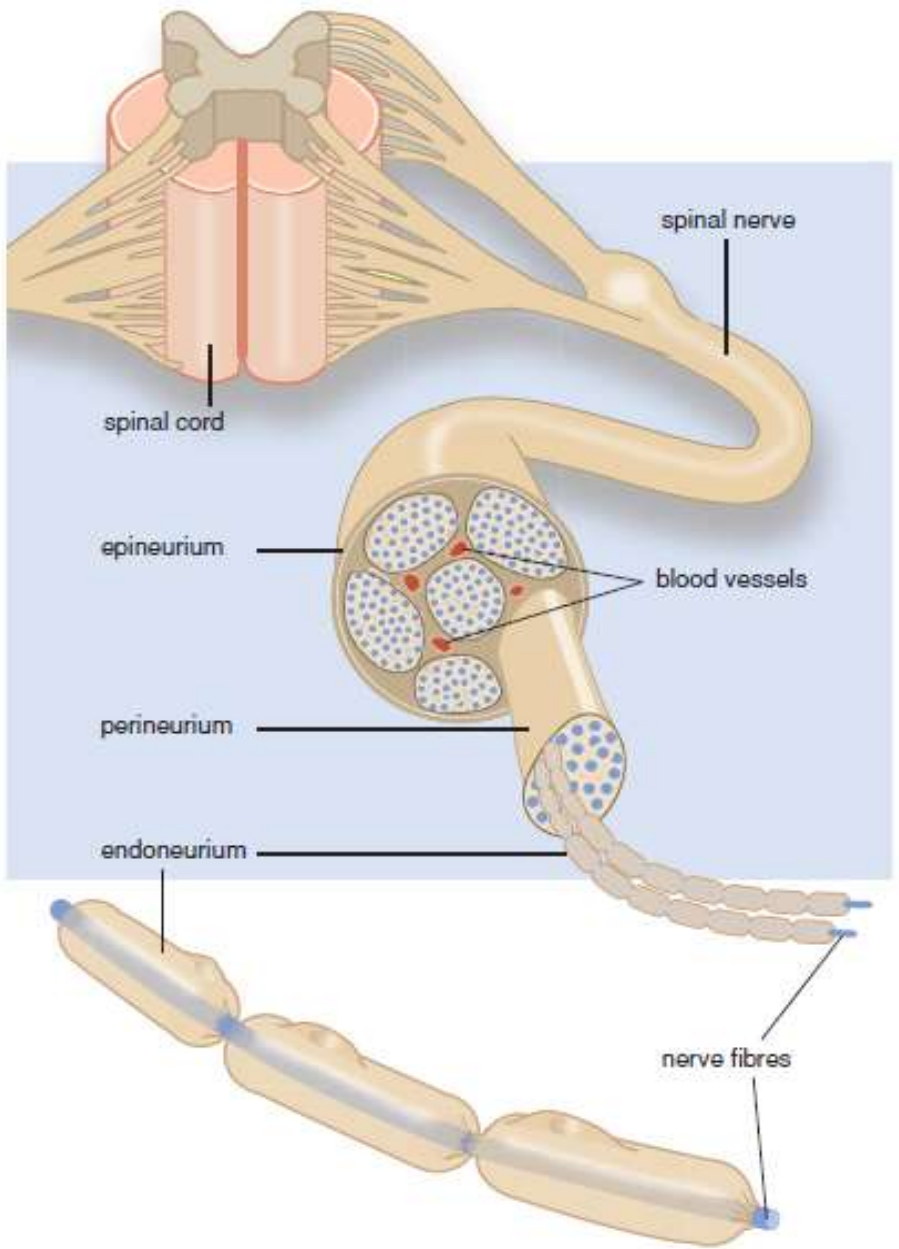
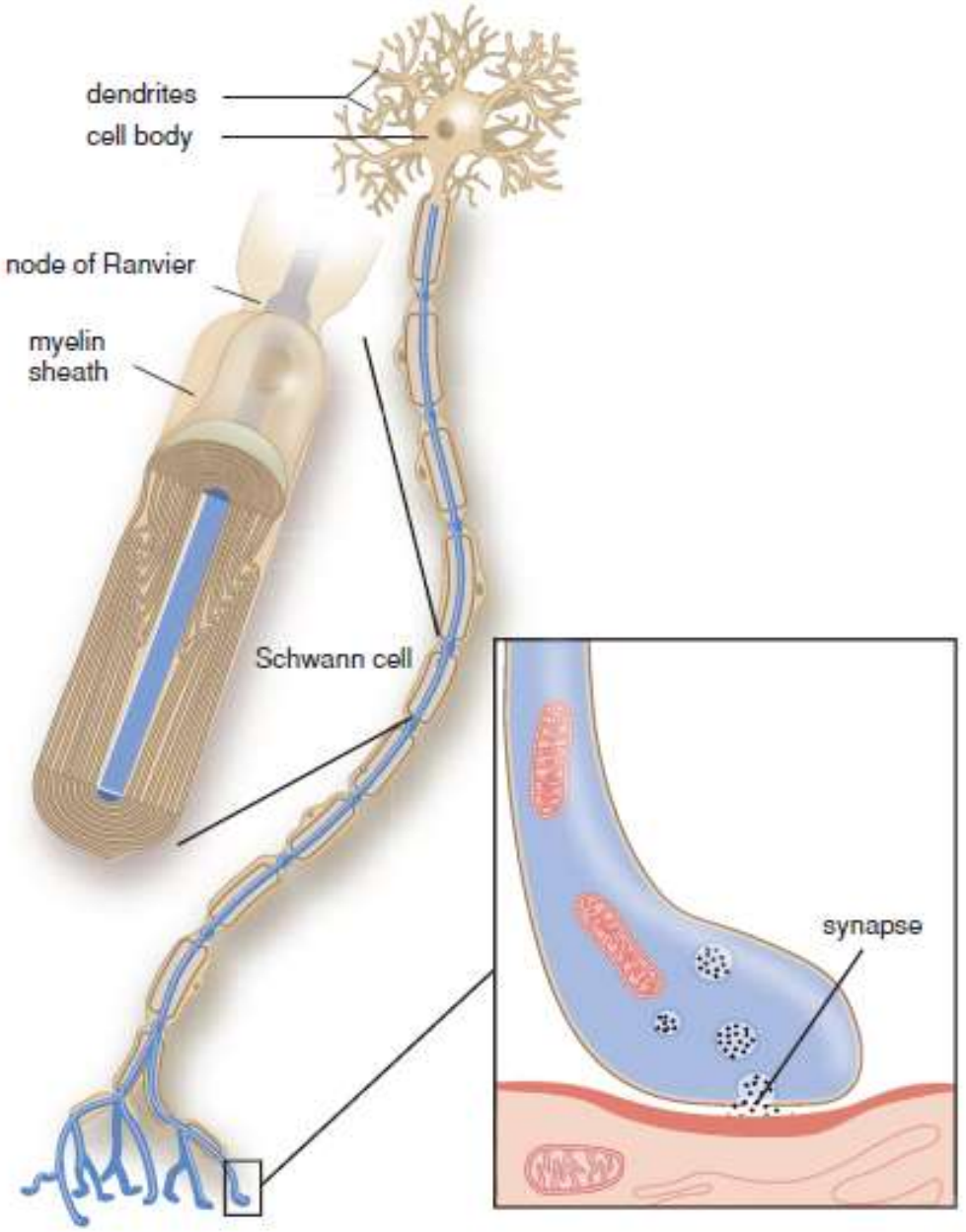
According to the World Health Organisation pain is defined as an ‘unpleasant sensation that occurs from imminent tissue damage’. From a physiological perspective, pain is a warning system. During dental treatment, patients will experience pain as something unpleasant.

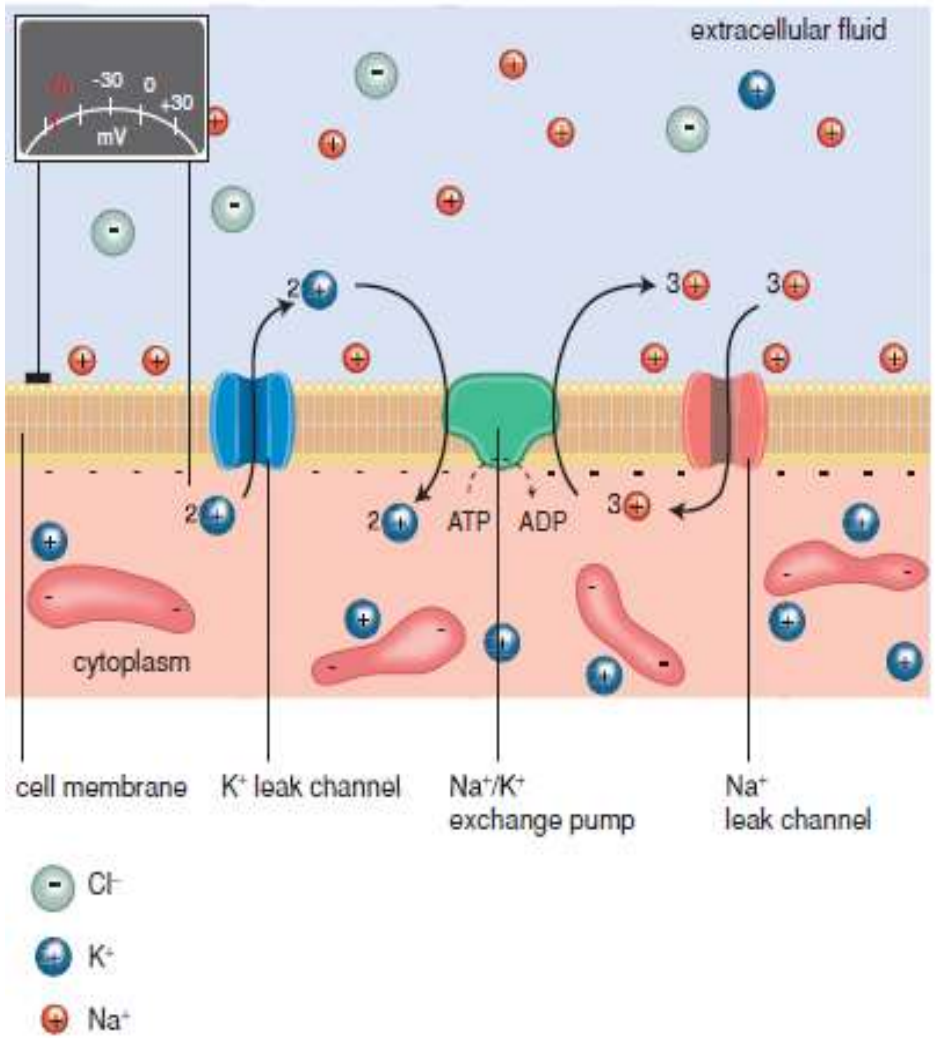
I. The structure of the peripheral nerve

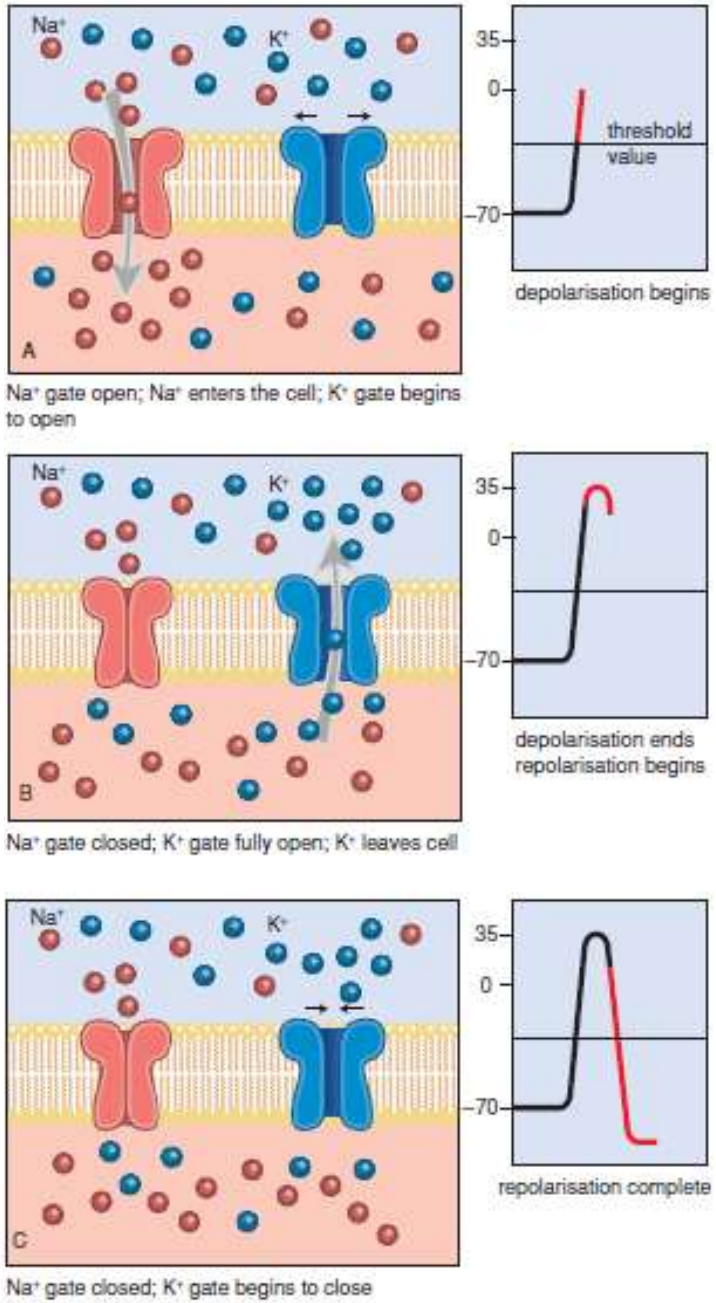


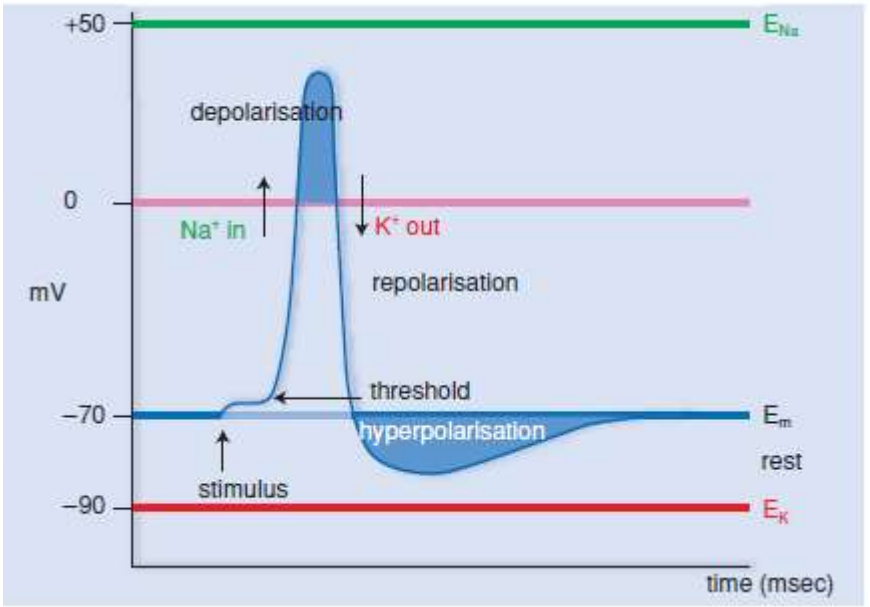


ELETROPHYSIOLOGY OF NERVE CONDUCTION

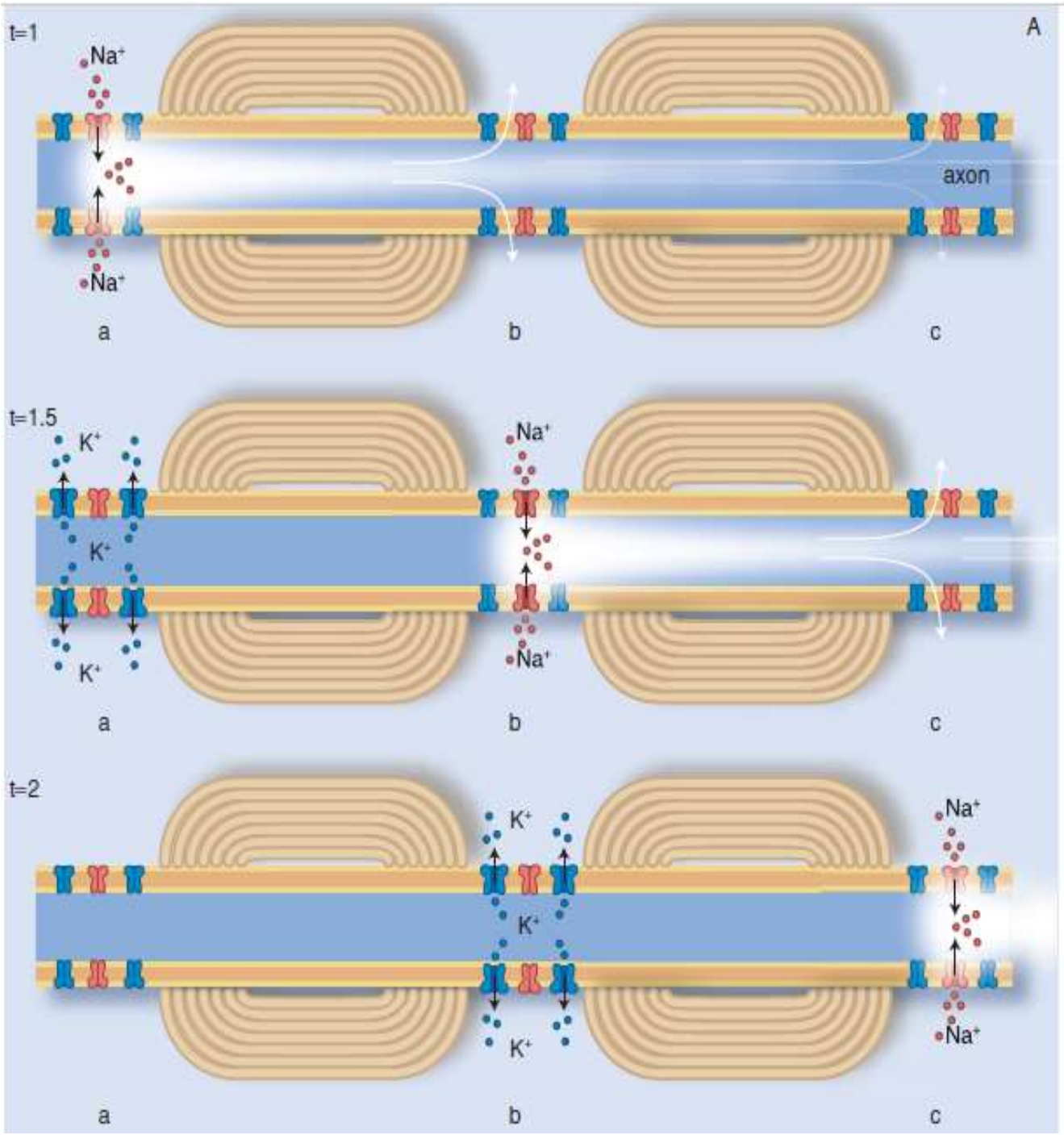
The impulse formation







Action potential



Impulse conduction

MYLINATED NERVES

SALTATORY CONDUCTION.

It is more rapid in thicker nerves because of increase in thickness of myelin sheath and increase in distance between adjacent nodes of Ranvier.

If conduction of impulse is blocked at one node the local current will skip over that node and prove adequate to raise that membrane potential at next node to its firing potential and produce depolarization.

Conduction rate of myelinated fibers is 120m/sec.

IMPULSE SPREAD

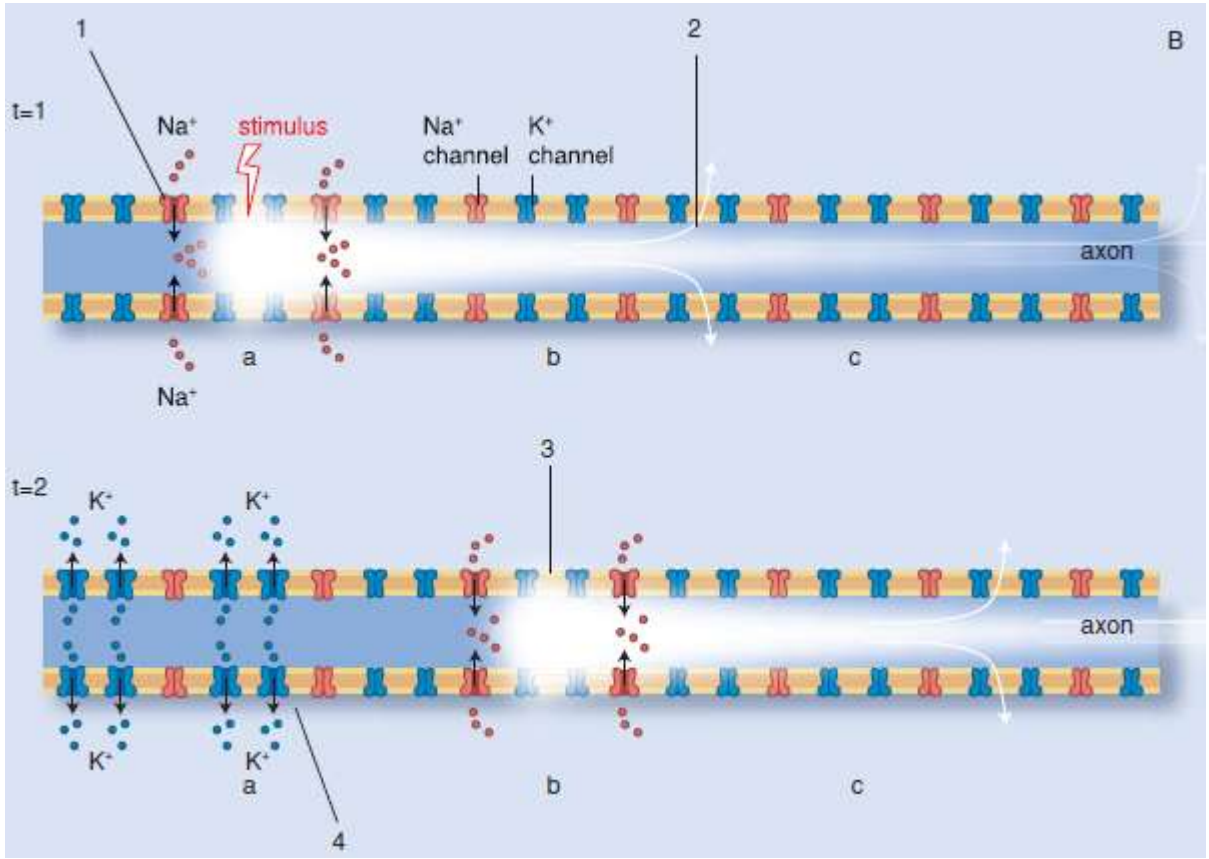
The propagated impulse travels along the nerve membrane towards CNS.

UNMYELINATED NERVES:

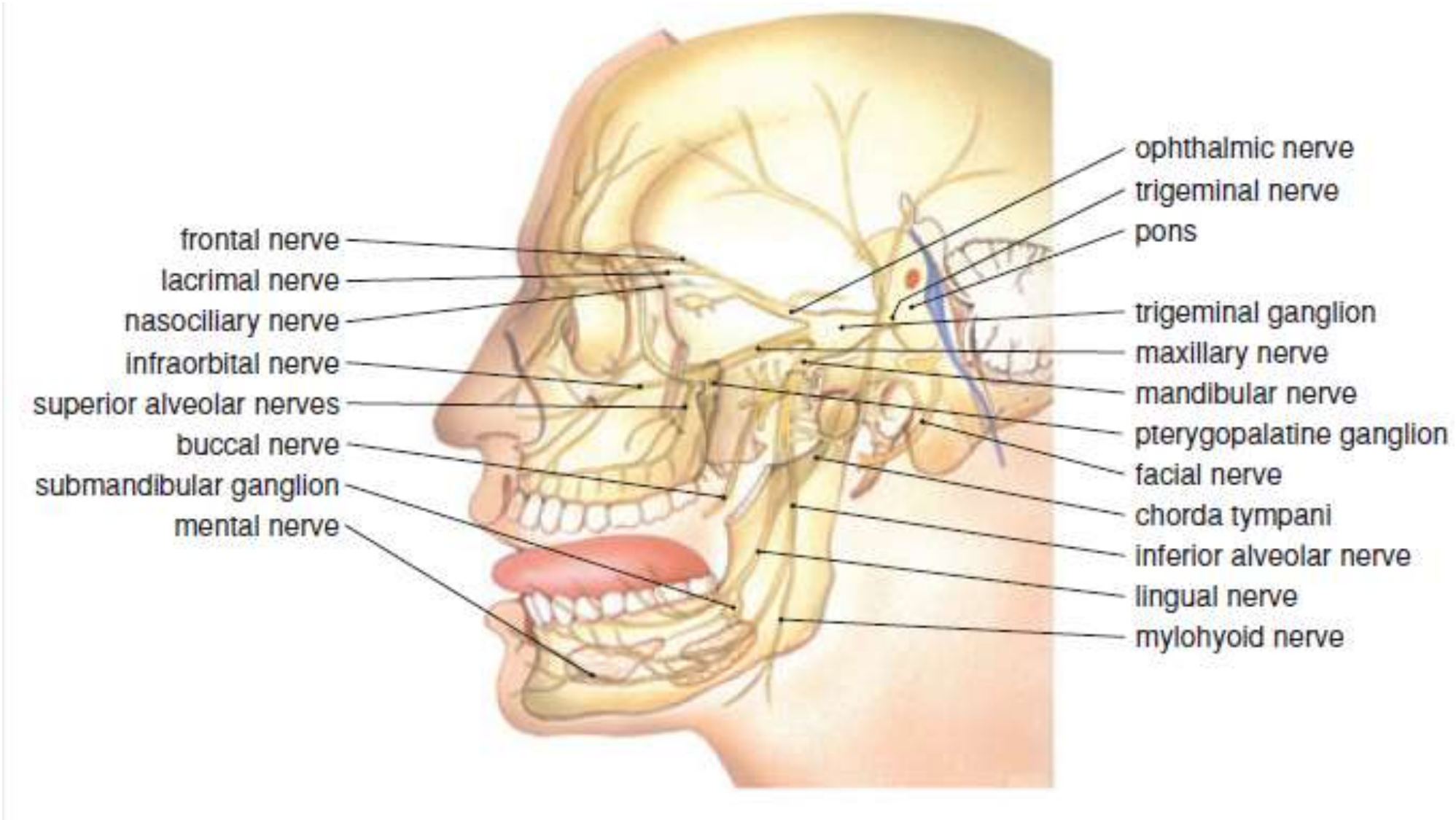
Continuous conduction

The spread of the impulse is characterized as a **slow forward-creeping process**.

Conduction rate is 1.2m/sec

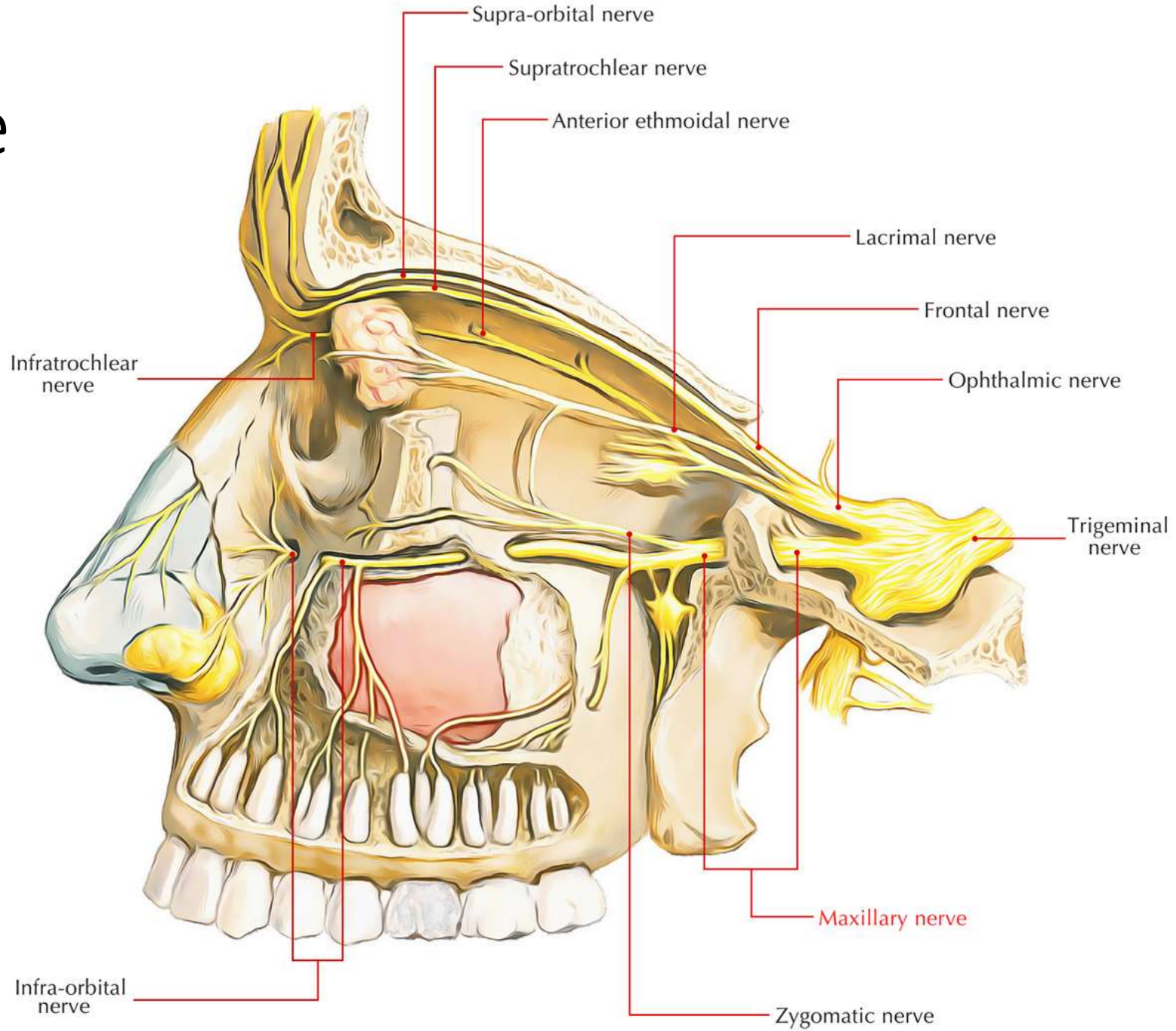


II. Anatomy of the Trigeminal nerve



Ophthalmic nerve

- **Nasociliary nerve**
  - ❖*Anterior ethmoidal*
  - ❖*Posterior ethmoidal*
- **Frontal nerve**
  - ❖*Supraorbital nerve*
  - ❖*Supratochlear nerve*
- **Lacrimal nerve**



Following are the branches of maxillary nerve

- In the **cranial cavity**: It gives **meningeal branch** which innervates duramater of the middle cranial fossa.
- In the **pterygopalatine fossa** it gives:
  - **2-3 ganglionic branches** to pterygopalatine ganglion (sensory fibers pass through the branches of perygopalatine ganglion to nasal cavity, palate, nasopharynx and orbit).
  - **Posterior superior alveolar nerves** which supply upper molar teeth and maxillary sinus.
  - **Zygomatic nerve** that divides into zygomaticotemporal and zygomaticofacial nerve and supply skin over the temporal region and over the zygomatic bone. **Zygomaticotemporal branch carries postganglionic parasympathetic fibers (secretomotor fibers) from pterygopalatine ganglion to the lacrimal branch of ophthalmic nerve** which supplies lacrimal gland.
  - **Infraorbital nerve** is the continuation of maxillary nerve. The infraorbital nerve gives following branches:
    - In the infra orbital canal:
      - **Middle superior alveolar** nerve- Innervates upper premolar teeth, gums and maxillary sinus.
      - **Anterior superior alveolar** nerve- Innervates upper canine and incisors, gums and maxillary sinus.
    - On the face:
      - **Palpebral branch** to lower eyelid.
      - **Nasal branch** to ala of nose.
      - **Labial branch** of upper lip.

Maxillary nerve

- **In the cranial cavity**

❖*Meningeal branch*

- **In the pterygopalatine fossa**

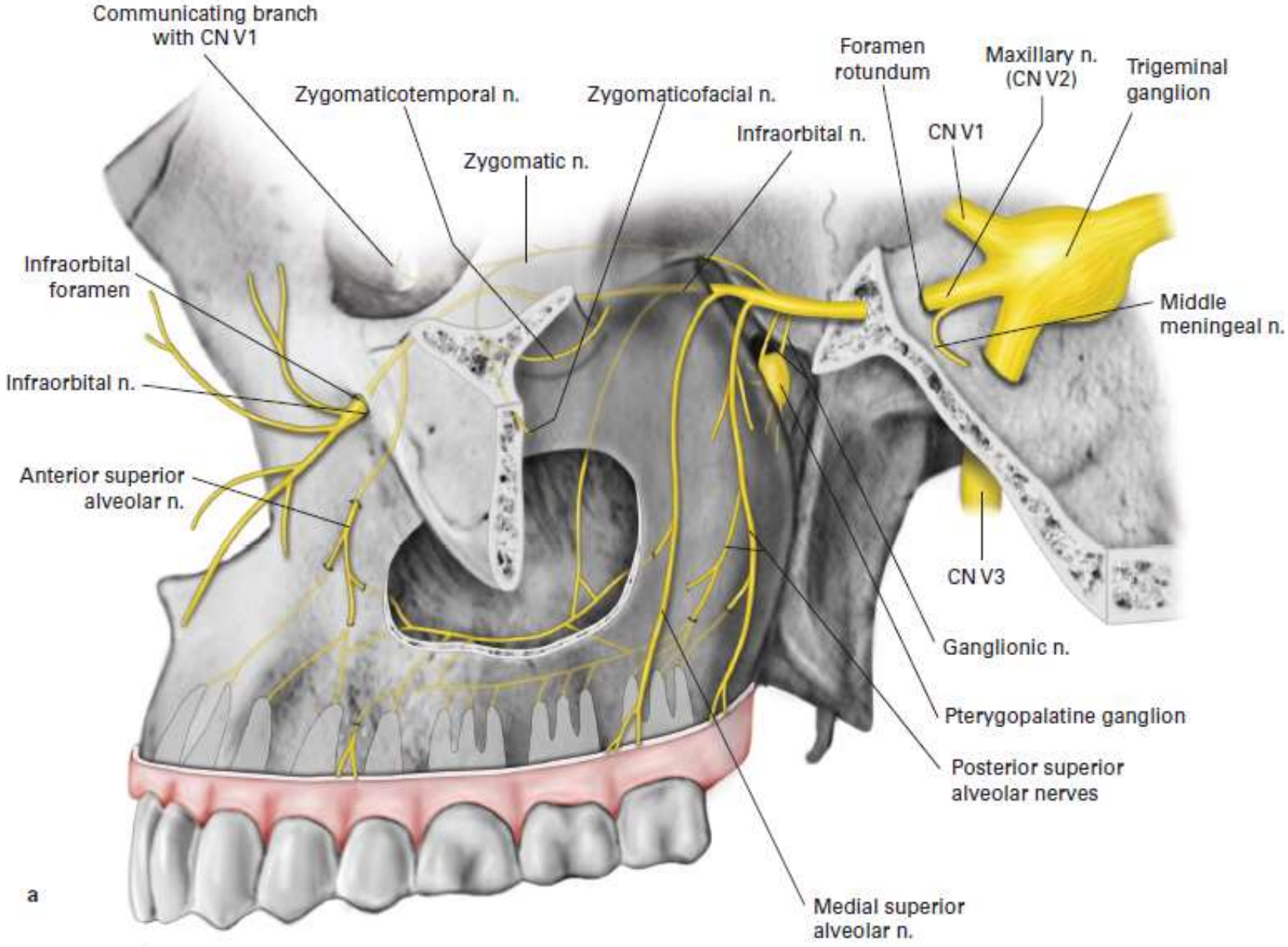
❖*2-3 ganglionic branches*

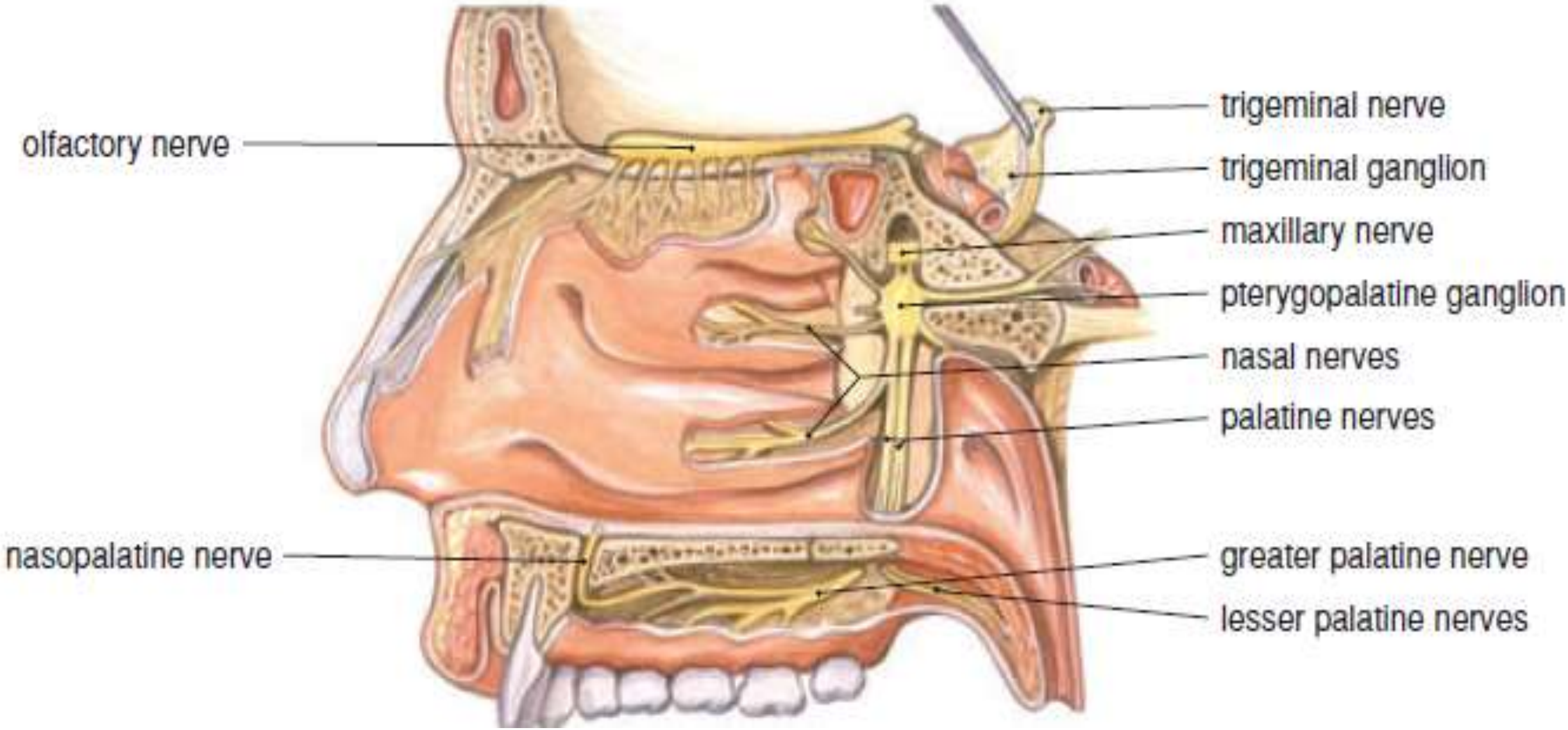
❖*Superior posterior alveolar br.*

❖*Zygomatic branch*

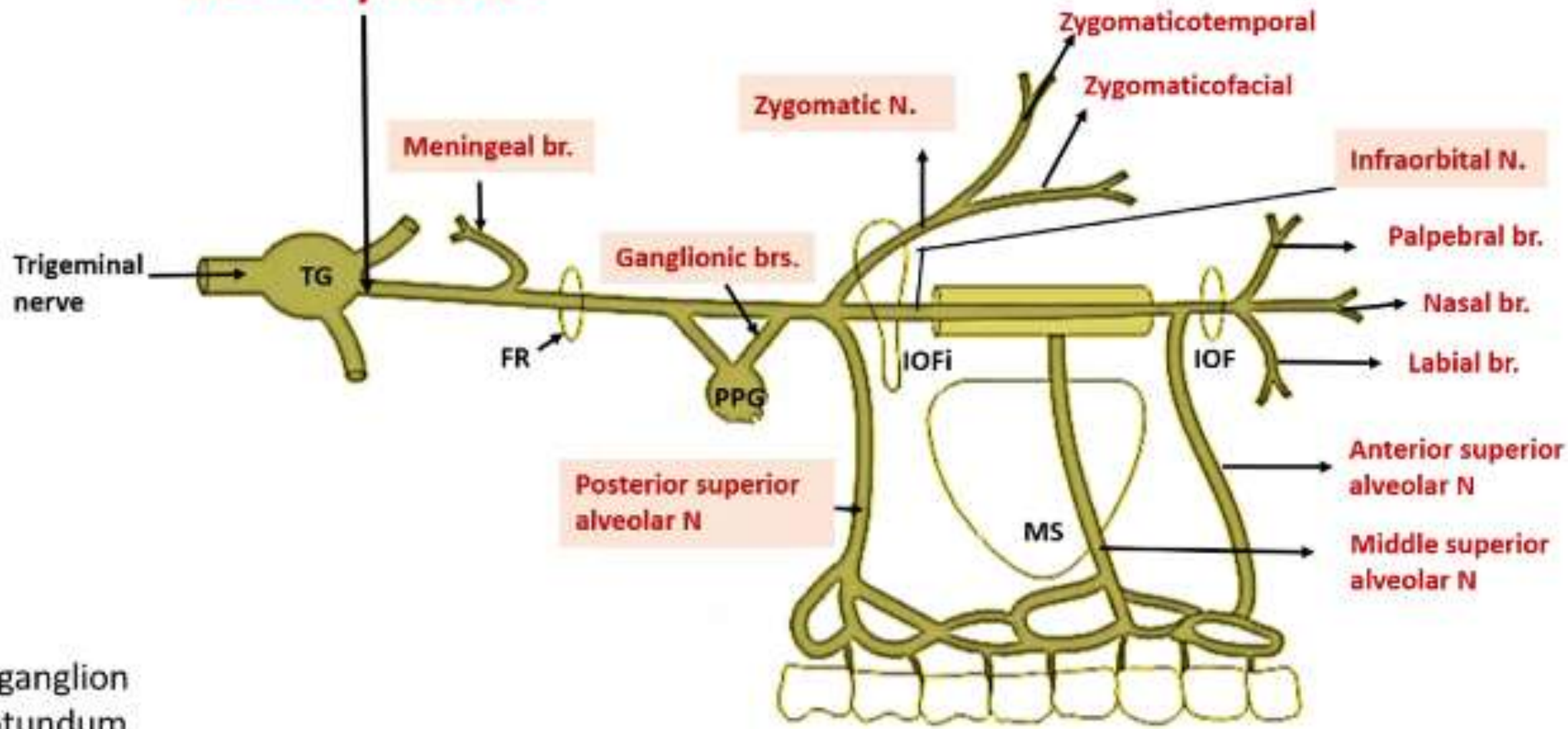
❖*Infraorbital n.* – continuation

- ✓ Middle superior
- ✓ Anterior superior
- ✓ Palpebral
- ✓ Nasal
- ✓ labial



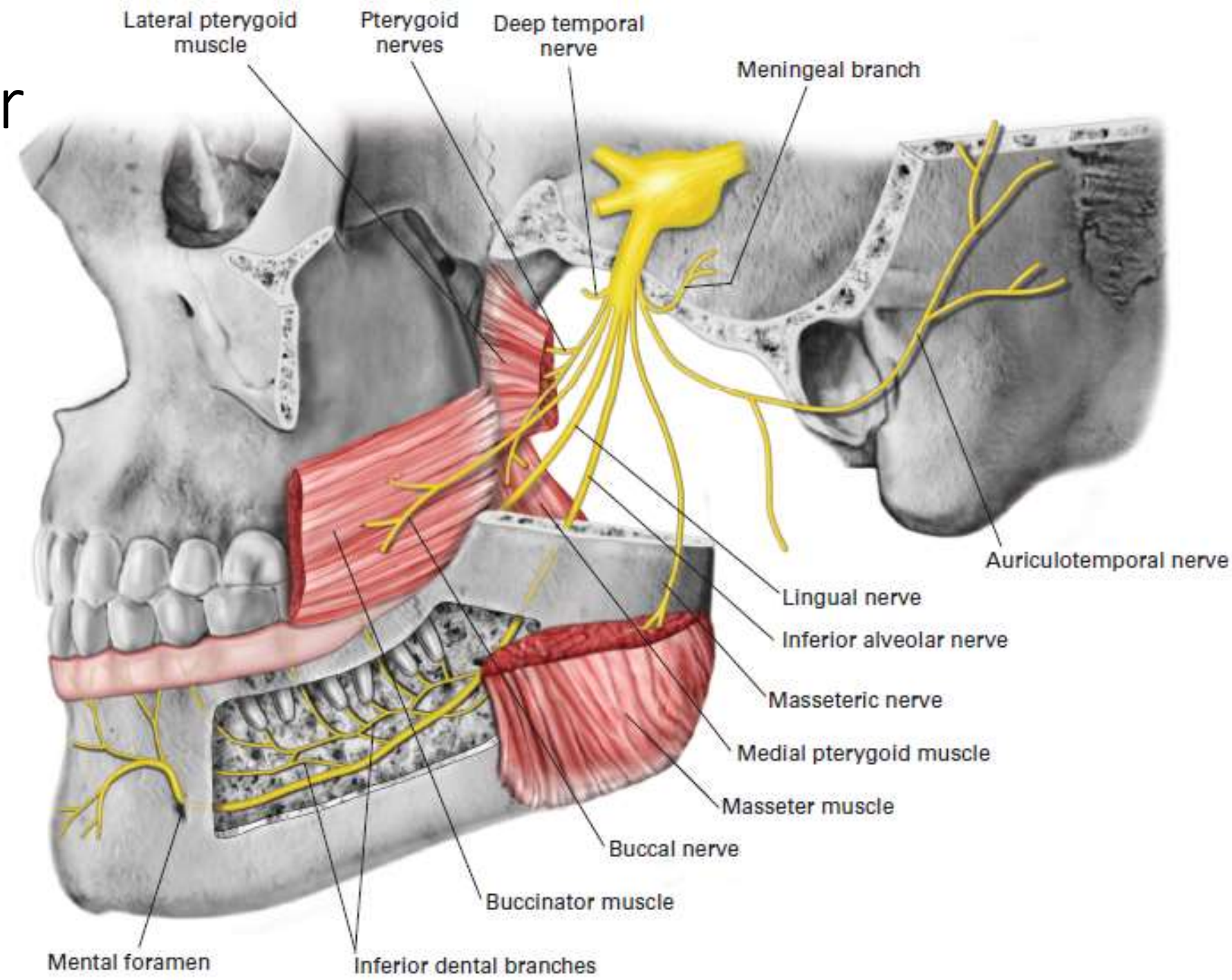

olfactory nerve
trigeminal nerve
trigeminal ganglion
maxillary nerve
pterygopalatine ganglion
nasal nerves
palatine nerves
nasopalatine nerve
greater palatine nerve
lesser palatine nerves

Maxillary Nerve



l ganglion
otundum
palatine ganglion

Mandibular nerve



Trigeminal nerve (1)

Branches of its mandibular subdivision (V3) (2),

Auriculotemporal nerve (3),

Inferior alveolar nerve (4),

Mylohyoid nerve (5),

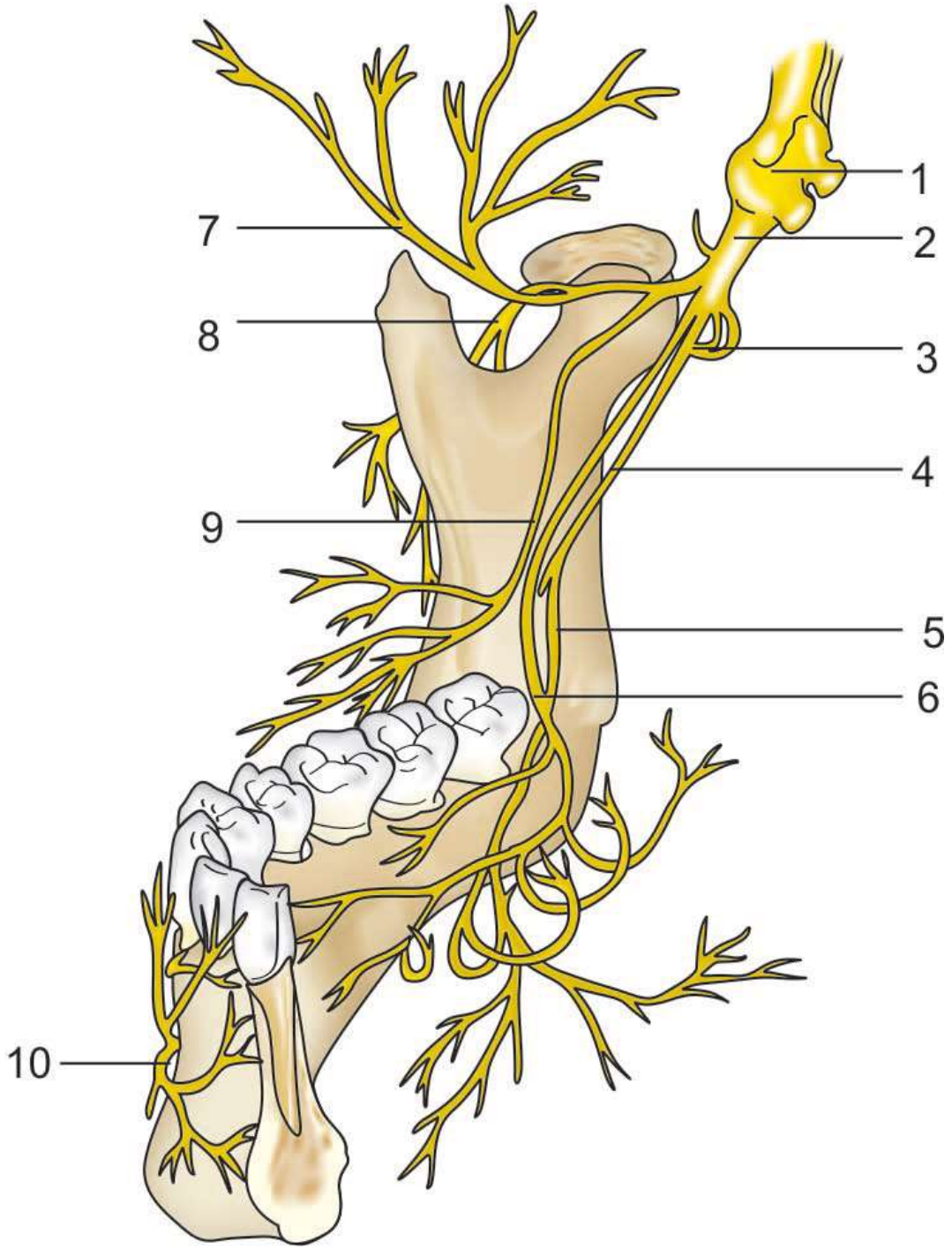
Lingual nerve(6),

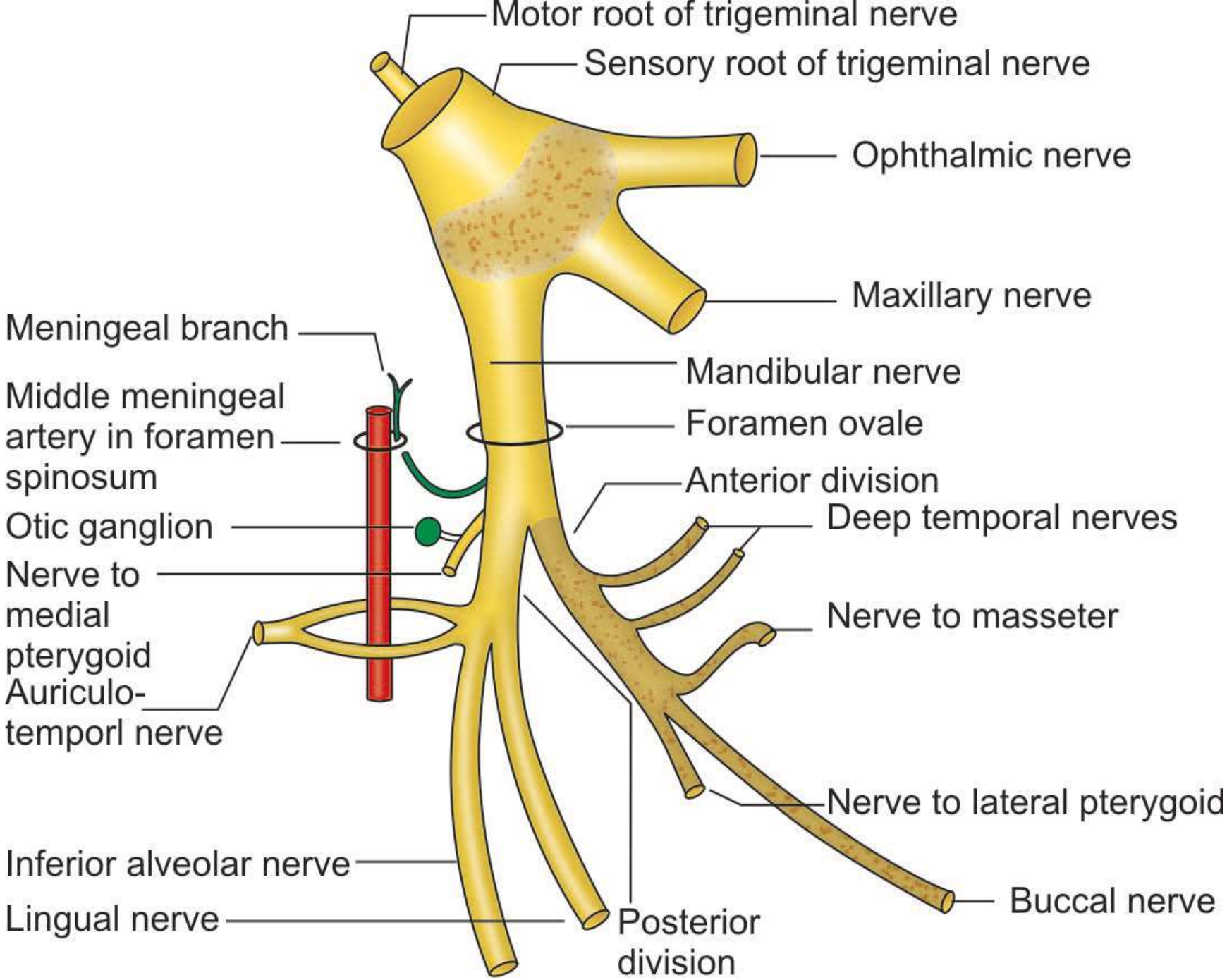
Deep temporal nerve (7),

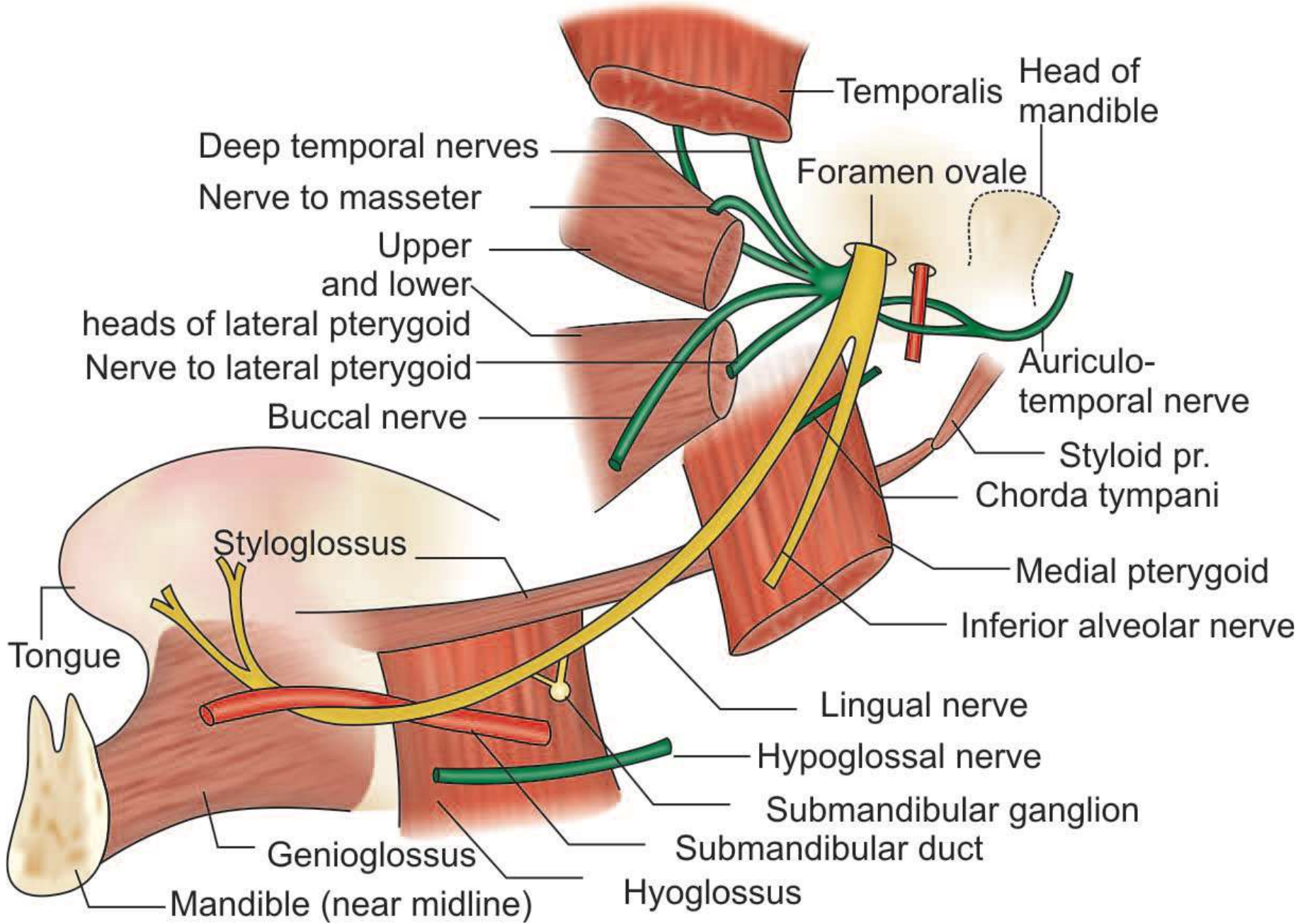
Masseteric nerve (8),

Long buccal nerve (9),

Mental nerve (10).

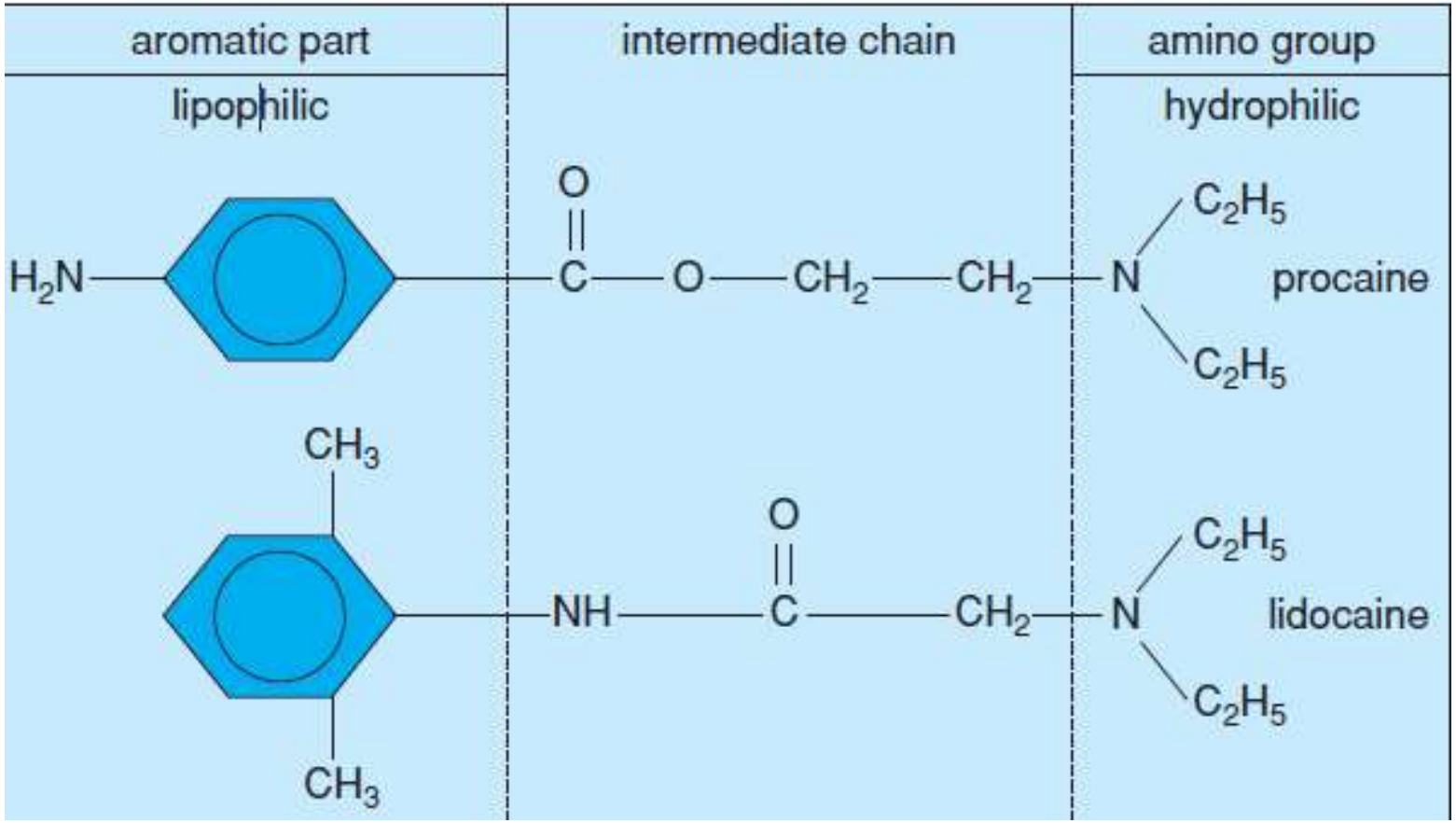



Motor root of trigeminal nerve
Sensory root of trigeminal nerve
Ophthalmic nerve
Maxillary nerve
Meningeal branch
Mandibular nerve
Middle meningeal artery in foramen spinosum
Foramen ovale
Anterior division
Otic ganglion
Deep temporal nerves
Nerve to medial pterygoid
Nerve to masseter
Auriculo-temporl nerve
Nerve to lateral pterygoid
Buccal nerve
Inferior alveolar nerve
Lingual nerve
Posterior division


Temporalis
Head of mandible
Deep temporal nerves
Foramen ovale
Nerve to masseter
Upper and lower heads of lateral pterygoid
Nerve to lateral pterygoid
Buccal nerve
Auriculo-temporal nerve
Styloid pr.
Chorda tympani
Styloglossus
Medial pterygoid
Inferior alveolar nerve
Tongue
Lingual nerve
Hypoglossal nerve
Submandibular ganglion
Submandibular duct
Genioglossus
Hyoglossus
Mandible (near midline)

III. Pharmacology of local anaestetics

- An aromatic lipophilic group
- An intermediate chain containing an ester or amide linkage
- A hydrophilic secondary or tertiary amino group



PHARMACOKINETICS OF LOCAL ANESTHETICS

When injected into soft tissue most local anesthetics produce dilation of vascular bed.

 Vasodilation is due to increase in the rate of absorption of the local anesthetic into the blood, thus decreasing the duration of pain control while increasing the anesthetic blood level and potential for over dose.

DISTRIBUTION

 Once absorbed in the blood stream local anesthetics are distributed through out the body to all tissues.

 Highly perfused organs such as brain, head, liver, kidney, lungs have higher blood levels of anesthetic than do less higher perfused organs.

METABOLISM (BIOTRANSFORMATION)

- ESTER LOCAL ANESTHETICS:

Ester local anesthetics are hydrolyzed in the plasma by the enzyme pseudocholinesterase.

- AMIDE LOCAL ANESTHETICS

The metabolism of amide local anesthetics is more complicated then esters. The primary site of biotransformation of amide drugs is liver.

EXCREATION

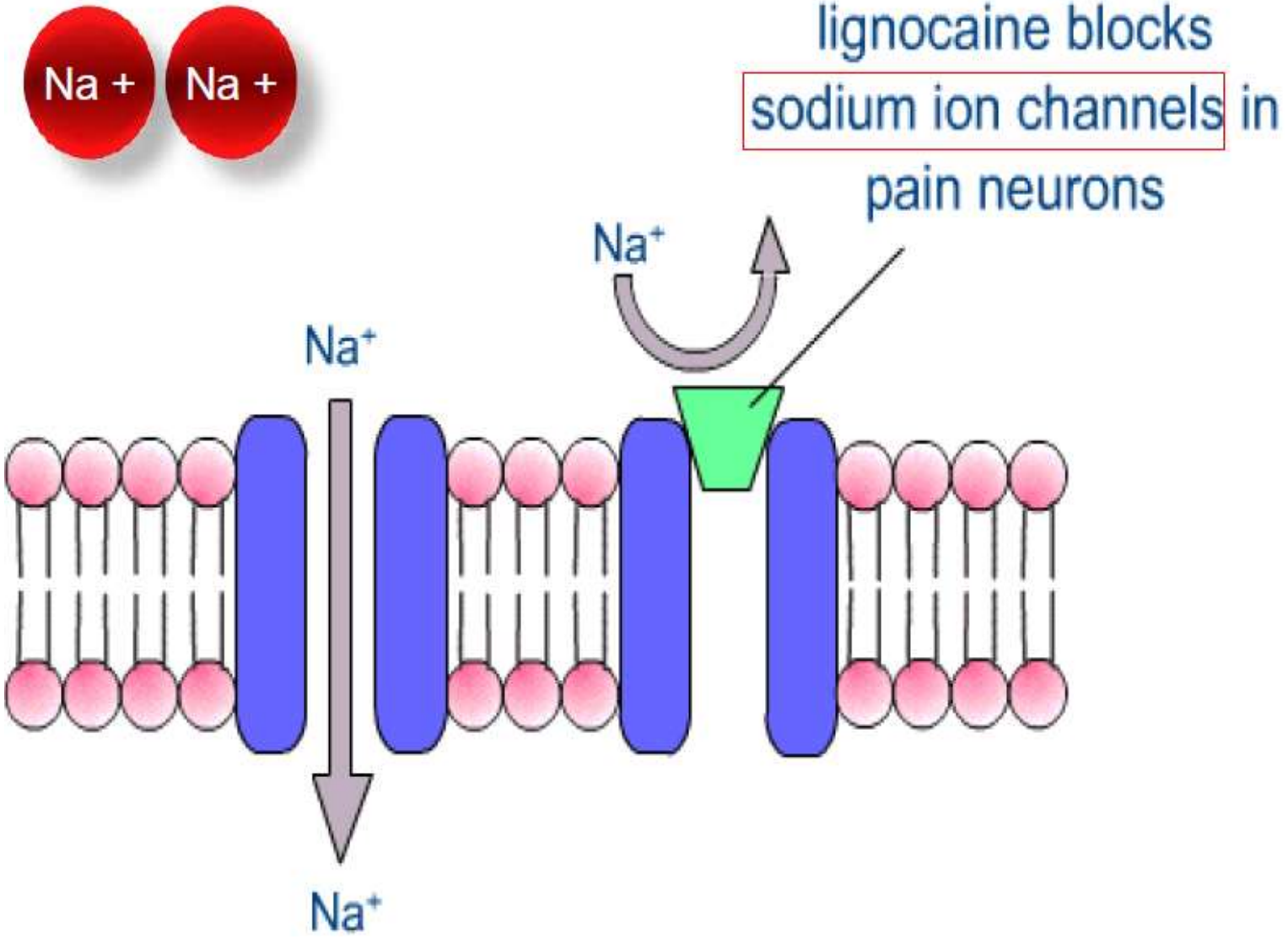
Kidneys are the primary excretory organs for both the local anesthetic and its metabolites A percentage of given dose of local anesthetic drug is excreted unchanged in the urine.

Esters appear in only very small concentration as the parent compound in urine.

Amides are present in the urine as a parent compound in a greater percentage then are esters.

Mechanism of action

- Displacement of calcium ions from the sodium channel receptor site
- Binding of local anesthetic molecule to this receptor site
- Blockade of sodium channel Decrease in sodium conductance
- Depression of rate of electrical depolarization
- Failure to achieve the threshold potential level
- Lack of development of propagated action potential
- **Conduction blockade…**



COMERCIALLY PREPARED LOCAL ANESTHESIA CONSISTS OF:

- Local anesthetic agent (xylocaine, lignocaine 2%)
- Vasoconstrictor (adrenaline 1: 80.000, 100.000, 200.000)
- Reducing agent (sodium metabisulphite)
- Preservative (methylparaben,capryl ydrocuprienotoxin)
- Fungicide (thymol)
- Vehicle (distillde water,NaCl)

REDUCING AGENT

- Vasoconstrictors are unstable in solution and may oxidize especially on prolong exposure to sunlight this results in turning of the solution brown and this discoloration is an indication that such a solution must be discarded.
- To overcome this problem a small quantity of sodium metabisulphite is added - competes for the available oxygen.
- SHELF LIFE INCRESES

PRESERVATIVE

• Modern local anesthetic solution are very stable and often have a shelf of two years or more. Their sterility is maintained by the inclusion of small amount of a preservative such as capryl hydrocuprienotoxin.

• Some preservative such as methylparaben have been shown to allergic reaction in sensitized subjects.

FUNGICIDE

- In the past some solutions tended to become cloudy due to the proliferation of minute fungi.
- In several modern solutions a small quantity of thymol is added to serve as fungicide and prevent this occurrence.

VEHICLE

- The anesthetic agent and the additives referred to above are dissolved in distilled water & sodium chloride.
- This isotonic solution minimizes discomfort during injection.

The properties that are desirable in a local anesthetic solution:

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 eiter be sterile or be capable of being sterilized by heat without deterioration.

Classification on the basis of chemical structure

Esters

- Of benzoic acid
  - Butacaine
  - Cocaine
  - Benzocaine
  - Tetracaine
- Of para-amino benzoic acid
  - Procaine
  - Propoxycaine

Amides

- Articaine
- Bupivacaine
- Dibucaine
- Etidocaine
- Lidocaine
- Mepivacaine
- Prilocaine
- Ropivacaine

*Amide local anesthetics generally have the letter **I** plus caine in their drug names. (L**i**docaine, mep**i**vacaine, bup**i**vacaine)*

Quinolones

- Centbucridine

On the Basis of Occurrence in Nature

1. Naturally occurring, e.g. cocaine
2. Synthetic compounds
    a. Nitrogenous compounds
        I. Derivatives of para-aminobenzoic acid (PABA)
            o Freely soluble, e.g. procaine
            o Poorly soluble, e.g. benzocaine
        II. Derivatives of acetanilide, e.g. lignocaine (lidocaine, xylocaine)
        III. Derivatives of quinolone, cinchocaine (nupercaine)
        IV. Derivatives of acridine, e.g. bucricaine (centbucridine, centoblock)
    b. Non-nitrogenous compounds, e.g. benzyl alcohol, and propanediol
3. Miscellaneous drugs with local anesthetic action, e.g. clove oil, phenol, chlorpromazine, certain antihistaminics such as diphenhydramine.

On the Basis of Duration of Action

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

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

TABLE 4–2. Dosages (Adult) for Local Anesthetics (based on average weight of 150 lbs or 70 kg)

Agent	mg/Cartridge	Maximum Dose mg/kg	Maximum Dose mg
2% lidocaine (Xylocaine)	36	4.5	300
2% lidocaine with 1:100,000 epinephrine	36	7	500
3% mepivacaine (Carbocaine, Polocaine)	54	5.5	400
2% mepivacaine with 1:20,000 levonordefrin	36	5.5	400
4% prilocaine (Citanest)	72	8	600
4% prilocaine with 1:200,000 epinephrine	72	8	600
0.5% bupivacaine with 1:200,000 epinephrine (Marcaine)	9	1.3	90
1.5% etidocaine with 1:200,000 epinephrine (Duranest)	27	5.5	400
4% articaine with 1:100,000 epinephrine (Septocaine)	68	7	500

The maximum amount of 2% lidocaine with 1:100,000 epinephrine that can be administered to a healthy 150 lb man is 477 mg (~13 dental cartridges).

Conversion of lb to kg: (2.2 lb/kg).

Adding a vasoconstrictor (like epinephrine) to the local anesthetic decreases its rate of absorption. This increases its duration of action, minimizes systemic toxicity, and helps with hemostasis.

Local Anesthesia Armamentarium

1.) The Syringe

2.) The Needle

3.) The Cartridge

4.) Other Armamentarium

- Topical Anesthetic (strongly recommended) -ointments, gels, pastes, sprays

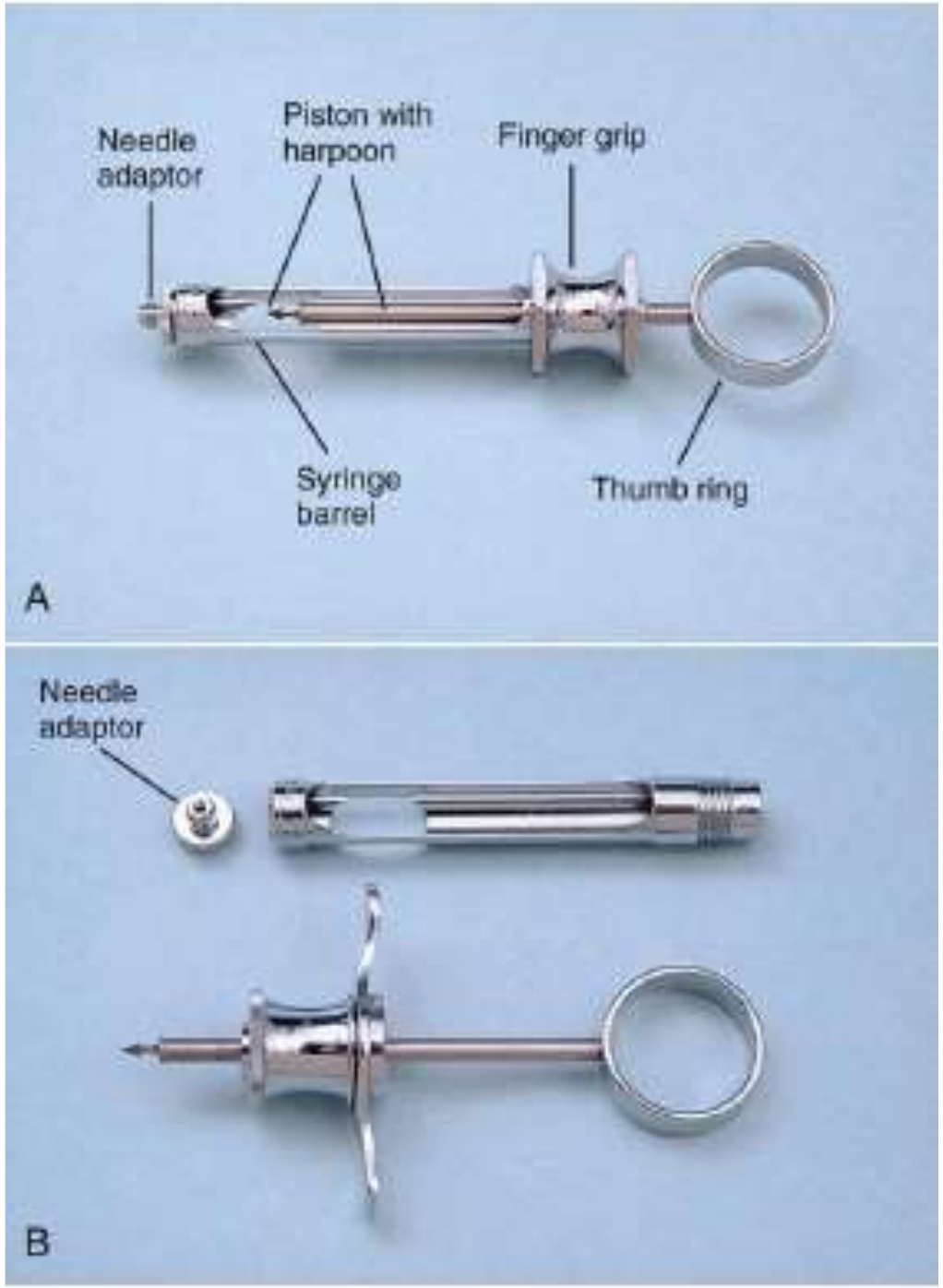
- Applicator sticks

- Cotton gauze

Syringe

- It is an instrument or a vehicle whereby the local anesthetic solution is delivered through the needle into the tissues of the patient.

- **Syringe Components**
- 1.) Needle adapter
- 2.) Piston with harpoon
- 3.) Syringe barrel
- 4.) Finger grip
- 5.) Thumb ring



Classification

I. Non-disposable (Reusable) syringes:
1. Breech-loading, cartridge type syringe. These syringes are available in the following forms: (a) Metallic, or plastic, (b) Aspirating, or non-aspirating, and (c) Self-aspirating types.
2. Side loading, aspirating and non-aspirating syringes.
3. Pressure syringe.
4. Jet injector.
5. Luer-Lock syringes.
II. Disposable or plastic syringes.
III. Safety syringes.

American Dental Association (ADA) criteria for acceptance of LA syringes:

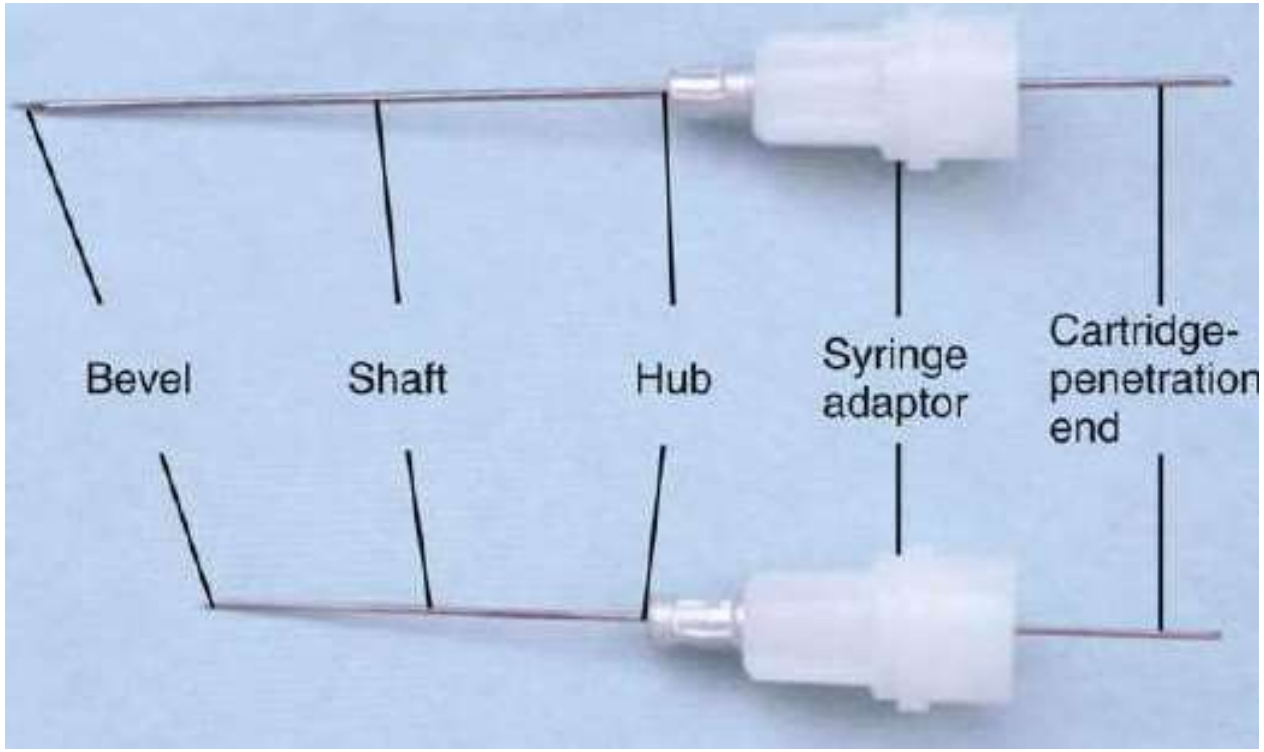
- 1-Durable and resterilzable or packaged in a sterile container (if disposable).
- 2-Accept a wide variety of cartridges and needles of different manufactures (universal use)
- 3-Inexpensive, light weight, and simple to use with one hand.
- 4-Provide effective aspiration and the blood be easily observed in the cartridge.
- The incidence of positive aspiration may be as high as 10%-15% in some injection techniques.

Non-disposable syringes

Disposable syringe and safety syringe

Needles

The needles permit the local anesthetic solution to travel from the dental cartridge into the soft tissues surrounding the tip of the needle.



The Needle

Gauge: the larger the gauge the smaller the internal diameter of the needle

Usual dental needle gauges are 25,27, & 30

Length:

1-Long(approximately 40 mm "32-40 mm"), for NB.

2-Short(20-25 mm).

3-Extra-short(approximately 15 mm), for PDL.

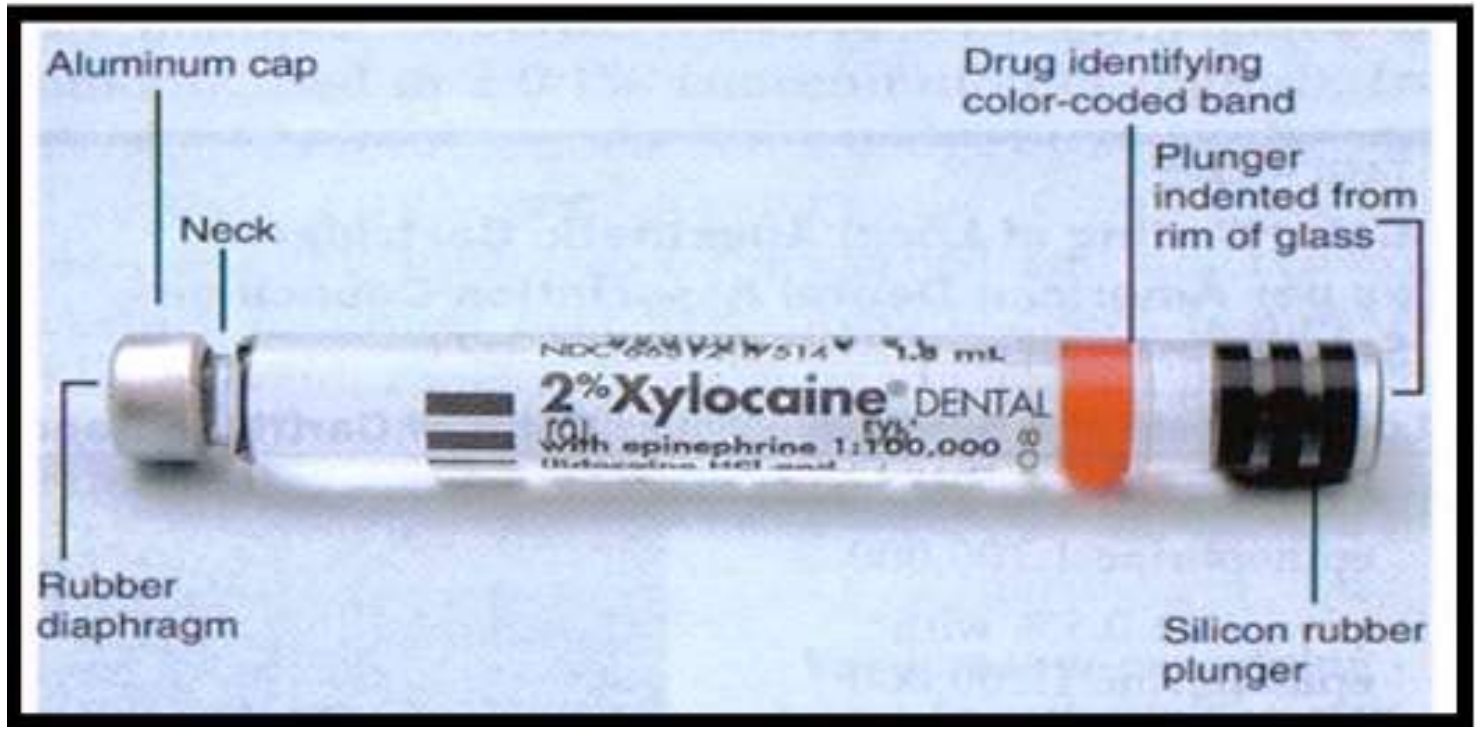
Cartridge

- The Cartridge Components:

- Cylinder, plunger, diaphragm

- Types: Standard – Self aspirating, plastic, Glass

- Volume: 1.8, 2.00 & 2.2 ML.



The Cartridge:

- Should not be autoclaved Stored at room temperature (21°C to 22°C (70°F to 72°F)
- Should not soak in alcohol
- Should not be exposed to direct sunlight