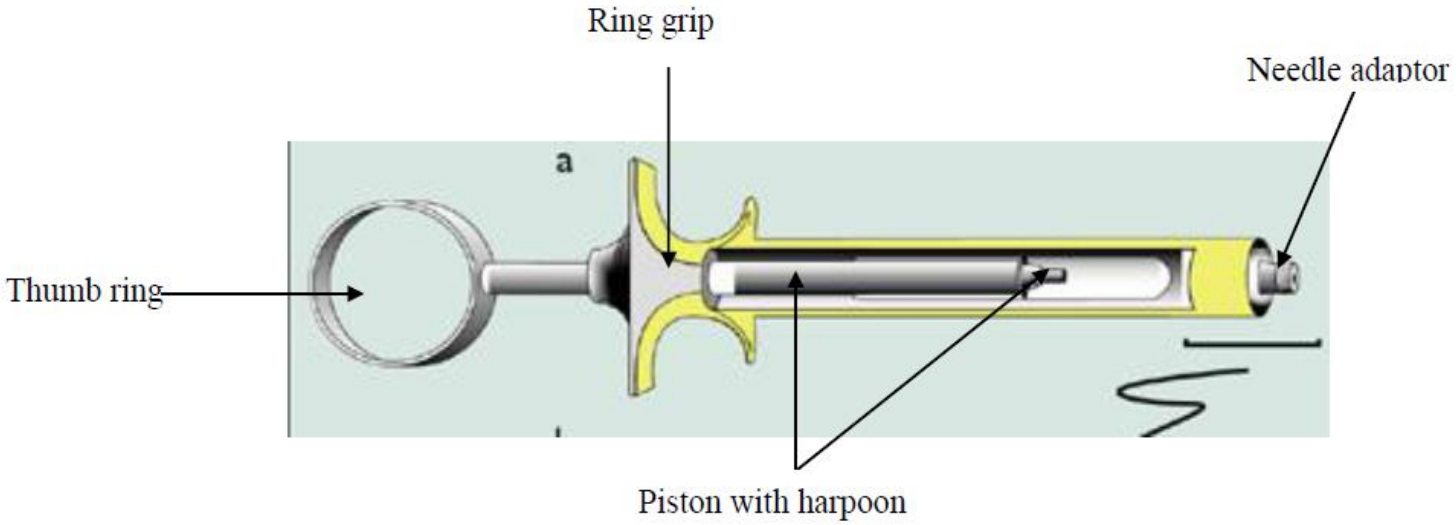


Fig6

- A double-ended needle is attached by means of a screw hub to other ended of the barrel. Opening of the hinge mechanism permits the insertion of a cartridge.
- The aspirating syringe has a device such as a tip or harpoon that is attached to the piston an is used to penetrate the thick rubber or silicone stopper at the opposite end of the cartridge.
- The manoeuvre of aspiration consists of withdrawal of the rubber plunger to create a negative pressure within the cartridge and is employed in order to ensure that a blood vessel has not been entered by the needle tip during its insertion into the soft tissues and prior to the injection of the solution. Positive aspiration results in a fine spiral of blood being clearly visible in the solution within the cartridge.

The advantages are:

- Visible cartridge
- Aspiration with one hand
- Autoclavable
- Rust resistant
- Long lasting with proper maintenance

The disadvantages are:

- Heavy weight
- May be too big size for small operators
- Possibility of infection with improper care.

A slight amount of aspiration may be achieved as follow:

Slight pressure on the piston produces a bulge in the rubber plunger. Which in turn exerts pressure on the solution in the cartridge, release of this produces suction. If the needle tip is in a blood vessel, a thin spiral of blood which rapidly diffuses will be seen in the solution.

Pressure syringes introduced in the late 1970, pressure syringes brought about a renewed interest in the periodontal ligament injection and also called intraligamentary injection technique.

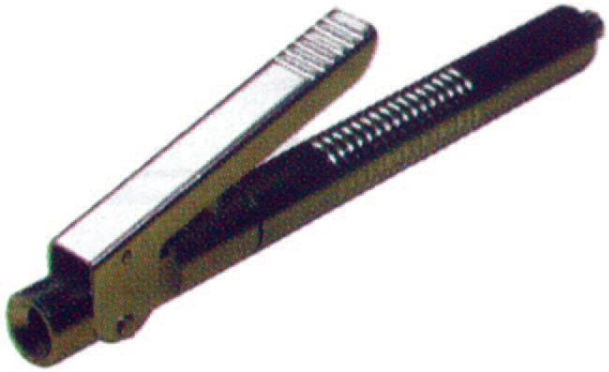
The 1st generation devices, using a pistol grip, are somewhat larger than the newer pen grip devices.

The advantages are:

- Measured dose
- Overcomes tissue resistance
- Cartridge protected

The disadvantages are:

- Cost
- Easy to inject too rapidly



Used for performing Periodontal Ligament (PDL) injections

- Compact and extremely durable
- Pen-style activator
- Injects only 0.06 ml of local anesthetic solution with each click of the activator level

Jet injector the primary uses to obtain topical anaesthesia prior to the insertion of a needle. In addition, it may be used to obtain mucosal anaesthesia of the palate.

The advantages are:

- Dose not require use of a needle
- Delivers very small volumes of local anaesthetic solution
- Used in topical anaesthesia

The disadvantages are:

- Inadequate for pulpal or regional block
- Some patients are disturbed by jet injection
- Cost
- May damage periodontal tissues

Care and handling

- The recommendations concerning care of the syringes as following:

1. After each use thoroughly wash and rinse the syringe free of any local anaesthetic solution, saliva, or other foreign matter. Autoclave the syringe in the same manner as other surgical instruments.

2. After every five autoclaving's, dismantle the syringe and lightly lubricate all threaded joints and where the piston contacts the thumb ring and guide bearing.

3. Clean the harpoon with a brush after each use.

Clinical problems

- Leakage during injection: When reloading a syringe with a second local anaesthetic cartridge and a needle already in place. One should be sure that the needle penetrates the center of the rubber diaphragm. An off-centre perforation will produce an ovoid puncture of the diaphragm that permits leakage of the anaesthetic solution around the outside of the metal needle and into the patient's mouth.

- Broken cartridge: A badly worn syringe may damage the cartridge, leading to breakage. This can result from a bent needle at its proximal end may not perforate the diaphragm on the cartridge. Positive pressure on the thumb ring increases intra-cartridge pressure, which can cause the cartridge to break.

The needle

The needle permits the local anaesthetic solution to travel from the cartridge into the tissues surrounding the needle tip. Most needles used in dentistry are stainless steel and are disposable.

Parts all needles have several components which include:

- The bevel: is long, medium, and short.
- The shank or shaft: the needle gauge and length.
- The hub: is the plastic or metal piece through which the needle attaches the syringe.
- The syringe adaptor: the interior surface of the needle
- The syringe penetrating end: is placed into the needle adaptor and perforates the rubber diaphragm of the cartridge.

the needles used in dental surgery, range from 24, 25, 27 and 30-gauges; and from 25 mm to 38-40 mm in length

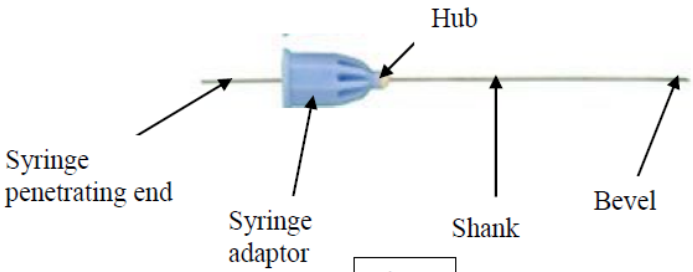
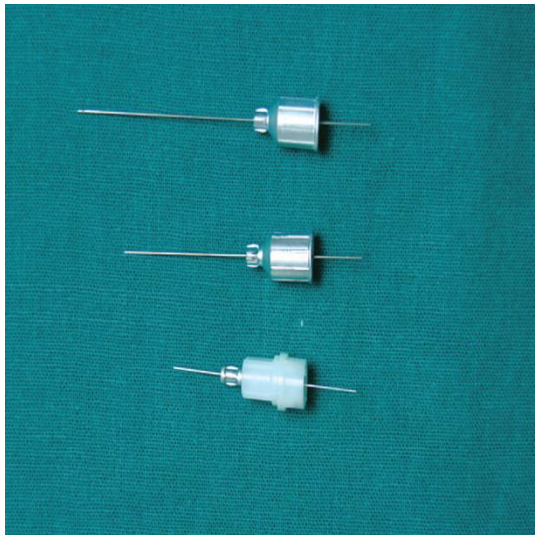


Fig. 8

Needles in dental practice are made up of stainless steel,

is most commonly used and is highly recommended.

Needles currently available are usually pre-sterilized and disposable



When needles are selected for use in various injection technique, there are two factors must be considered which are:

- The gauge: Gauge refers to the diameter of the lumen of the needle; the smaller the number the greater the diameter of the lumen. A 30 gauge needle has a smaller internal diameter than a 25 gauge needle. The smaller diameter needles are less traumatic to the patient than needles with larges diameter. The most commonly used needles in dentistry are 25, 27, and 30 gauge

- Length:: Dental needles are available in two lengths: long approximately 40mm and short approximately 25mm. Needles should not be inserted into tissues to their hub unless it is absolutely necessary for the success of the injection. There are several reasons for this rule: needle breakage. **The weakest portion of the needle is at the hub so that the needle breakage occurs.** Long needles are preferred for all injection techniques requiring penetration of significant thicknesses of soft tissue.

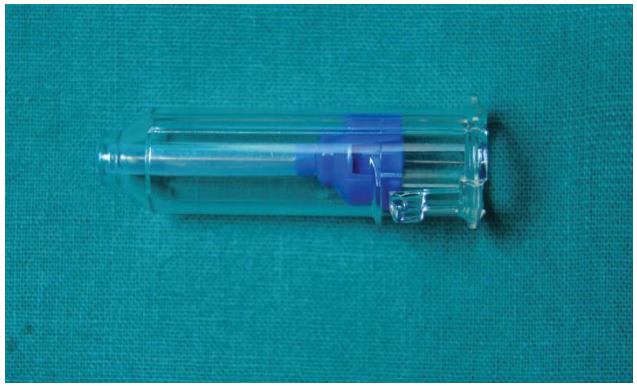
Care and handling

1. Needles must never be used on more than one patient.

2. Needles should be changed after three or four tissue penetration in same patient.

3. Needles should be covered with a protective sheath when not being used.

4. Needles must be properly disposed of after use.



Clinical problems

- Pain on insertion: The used of a dull needle can lead to pain on initial penetration of the mucosa. This may be avoided by using sharp, new, disposable needles and the application of topical anaesthetic at the penetration site.

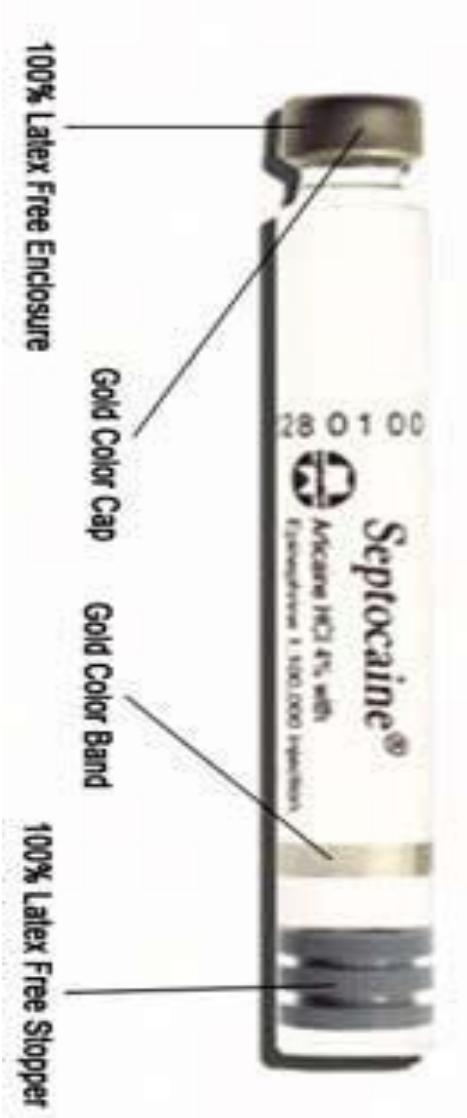
- Breakage: Bending weakens needles making them more likely to break on subsequent contact with hard tissues such as bone. Never attempt to force a needle against resistance. Smaller gauge needles are more likely to break than larger gauge needles.
- Pain on withdrawal: Pain on withdrawal is more likely that they occur when the needle tip forcefully contacts a hard surface as bone, therefore a needle should never be forced against resistance.

- Injury to the patient or administrator: A major cause is carelessness and inattention by the administrator, although sudden unexpected movement by the patient is also a frequent cause. The needle should remain capped until is to be used and should be made safe immediately after withdrawal from the mouth.

The cartridge (carpule) The dental cartridge is a glass cylinder containing the local anaesthetic drug. The glass cylinder itself can hold either 1.8ml, 2ml, or 2.2ml. The dental cartridge is by common usage, referred to as **a carpule** by dentist.

The prefilled dental cartridge consists of four parts are:

- **Cylindrical glass tube**
- **Stopper:** is located at the end of the cartridge that receives the harpoon of the aspirating syringe. The stopper was mixed with paraffin wax to produce an airtight seal against the glass walls of the cartridge. Glycerine was added in channels around the stopper as lubricant. Today the stopper treated by silicone, eliminating both the paraffin and the glycerine.
- **Aluminum cap:** is located at the opposite end of the cartridge from the rubber plunger. It fits around the neck of the glass cartridge holding the diaphragm in position.
- **Diaphragm:** is a semipermeable membrane, usually latex rubber through which the cartridge end of the needle penetrates. The perforation of the needle is centrically located and round forming a tight seal around the needle.



Cartridge contents

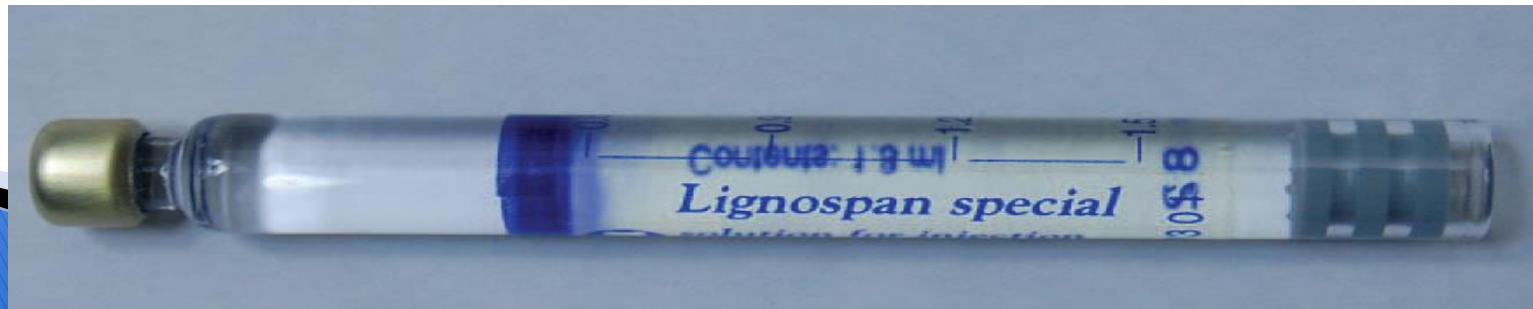
The solution contained within the dental cartridge are:

- Local anaesthetic drug: the drugs contained within the cartridge are listed by their percent concentration. The number of milligrams of the agent can be calculated by multiplying the percent concentration(e.g. 2% = 20mg/ml) so a 1.8 ml cartridge of a 2% solution contains 36 mg.

- A vasopressor drug is included in some anaesthetic cartridges to increase the safety and the duration of action of the local anaesthetic. Cartridges containing vasopressor also contain a chemical that serves as an antioxidant most frequently used sodium bisulfite.

- Sodium chloride: is added to the contents of the cartridge to make the solution isotonic with the tissue of the body.

- Distilled water: is used as the diluent to provide the volume of solution in the cartridge



Care and handling

- Cartridge should be stored at room temperature .
- Cartridge should be not used after their expiry date.
- Cartridge should be listed by their percent concentration.

Clinical problems

- Bubble in the cartridge: A small bubble of approximately 1-2 mm diameter will frequently be found in the dental cartridge. It is composed of nitrogen gas which was bubbled into the local anaesthetic solution during manufacture to prevent oxygen from being trapped in the cartridge and potentially destroying the vasopressor. A large bubble which may be present with a plunger that is extruded beyond the rim of the cartridge, is the result of the freezing of the anaesthetic solution, such cartridges should not be used, since sterility of the solution cannot be assured.

- Extruded stopper: The stopper can be extruded when a cartridge is frozen and the liquid inside expands. In this case the solution can no longer be considered sterile and should not be used for injection. Frozen cartridges can be identified by the presence of a large air babble more than 2mm by the extruded stopper. An extruded stopper without bubble is indicative of prolonged storage in a chemical disinfecting solution and diffusion of the solution into the cartridge.

Burning on injection: A burning sensation on injection of anesthetic solution may be the result of one of the following:

- Normal response to pH of the drug: The pH of the dental cartridge containing vasopressor is lower (3.3-4) than that without vasopressor (5.5-6), so the plain anaesthetics have a somewhat more rapid onset of clinical action and more comfortable.
- In addition the inclusion of sodium bisulfite as antioxidant into the anaesthetic solution to prevent the biodegradation of the vasopressor by oxygen which might be present in the cartridge during manufacture or which can diffuse through the semipermeable diaphragm after tilting, reacts with oxygen before the oxygen can destroy the vasopressor.

2. Cartridge containing sterilizing solution
3. overheated cartridge
4. cartridge containing a vasopressor

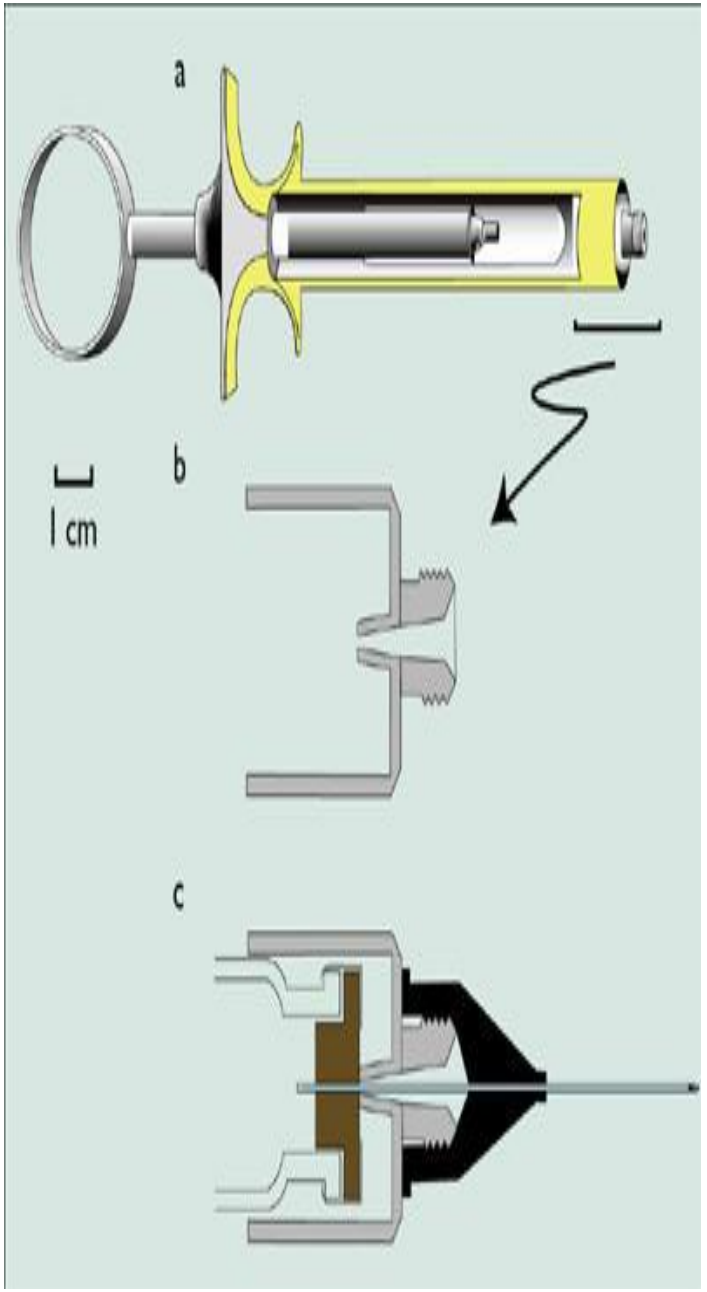
- Leakage during injection
- Broken cartridge

Preparation of the armamentarium

Proper care and handling of the local anaesthetic armamentarium can prevent or at least minimize the development of complications associated with the syringe, needle, and cartridge.

Step of the preparation:

1. Remove the sterilized syringe from its container.
2. Retract the piston fully prior to attempting to load the cartridge.
3. Insert the cartridge while the piston is fully retracted into the syringe, insert the rubber stopper end of the cartridge.
4. Engage the hook push the piston forward until the hook is firmly engaged in the plunger.
5. Attach the needle to the syringe after removal of the plastic cap from the syringe end of the needle.
6. Carefully, remove the plastic protective cap from the opposite end of the needle and expel a few drops of solution to test for proper flow.
7. The syringe is now ready for use.



Additional armamentarium

- Topical antiseptic: Such as 5% Betadine, Povidone-iodine
- Topical anesthetic: Such as 2% Lidocaine jelly, or 5% Benzocaine, ointment (Mucopain).
- Applicator sticks.
- Cotton/gauze.
- Hemostat: To remove needle from the soft tissue in the event of needle breakage.
- Small stainless steel bowls.
- Cartridge dispenser and warmer

Local anesthesia in Oral Surgery

by
Dr. Elham H. Abdulkareem

Lecture 1

2020-2021

Table 1.2: Timewise development of various local anesthetic agents

Year	*Esters*	*Amides*	*Discoverer*
1905	Procaine		Alfred Einhorn
1943		Lidocaine	Nils Lofgren
1948			Applied in clinical practice
1952	Propoxycaine		Clinton and Laskowsky
1953		Prilocaine	Prepared by Lofgren and Tegner
1956-57		Mepivacaine	Prepared by AF Ekenstam
1960			Introduced in dentistry
1957		Bupivacaine	AF Ekenstam
1969		Articaine	H Rusching et al
1971		Etidocaine	Takman

There are two methods for obtaining anesthesia in dentistry, local and general.

- **Local anesthesia:** It is a method, whereby a certain operative area is made insensitive to pain, without loss of consciousness.

The sensory or the efferent nerves are blocked at the periphery or at any point between operative field and the center in the brain.

- **General anesthesia:** It is a method, whereby a certain operative area is rendered insensitive to pain, with loss of consciousness, by blocking brain function.

"Anesthesia" means loss of all forms of sensation including pain, touch, temperature and pressure perception and may be accompanied by impairment of motor function.

Another term "analgesia" is used to denote loss of sensation unaccompanied by loss of other forms of sensation.

As a general rule, a larger dose of the agent is required to obtain anesthesia than to obtain analgesia. When only a part of the body is involved then the terms "local analgesia" and "local anesthesia" are used.

FACTORS AFFECTING NERVE CONDUCTION

Diffusion of Solution

Local anesthetic agents are alkaloid bases, which are combined with acids, usually hydrochloric acid, to form water-soluble salts. All local anesthetic salts are formed by a combination of a weak base and a strong acid

- The purpose of using salts is to render the salts stable and soluble in water. Water solubility is necessary for their diffusion through the interstitial fluids to the nerve fiber

Injection of Local Anesthetic Agents Close to the Nerve Membrane

For maximum action, the anesthetic agent, should be injected sufficiently close to the target nerve, so that adequate concentration is available for diffusion into the nerve.

pH of the Tissue

The presence of a low pH, as in areas of infection (pH of pus is 5.5 to 5.6); may interfere with achieving adequate anesthesia by preventing deprotonization and liberation of the free base.

Lipid Solubility and Protein Binding

- Higher the lipid solubility and percentage of protein binding, more rapid and long lasting are the effects.

- The addition of a butyl group to procaine results in the formation of tetracaine, an agent having 16 times the anesthetic activity and 4 times the duration of the compound.

Type of Nerve

- The myelinated nerves usually require a greater concentration of local anesthetic solution. These nerves also require more time for blocking them.

- The non-myelinated nerve-fibers require lesser concentration and lesser time.

Size of Nerve

The larger the diameter of nerve fiber, the greater is the concentration required to prevent impulse conduction.

Since pain is the only modality of sensation in the tooth, all sensations are adequately eliminated when pain fibers are anesthetised.

Analgesia is produced as a result of blockage of afferent transmission,

whereas **relaxation of skeletal muscles** and inhibition of autonomic innervated structures cause blockade from afferent transmission.

Presence of a Vasoconstrictor

Local anesthetic solutions containing a vasoconstrictor are less absorbed than those without a vasoconstrictor. The solution which are rapidly absorbed into cardiovascular system, there is less likelihood of developing an adequate block anesthesia.

Injection into a Vascular Area

A local anesthetic solution injected into a highly vascular area is rapidly absorbed in cardiovascular system. The rapid absorption reduces the effective concentration in the vicinity of the nerve and causes a rapid termination of analgesia.

Presence of Infection

Infection reduces alkalinity of tissues which retards the deprotonization of local anesthetic agents. This prevents liberation of free alkaloid base, which is necessary for the development of effective analgesia.

The effectiveness of local anesthetic agents depends on the following:

1. The chemical nature of the drug used.

2. The concentration of the drug used.

3. The volume of solution injected.

4. The rate of diffusion of both the anesthetic salt and the free base.

5. Addition of vasoconstrictor. It influences the time during which the free base remains in contact with the nerve.

Indications

In general, local anesthesia is used to render the teeth and supporting structures insensitive to painful procedures. Specifically, it is used for the following:

Oral Surgery

1. To make needle insertion painless
2. Extraction of teeth and fractured roots
3. Odontectomy
4. Treatment of alveolalgia
5. Alveolectomy
6. Apicoectomy
7. Incision and drainage of localised abscesses
8. Removal of cysts, residual infection areas, hypertrophic tissues and neoplastic growths, Ranula and salivary calculi
9. In the treatment of tic douloureux by producing prolonged anesthesia with a combination of a local anesthetic agent and alcohol injection, for blocking the involved nerve.
10. A therapeutic test to localise the source of vague pain about the face.

Tic douloureux or trigeminal neuralgia is a severe, stabbing pain to one side of the face.

Conservative Dentistry

The following operative and restorative procedures:

i. Cavity preparation

ii. Crown and bridge abutment preparation

iii. Pulpotomy or pulpectomy.

Periodontology

i. Surgical treatment of periodontal diseases

ii. Deep scaling and prophylaxis treatment

iii. Mucogingival surgical procedures.

Prosthodontics

Giving denture patients relief from sore spots which are painful even though dentures have been relieved.

Orthodontia

Separation of teeth.

Radiology

To prevent gagging and retching caused by the contact of film with palatal tissues and posterior part of oral cavity. These tissues or the areas are anesthetised before placing the film. In these cases usually surface anesthesia is used.

CONTRAINDICATIONS

These can be divided into two groups:

(a) Absolute contraindications, and (b) Relative contraindications

Absolute Contraindications

History of Allergy to Local Anesthetic Agents

Local anesthetic agents belonging to the same chemical group should not be used. However, local anesthetic agents in the different chemical group can be used.

In case, a patient gives history of allergy to an amide local anesthetic agent, an ester local anesthetic agent can be used.

History of allergy to any of the constituents of the local anesthetic solution.

- **Bisulfites,** in the form of **Sodium-bisulfite** and **sodium-metabisulfite** are used as anti-oxidants or as preservatives to the vasoconstrictor in the local anesthetic solutions.

- Other general preservatives present in the local anesthetic solution **include thymol, methylparaben, and chlorbutol**.

- The solution containing the constituent should be avoided.
- An alternate solution should be used, if possible.

Relative Contraindications

1. Fear and apprehension: Where the patient is uncooperative or refuses for regional analgesia.

2. Presence of acute inflammation or suppurative infection at the site of insertion of the needle: There are increased chances of dissemination of infection with the passage of the needle from the abscess area to the deeper tissues.

3. Infants or small children: These patients lack reasoning and understanding.

4. Mentally retarded patients: These patients are unable to cooperate.

5. Restricted mouth opening: When the patient cannot open his mouth sufficiently, in situations, such as (i) trismus, or (ii) partial or complete ankylosis of temporomandibular joint.

6. Patients with significant medical disease: (a) cardiovascular disease, (b) hepatic dysfunction, (c) renal dysfunction, and (d) clinical hyperthyroidism.

a. Patients with significant cardiovascular disease: All local anesthetic
solutions containing high concentrations of vasoconstrictor, such as epinephrine, as in gingival retraction cords, should be avoided.

Local anesthetic agents containing higher dilution of epinephrine, such as 1:100 000 or 1:200 000, or 3% mepivacaine or 4% prilocaine can be used (for nerve blocks).

b. Patients with significant hepatic dysfunction: All local anesthetic agents belonging to amide group undergo biotransformation in liver (fixed function oxidases). These agents are best avoided, if not, should be used judiciously.

c. Patients with significant renal dysfunction: All amides and esters should be avoided, however, these can be used judiciously.

d. Patients with clinical hyperthyroidism: High concentrations of vasoconstrictor, as in epinephrine gingival retraction cords, should be avoided. Local anesthetic agents containing higher dilutions of epinephrine such as 1:100 000 or 1:200 000, or 3% mepivacaine or 4% prilocaine (nerve blocks) can be used.

7. Major surgical procedures

8. Presence of certain anomalies or developmental defects: These situations make regional analgesia difficult or impossible.

9. Presence of congenital Methemoglobinemia: It can be idiopathic or congenital.

a. **Articaine and prilocaine** when used in large doses, can produce Methemoglobinemia (Bellamy et al, 1992). These two drugs should be avoided in patients with congenital Methemoglobinemia, and other clinical syndromes with reduced O_2 carrying capacity of blood; because, there is increased risk of producing clinically significant Methemoglobinemia. These agents may be administered, if absolutely necessary; however, their dose should be minimised. The maximum recommended dose of prilocaine is 8 mg/kg body weight.

Methemoglobinemia is less likely to occur at lower doses. **Alternatively, local anesthetic agents belonging to other groups both amides or esters can be used.**

b. **Benzocaine**, a topical local anesthetic agent, when used in very large doses can also induce methemoglobinemia (Guertler and Pearce, 1994; and Rodriguez et al, 1994).

10. Presence of atypical plasma cholinesterase:

- **Cholinesterase, is an enzyme, present in plasma, and is required for biotransformation of all esters by causing hydrolysis.**

- These agents undergo biotransformation (hydrolysis) in the blood by the enzyme plasma cholinesterase, which is produced in the liver.

- In such situations, it is preferable to use an amide type of local anesthetic agent. Amides do not present any risk of high blood levels, because these agents undergo biotransformation in the liver.

ADVANTAGES

1. Patient remains awake and cooperative.
2. Little distortion of normal physiology; therefore can be used in poor risk patients.
3. Low incidence of morbidity.
4. Patient can leave hospital unescorted.
5. Additional trained personnel not required.
6. Technique not difficult to master.
7. Percentage of failure is small.
8. No additional expense to the patient.
9. Patient need not miss the previous meal. In fact, should have one. Patients should not come on empty stomach.

DISADVANTAGES

- No true disadvantage to the use of regional analgesia; when the patient is mentally prepared and when there are no contraindications.

- In every instance, when satisfactory anesthesia can be achieved and the patient is cooperative, regional analgesia is the method of choice.

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Local Anesthetic Agents

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2020-2021

PROPERTIES OF AN IDEAL LOCAL ANESTHETIC AGENT

The properties that are desirable in a local anesthetic solution are as follows:

1. It should be non-irritating and produce no local reaction to the tissues to which it is applied.

2. It should not cause any permanent change in the nerve structure.

3. It should cause minimal systemic toxicity.

4. It must be effective when injected into the tissues and should have sufficient penetrating properties to be effective as a topical anesthetic, when applied topically to the mucous membrane.

5. It should have a short time of onset, if possible.

6. The duration of action must be long enough to allow completion of procedure.

Bennett (1974) has added some properties which are as follows:

1. It should have enough potency to give complete anesthesia without the use of harmful concentrated solutions.

2. It should be relatively free from producing allergic reactions.

3. It should be stable in solution and readily undergo biotransformation in the body.

4. It should either be sterile or be capable of being sterilized by heat without deterioration.

CLASSIFICATIONS

The local anesthetic agents can be classified in various ways.

On the Basis of Occurrence in Nature

1. Naturally occurring, e.g. cocaine
2. Synthetic compounds

Freely soluble, e.g. procaine

Poorly soluble, e.g. benzocaine

3. Miscellaneous drugs with local anesthetic action, e.g. clove oil, phenol, chlorpromazine, certain antihistaminics such as diphenhydramine.

On the Basis of Chemical Structure

Esters

These can be further classified as:

i. Esters of benzoic acid, e.g. cocaine, benzocaine (ethylaminobenzoate), and butacaine.

ii. Esters of para-aminobenzoic acid, e.g. procaine, chloroprocaine, and propoxycaine.

Amides

For example, articaine, bupivacaine, lidocaine, mepivacaine, and prilocaine.

On the Basis of Duration of Action

a. *Short-acting:* Articaine, lidocaine, mepivacaine, prilocaine, etc.

b. *Long-acting:* Bupivacaine, etidocaine, bucricaine, etc.

Lignocaine (lidocaine, xylocaine, octocaine, dentocaine)

It is the most commonly used local anesthetic agent in dentistry.

Chemistry

- It is an amide.
- It is stable, as it can be stored for a long time at room temperature.
- It withstands boiling and autoclaving.
- It is compatible with all types of vasoconstrictors.

Biotransformation

Lidocaine undergoes biotransformation in liver.

a. *Metabolism:* It is metabolised in liver by microsomal fixed-function oxidases.
b. *Excretion:* Lidocaine and its breakdown products are excreted to some extent in urine, by kidney/
Potency: 2 times as potent as procaine. Today, it is taken as the standard for comparison of various other local anesthetic agents.
Toxicity: 2 times as toxic as procaine.
Time of onset of action: Rapid (2-3 minutes).
Duration of action: It depends upon:
i. Type of injection: Nerve block has longer duration than infiltration.
ii. Amount of vasoconstrictor used in the solution.

Effective dental concentration: 2%
Anesthetic half-life: 1.6 hours
Topical anesthetic action: It has topical anesthetic effect. It forms an excellent surface anesthetic. It is used in the following forms topically:

- 2% in the form of jelly
- 5% in the form of ointment
- 10% and 15% in the form of spray (aerosol).

Maximum Recommended Dose (MRD)

It is used in the concentration of 2%. It simply means 2 g of solute is contained in 100 ml of solution, which means 2000 mg of the solute are present in 100 ml of solution. Hence, it means 20 mg of the solute is contained in 1 ml of solution. In other words 1 ml of 2% lignocaine solution contains 20 mg of the local anesthetic agent (lignocaine).

the Maximum Recommended dose for lidocaine with or without a vasoconstrictor is 4.4 mg/kg body weight. The Maximum Recommended Doses are mentioned here as shown in Table 7.1, for individuals with their body weights ranging from 10 to 70 kg.

Table 7.1: The maximum recommended doses for various body wieghts

Body weight (kg)	*Dose (Body weight x 4.4) = mg*	*MRD (ml)*	*MRD (Cartridges) (approx)*
10	44	2.2	1.1
20	88	4.4	2.2
30	132	6.6	3.3
40	176	8.8	4.4
50	220	11	5.5
60	264	13.2	6.6
70	300	15.4	7.7

Availability in Dentistry

i. Dental cartridges: 2% lidocaine with epinephrine 1:80, 000 in India.
ii. Vials:
a. 2% lidocaine, without epinephrine (Lidocaine Plain)
b. 2% lidocaine with epinephrine 1:80,000, 1:100,000, and 1:200,000.

Toxicity

The deleterious effects of toxic doses on various systems are as follows:

Central Nervous System

The manifestations of stimulation vary from mild restlessness to severe convulsions. The depression is manifested as drowsiness to loss of consciousness.

Respiratory System

a. In small doses it causes mild bronchodilatation.
b. In large doses it causes respiratory arrest (apnea) (the most common cause of death related to overdose of local anesthetic agent). In majority of cases, respiratory arrest precedes cardiac arrest.

Cardiovascular System

The effects on cardiovascular system vary with the dose used.

a. *Moderately large doses:* It produces overall inhibition on the contractility of heart muscle, in the form of:

i. A decrease in the electrical excitability of myocardium.

ii. A decrease in the force of contraction (negative inotropic effect).

iii. A decrease in the rate of electrical impulse conduction (negative chronotropic effect).

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Table 7.6: Showing the comparison of various other local anesthetic agents

Properties	*Mepivacaine*	*Bupivacaine*	*Prilocaine*
Trade names	Scandonest, Polocaine, Carbocaine	Marcaine, Sensorcaine	Citanest, Citanest forte
Chemical structure	Amide, with N-methyl group at hydrophilic end	Amide, with a butyl group replacing ethyl group at hydrophilic end	Amide, a derivative of toluidine
Onset	1½ - 2 min	6-10 min	2-4 min
Duration of action	2-3 hr	6-8 hr	2-3 hr
Potency	Similar to lignocaine	4 times as potent as lignocaine	Similar to lignocaine
Toxicity	Similar to lignocaine	Similar to lignocaine	Lesser than lignocaine
Metabolism	By hepatic fixed-function oxidases	By hepatic amidases	By hepatic amidases
Excretion	Kidney	Kidney	Kidney
pH			
i. Plain solution	4.5	4.5-6.0	4.5
ii. Solution with vasoconstrictor	3.0-3.5	3.0-4.5	3.0-4.0
Effective dental concentration	2% with vasoconstrictor and 3% without vasoconstrictor	0.25% and 0.5%	3% and 4%
Anesthetic half-life	1.9 hours	2.7 hours	1.6 hours
Maximum recommended dose	6.6 mg/kg BW, not to exceed 400 mg	1.3 mg/kg BW, not to exceed 90 mg	6 mg/kg BW; not to exceed 400 mg
Contraindications			i. Patients with congenital or idiopathic methemoglobulinemia ii. Patients taking acetaminophen or phenacetin
Others uses		i. Spinal anesthesia, ii. Epidural anesthesia	

SELECTION OF LOCAL ANESTHETIC AGENTS

There are several anesthetic agents available for use in dentistry. The agents are selected on the basis of the needs of a particular patient.

1. Duration of action
2. Need for control of postoperative pain
3. Physical and mental status of the patient
4. Concomitant medications.

Duration of Action

It is an important aspect to be considered. An approximate duration for completing of the surgical procedure for which anesthesia is required, should be taken into account. The working time should be adequate. On the basis of duration of action, various local anesthetic agents may be arbitrarily grouped as follows:

1. Ultra-short acting agents: Where the duration of action is less than 30 minutes:

i. Procaine without a vasoconstrictor
ii. 2-chloroprocaine (1.2% or 3%) without a vasoconstrictor
iii. 2% lidocaine without a vasoconstrictor
iv. 4% prilocaine without a vasoconstrictor for infiltration.

2. *Short-acting agents:* Where the duration of action is 45 to 75 minutes.

i. 2% lidocaine with 1:100 000 epinephrine
ii. 2% mepivacaine with 1:200 000 levonordefrine

3. *Medium-acting agents:* Where the duration of action is 90 to 150 minutes:

4% prilocaine with 1:200,000 epinephrine

4. Long-acting agents: Where the duration of action is 180 minutes or longer.

0.5% bupivacaine with 1:200,000 epinephrine

Need for Control of Postoperative Pain

Most of the oral surgical procedures result in varying amount of postoperative pain. The local anesthetic agent serves as an additional medication that sometimes eliminates the need for postoperative analgesics. The local anesthetic agents that have shown to produce longer duration of analgesia even after the other sensations have returned are bupivacaine and etidocaine.

Physical, Medical and Mental Status of the Patient

- Any co-existing medical conditions, such as hypertension or diabetes mellitus should be considered.

- A patient with a history of allergy to a specific local anesthetic agent, or of any of the other components used along with the local anesthetic agents should be considered.
- Patients with a history of malignant hyperpyrexia, the use of amide derivatives is contraindicated.
- The mental status of the patients has to be evaluated. Small children and mentally challenged adults are sometimes fascinated with the numbness and the tingling sensation produced by the local anesthetic agents. These patients land up into traumatising their lip, tongue or cheeks intentionally or inadvertently. Hence for these reasons, the use of long acting local anesthetic agents is contraindicated in such patients.

Concomitant Medications

The use of vasoconstrictors is contraindicated in patients who are taking monoamino-oxidase (MAO) inhibitors, tricyclic (TCA) antidepressants, etc.