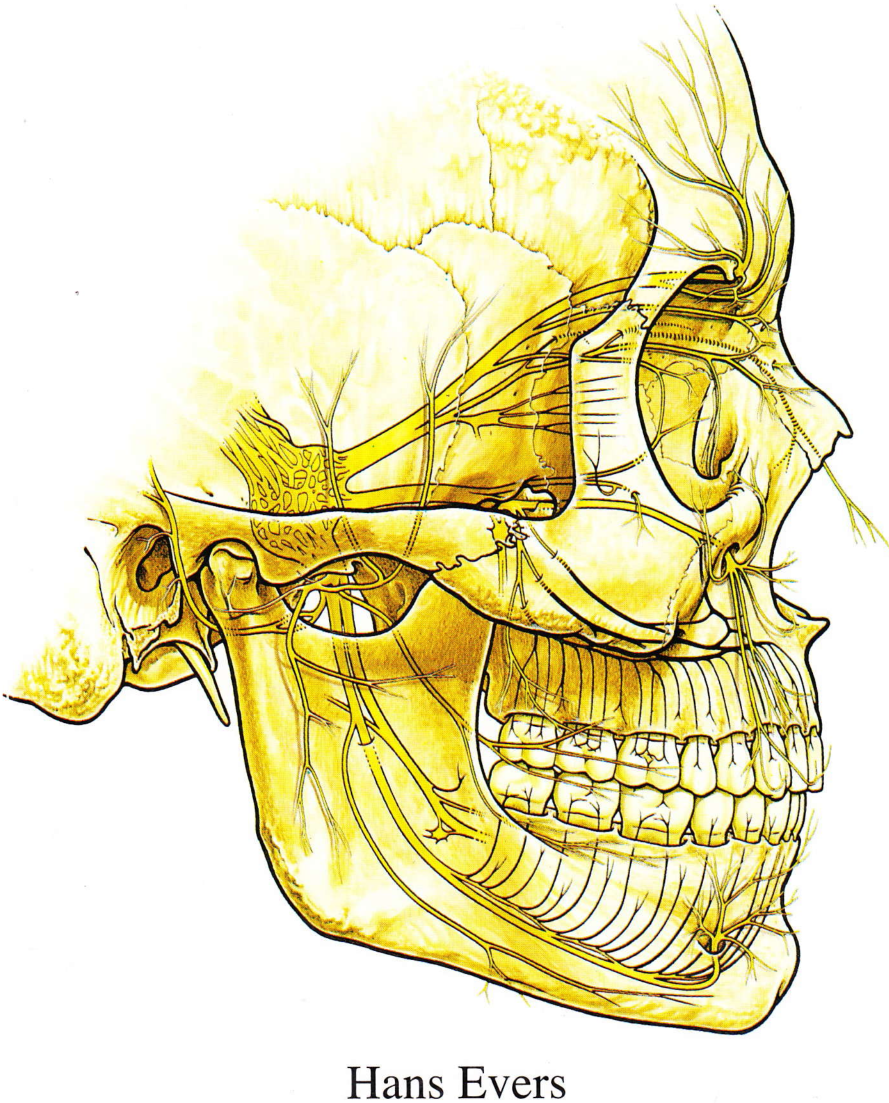
Introduction to Dental Local Anaesthesia



Hans Evers
Glenn Haegerstam

DENTSPLY PHARMACEUTICAL

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Introduction to Dental Local Anaesthesia

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Introduction to Dental Local Anaesthesia

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DENTSPLY PHARMACEUTICAL

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NOTICE

The authors and publisher have made every effort to ensure that the patient care recommended herein, including choice of drugs and drug dosages, is in accord with the accepted standards and practice at the time of publication. However, since research and regulations constantly change clinical standards, the reader is urged to check the product information sheet included in the package of each drug, which includes recommended doses, warnings and contraindications. This is particularly important with new or infrequently used drugs.

Photos in the book are taken at the Royal Dental College Aarhus, Denmark.
by Helle Winter Larsen under supervision of M.S. Jens Kølsen Petersen

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Trigeminal nerve

The *trigeminal nerve* is predominantly sensory, and the cell bodies of these sensory fibres form the semilunar ganglion (the Gasserian ganglion), which lies in Meckel's cavity in the bottom of the middle cranial fossa. Three large trunks originate from the ganglion: the *maxillary nerve*, the *ophthalmic nerve*, and the *mandibular nerve (Inferior alveolar nerve)* (Fig 1).

Fig. 1.
1. Trigeminal nerve
2. Trigeminal (Gasserian) ganglion
3. Ophthalmic nerve
4. Nasociliary nerve
5. Supraorbital nerve
6. Lacrimal nerve
7. Frontal nerve
8. Supratrochlear nerve
9. Infratrochlear nerve
10. Maxillary nerve
11. Zygomatic nerve
12. Middle superior alveolar nerve
13. Posterior superior alveolar nerve
14. Anterior superior alveolar nerve
15. Infraorbital nerve
16. Mandibular nerve
17. Auriculotemporal nerve
18. Mandibular nerve (Inferior alveolar nerve)
19. Lingual nerve
20. Buccal nerve
21. Mental nerve

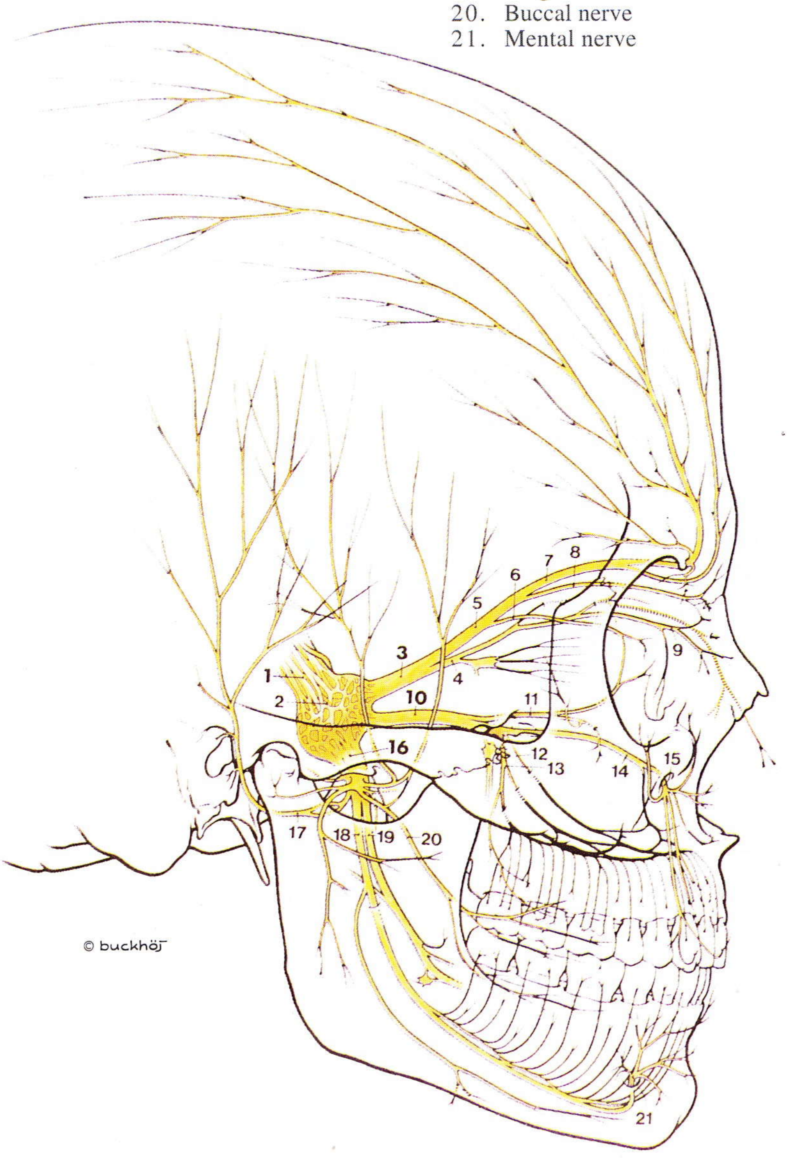


Fig. 1

Maxillary nerve

The *maxillary nerve*, exclusively sensory, passes through the foramen rotundum to reach the pterygopalatine fossa, where it gives off a number of branches. Two branches enter the sphenopalatine ganglion, and come to form the *greater palatine nerve*, the *nasopalatine nerve*, and *posterior nasal nerve* twigs. Just before it enters the infraorbital canal, the maxillary nerve trunk gives off the *zygomatic nerve* which passes anteriorly and laterally, and the *descending posterior superior alveolar branches* (Fig. 1).

Infraorbital nerve

Anterior superior alveolar nerve twigs leave the trunk just before the exit of the infraorbital foramen, and outside the foramen twigs to the skin between the nostril and the eye (Fig. 1).

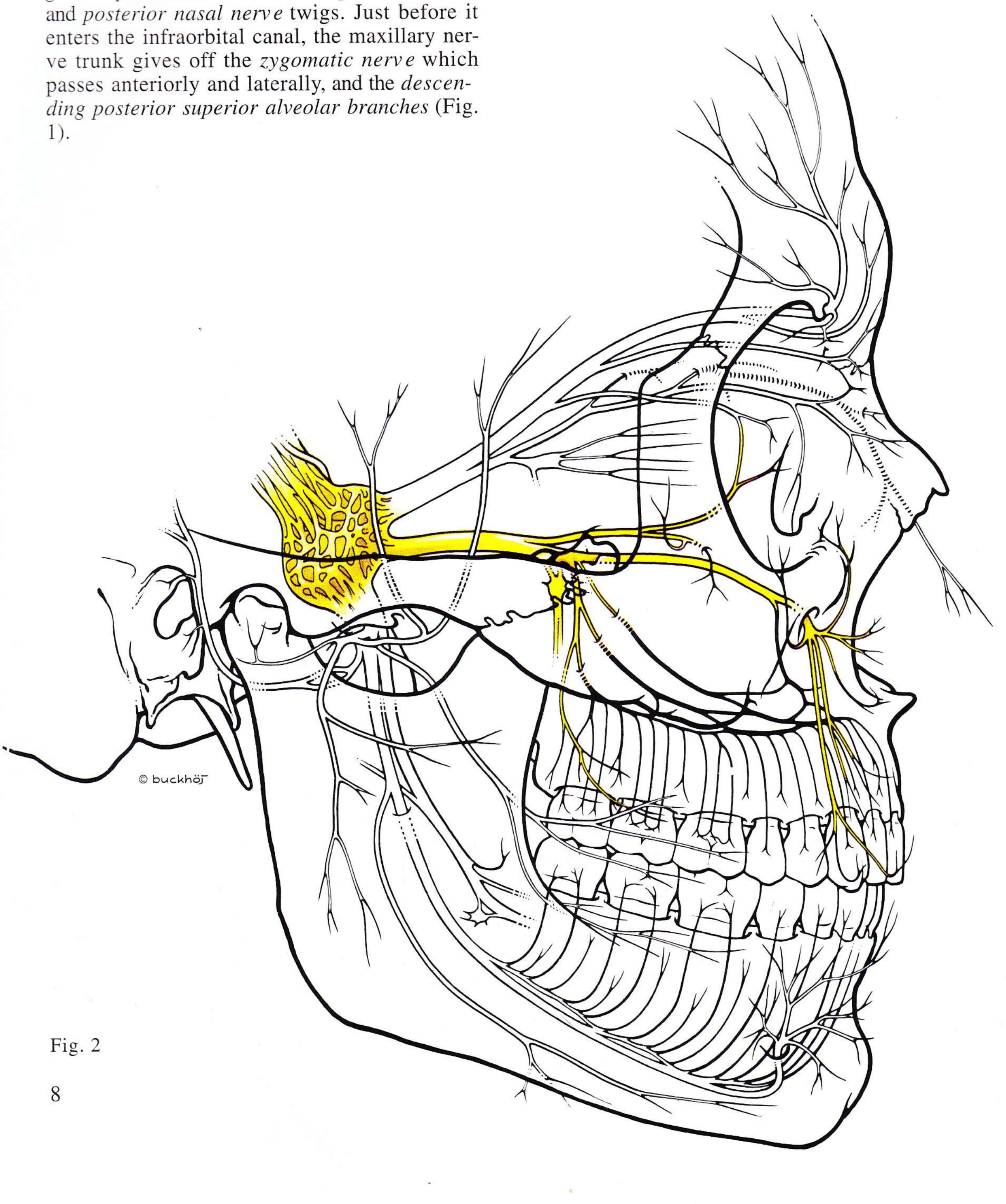


Fig. 2

The superior dental plexus

The *superior dental plexus* is formed by the *superior posterior and anterior alveolar branches*. The teeth and the buccal gingiva of the upper jaw are innervated by this plexus. Sometimes an irregular branch - *the middle superior alveolar branch* - is also present (Fig. 2).

One of the *posterior alveolar branches* passes downward on the surface of the maxillary bone to the gingiva of the buccal side of the molar region. The posterior part of the mucous membrane of the cheek is also innervated by this branch (Fig. 3).

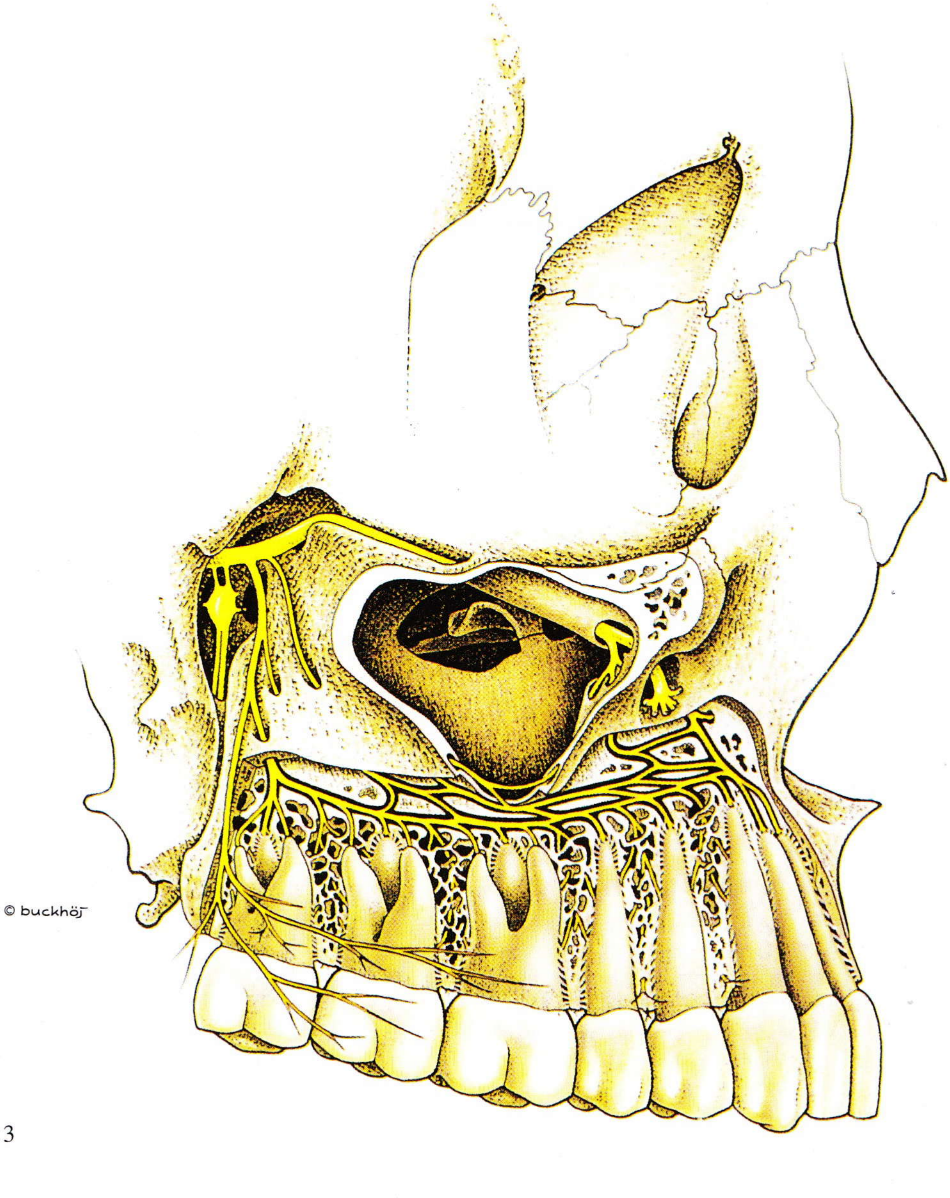


Fig. 3

Superior gingival branches from the *superior dental plexus* penetrate the bone and supply the interdental papillae, the periodontal ligament and the buccal gingiva.

Nasopalatine nerve

The nasopalatine nerve leaves the *sphenopalatine ganglion* through the sphenopalatine foramen. It passes forward and downward on the nasal septum to reach the incisal canal, where it gives off its terminal branches. The mucous membrane and gingiva in the anterior part of the hard plate are innervated by the nasopalatine nerve (Fig. 4).

Greater palatine nerve

The *greater palatine nerve* leaves the *sphenopalatine ganglion* and descends through the greater palatine canal to emerge from the greater palatine foramen. The posterior part of the mucous membrane of the hard plate and the palatal gingiva are innervated by this nerve (Fig. 4).

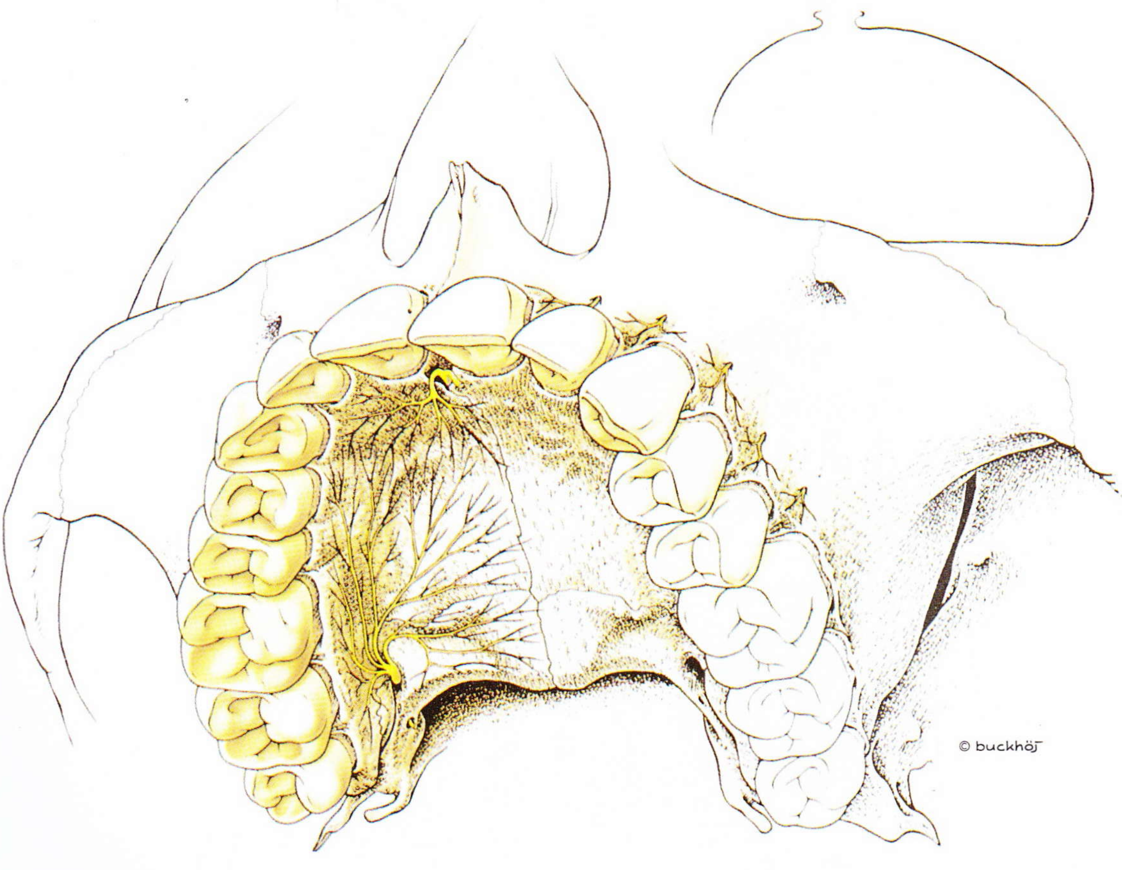


Fig. 4.

Zygomatic nerve

The *zygomatic nerve* enters the orbital cavity via the inferior orbital fissure. It runs along the lateral wall of the orbital cavity and divides into two branches. These branches penetrate the bone to reach the skin over the anterior temple and the lateral angle of the eye. The zygomatic nerve communicates with the *lacrimal nerve* (Fig. 5).

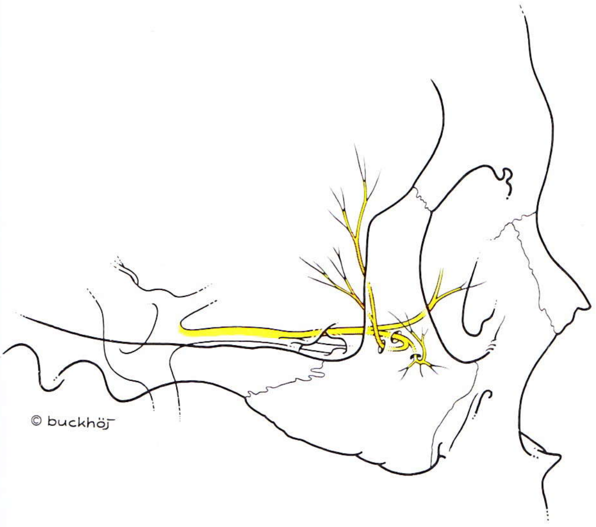
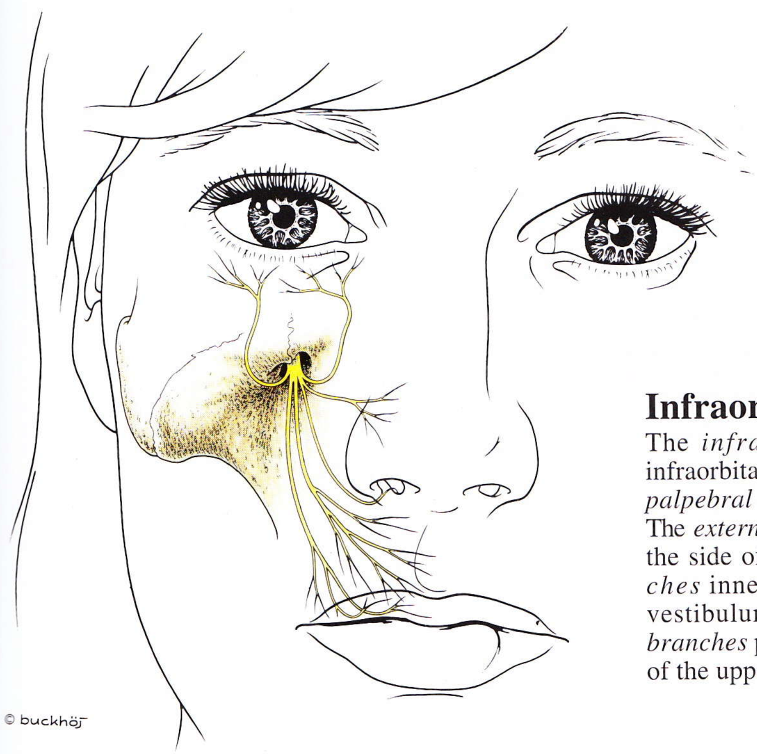


Fig. 5.

Fig. 6.



Infraorbital nerve

The *infraorbital nerve* emerges from the infraorbital foramen and ramifies. The *inferior palpebral branches* innervate the lower eyelid. The *external nasal branches* pass to the skin on the side of the nose. The *internal nasal branches* innervate the mucous membrane of the vestibulum of the nose. The *superior labial branches* pass to the skin and mucous membrane of the upper lip (Fig. 6).

Ophthalmic nerve

The *ophthalmic nerve* is purely sensory. It enters the orbit via the superior orbital fissure and then forms three branches, the *lacrimal nerve*, the *nasociliary nerve*, and the *frontal nerve* (Fig. 1).

Lacrimal nerve

The *lacrimal nerve* courses in an supero-anterolateral direction to reach the lacrimal gland. It also innervates the conjunctiva and the skin of the lateral angle of the eye (Fig. 7).

Postganglionic secretory fibres from the *sphenopalatine ganglion* reach the lacrimal nerve via a communicating branch of the *zygomatic nerve*.

Nasociliary nerve

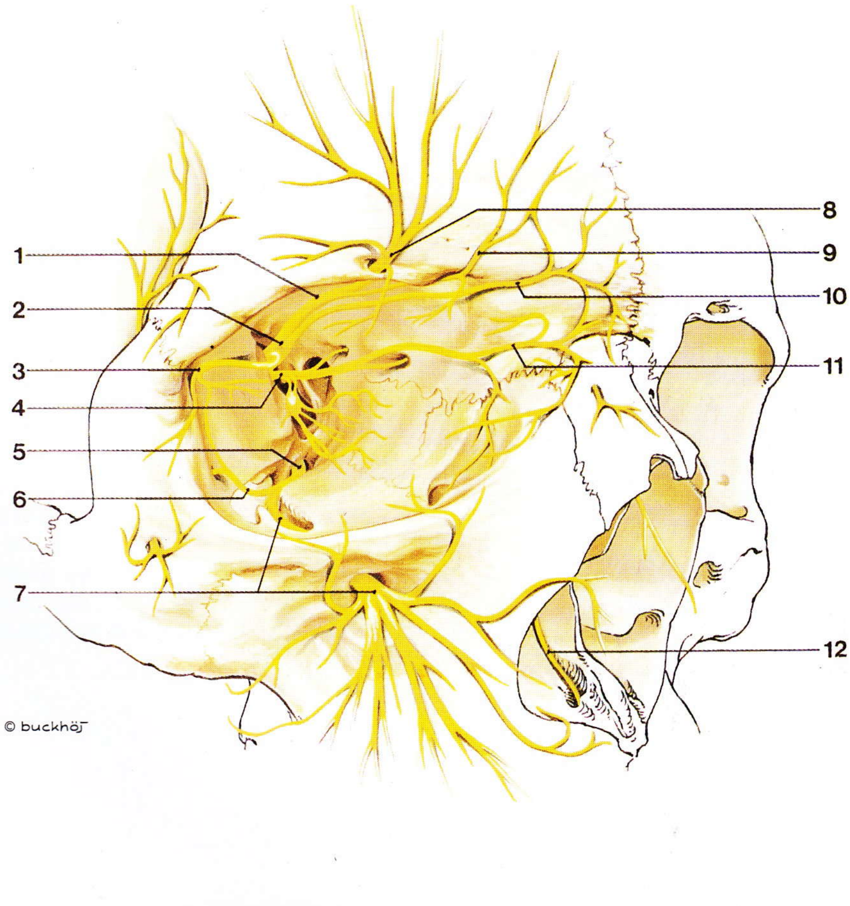
The *nasociliary nerve* crosses the orbital cavity in an anteromedial direction toward the medial orbital wall. The *terminal branches* innervate the mucous membrane of the superoanterior part of the nasal cavity and the skin between the nose and the medial angle of the eye (Fig. 7).

Frontal nerve

The *frontal nerve* continues in the direction of the *ophthalmic nerve trunk*. It divides in the orbital cavity. The largest branch (the *supraorbital nerve*) the orbit to supply the skin of the upper eyelid, the forehead and the anterior scalp region. The *supratrochlear nerve* leaves the frontal nerve deep in the orbit and approaches the upper medial angle of the orbit and innervates the upper eyelid and the forehead (Fig. 7).

Fig. 7.
1. Supraorbital nerve
2. Frontal nerve
3. Lacrimal nerve
4. Nasociliary nerve
5. Maxillary nerve
6. Zygomatic nerve
7. Infraorbital nerve
8. Lateral branch of the frontal nerve
9. Medial branch of the frontal nerve
10. Supratrochlear nerve
11. Infratrochlear nerve
12. Nasopalatine nerve

Fig. 7.



Mandibular nerve

The *mandibular nerve* is a mixed nerve, though mainly sensory. It reaches the infratemporal fossa via the foramen ovale. Motor branches for the muscles of mastication leave the trunk in the fossa. The nerve then gives off several sensory branches (Fig. 8).

Fig. 8.

Auriculotemporal nerve

The *auriculotemporal nerve* leaves the main trunk medial to the neck of the mandibular condyle, passes behind the condyle up to supply the external auditory canal and the skin of the anterior aspect of the temple (Fig. 10).

Buccal and deep temporal nerves

The *buccal nerve* and the *deep temporal nerves* leave the mandibular nerve together, and pass upwards to innervate the anterior and posterior aspects of the temporalis muscle (Fig. 10).

Masseter nerve

The *masseter nerve* passes in front of the temporomandibular articulation and enters the masseter muscle (Fig. 10).

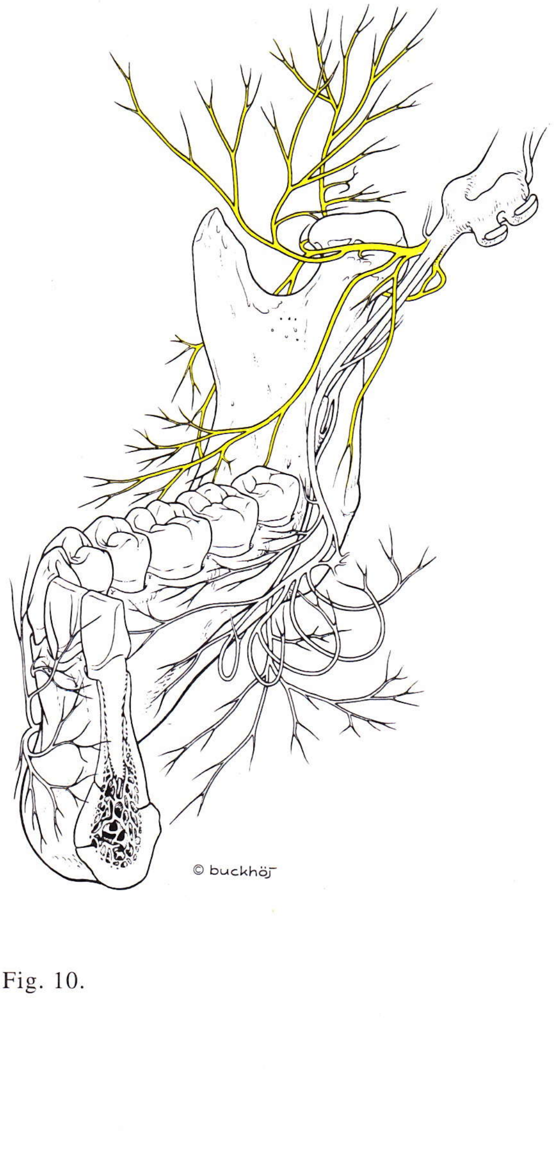


Fig. 10.

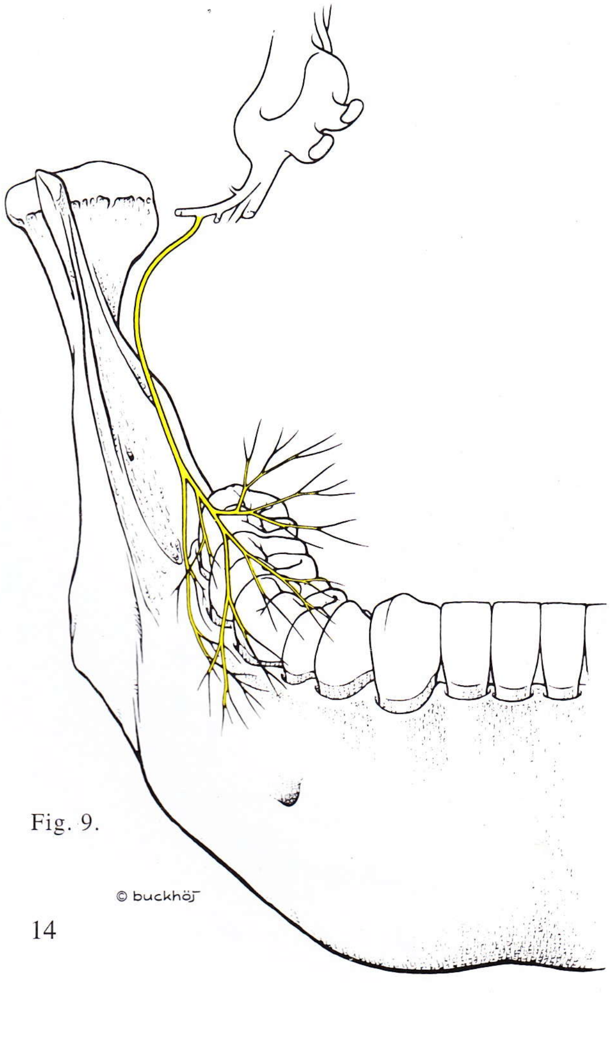


Fig. 9.

Buccal nerve

The *buccal nerve*, which is a sensory branch, passes along the medial side of the mandibular ramus anterior to the inferior alveolar nerve. It then crosses the anterior border of the mandibular ramus and ramifies. The branches innervate the buccal gingiva between the second premolar and the second molar.

Inferior alveolar nerve

The *inferior alveolar nerve* passes downward along the medial side of the mandibular ramus to the mandibular foramen. In the mandibular canal the nerve gives off branches which form the inferior dental plexus from which branches innervate the teeth and gingiva of the lower jaw.

Before the nerve enters the mandibular foramen it gives off the *mylohyoid branch*, which continues along the mandibular ramus. The mylohyoid muscle and the anterior belly of the digastric muscle receive motor fibres from this mixed nerve branch (Fig. 12).

Mental nerve

The *inferior alveolar nerve* gives off a branch in the mandibular canal - the *mental nerve* - which passes through the mental foramen to innervate the bucal gingiva between the midline and the second premolar, and the skin of the lower lip and chin (Fig. 11).

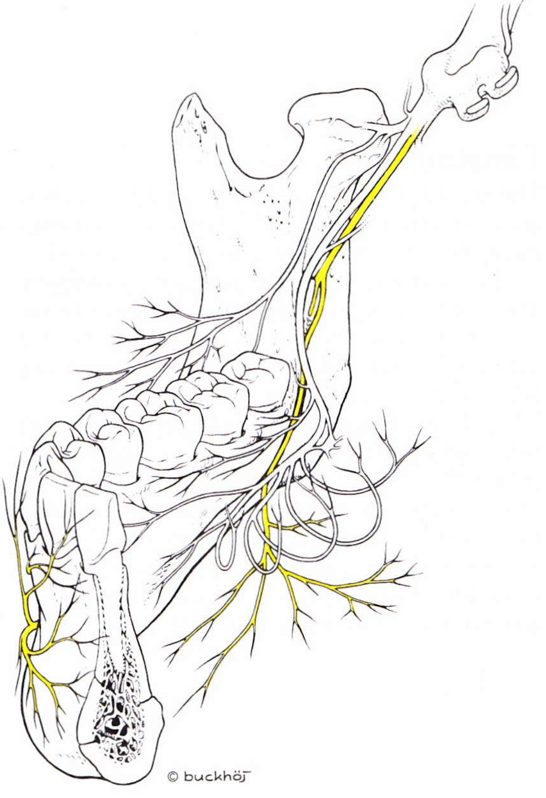


Fig. 12.

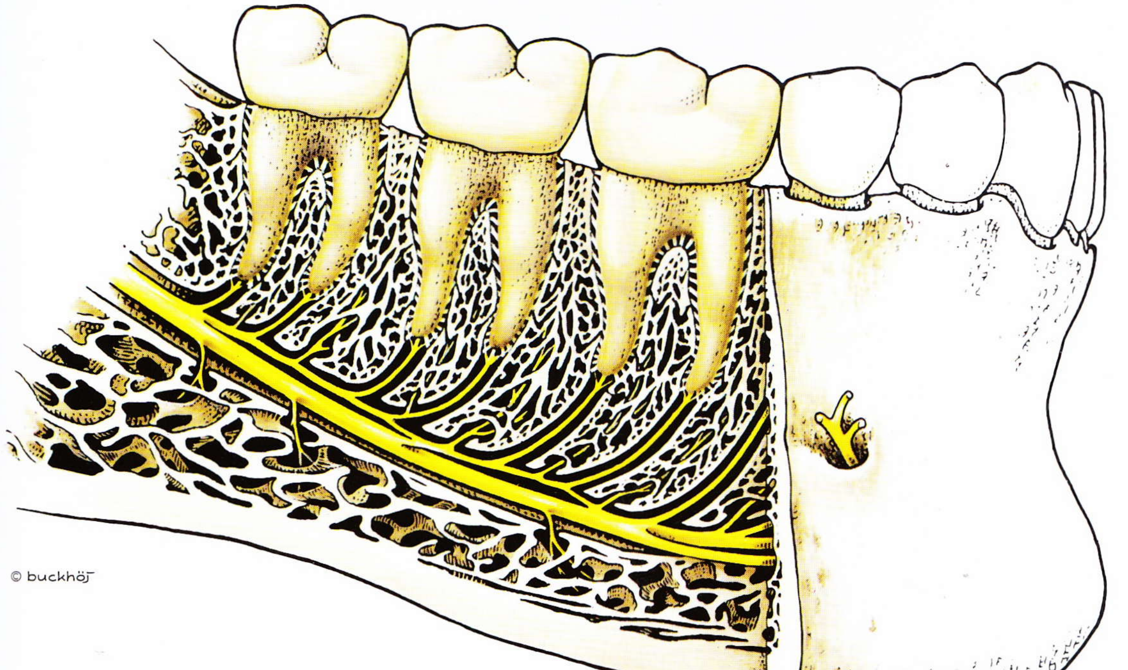


Fig. 11.

Lingual nerve

The *lingual nerve* passes downwards together with the inferior alveolar nerve, and communicates with the *chorda tympani of the facial nerve* just before reaching the mandibular foramen. This connection gives off secretory fibres to the submandibular and sublingual gland via the submandibular ganglion and special sensory fibres to the taste buds on the tongue.

The trunk of the lingual nerve gives off small branches to the lingual gingiva in the molar region. The lingual gingiva of the anterior aspect of the lower jaw, and the mucosa of the floor of the mouth are supplied by the *sublingual nerve*, a branch of the lingual nerve. The terminal branches of the lingual nerve enter the tongue and innervate the corpus linguae (Fig. 13).

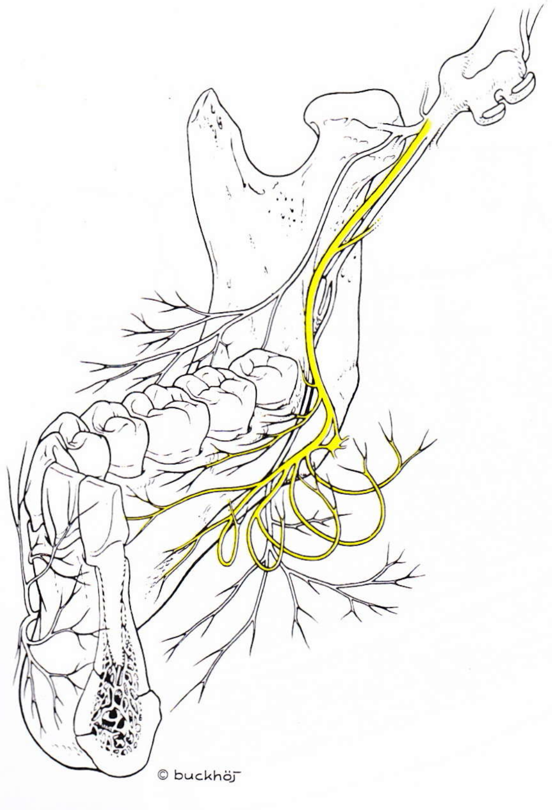


Fig. 13.

Physiology of the peripheral nerve

The conduction process in the nerve fibre is essentially dependent upon changes in the electrophysiological status of the nerve membrane. When a nerve is inactive there is a negative "resting" potential of -50 to -70 mV within the cell (by comparison with the exterior surface of the cell membrane). When excitation occurs, a distinct transmembrane action potential can be recorded by means of an intracellular electrode (Fig. 14).

The sequence of events after excitation is as follows: a relatively slow phase of depolarization occurs during which the electrical potential within the nerve cell becomes progressively less negative. When the potential difference between the interior and exterior surface of the cell membrane reaches a critical level, the "threshold potential" or "firing level", depolarization reverses the potential so that the nerve interior is positively charged by comparison with the exterior aspect of the cell membrane. At the peak of the action the intracellular positive potential reaches about 40 mV. Thereafter, a process of repolarization begins, continuing until the intracellular resting potential of -50 to -70 mV is restored.

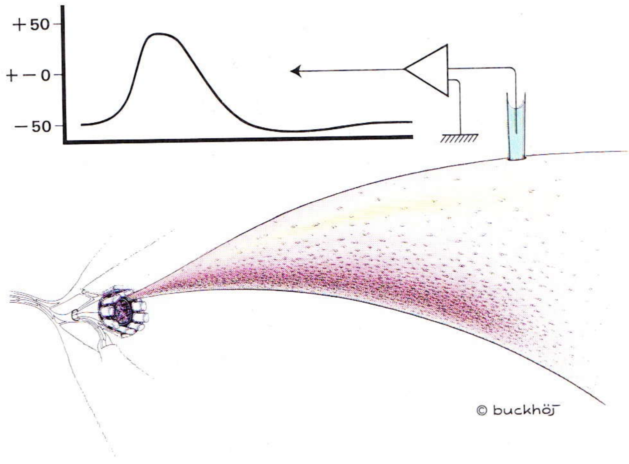


Fig. 14.

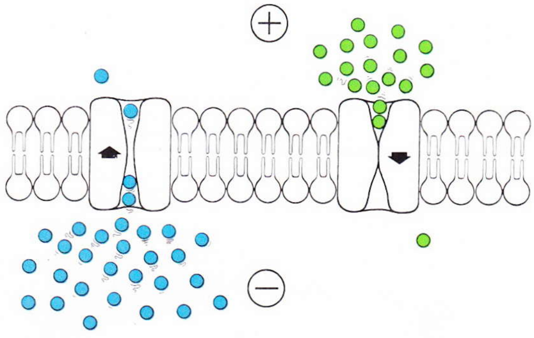


Fig. 15.

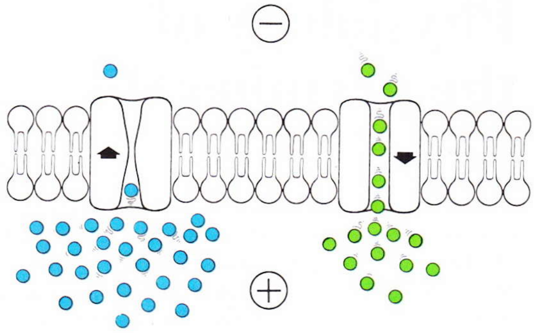


Fig. 16.

The interior of a resting peripheral nerve cell - the cytoplasm (Fig. 15) - is possessed of a high concentration of potassium ions and a low concentration of sodium ions. This state is the opposite of that in the extracellular fluids. At rest the inside/outside potassium ratio (K_i/K_o) is about 30, and it is this gradient which accounts for the negative intracellular resting potential. At rest, the cell membrane (Fig. 17) is relatively resistent to ion passage, but, on excitation, cell membrane permeability increases and there is, initially, an influx of sodium ions into the cell. This accounts for the depolarization phase of the action potential (Fig. 16).

When the cell is maximally dopolarized, sodium ion passage is arrested, and potassium ions pass out of the cell. This effects a repolarization of the cell membrane (Fig. 18).

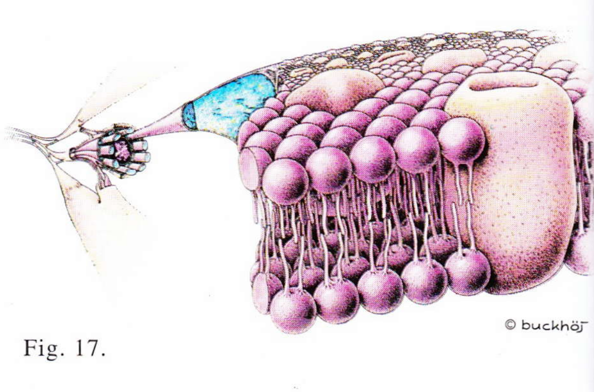


Fig. 17.

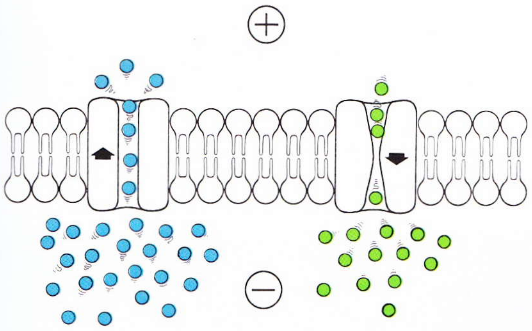


Fig. 18.

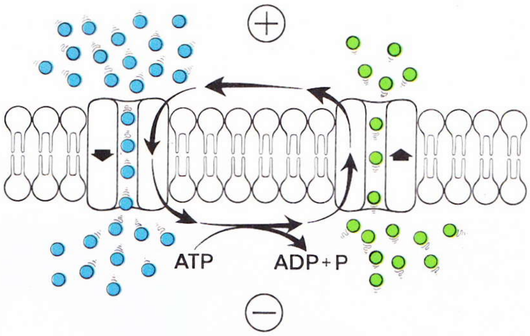


Fig. 19.

This sodium and potassium movement during excitation is passive, since both ions move along a concentration gradient, but after repolarization there is an intracellular imbalance in comparison with the resting state - too many sodium ions intracellularly and too many potassium ions estracellularly. In this situation the necessary movement of ions must be active, because the movement is against the ionic concentration gradient. Sodium is extrudent by the sodium pump, and the necessary energy is derived from the oxidative metabolism of adenosine triphosphate (ATP) (Fig. 19).

A metabolic pump may also effect the restoration of the resting intracellular potassium ion concentration, because the necessary movement is also against the concentration gradient. Alternatively potassium ion transport may be effected along the electrostatic gradient between the resting cell and its milieu. This would not require energy expenditure.

This localized change in electrical potential across the nerve membrane initiates a chain reaction which produces a sequential series of depolarizations along the nerve fibre. It is this series of depolarization steps which is responsible for the propagation of an impulse along a nerve fibre. In myelinated fibres these changes in potential occur at the nodes of Ranvier. The nerve impulse travels in a saltatory fashion from one node of Ranvier to the next (Fig. 20).

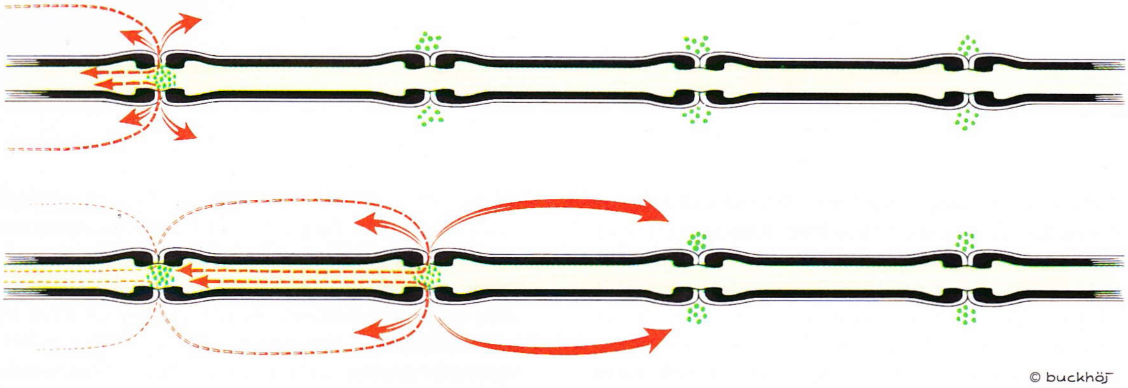
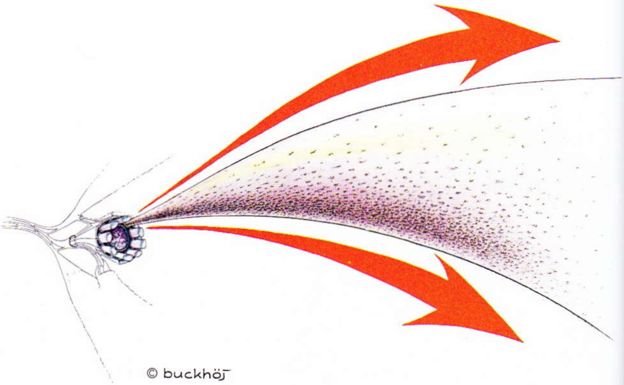


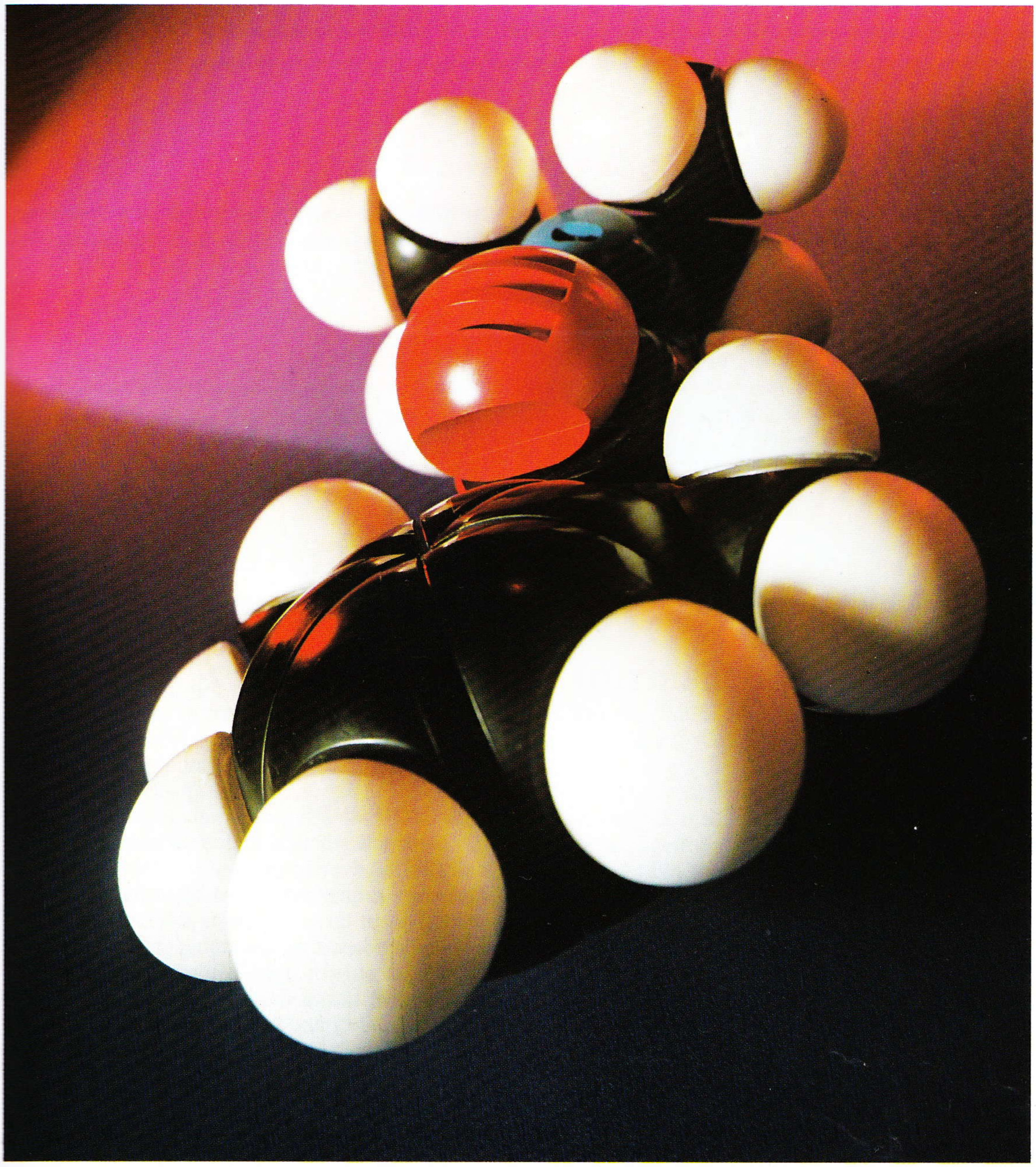
Fig. 20.

Fig. 21.



In unmyelinated fibres no nodes of Ranvier exist. In these nerve fibres the impulse moves from the initial area of depolarization to the next contig-uous segment of nerve. Thus, one depolarized segment of nerve activates the adjacent polarized area (Fig. 21).

Blocking of nerve conduction



Reversible block by the proper application of local anaesthetic agents is an invaluable clinical aid. These anaesthetic agents belong to the chemical groups of amino-esters, or amino-amides.

Amino-esters

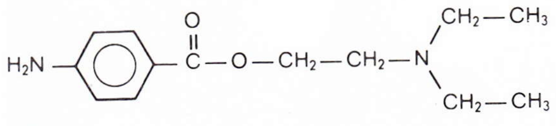


Fig. 22.

All local anaesthetics in this group in clinical use are esters of para-aminobenzoic acid. The first was procaine (1905), which was the standard drug for more than 40 years. It has no topical anaesthetic properties (Fig. 22).

Amino-amides

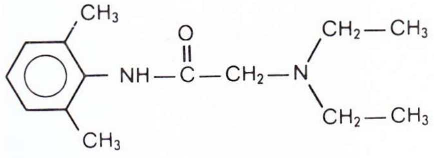


Fig. 23.

The first commercially available agent in the series of amino-amides was *lidocaine* (lignocaine), which became available in 1944. Because of its significant pharmacological advantages over procaine, lidocaine soon became the standard drug. It is still the most widely used local anaesthetic in dentistry. Lidocaine possesses good topical anaesthetic properties (Fig. 23).

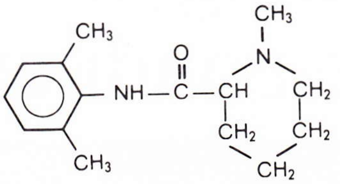


Fig. 24.

Another agent in this series is *mepivacaine*, which is similar to lidocaine in many respects but lacks topical anaesthetic qualities (Fig. 24).

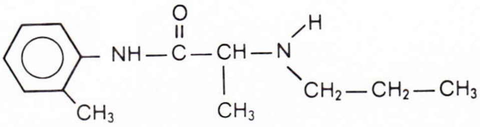


Fig. 25.

The most recent of the agents in this series is *prilocaine*, a compound similar to lidocaine. Its low systemic toxicity is the main clinical advantage of this potent local anaesthetic agent (Fig. 25).

Structure-activity relationships

All local anaesthetics in clinical use have a typical chemical arrangement - an aromatic and amine constituent connected by a chain. The aromatic part of the molecule is responsible for the lipophilic properties; the amine end is associated with hydrophilicity. Changes in any of these portions will alter the characteristics of lipid/-water solubility and protein-binding. The consequences of such changes will be an altered anaesthetic effect. Such alterations are reflected in changes in intrinsic anaesthetic potency, onset time, duration of action, toxicity ratio, and rate of degradation.

Pharmacodynamic aspects

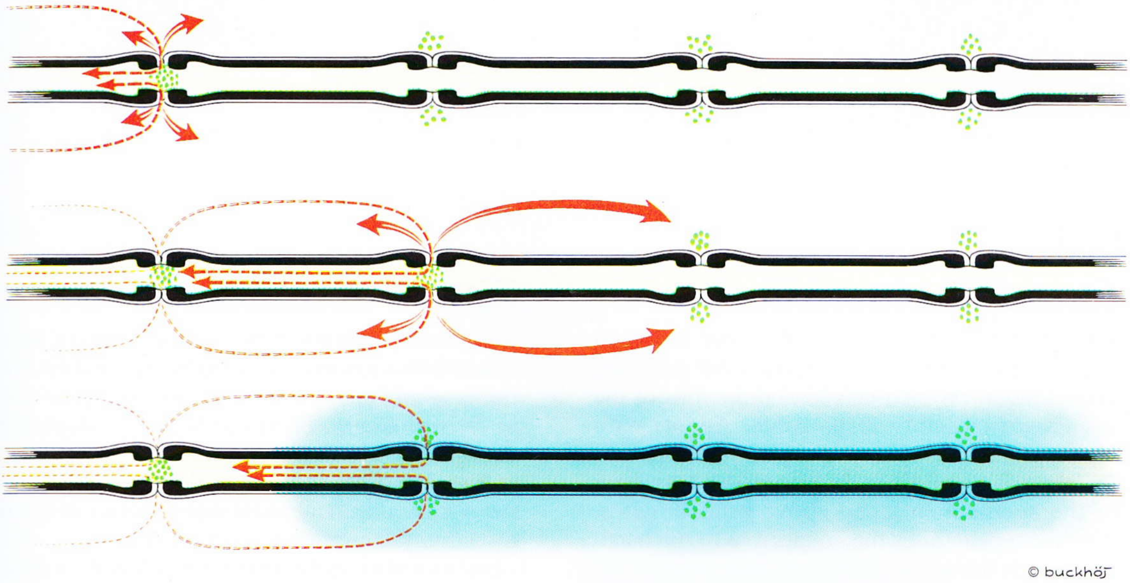


Fig. 26.

Mode of Action

The excitation process in the nerve membrane can be inhibited in various ways. Local anaesthetic agents interfere with nerve conduction by decreasing the rate of rise of the depolarizing phase of the action potential. The membrane resting potential is not influenced. The localanaesthetic agents interfere with the depolarization phase by reducing the influx of sodium ions. The potasium efflux, on the other hand, is influenced very little, which explains the lack of change in the resting potential. The sequence of events is as follows: the reduction in cell mem-brane sodium permeability entails a reduction in the degree of the depolarization phase. The critical threshold potential is not reached, and no action potential is "fired". Thus there is no conduction (Fig. 26).

Intrinsic potency

The minimum concentration of a local anaesthetic agent required to reduce the nerve action potential by the half of its amplitude within 5 minutes is taken as the measure of the intrinsic potency of the agent. Procaine is the least potent of the agents used in dental practice. Mepivacaine, prilocaine and lidocaine are respectively, 2,3 and 4 times as potent as procaine.

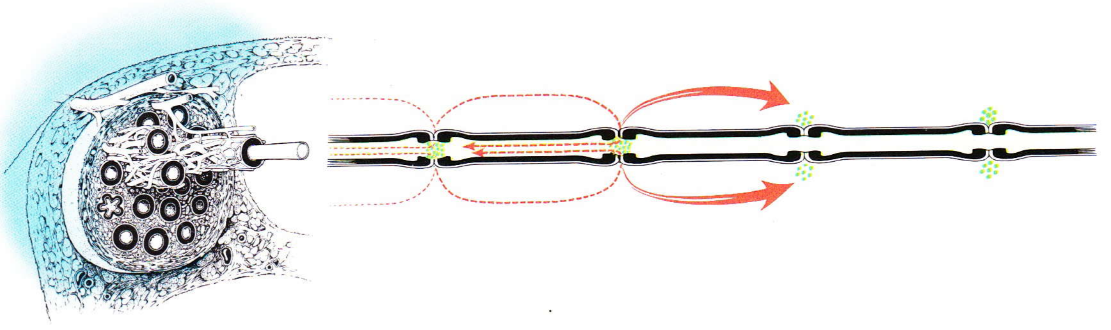


Fig. 27.

Onset of blockade

Onset of nerve block is much the same for mepivacaine, prilocaine and lidocaine, but procaine takes longer. Physico-chemical properties of the agents are probably responsible. Agents with high lipid solubility and low pKa act faster. At the physiological pH in the nerve, the base form of the agents mentioned above predominates. This form penetrates the connective tissue barrier to reach the nerve fibres, and this capacity for penetration is dependent on the lipid solubility of the agent (Fig. 27).

Site of action

The axon membrane is the site of action of local anaesthetic agents. It is highly probable that these agents interact with specific receptor sites in the membrane. These are probably situated in the vicinity of the sodium channels on both the external and the internal surfaces of the nerve membrane. Clinical local anaesthetics seem to affect only the internal receptor sites.

Sodium flux may also be hindered by less specific mechanisms. The highly lipid soluble anaesthetic agents penetrate the lipid content of the cell membrane, and may modify membrane structure or function so that ionic passage is impaired (Fig. 28).

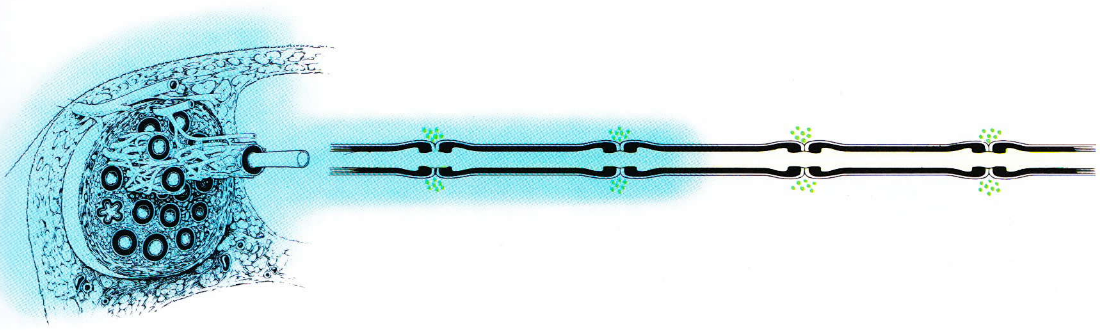


Fig. 28.

Form of action

The clinically used local anaesthetic agents exist in solution both as free base (B) and as posi-tively charged cations (BH^+). The equilibrium of these two forms is determined mainly by the pH of the solution and the pKa of the anaesthetic agent. The latter is a constant, characterizing the equilibrium of a particular compound. When pH and pKa have the same value, the two forms (B and BH^+) exist in solution in equal quantities. The relative proportion of free bases and charged cations is thus critically dependent on the pH of the solution. The free base penetrates biological membranes most easily, and it is, therefore, this form which penetrates the connective tissue to reach the axons. Equilibrium between base and cation is re-established at the nerve membrane, and the cations bind to the receptors, effecting a conduction block.

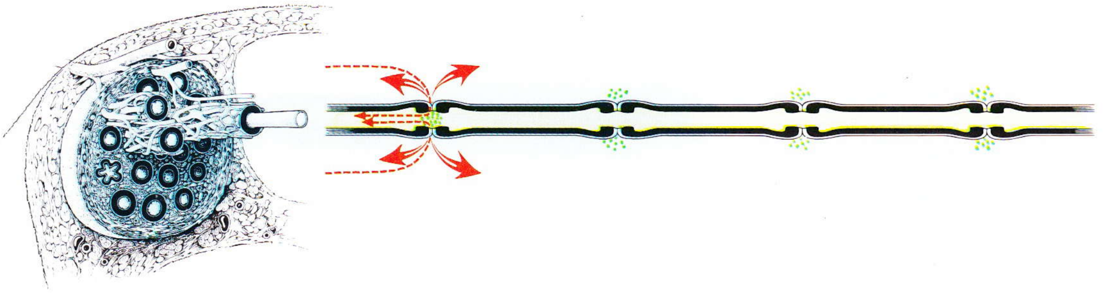


Fig. 29.

Duration of block

Local anaesthetics used in dentistry usually have a short duration of action, especially after infiltration methods and unless a localizing (vasoconstrictive) agent is added. This duration depends on the concentration of the cationic form round the axons, and the concentration depends, in turn, on the diffusion capacity of the anaesthetic agent, and the rate of elimination of the agent. Elimina-tion is the consequence of passive diffusion of the agent along a concentration gradient away from the nerve to the extrafascicular space, and of absoption into blood vessels in and around the nerve (Fig. 29).

Techniques of regional anaesthesia in dentistry

Preparation of the patient

An injection may be routine for the dentist, but it is often an unpleasant experience for the patient. Re-assurance, psychological support, is essential, and will increase the patient's confidence in his dentist (Fig. 30).

No particular formula is universally applicable. Some patients will gain confidence if a forthright approach, fully informative with nothing hidden, is used. Sometimes fears cannot be allayed, and the dentist must accept avoidance behaviour (closed eyes, clenched fists, and breath holding) while giving the injection. Often such patients will admit that the procedure was not as bad as they had feared.

Judicious use of premedication may help in preparing a restless or frightened patient for an injection, and allow the dentist more scope to practise his psychology. The ultimate success of the treatment depends heavily on a calm and confident patient - the anaesthetic must be effective, and it may be that the premedication should include an antianxiety agent.

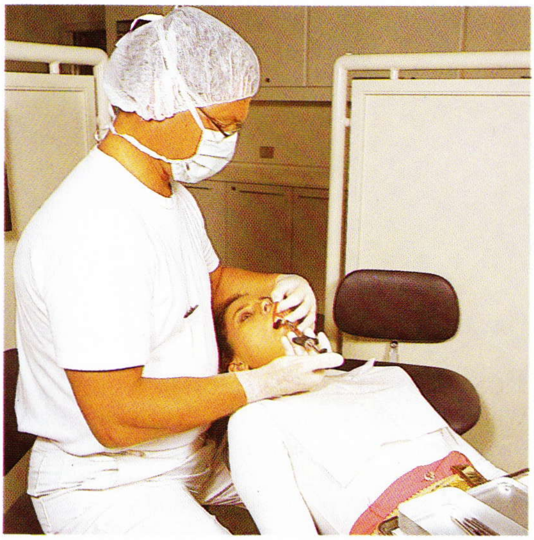


Fig. 30.

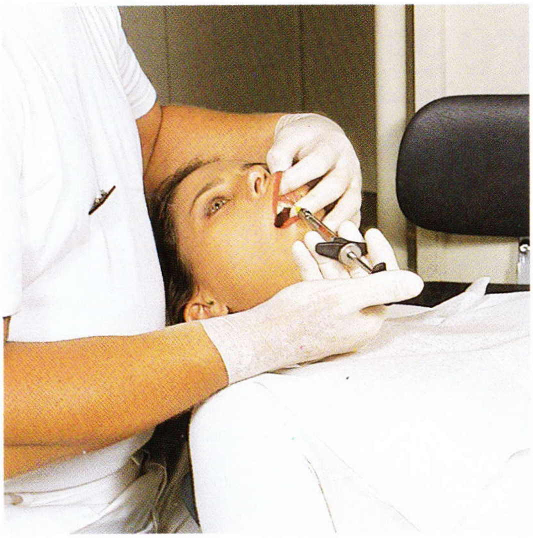


Fig. 31.

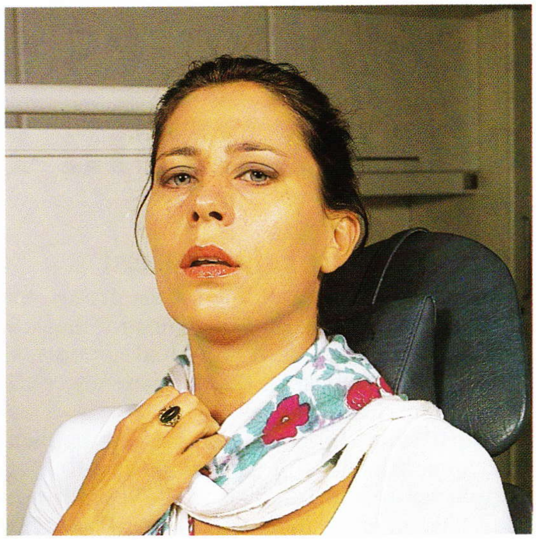


Fig. 32.

Position of the patient

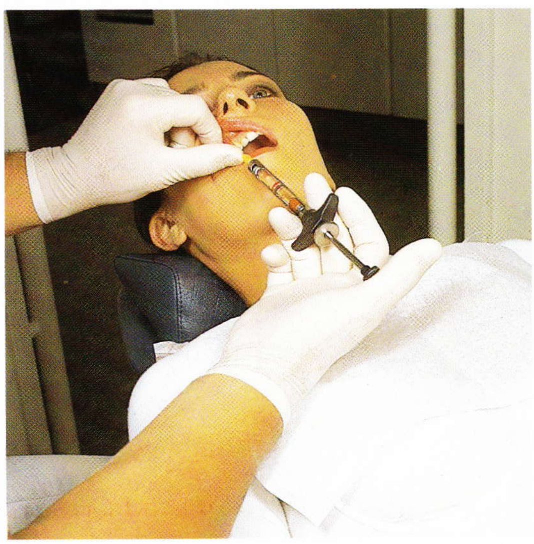
When possible, treatment should be given with the patient supine, which entails little risk of vasovagal attacks - hypotension and syncope (Fig. 31). Some physical or emotional conditions make the position impractical or impossible to use. For example, it is not suitable in pregnant women, in patients with some orthopedic disabilities, nor in those who simply cannot be trained, or psychologically reassured, so that they will accept treatment in the supine position.

Comfort to the patient

Tight fitting garments may partially obstruct the flow of blood in the head and neck area. A blouse or shirt collar sholud be loosened to avoid this (Fig. 32).

The operation light should give good visibility for the dentist, but not blind the patient (Fig. 33).

Fig. 33.



Pre-injection topical anaesthesia

Using modern disposible needles, the actual pain of penetration is minimal if the dentist's technique is in order. Distraction analgesia also helps. If the tissue is gently pressed at some distance from the intended puncture site, or if the patient's lip is lightly compressed, the perception of puncture pain will be further diminished (Fig. 34).

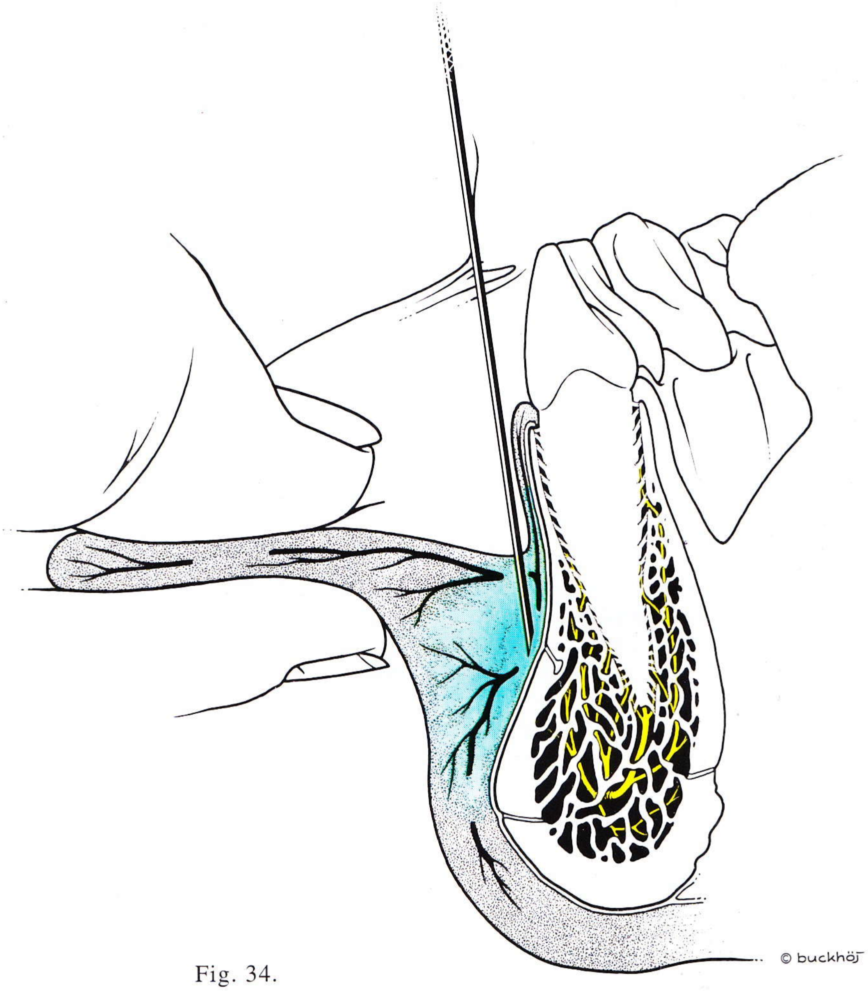


Fig. 34.

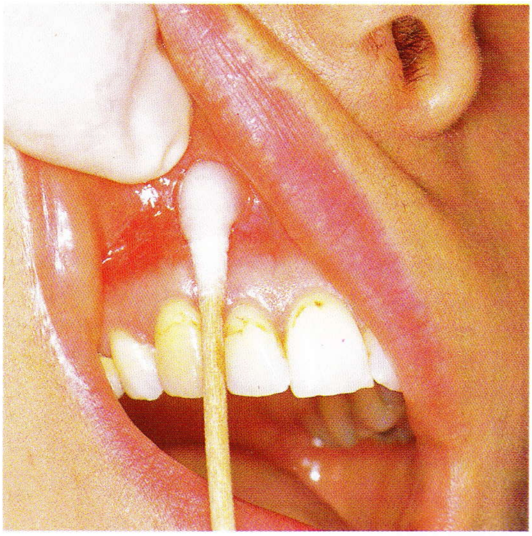


Fig. 35.

Ointment and spray

The mucosa at the puncture site can be anaesthetized in advance by a suitable topical ointment or spray. The most effective of these topical preparations contain the base form of the local anaesthetic agent. Those containing the water soluble hydrochloride salt have less of the base form, and are, in consequence, less active (Fig. 35).

Despite the proximity of the terminal nerve twigs near the surface of the mucosa, some time elapse - at least 2 minutes - must be allowed if the topical agent is to effectively block the pain of puncture. Clinical studies of shorter periods indicate that the mucosal block is inadequate, and any claims that a topical agent has a shorter onset of action than 2 minutes should be regarded with scepticism.

Local anaesthetic sprays tend to taste badly, and may induce salivation, especially if the spray contacts the tongue. It is also difficult to restrict the spray to the desired area, and its spread in the mouth elicits strong taste reactions, especially in children.

Duration

Duration of topical anaesthesia is short. Despite experimentally demonstrated differences between different preparations, only exceptionally will mucosal analgesia persist for more than 10 minutes.

We find topical anaesthesia ointment, spread on a cotton pellet, to be best. The dentist places the pellet at the desired site, and the patient holds it in place for the desirable minimum of 2 minutes. Before injection, the area is wiped with a dry compress to remove excess ointment and prevent undue spread.

Slow injection

Despite adequate mucosal anaesthesia, pain may be experienced not during puncture, but during the fluid injection, especially if this is made too rapidly.

pH

Local anaesthetic solutions with a vasoconstrictor preservative have a pH of 4, or even lower if they have not been properly stored.

Experimental studies show that plain solutions with near normal pH tend to cause less initial pain on injection. The temperature of the injected solution was found to be not critical. Warming of the solution to body temperature was without effect on the perception of pain.

Clinical requirements for local anaesthesia

Sterility

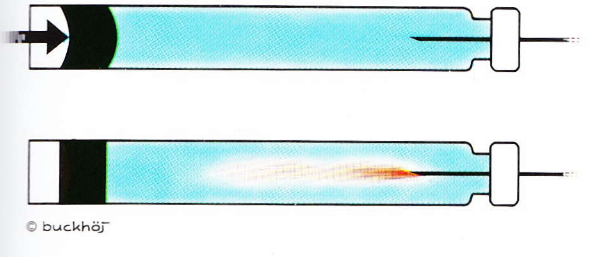
In principle, the administration of a local anaesthetic should be made under sterile conditions, as for all other surgical procedures. The fact that it is practically impossible to achieve sterility in the oral cavity does not relieve the dentist of his principle responsibility. Great care must be taken, and everything that can be sterile, must be sterile. In practice, injections made into healthy oral tissues virtually never give rise to infection. If the tissue at the injection site, or in the vicinity, is infected, there is a distinct risk of spread.

In the particular patient, for example a patient with rheumatic heart disease, everything possible must be done. Even though the oral cavity cannot be sterilized, the number of bacterial colonies can be reduced by disinfection. In the special case, prophylactic antibiotics may be required.

Up to this point, the situation is one of necessary compromise, but no compromise is allowable in respect of the instruments. The needle, cartridge and syringe must be absolutely sterile. 0.00004 ml of infected serum is all that is necessary to communicate serum hepatitis! A new sterile disposible needle a fresh cartridge, and a sterile syringe, are obligatory for each and every patient.

It should not be necessary to emphasize this further, but the use of "non-aspirating" cartridge syringes is no safeguard. Blood is, in fact, aspirated in more than 30% of such cartridges (Fig. 36)! Therefore a new cartridge for each patient!

Fig. 36.



The cartridge system is better than the multiple dose vial, but even with a cartridge, extra care must be taken. The rubber diaphragm should be rinsed in 70% alcohol, two minutes before use.

Aspiration and injection

The patient's dentures must be removed! Before injection, control aspiration must always be made. Thereafter, the injection should be given with as little pressure as possible. In general, the fluid flow will be virtually free, but injections into the papillae and hard palate require some pressure. The mucosa of the hard palate is tightly adapted to the periosteum - inject slowly using no more force or volume of local anaesthetic than is absolutely necessary."

Preparing the syringe

Prior to injection the rubber plunger of the cartridge should be displaced by slight pressure on the piston, because the plunger sticks to the glass during storage. If this is not done, there will be a jerk at the beginning of the injection, and the patient will experience pain, because of initially too rapid injection (Fig. 37).

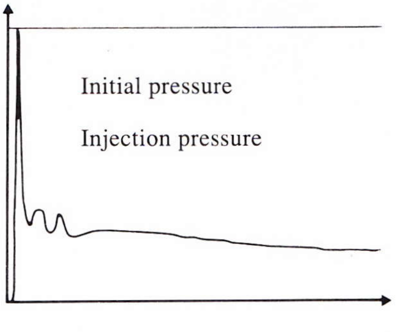
The air bubble in the cartridge should be expelled so far as possible, at the same time.

Gas bubbles

When cartridges are used the actual needle cannot be filled with the solution because of the elasticity of the rubber plunger, but the volume is so small that this is of no consequence.

Larger air bubbles in the system must be eliminated to avoid the potential hazard of air injection into a vein.

Fig. 37.



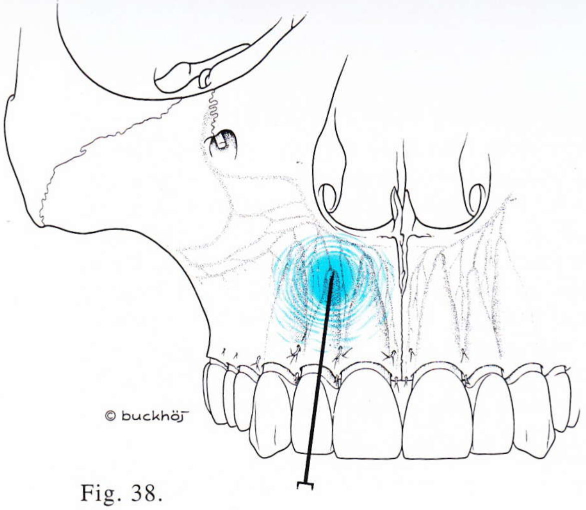


Fig. 38.

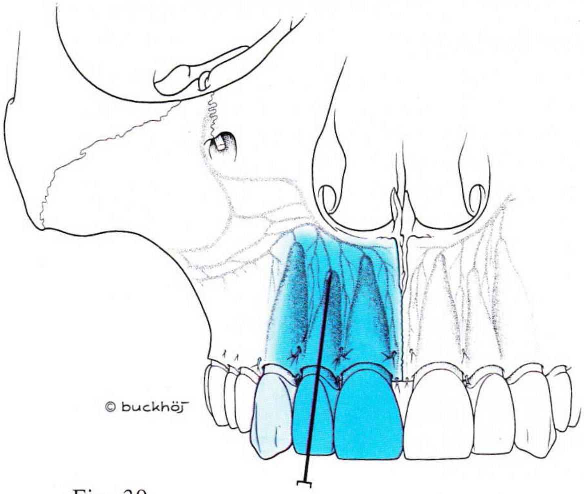


Fig. 39.

Solution properties of clinical importance

Onset time

After infiltration of the solution, diffusion from the depot at the buccal fold to the apex of the tooth is rapid, especially in the frontal, and upper premolar areas (Fig. 38). Modern solutions work within two minutes, and the amide local anaesthetics are virtually identical in their effects, though differences can be demonstrated by refined methods. One preparation may work perhaps 15 seconds quicker than another, but this is of no clinical importance.

The onset of inferior alveolar nerve block takes longer, irrespective of the solution - about 3 to 5 minutes.

Spread

Good spreading capacity can be an advantage, especially in the frontal area. One injection may cover several adjacent teeth. An injection at the apex of the upper lateral incisor induces pulp analgesia in the two adjacent teeth in about 80 % of subjects (Fig. 39). Good spread also helps when needle placement cannot be, or is not, ideal, and it has been proposed that a spreading agent, e.g. hyaluronidase, be added to some dental local anaesthetic solutions. In some instances this might be of use, but the logical corollary of better spread is reduced concentration of the agent overall - also in the area where optimal effect is desirable.

Frequency of effective analgesia

Solutions with an efficacy of less than 90% at a volume dosage of 1-2 ml are of no interest in modern practice. Most available solutions meet these requirements, but there are exceptions. Lidocaine 2% with noradrenaline is only just adequate. Plain solutions of high concentration are somewhat unpredictable.

Duration of anaesthesia may be very short, and effects vary widely between individuals. It is important to realize that "failures" with these solutions are just as likely to be attributable to duration of anaesthesia, as to failure because of faulty technique.

In regional blocks, e.g. mandibular, success depends rather more on technique than on the properties of a particular agent.

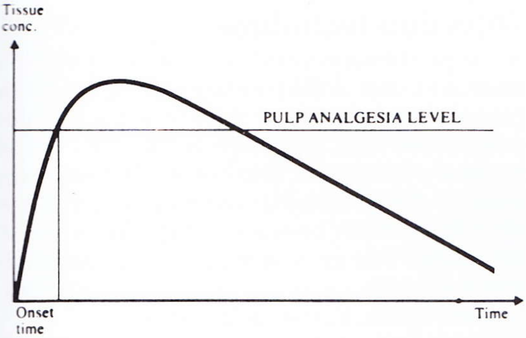


Fig. 40.

Duration of pulp anaesthesia

Local anaesthetic solutions differ most in respect of the duration of pulp anaesthesia. A specific solution with vasoconstrictor additives differing both in concentration and type has different durations of action. Clinical documentation of this is difficult, but differences are clear when Björn's electrical stimulation experimental method is applied.

Infiltration of 2% lidocaine containing 10-12.5 µg/ml adrenaline, gives good pulp analgesia for about one hour, though variation between patients can be great.

If solutions containing higher percentages of local anaesthetic are used, frequency of analgesia may be slightly increased, while the duration of analgesia is not much prolonged.

In general, a fine balance between the concentrations of the local anaesthetic and its vasoconstrictor additive determines the duration of the analgesia, whereas frequency of effect is primarily a function of anaesthetic concentration (Fig. 40).

Extremely lipid soluble local anaesthetics, such as bupivacaine, have longer duration of effect, from 6-8 hours, when used for regional blocks. This is an advantage when procedures are long - extraction of an impacted lower wisdom tooth, for example, but the patient is forced to accept numbness of the lips often over a long postoperative period of time.

It is in general surgery, below the umbilicus, where these agents are of primary use. An epidural block, for example, will give substantial analgesia long into the postoperative period.

Duration of soft tissue anaesthesia

The persistence of soft tissue anaesthesia long after the cessation of pulp anaesthesia is an undesirable side effect of dental local anaesthesia. Practically, nothing can be done about this if a mandibular block is made, but, when infiltration anaesthesia is used, the duration of numbness depends rather more on the choice of local anaesthetic. Thus, the duration of soft tissue numb-ness can be reduced by about an hour if a plain solution (with no vasoconstrictor additive) is used. But this is not without cost! - the duration of pulp anaesthesia is also reduced (Fig. 41).

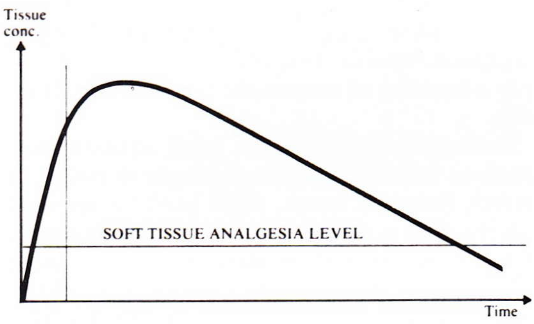


Fig. 41.

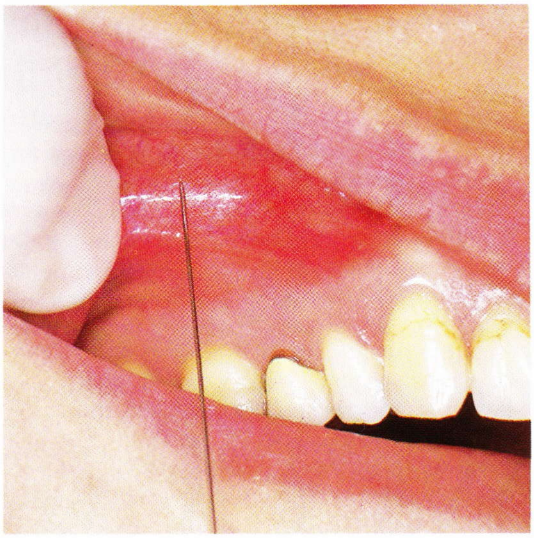


Fig. 42.

Injection technique

Some practitioners inject a few drops under the mucosa as soon as the puncture is made, and then proceed each advance of the needle towards the target area with drop injections. This is not necessary. It does not help because the analgesia effect is always delayed, and may in fact, cause extra discomfort because of the distension of the tissues. Fan movements of the needle in the vicinity of the target area are also unnecessary. Modern agents are fast spreading.

So, in summary, the needle should be inserted gently and directly in one continuous movement to the target area, where, after careful aspiration, the injection should be made, exerting as little pressure on the plunger as possible. Take time!

Manual dexterity is very important, both during introduction, and fixation of the needle before injection is made (Fig. 42).

Fig. 43.

The fingers must provide a constant and stable reference and rest for the syringe. Any patient, especially a child, may suddenly move the head. Use the teeth and face as anchor points for the fingers of the injecting, and supporting hand. The method shown in the diagram is to be recommended (Fig. 43). Always precede an injection by aspiration. Inject slowly so that no counter pressure is produced. The hard palate and papillae constitute exceptions because the mucosa is tightly adherent to the periosteum. Some pressure is therefore necessary to effect the injection, but use no more pressure than is absolutely necessary. Inject slowly and use only the minimal amount of anaesthetic Intravascular injections are not uncommon in the palate. Be careful! A sudden loss of tissue resistence during injection may betoken vessel puncture, and, retrospectively, bleeding from the puncture site when the needle is withdrawn.

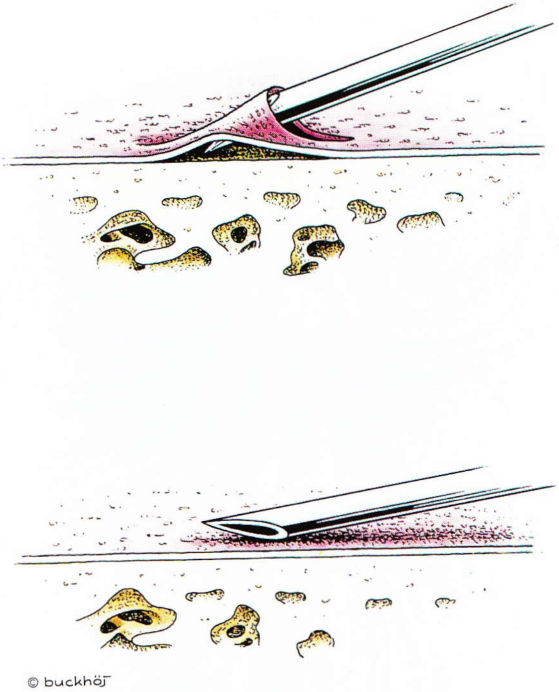


Fig. 44.

Do not scrape the periosteum with the needle point (Fig. 44).

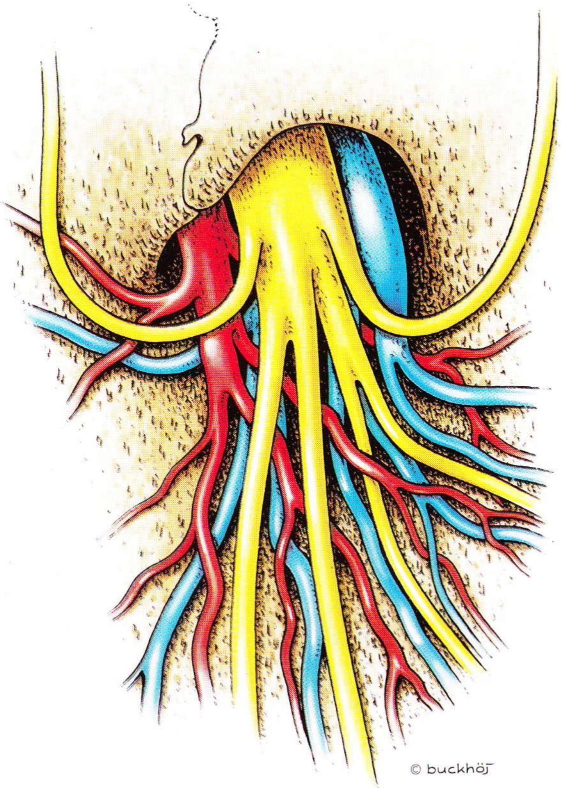


Fig. 45.

Fig. 46.

Post-injection precaution

Never leave the patients alone after an injection. Allergic or other reactions may occur instantaneously at any time. Dentist or nurse must always be present, and modern anaesthetic solutions work so quickly that there is, today, no excuse to leave the patient (Fig. 46).

Never introduce the tip of the needle into a foramen. Risk of damage to vessels and nerves is considerable. Haematoma, paraesthesia, and prolonged anaesthesia may result (Fig. 45).

Anaesthesia of the upper jaw

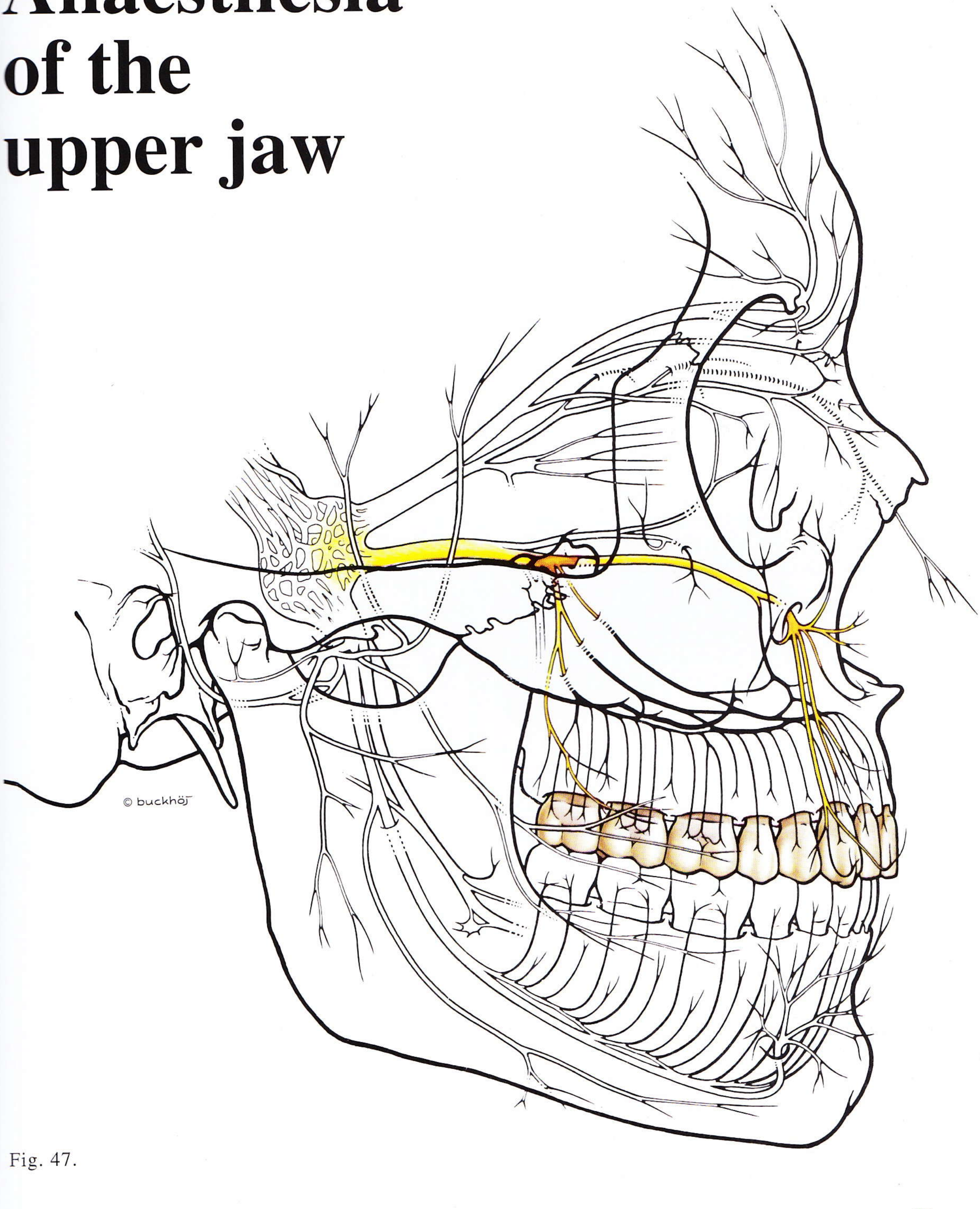


Fig. 47.

General considerations

The outer bone lamina covering the maxilla is comparatively thin and in many areas porous. This facilitates diffusion from an injection depot over the buccal fold to the target area at the apices of the upper teeth. To obtain an effective blockade of the palatal roots of the molars, additional infiltration must be made at the palate to block the fibres from the greater palatine nerve.

In many patients, the structure of the lower border of the zygomatic arch is such that the distance between the buccal fold, where the injection depot is layed, and the buccal apices of the first and second molars, is increased. Despite this, the diffusion capacity of modern solutions is virtually always adequate, and anaesthesia, at least good enough for routine cavity preparation, is achieved.

As in the frontal area in the lower jaw, it is very important to make needle contact with the bone before injection of the solution. If this is not ensured, the fascia of the circumolar muscles will hinder diffusion to the apex of the tooth.

Regional blocks in the upper jaw can be used to advantage, e.g. infraorbital block and the so-called tuberosity block, especially in connection with surgical interventions. These areas are highly vascular, and, particularly with the infraorbital block, which necessitates injection near to a bony canal, a sound knowledge of the anatomy is obligatory.

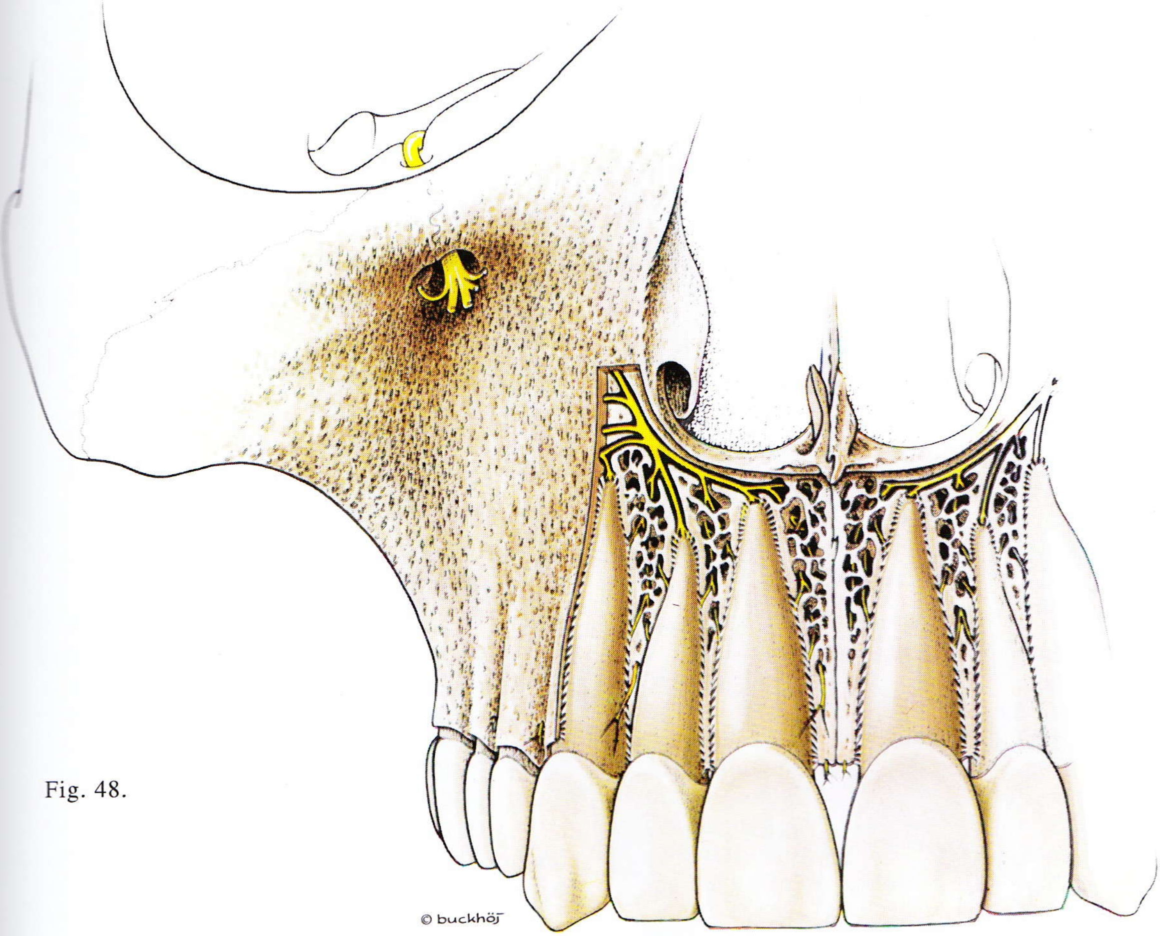


Fig. 48.

Incisors and canines

Anatomy of the upper front area

This region is innervated by the superior alveolar nerves which branch off from the infraorbital nerve just before it emerges from the infraorbital canal below the orbit. These branches supply the incisors and canines, the buccal gingiva and the periosteum (Fig. 48). These nerves anastomose over the midline. The palatal gingiva, mucosa and periosteum are innervated by the nasopalatine nerve which emerges from the bone through the incisal foramen. The medial spread of the local anaesthetic may be hindered by the labial frenulum in the midline.

The maxillary bone is covered by a thin and porous lamina easily penetrated by a local anaesthetic solution injected at the level of the apices.

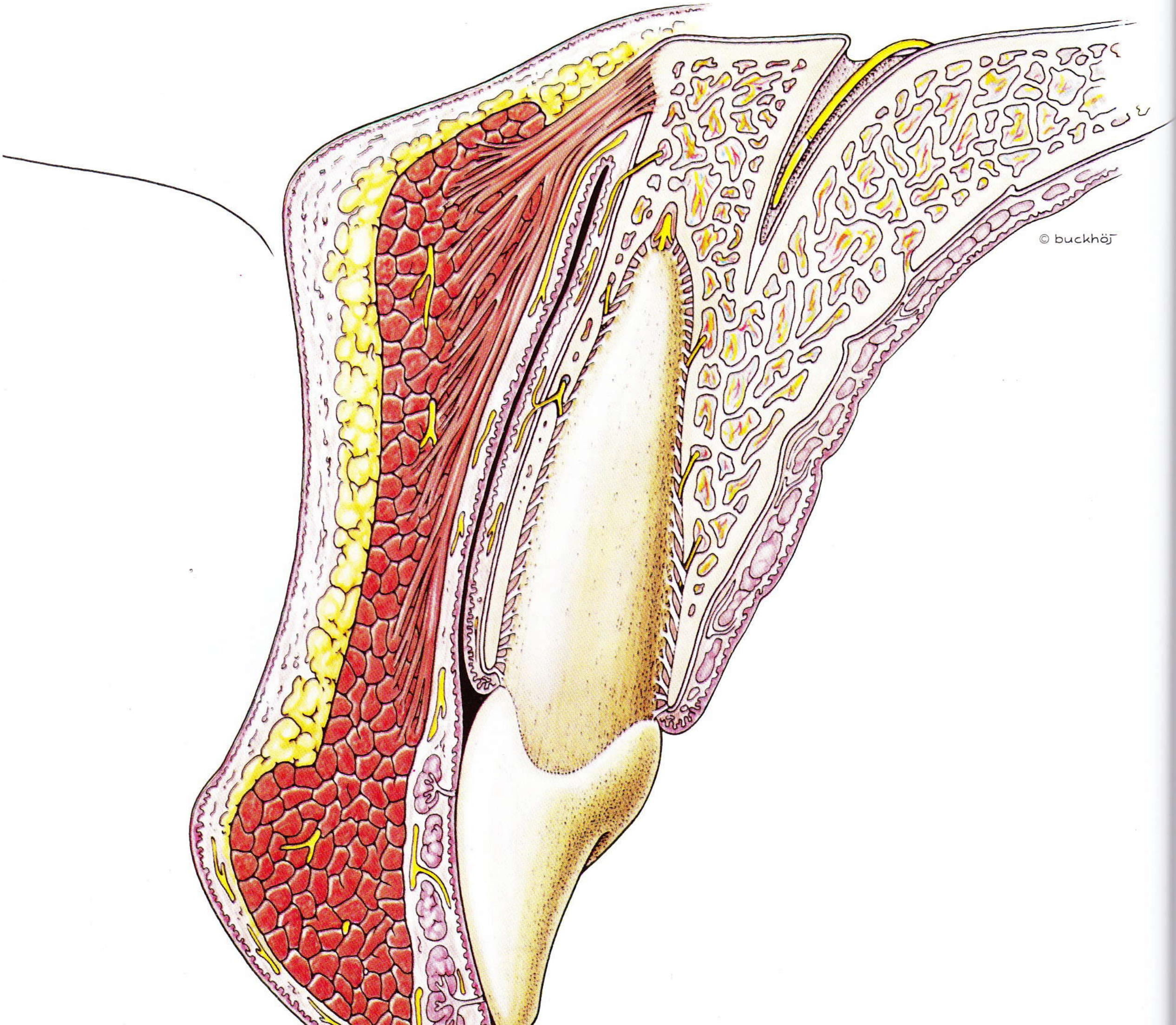


Fig. 49.

A too superficial placement of the needle will entail that the point lies between the fasciae of the labial muscles (Fig. 49). Diffusion will be hindered, and anaesthesia reduced. A too rapid injection in this area, especially at the nasal spine, may unduly distend, even tear the tissues. The resultant pain may be particularly severe.

Operative aspects

Cavity preparations and pulp surgery

A buccal fold injection suffices for restorative work, and when making cavity preparations, it will often be found that diffusion from a single injection is sufficient to cover the adjacent teeth, so that adjacent cavities may be prepared without further local anaesthesia procedure. If a rubber dam is used, a supplementary palatal injection may be necessary to relieve pain caused by ligatures or clamps.

Surgical procedures

For extractions the palatal gingiva must also be anaesthetized. This is effected by supplementary injection at the edge of the incisive papilla (naospalatine block) or for a single extraction, as infiltration anaesthesia of the palatal mucosa near the affected tooth. For apical resections, or in other cases where a flap must be raised during an operation, complete anaesthesia must be attained before commencing the operation, as it may be difficult to supplement anaesthesia after the bone surface has been exposed. In periodontal surgery (e.g. gingivectomy), anaesthesia is produced by infiltration into the operation field with an injection in the buccal fold. Sometimes it may be advisable to complete the local ischaemic effect by injecting a few drops of solution into the papillae. This injection should be given after anaesthesia has been attained by infiltration in the buccal fold.

Sometimes there is a supplementary innervation from twigs of the nasopalatine nerve. These often account for unsatisfactory, incomplete, anaesthesia of the field, but can easily be blocked by a swab soaked in topical anaesthetic cream and placed into the nostril.

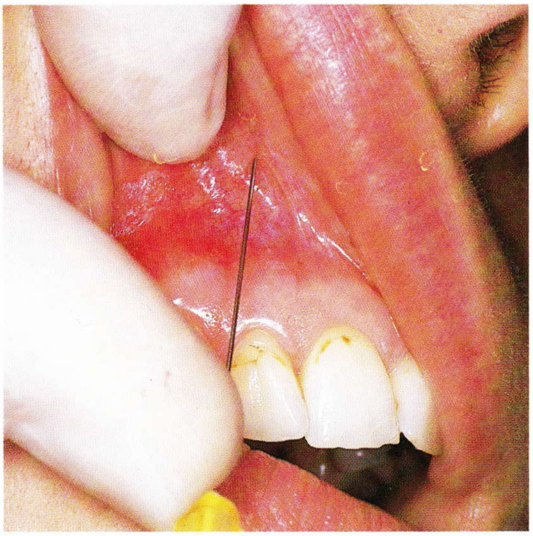


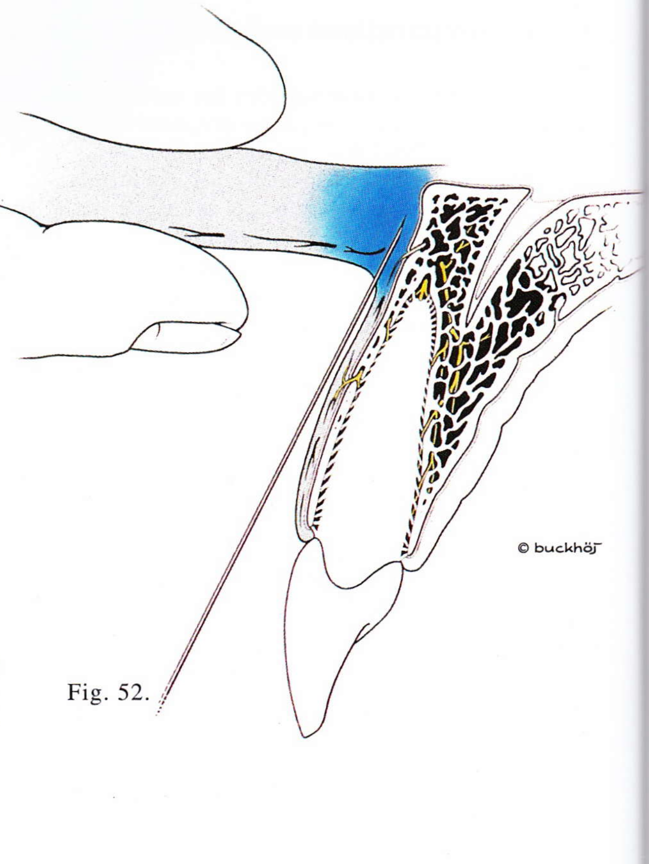
Fig. 50.

Fig. 51.

The injection

The incisors and canines of the upper jaw are usually anaesthetized by injections in the buccal fold (infiltration anaesthesia). The injection is applied just adjacent to or mesial to the tooth. The needle is introduced near the bone, and passed axially towards the apex of the tooth. This ensures minimal distance between needle point and the apex target area (Figs. 50 and 51):

If the needle is introduced obliquely, the anaesthetic deposition may well come to lie too far from the target area. When contact is made with the bone, a slow injection of 1-2 ml solution (Fig. 52) will effect anaesthesia of the target tooth, and one, or both, of the adjacent teeth. Central incisors are best anaesthetized by somewhat distal injections, because of the proximity of the nasal spine.



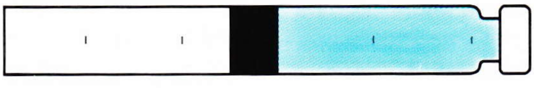


Fig. 52.

Spread of analgesia

The injection of a standard volume of 1-2 ml of the solution will ensure adequate analgesia of the tooth pulp in this area (Fig. 53 and 55). The root of the canine is longer than those of the incisors and the apical part of the root is often distally oriented. This must be kept in mind during the injection of the solution.

The area of soft tissue anaesthesia corresponds to the coloured zone in the figures 54 and 56.

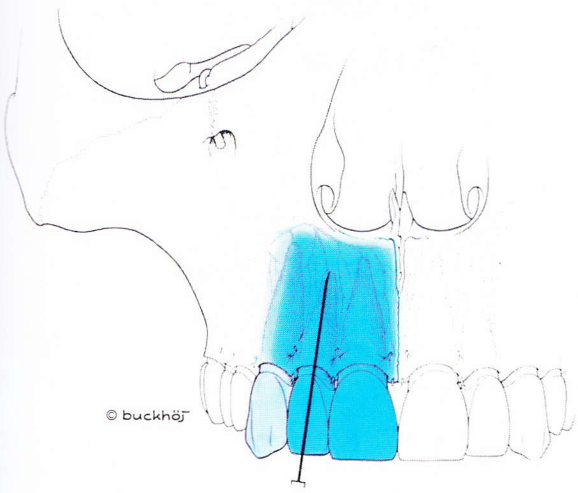


Fig. 53.

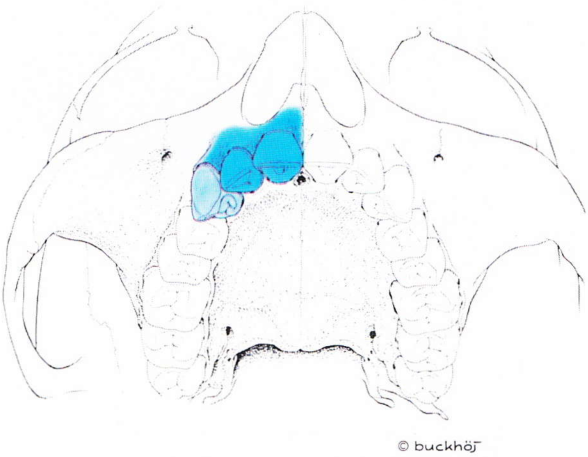


Fig. 55.

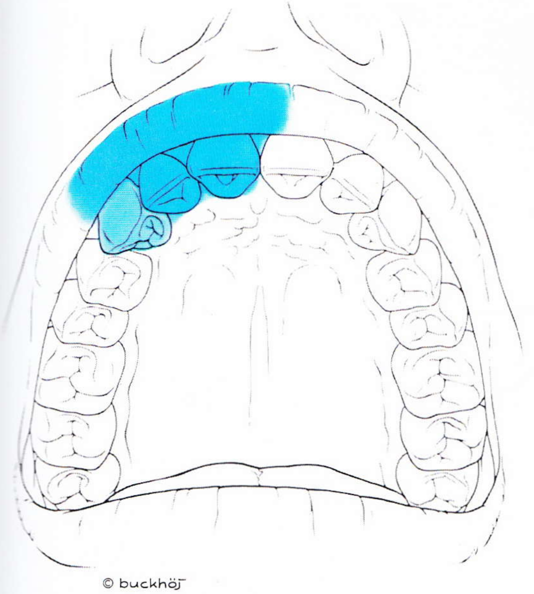


Fig. 54.

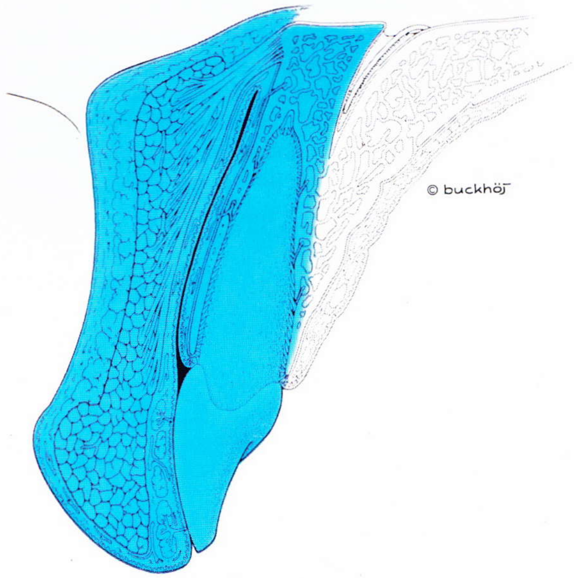


Fig. 56.

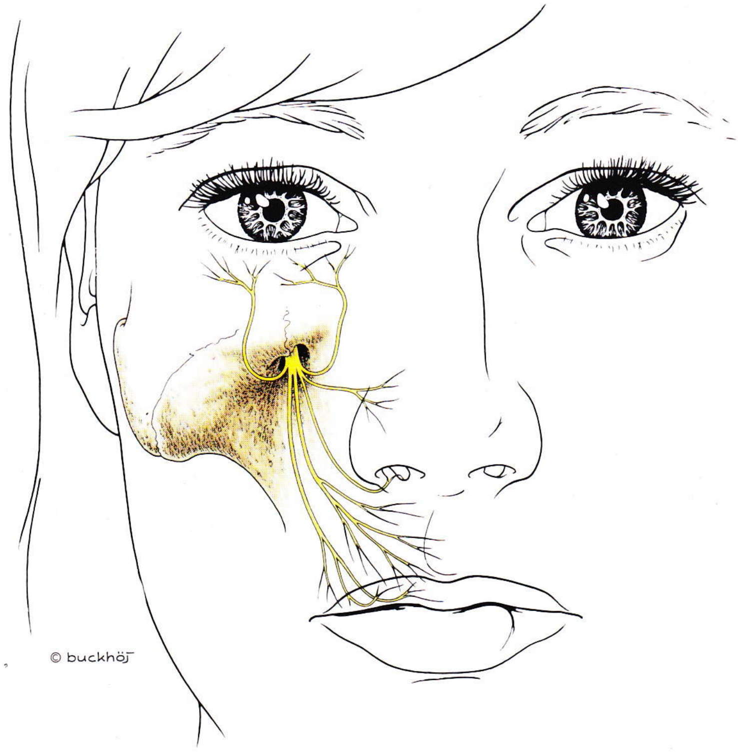


Fig. 57.

The infraorbital block

In certain cases, especially in connection with oral surgery, the anterior teeth of the upper jaw can also be anaesthetized by conduction anaesthesia, i.e. infraorbital block (Figs. 57 and 58).

The intraoral technique is the simplest for dental purposes and is applied as follows.

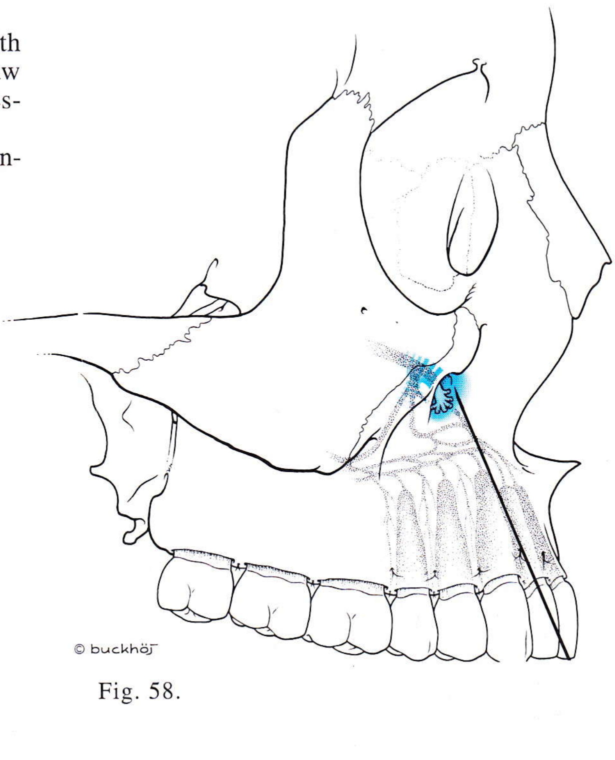


Fig. 58.

Fig. 59.

The centre of the inferior margin of the orbit is palpated with the index finger. The finger is then gently passed to a point about 1 cm below the orbital margin. At this point in most cases one can detect a bundle of vessels and nerves emerging from the infraorbital foramen. The index finger is held at this point while the upper lip is lifted with the thumb (Fig. 59).

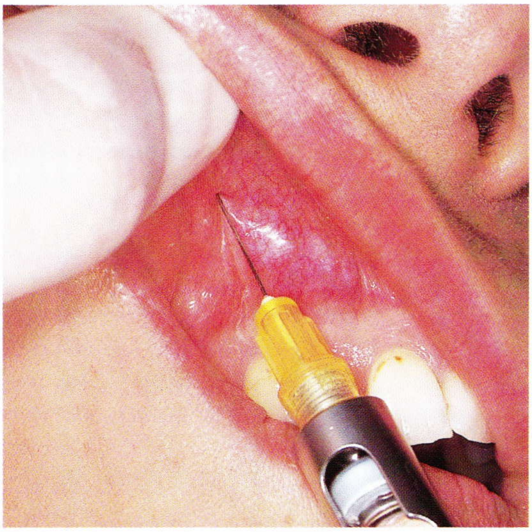


Fig. 60.

The syringe is held in the other hand and the needle is introduced into the buccal fold directly over the canine. The needle is gently pushed forward near to the bone towards the tip of the index finger (Fig. 60). When the needle has reached this site, aspiration is performed to verify that the tip of the needle is not placed in a vessel. About 1 ml of solution is slowly injected The index finger tip is kept in place during the injection to control the deposition of the solution. The puncture can also be made in the buccal fold just over the first premolar where the underlying bone is flat.

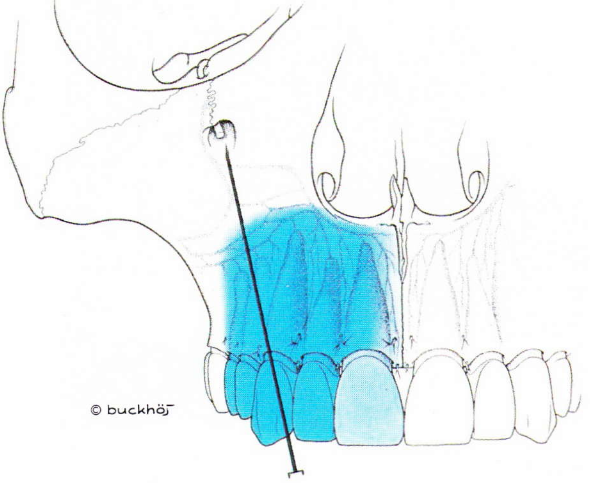


Fig. 61.

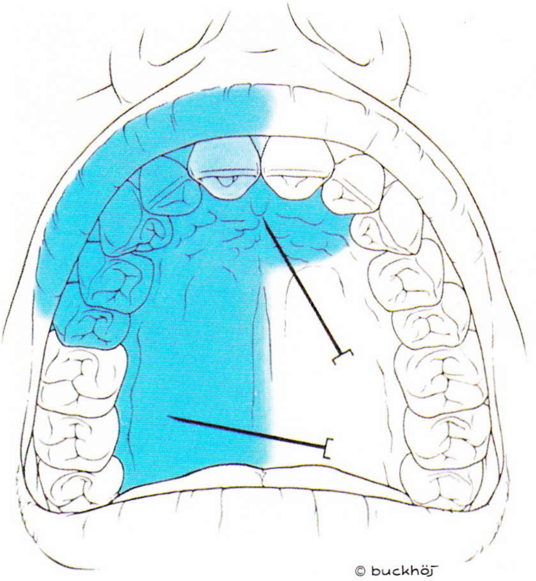


Fig. 63.

Spread of analgesia

The injection of 1.0 ml at the infraorbital foramen will anaesthetize the teeth and bone within the coloured area (Fig.61).

Gingival and soft tissue anaesthesia after infraorbital block (Fig. 62).

Fig. 62.

© buckhöj

The area of anaesthesia resulting when supplementary block is made of the palatine nerves at the incisive papilla, and at the major palatine foramen (Fig. 63).

To ensure complete anaesthesia of the medial incisor in the same quadrant it may be necessary to block anastomosing fibres from the dental nerve plexus from the opposite side of the midline. In such cases the infraorbital block is supplemented with about 0.5 ml of the solution injected in the contralateral buccal fold.

Premolars

Anatomy of the premolar area

The region is innervated by the superior dental plexus, which is formed by convergent branches from the superior, posterior, and anterior alveolar nerves (Fig. 64). The presence of the middle superior alveolar nerve is irregular. When present, it innervates the premolars, the buccal gingiva and the periosteum around these teeth, and often the mesiobuccal root of the first molar. The palate is innervated mainly by the greater palatine nerve, but anastomosing branches from the nasopalatine nerve may occur in the area of the first premolar.

Diffusion of the solution from the depot in the buccal fold is especially good in this area, so that there are no problems with the anaesthetizing of the palatal roots of the premolars.

The diffusion barrier is thin; the apices of the teeth lie very near the surface of the bony lamina. Small volume injection suffices.

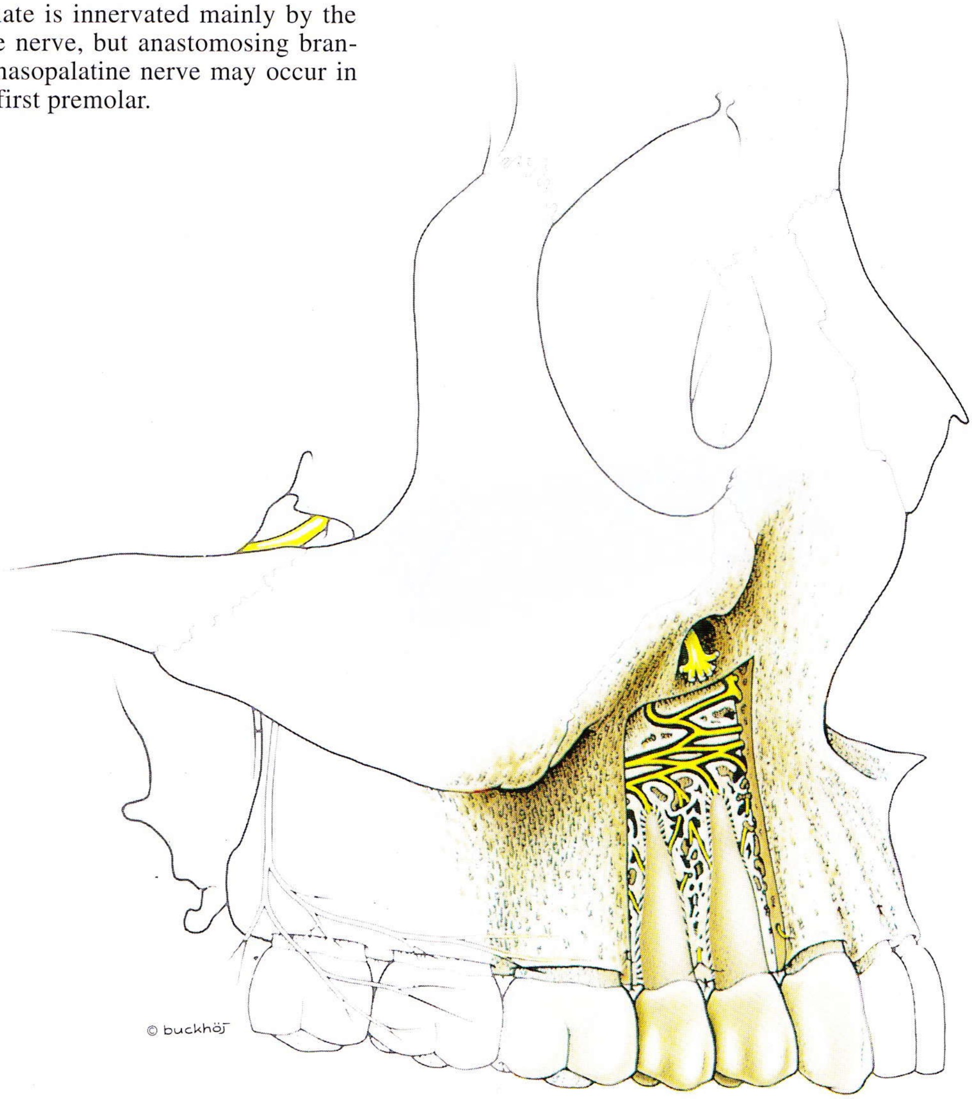


Fig. 64.

Operative aspects

Cavity preparations and pulp surgery

In these cases sufficient anaesthesia is obtained by infiltration in the buccal fold. If both premolars are to be anaesthetized, the solution can be deposited in the apical region between the teeth.

Surgical interventions

A supplementary injection must be applied palatally to anaesthetize the palatal soft tissues. Rather than blocks of both the greater palatine and the nasopalatine nerves, which practice requires two injections, it is better to effect the desired anaesthesia by one injection in the palatal mucosa adjacent to the premolars.

Injection

The premolars of the upper jaw are anaesthetized by infiltration in the buccal fold next to the teeth. After puncture, the needle is advanced axially (Figs. 65 and 66).

1.0-1.5 ml of solution is deposited in the apical region of the premolars (Fig. 67).

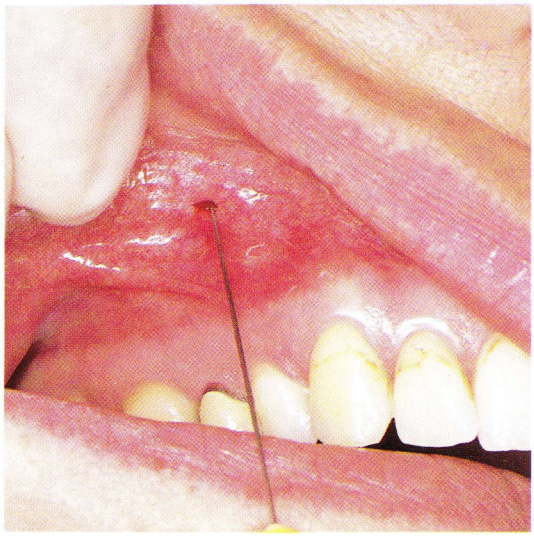


Fig. 66.

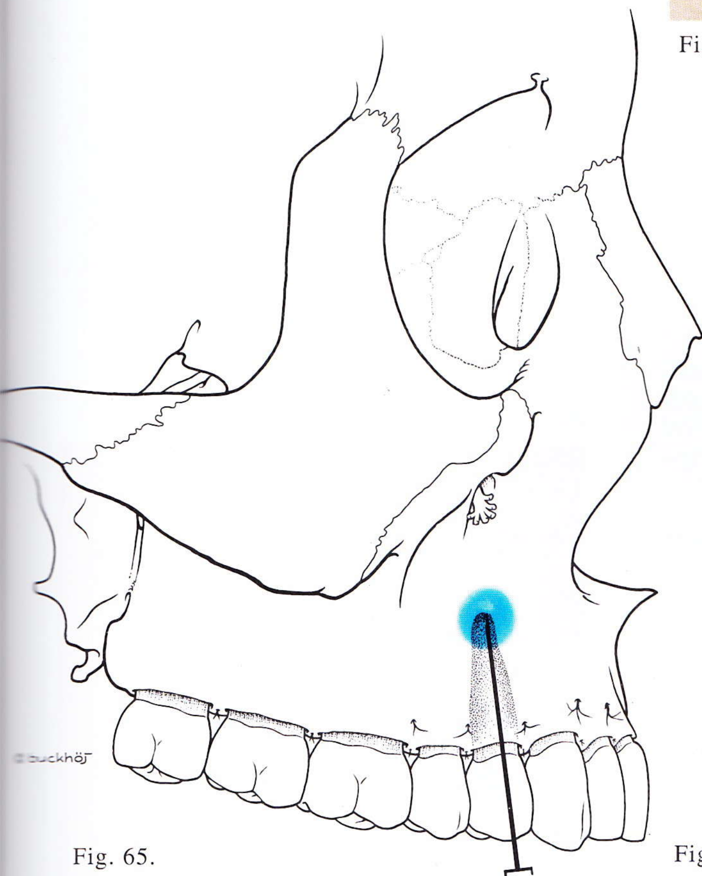
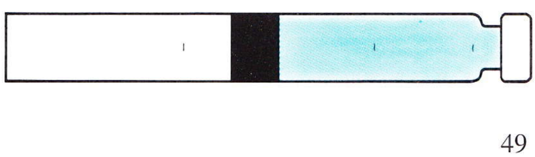


Fig. 65.

Fig. 67.



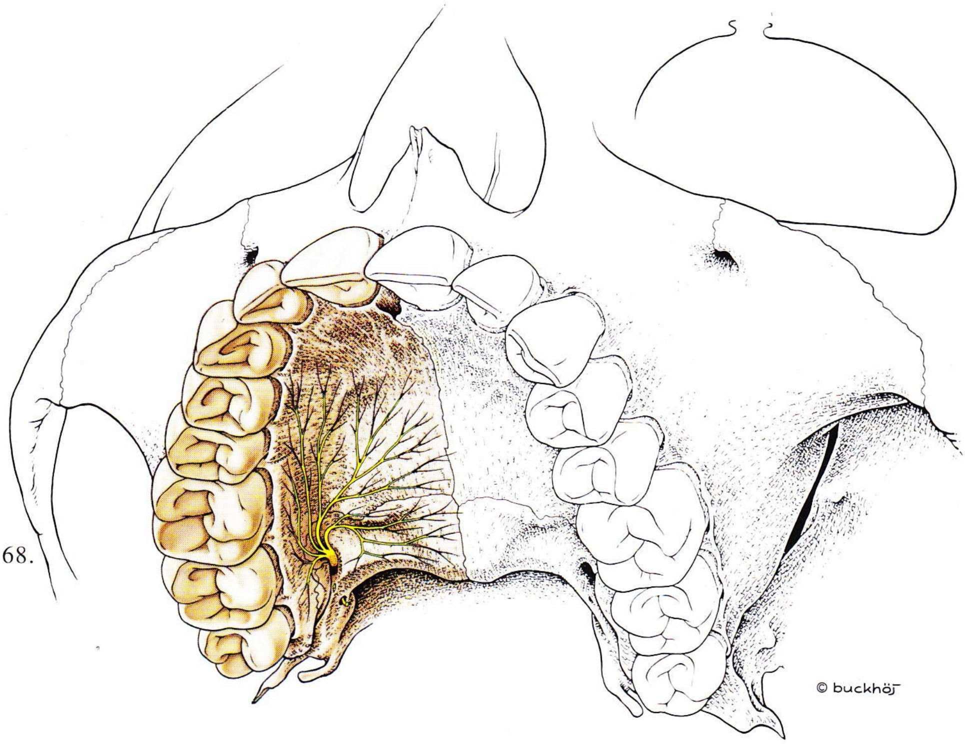


Fig. 68.

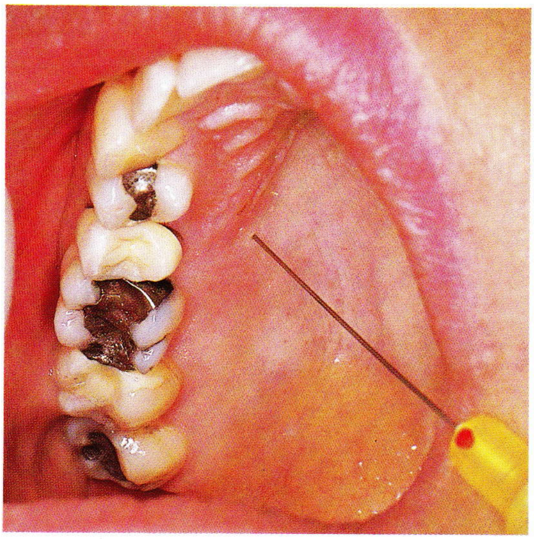
Supplementary injection in the palate

For extractions and gingivectomy, the palatal mucosa and gingiva are most easily anaesthetized by puncture at right angles to the mucosa at a point roughly one half the tooth height (Figs. 68 and 70). Inject about 0.1 ml there (Fig. 69).

This injection obviates the need to block both the nasopalatine and greater palatine nerves

Fig. 69.

Fig. 70.



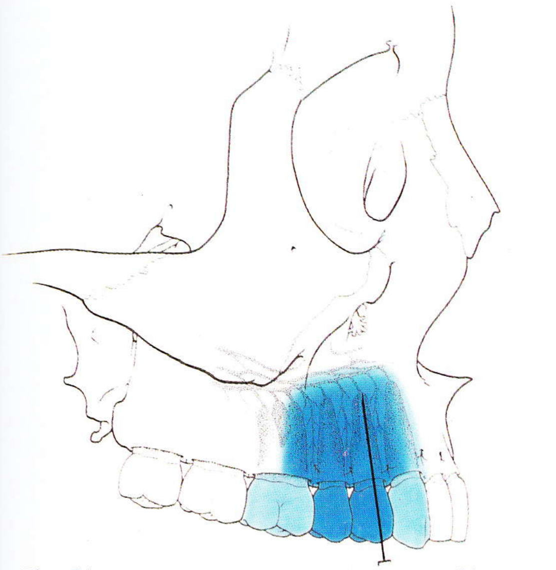


Fig. 71.

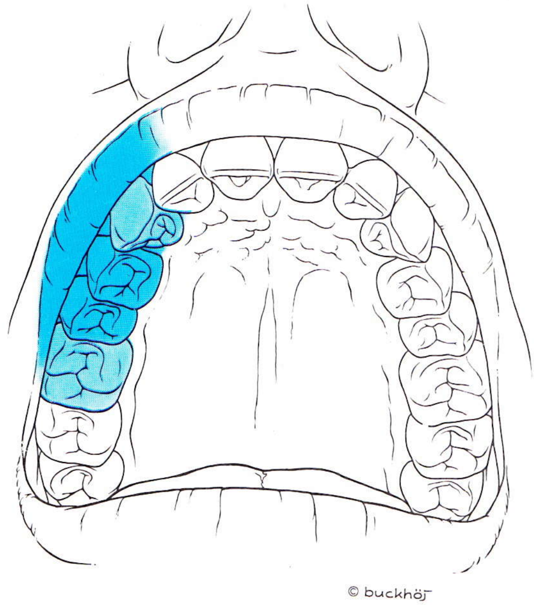


Fig. 73.

Spread of analgesia

Teeth and bone anaesthesia after buccal fold injection of 1.0 ml solution (Figs. 71 and 72).

Soft tissue anaesthesia (Fig. 73).

After additional blocking of the palatine by injection at the lingual side of the premolars (Fig. 74).

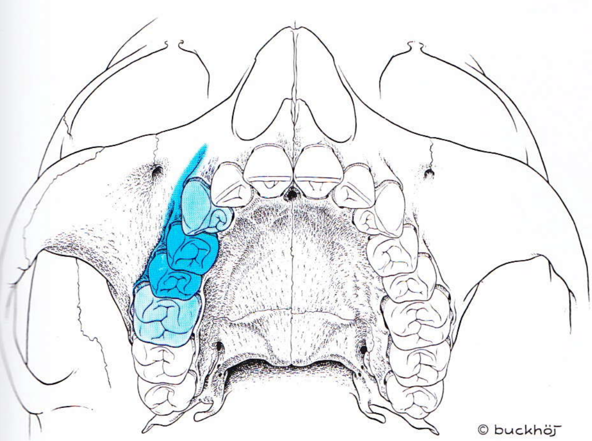


Fig. 72.

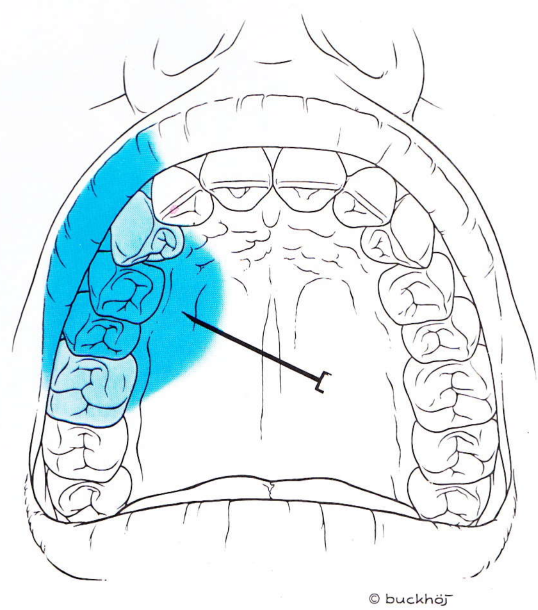


Fig. 74.

Molars

Anatomy of the molar area

The molar region of the upper jaw is innervated by the superior posterior alveolar nerve, which branches from the infraorbital nerve before it reaches the orbital cavity. These branches pass down the maxillary tuberosity, which they enter to innervate the upper molars, the buccal gingiva and periosteum in this region. The palatal gingiva, mucosa, and periosteum are supplied by the greater palatine nerve, which runs from the pterygo-palatine fossa, down the pterygo-palatine canal, and passes through the greater palatine foramen to reach the hard palate (Fig. 75).

The distance between the buccal fold and the apices of the upper molars varies from patient to patient. Sometimes the lower margin of the zygomatic arch lies so low that the distance is too great for adequate quantities of anaesthetic solution to diffuse from the buccal depot to the apical target.

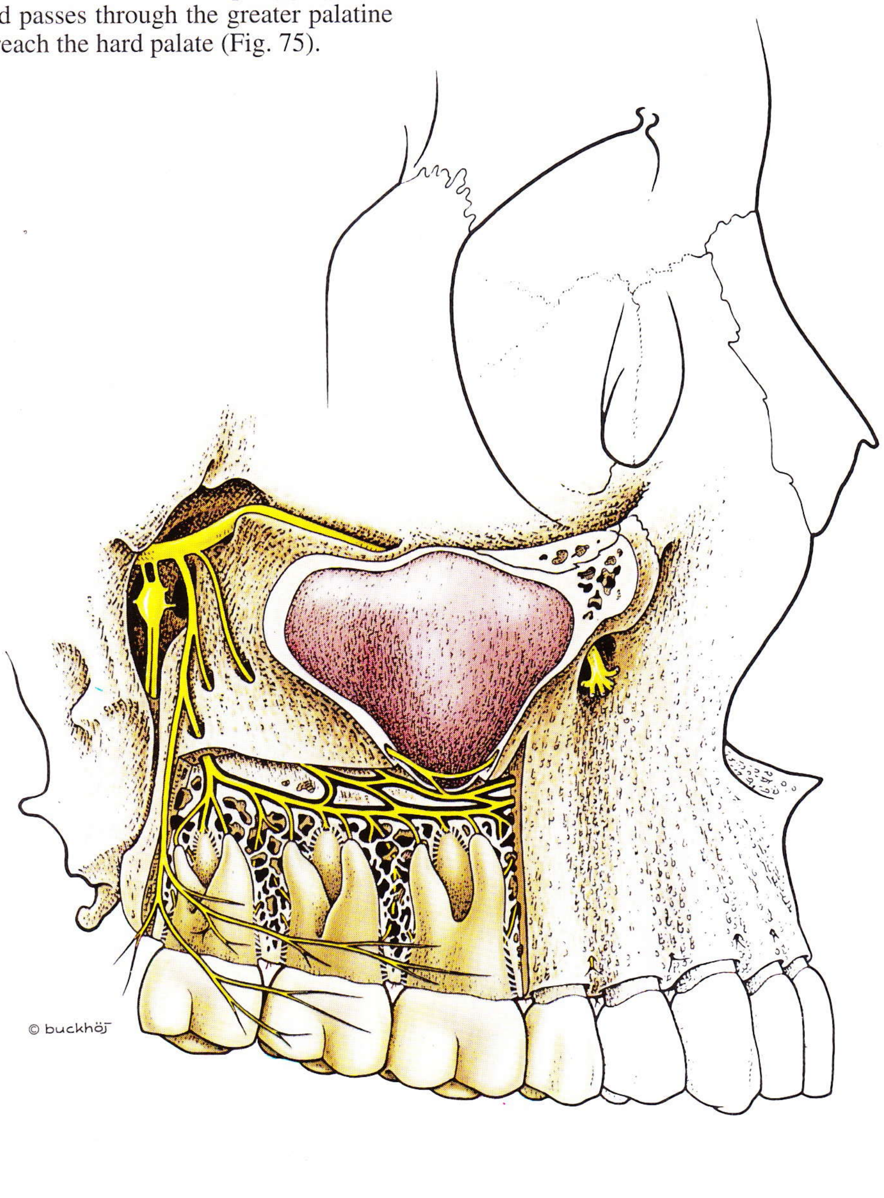


Fig. 75.

Operative aspects

Cavity preparations and pulp surgery

Effective anaesthesia is usually obtained by infiltration in the buccal fold next to the tooth involved. In some cases it may be necessary to supplement blocking of the palatal root by an injection on the palatal side.

Surgical procedures

A supplementary block of the greater palatine nerve will also anaesthetize the palatal gingiva and mucosa. See also "Incisors and canines".

The teeth can be anaesthetized by infiltration in the buccal fold. This applies also the 2nd and 3rd molars, which used to be anaesthetized by regional block (tuberosity anaesthesia). This block is no longer to be recommended due to the prescence of the venous plexus, increasing the risk for intravascular injection and hematoma. Best is a modifi-cation which gives results equivalent to those obtained by buccal fold infiltration. The injection is made at the apex of the actual tooth - not in the pterygopalatine fossa.

Sometimes, and particularly when a recess of the maxillary sinus extends down between the buccal and palatal roots, local anaesthetic diffusion from a buccal depot is impaired. In these cases a palatal injection should also be given.

The tuberosity anaesthesia block (mentioned above) was used especially when the infrazygomatic crest was well developed, because this crest was reckoned to make infiltration anaes-thesia difficult. The vicinity of the pterygoid venous plexus, however, entails that the tuberosity anaesthesia block is potentially hazardous, and it is relatively contraindicated because of the risk of intravenous injection and/or haematoma formation. If unavoidable, aspiration control and needle tip control must be extremely rigorous.

Buccal infiltration

Infiltration anaesthesia of the upper molars is carried out by injecting close to the tooth. The buccal fold is punctured somewhat mesially to the tooth.

The tip of the needle is then advanced upwards and backwards towards the apex until bone contact is felt. 1-2 ml of solution is then injected (Figs. 76-78).

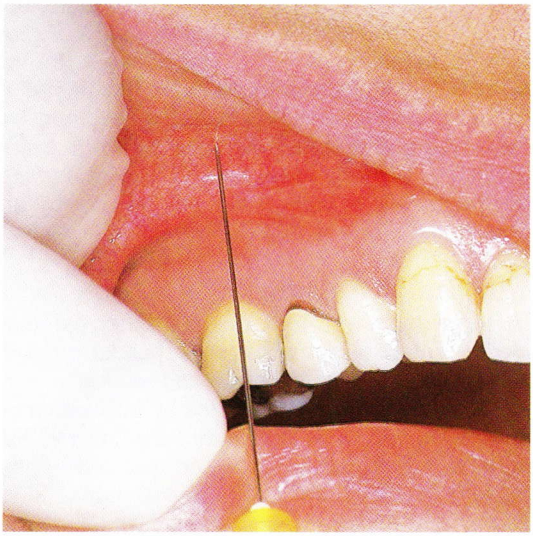


Fig. 77.

If an injection is to be made in the distal aspect of the upper jaw, it is advisable not to open the patient's mouth too widely. If the mouth is too widely opened the coronoid process of the mandible is moved ventrally, and may cover the injection site.

Fig. 76.

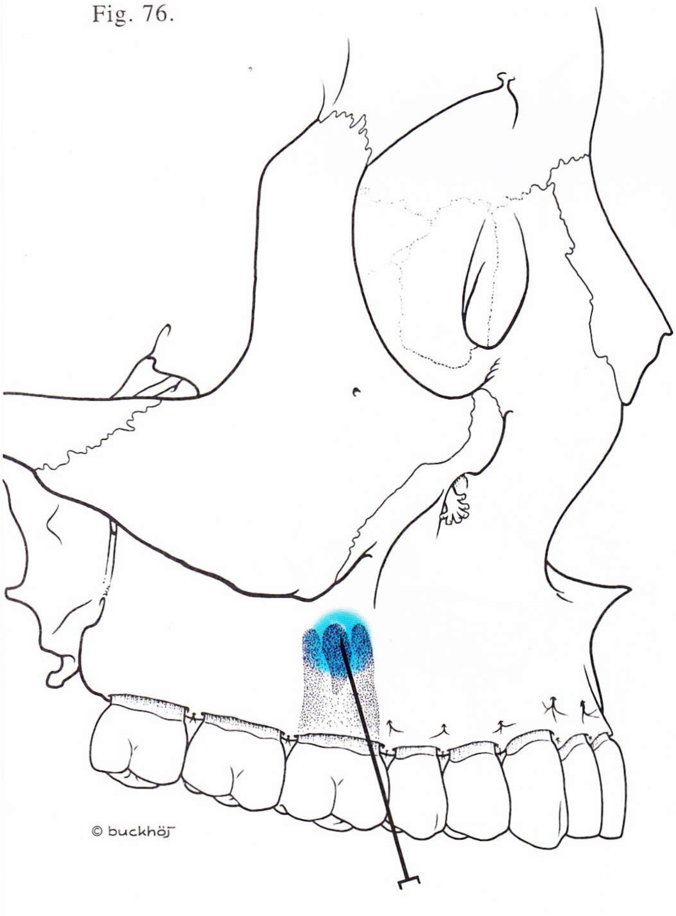


Fig. 78.

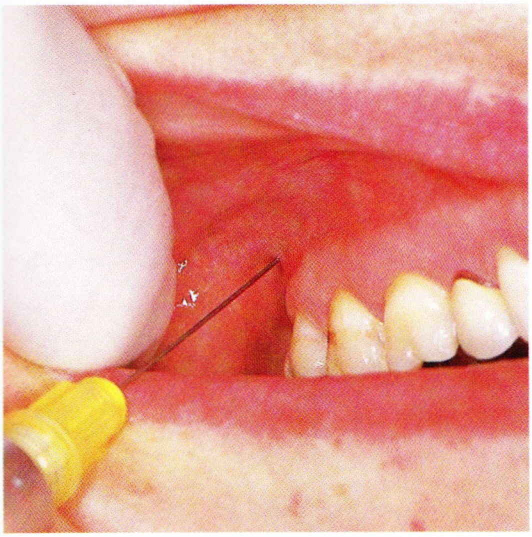
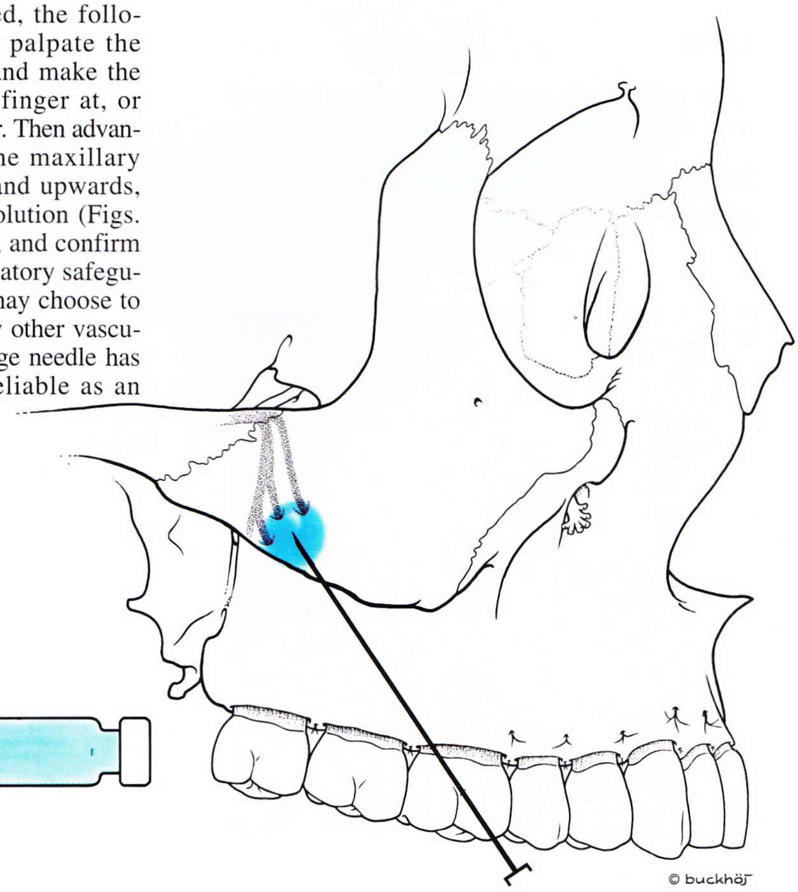


Fig. 79.

Numbness of the soft tissues (lip), often a subjective confirmation for the patient that he is anaesthetized, is often only slight or absent when injections are made into the buccal molar area. Inform the patient of this before starting the procedure to allay false fears that the anaethetic hasn't worked.

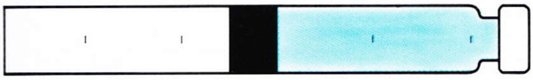
Fig. 81.



Tuberosity injection

If this injection cannot be avoided, the following procedure should be used: palpate the infrazygo-matic crest, as shown, and make the puncture dorsal to the retracting finger at, or slightly distal to, the second molar. Then advance the needle keeping close to the maxillary tuberosity, inwards, backwards, and upwards, about 2 cm. Inject 1-2 ml of the solution (Figs. 79-81). Avoid the pterygoid plexus, and confirm this by aspiration, which is an obligatory safeguard before injection. The operator may choose to use a 25 gauge needle in this or any other vascular area since both a 30 and 27 gauge needle has been shown to be relatively unreliable as an aspirator of blood.

Fig. 80.



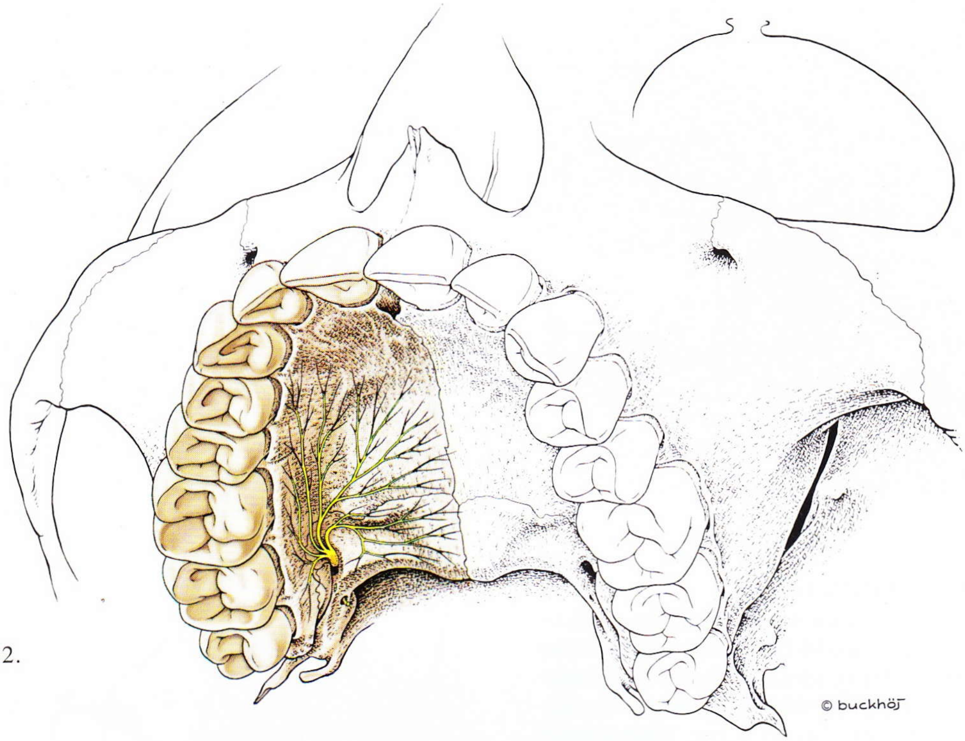
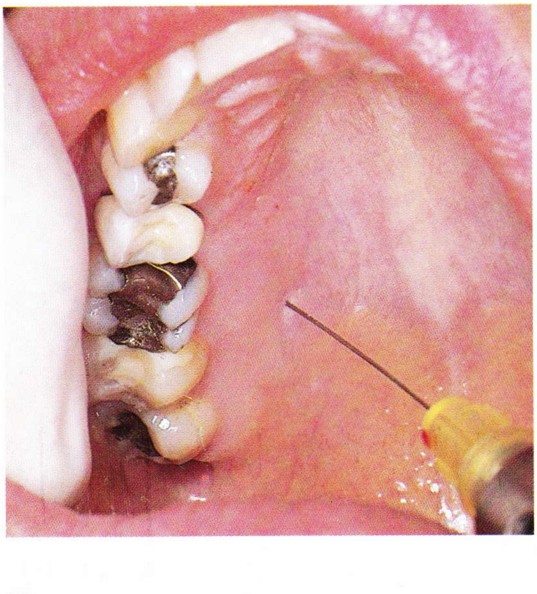


Fig. 82.

Supplementary blocking of the greater palatine nerve

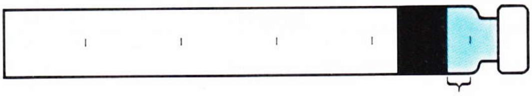
Fig. 83.



To anaesthetize the palatal gingiva and mucosa in the molar region, insert the needle 0.5-1 cm above the gingival margin at the second molar and at right angles to the mucosa (Figs. 82 and 83).

When the needle reaches bone withdraw it 1 mm, aspirate and inject about 0.2-0.3 ml (Fig. 84). This will block the greater palatine nerve at its exit from the greater palatine foramen.

Fig. 84.



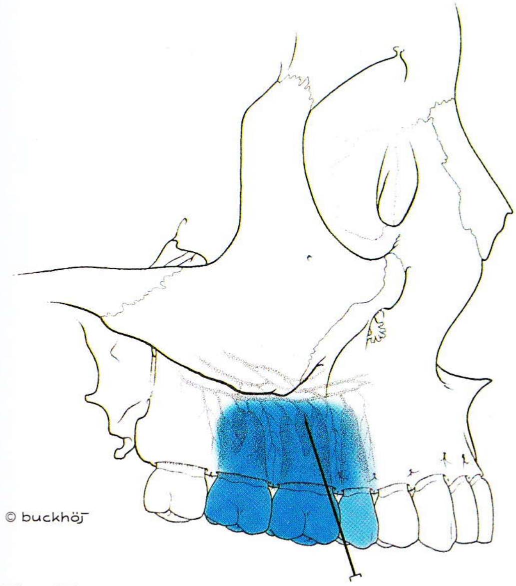


Fig. 85.

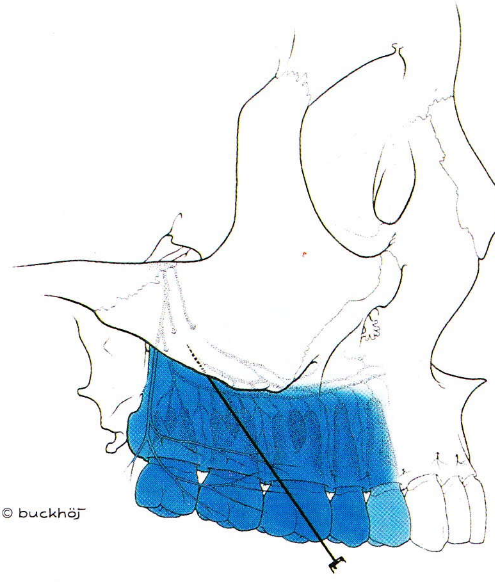


Fig. 87.

Spread of analgesia

Teeth and bone anaesthesia after buccal injection at the first molar (Fig. 85).

Gingival and soft tissue anaesthesia. Observe relative absence of lip anaesthesia (Fig. 86).

Teeth and bone anaesthesia after tuberosity injection of 1.5 ml of solution (Fig. 87).

Gingival and soft tissue anaesthesia after tuberosity injection of 1.5 ml. Lip anaesthesia is in many cases minimal (Fig. 88).

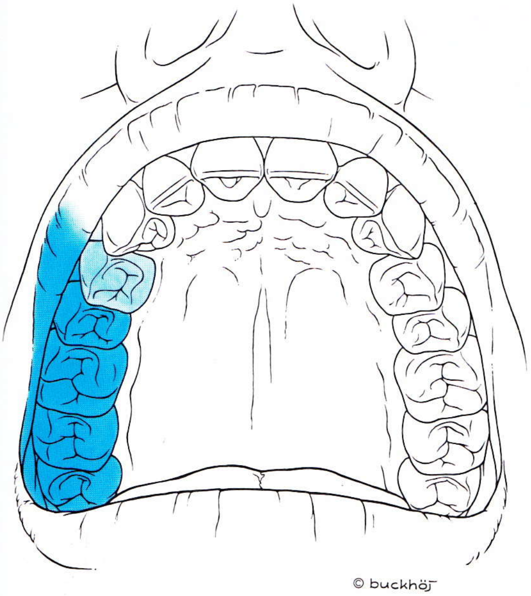


Fig. 86.

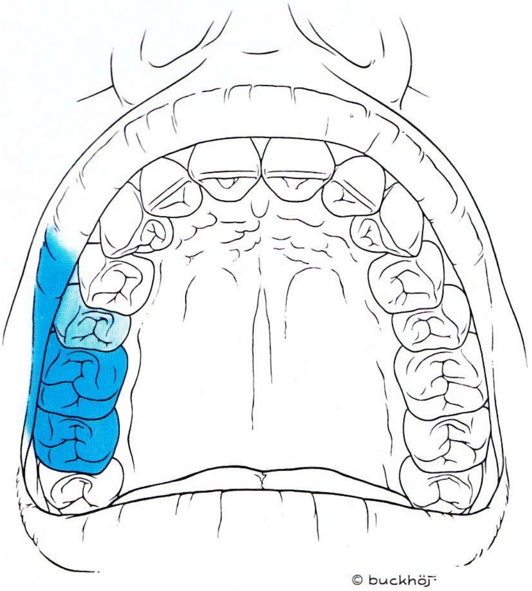


Fig. 88.

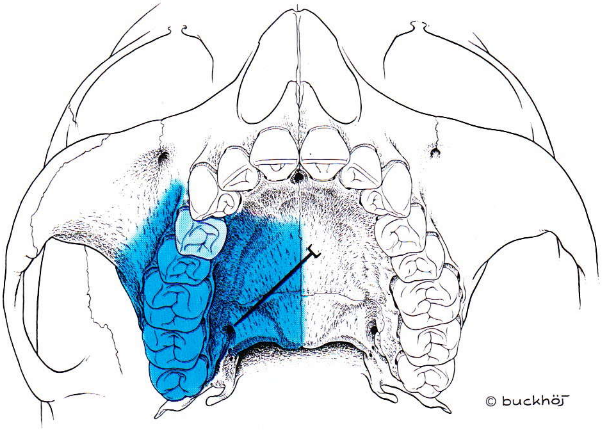


Fig. 89.

Teeth and bone anaesthesia after supplementary block at the greater palatine nerve (Fig. 89).

Gingival and soft tissue anaesthesia after sup-ple-mentary blocking of the greater palatine nerve (Fig. 90).

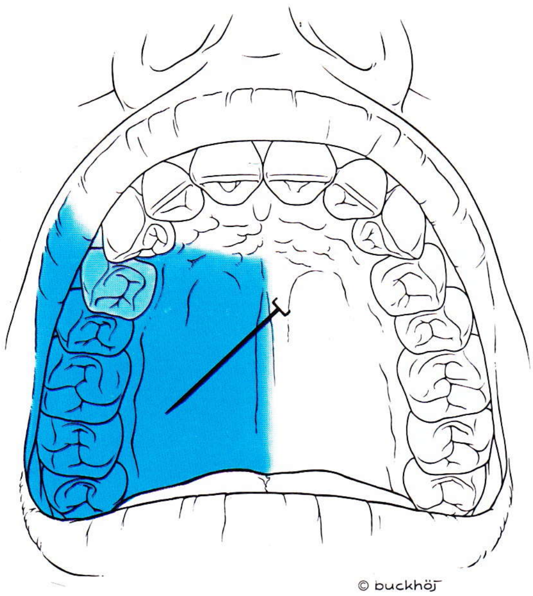


Fig. 90.

Anaesthesia of the lower jaw

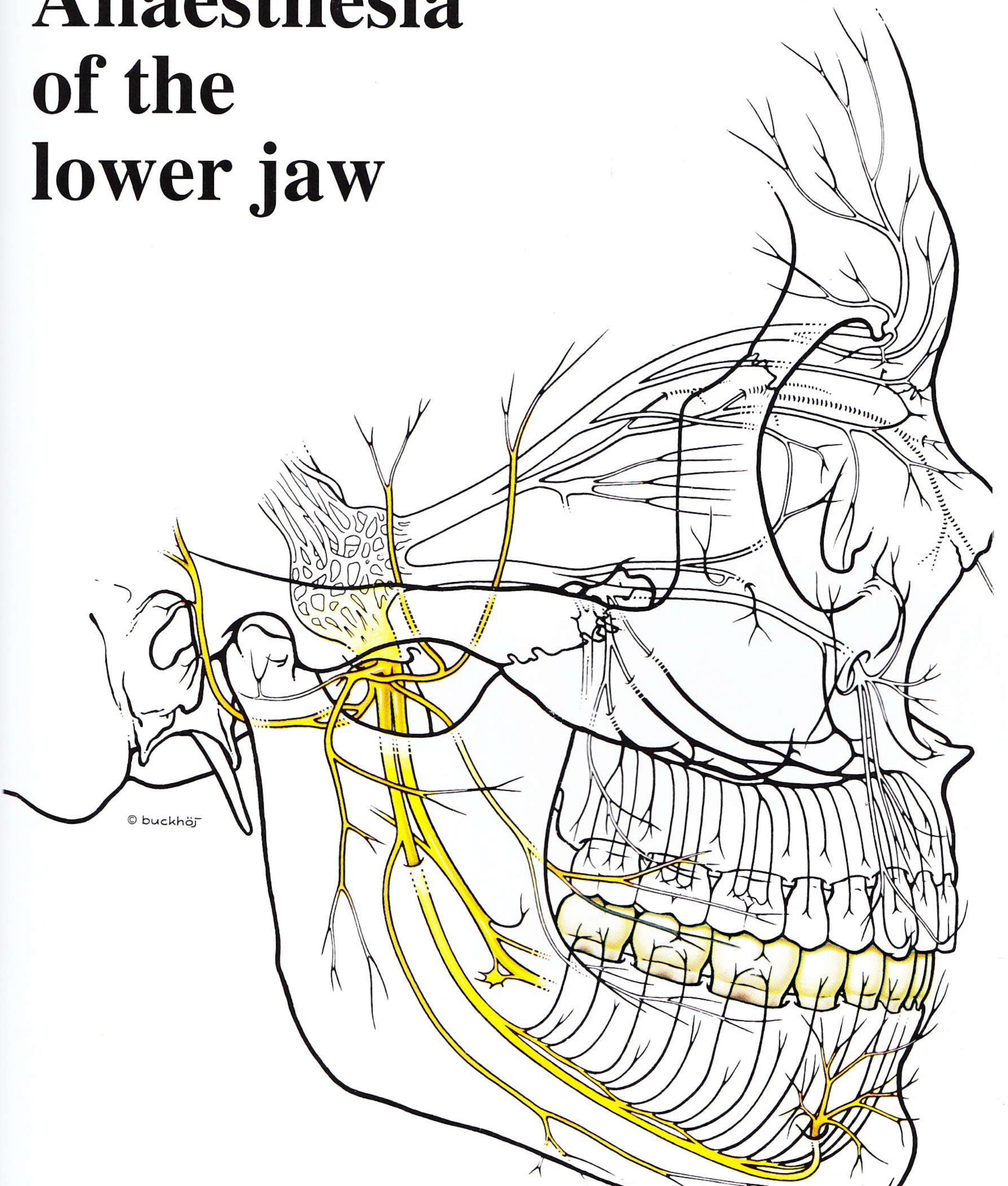


Fig. 91.

Fig. 92.

General considerations

By contrast with the upper jaw, the roots of the premolars and molars in the mandible are covered with a thick compact bone lamina, which effectively prevents diffusion of a local anaesthetic bolus near the apices. A proximal target area, before the nerve enters the bone, is therefore necessary (Fig. 92).

Mandibular block is only successful when the dentist is master of the anatomy of the area, and when the full cooperation of the patient is obtained.

General principles of local anaesthesia are insufficient guides in the mandibular region. One must particularize. Thus, to anaesthetize the first premolar, a mental block is necessary, and this sometimes effects anaesthesia also of the second premolar. The mandibular bone here is thick and impervious to diffusion. In the frontal area, the apices of the canines and incisors can be reached by infiltration anaesthesia, because the buccal bone lamina is relatively thinner and porous, and allows diffusion.

Incisors and canines

Anatomy of the lower front area

The incisive nerve, a distal branch of the inferior dental nerve, innervates the canine and incisor teeth. Its course lies within the bone but it may be anaesthetized by diffusion because the covering bone lamina is thin and porous (Fig. 93).

The tip of the needle must be in contact with the bone in the lower front area, because diffusion will otherwise be hindered by the fascia of the circumoral muscles, and the pulp and periodontal anaesthesia will be inadequate.

The canines in children and adolescents, may be anaesthetized by infiltration at the apex, because, here again, the bone lamina is thin. In adults the bone may become impenetrable, and a mandibular or mental block is to be preferred.

The anterior aspect of the lower jaw can also be anaesthetized by regional block, but there are often anastomoses over the midline. These must also be blocked by bilateral infiltration, or by bilateral mental block.

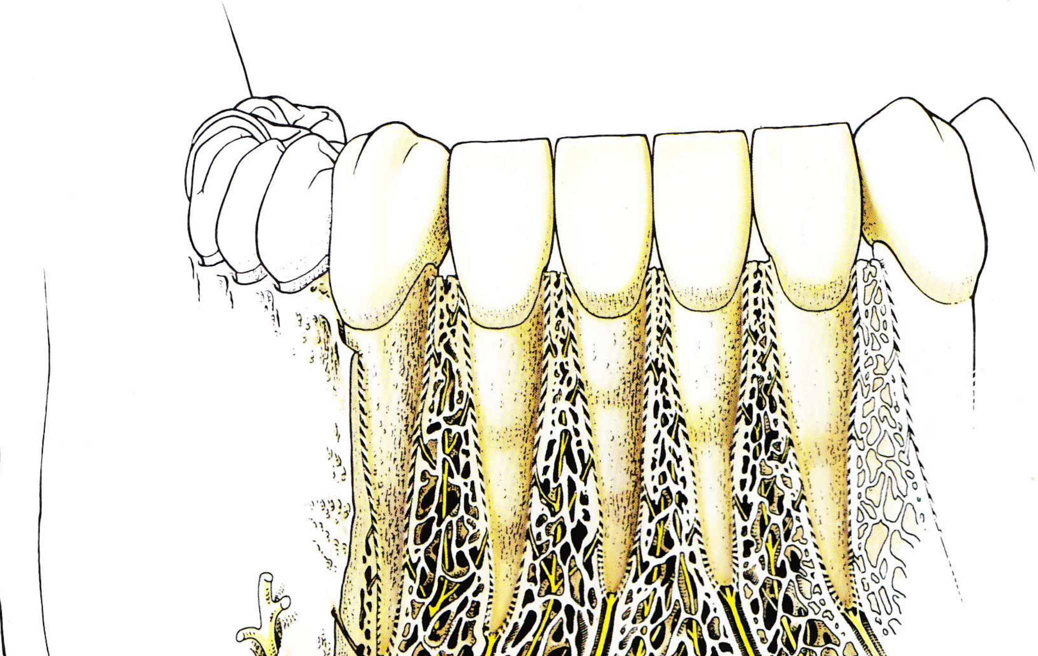


Fig. 93.

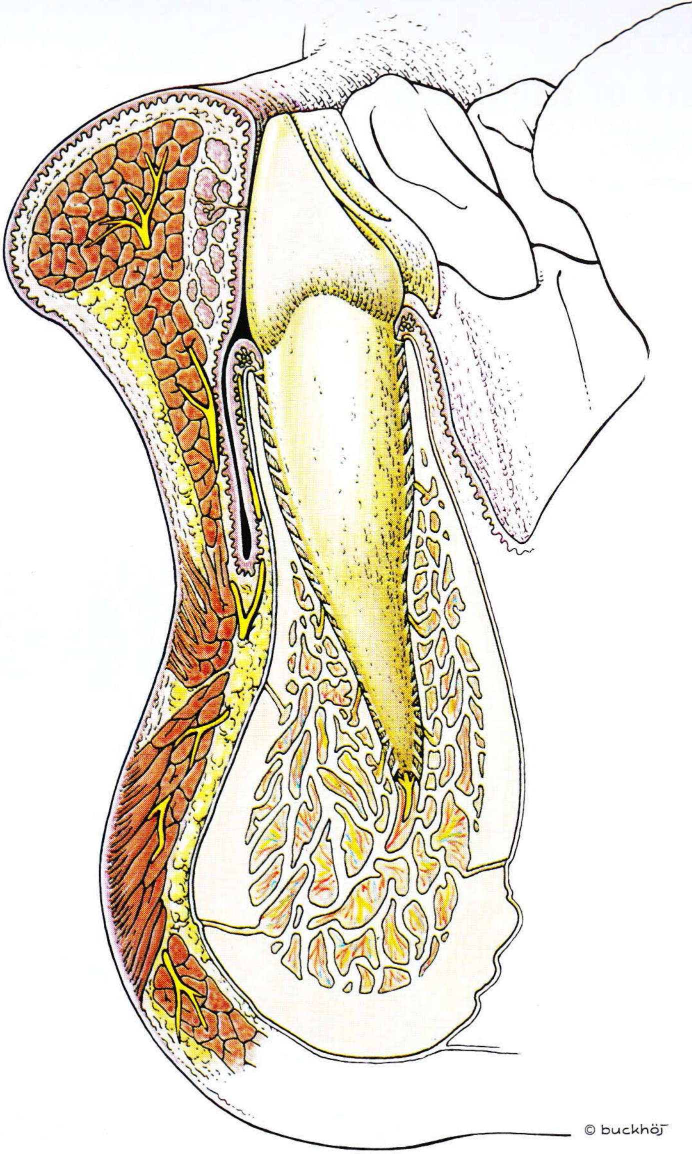


Fig. 94.

The buccal soft tissues are innervated by the mental nerve while the lingual gingiva and periosteum are supplied by the sublingual nerve (Fig. 94). The later is blocked by injection under the lingual attached gingiva at the apex of the tooth, or by similar injection at the premolar level.

Operative aspects

Cavity preparations and pulp surgery

These procedures may be conducted under infiltration or conduction block anaesthesia. If pulpal ischaemia is desired, infiltration anaesthesia is the method of choice, because conduction block at the mandibular or mental foramen has only minimal effects on pulp circulation, even though the solution contains a vasoconstrictor.

Surgical procedures

For extractions, the lingual gingiva and periosteum must also be anaesthetized. This is effected by injection of 0.3-0.5 ml of local anaesthetic into the unattached gingiva on the lingual alveolar ridge near the tooth. Avoid damage to the blood vessels in the floor of the mouth.

The injection

With the patient in a supine position single incisors in the lower jaw are easily anaesthetized by injecting through the buccal fold near the tooth (Fig. 95).

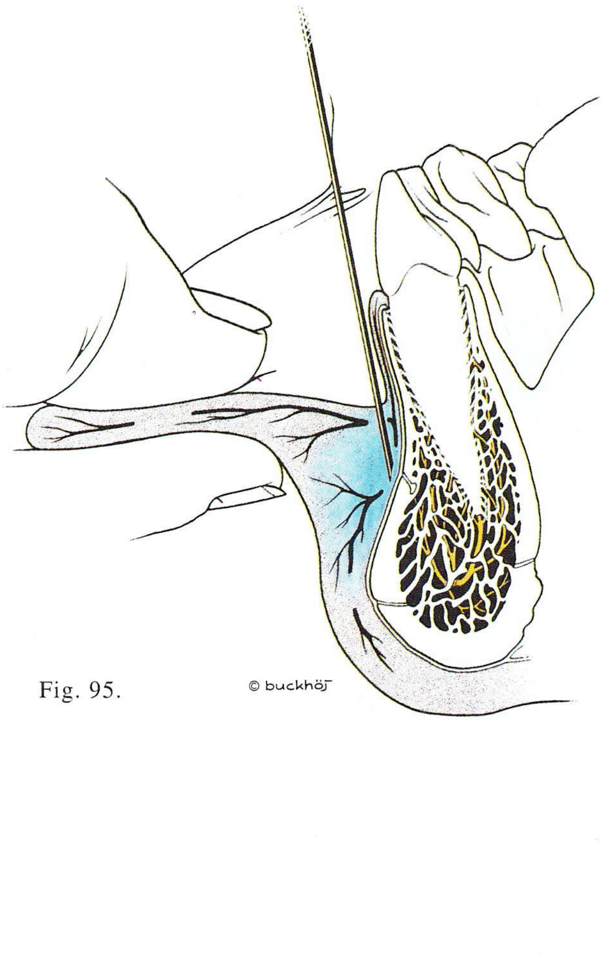


Fig. 95.

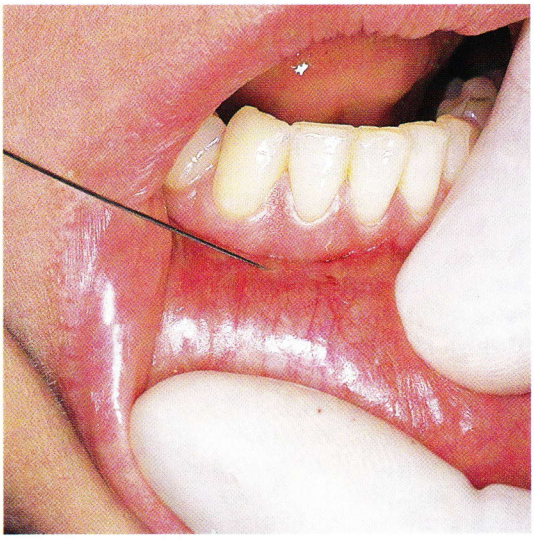


Fig. 96.

In a patient sitting upright the needle is guided from a lateral approach. Injection of the solution is made during withdrawal of the needle (Fig. 96).

If resistence is felt during injection it may mean that the needle tip is situated in a circumoral muscle fascia, at some distance from the ideal supraperiosteal position.

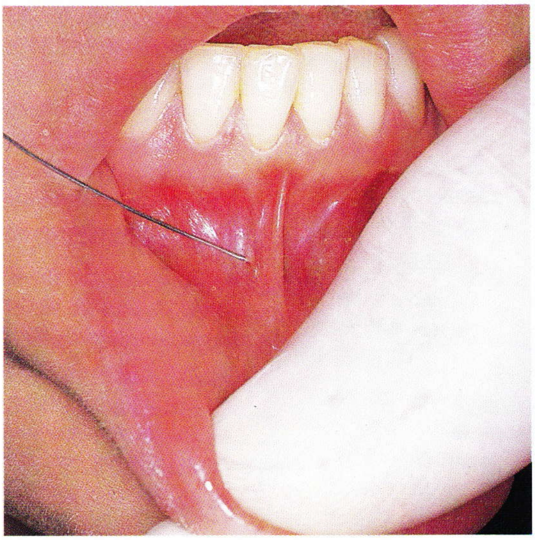
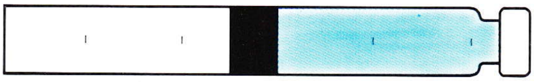


Fig. 97.



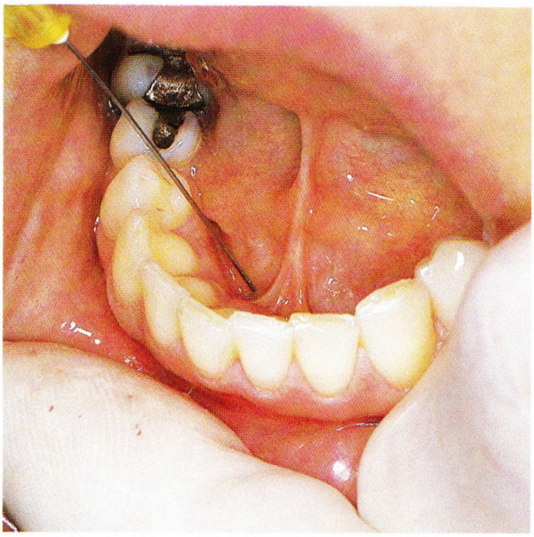


Fig. 98.

Supplementary blocking of the lingual nerve

The lingual nerve is blocked by infiltration just under the attached gingiva (Fig. 98 and 100).

Fig. 100.

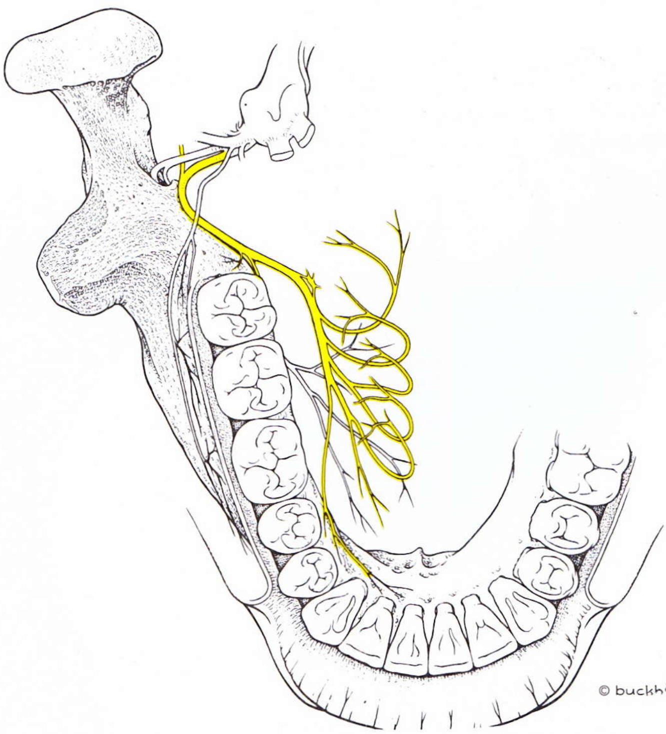
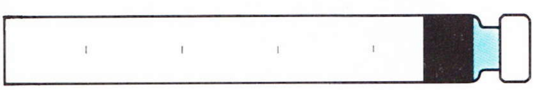


Fig. 99.



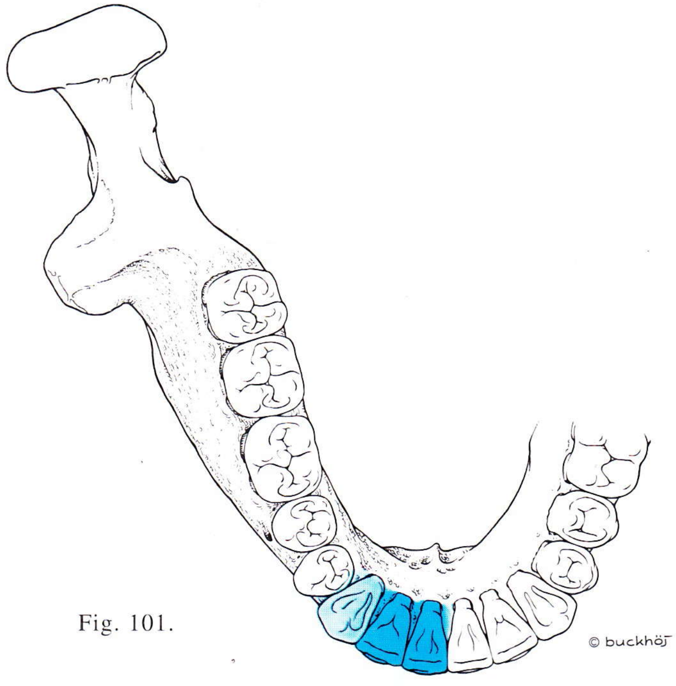


Fig. 101.

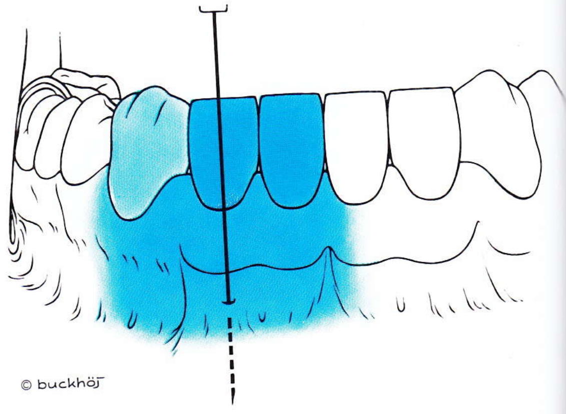


Fig. 103.

Spread of analgesia

The injection of a standard volume of 1 ml of the solution will ensure adequate analgesia of the tooth pulp and the bone in this area (Figs. 101 and 102).

Gingival and soft tissue anaesthesia after buccal infiltration (Fig. 103 and 104).

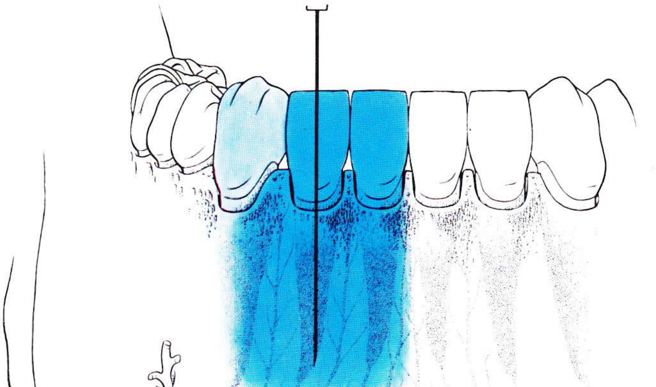


Fig. 102.

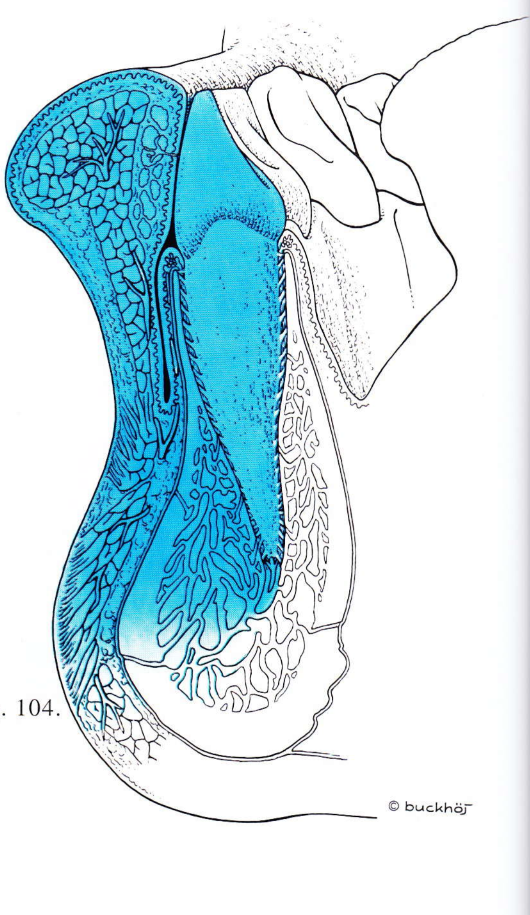


Fig. 104.

Premolars

Anatomy of the premolar area

The premolar region of the lower jaw is innervated mainly by the inferior alveolar nerve (Fig. 1). The buccal gingiva in the premolar area is innervated by the buccal nerve, while the lingual gingiva is supplied by the sublingual nerve. The mental foramen lies just below and usually between the apices of the premolars (Fig. 105).

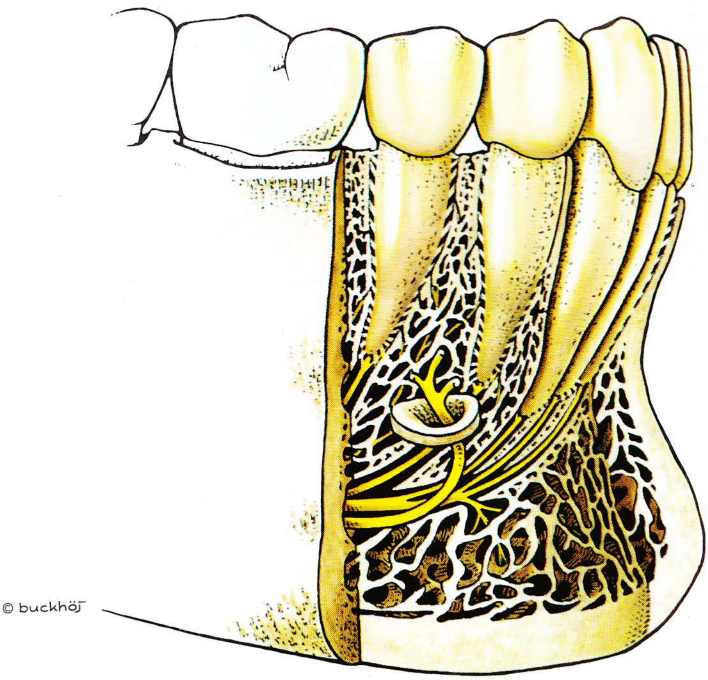


Fig. 105.

The thick, compact mandibular bone surrounding the premolars makes the use of infiltration anaesthesia in this area unreliable. A mandibular injection or a mental block must be used (Fig. 106).

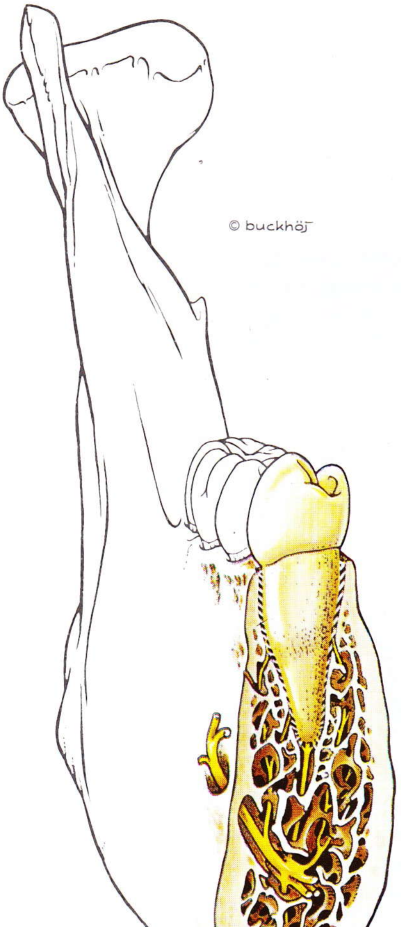


Fig. 106.

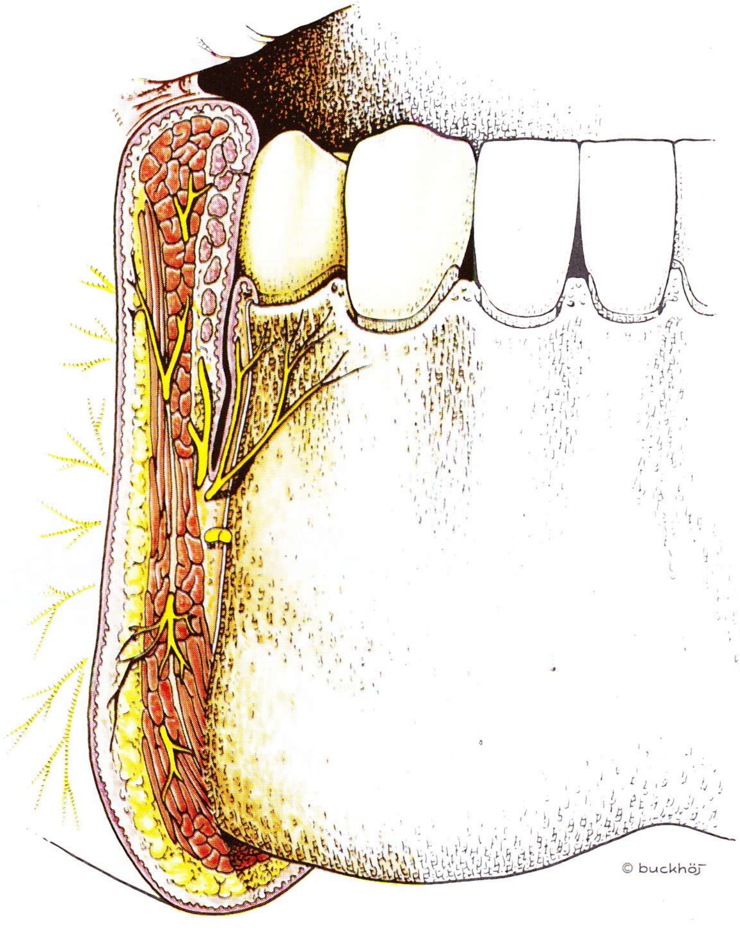


Fig. 107.

From the mental foramen the mental nerve spreads out in the buccal gingiva and innervates the lower lip, the mucosa and the skin (Fig. 107).

The position of the mandibular, lingual buccal and mental nerves in the premolar area (Figs. 108 and 109).

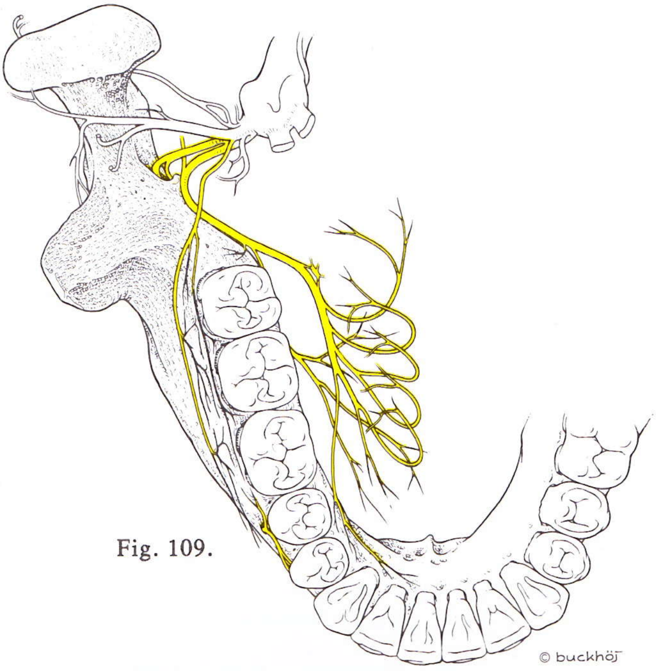


Fig. 109.

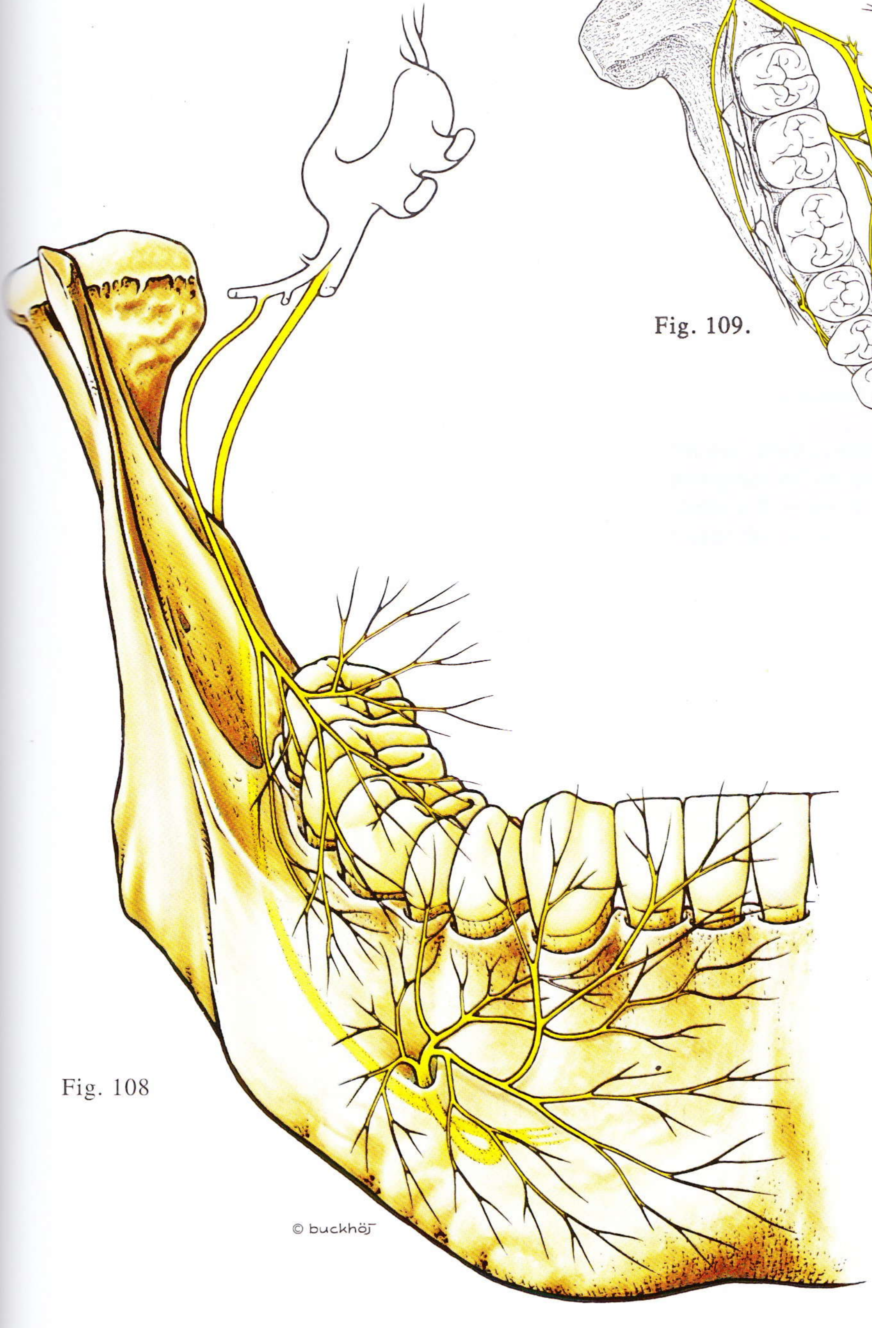


Fig. 108

Operative aspects

Cavity preparations and pulp surgery

A mandibular block ensures effective anaesthesia, but if only the first premolar is to be treated, a mental block will suffice. Irrespective of the nature of the solution, a mandibular block has only a weak ischaemic effect on the tooth pulp.

Surgical procedures

In mandibular anaesthesia, the lingual nerve can be blocked by injection at the mandibular temporal crest. This will anaesthetize the lingual gingiva and periosteum in this area. The buccal soft tissues are anaesthetized by injecting at the buccal nerve or by local infiltration. These injections may also be necessary as supplements of a mental block.

Mental block

The anatomical direction of the bony canal where the mental nerve is situated is medial-ventral-caudal (Fig. 110).

A needle oriented in this direction and inserted into the bony canal may lacerate the nerve and blood vessels (see p. 99).

Even though profound analgesia may result, this procedure is not to be recommended. A slightly larger injection volume will ensure adequate penetration of the mental nerve when the needle is inserted at an angle to the direction of the canal. This is a much safer procedure.

Fig. 111.

When a mental block is to be carried out, the mental foramen is palpated with the index finger.

The needle is inserted at an angle to the bony canal at the mental foramen. After aspiration 1-1.5 ml is injected (Figs. 111 and 112).

Mental block sometimes produces only partial analgesia of the premolar pulps. The preferred method is a block of the inferior alveolar nerve (mandibular block).

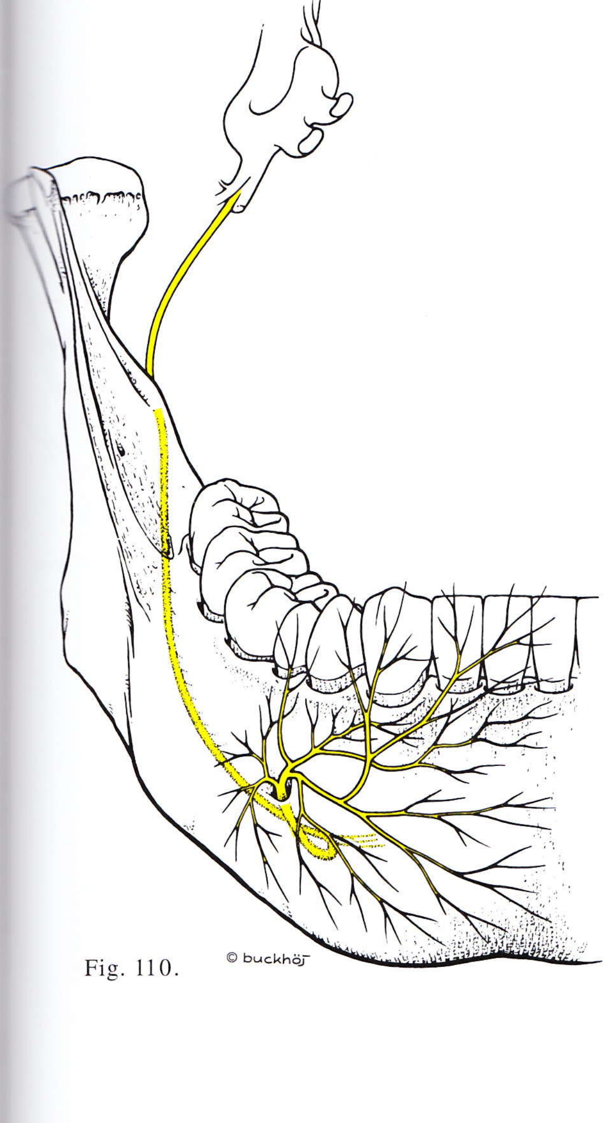


Fig. 110.

Fig. 112.

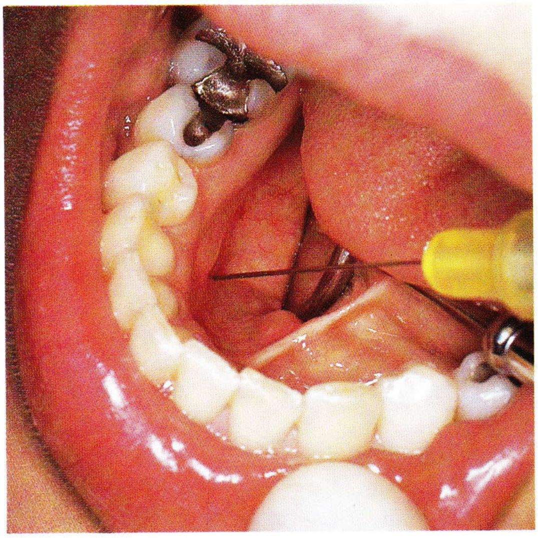


Fig. 113.

Supplementary blocking of the lingual nerve

The lingual nerve is blocked by introducing the needle just below the surface of the mucosa lingually to the premolar (Fig. 113 and 114). About 0.5 ml of the solution is injected (Fig. 115). Care should be taken not to damage the blood vessels in the area.

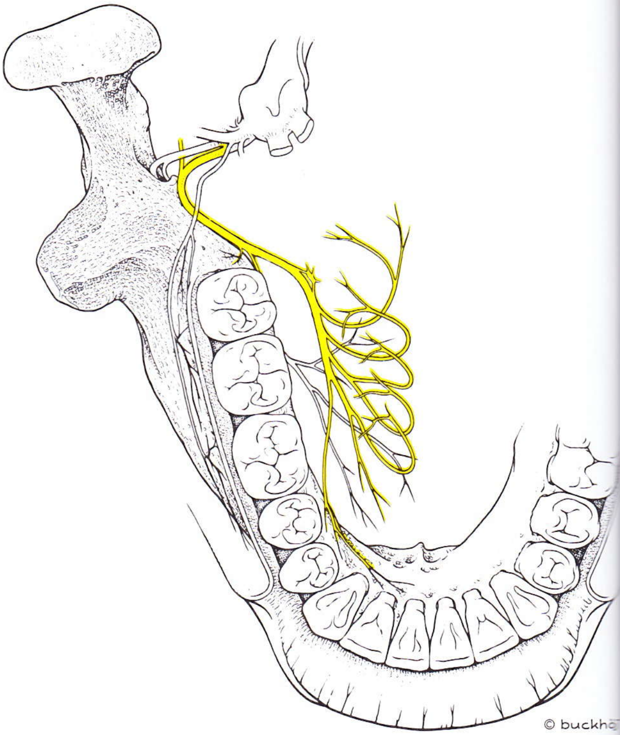
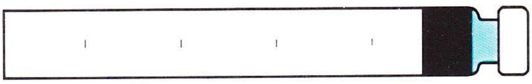


Fig. 114.

Fig. 115.



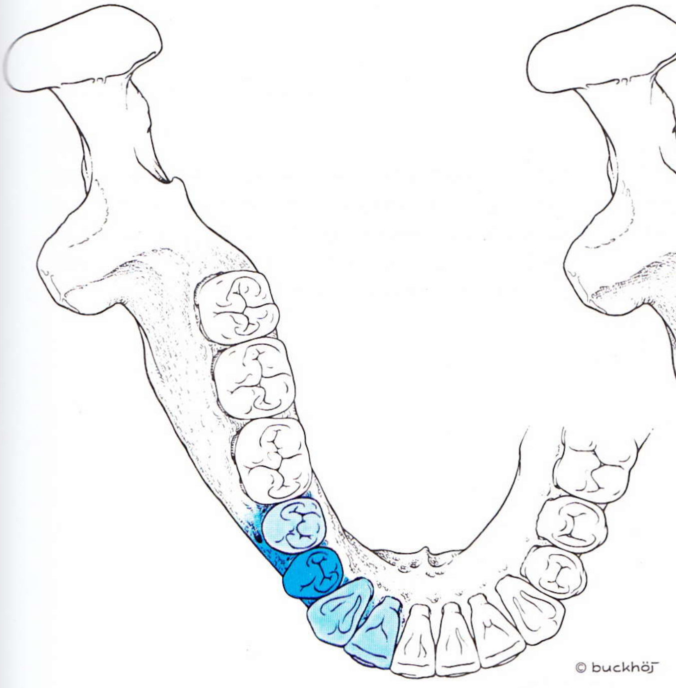


Fig. 116.

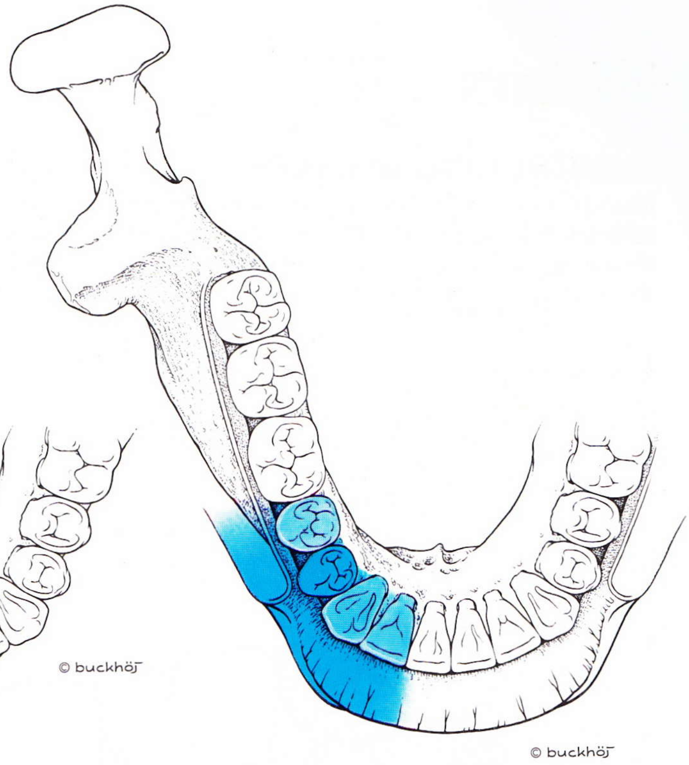


Fig. 117.

Spread of analgesia

A mental nerve block will cause analgesia in the first and, in some cases, in the second premolar. Penetration of the medial constituents of the inferior alveolar nerve is poor, and, therefore, the canines are sometimes not anaesthetized (Fig. 116).

Some of the peripheral fibres of the buccal nerve will also be blocked by the injection at the mental foramen, anaesthetizing a comparatively large area of the buccal soft tissues (Fig. 117).

Molars

Anatomical aspects

The apices of the molars of the lower jaw are embedded in thick compact bone, and innervated by the inferior alveolar nerve, which passes in the mandibular canal (Fig. 1).

Like the premolars, the molars cannot be anaesthetized by infiltration because of the massive mandibular bone (Fig. 118). Analgesia of the molars is thus only achieved by block of the nerve, before it enters the mandibular canal.

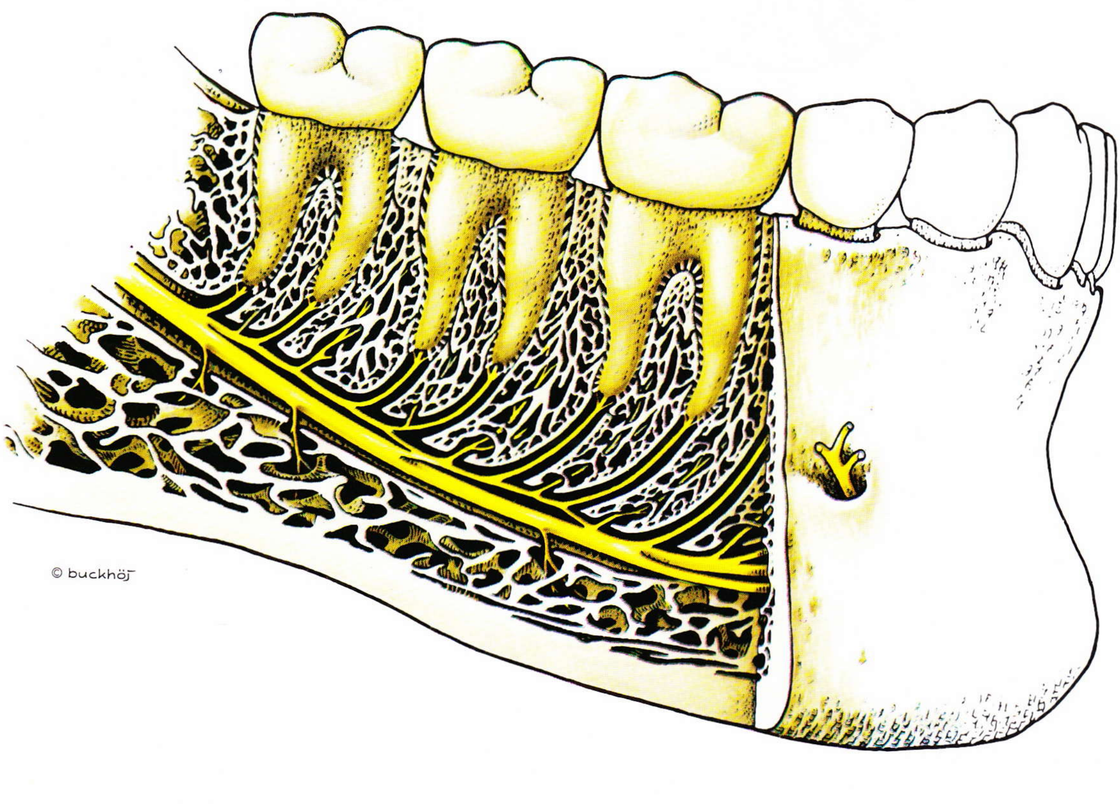


Fig. 118.

Innervation of the mandible

The mandibular nerve (inferior alveolar nerve) innervates the teeth and the mandibular bone from the molar area to the mandibular midline (Fig. 119).

The lingual gingiva in the molar area is innervated by the lingual nerve, some branches of which spread out over the lingual mandibular mucosa (Fig. 120).

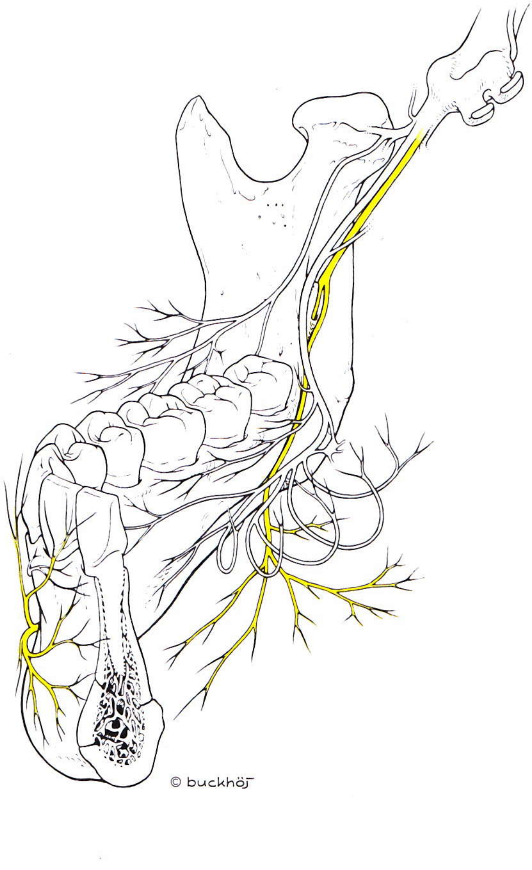


Fig. 119.

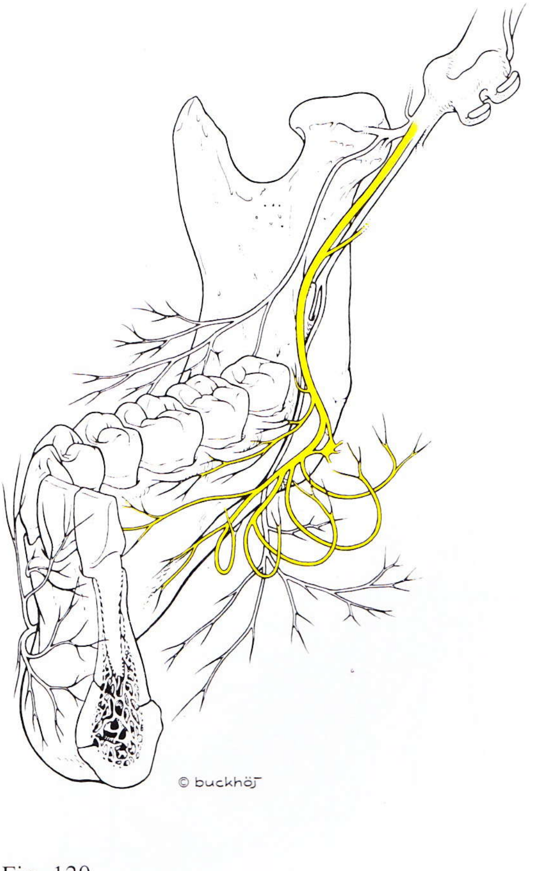


Fig. 120.

The terminal branches of the buccal nerve penetrate the buccinator muscle and innervate the buccal gingiva in the molar area (Fig. 121).

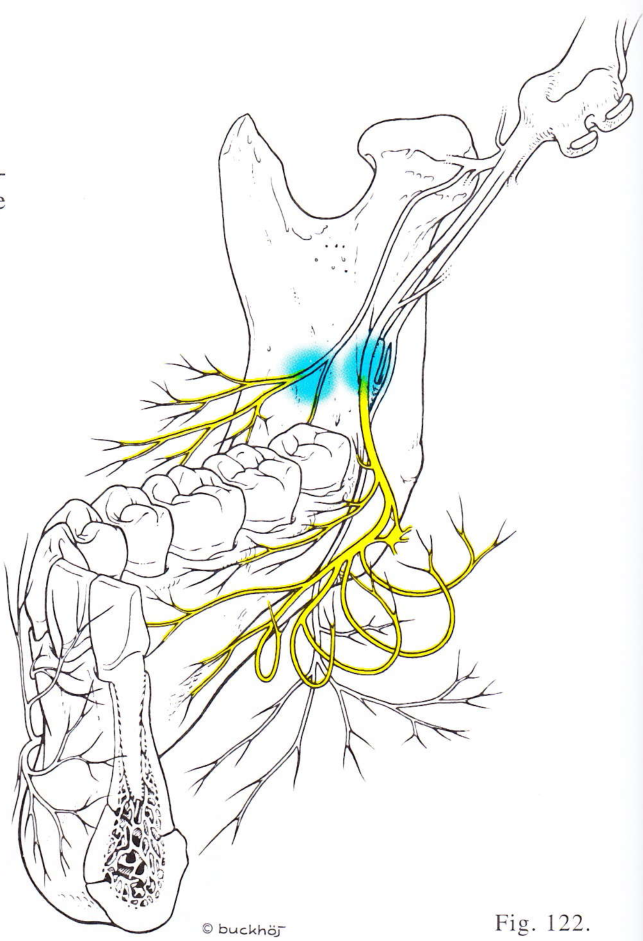


Fig. 122.

The mandibular and the lingual nerves may be blocked by one injection, while the buccal nerve requires a separate injection (Fig. 122).

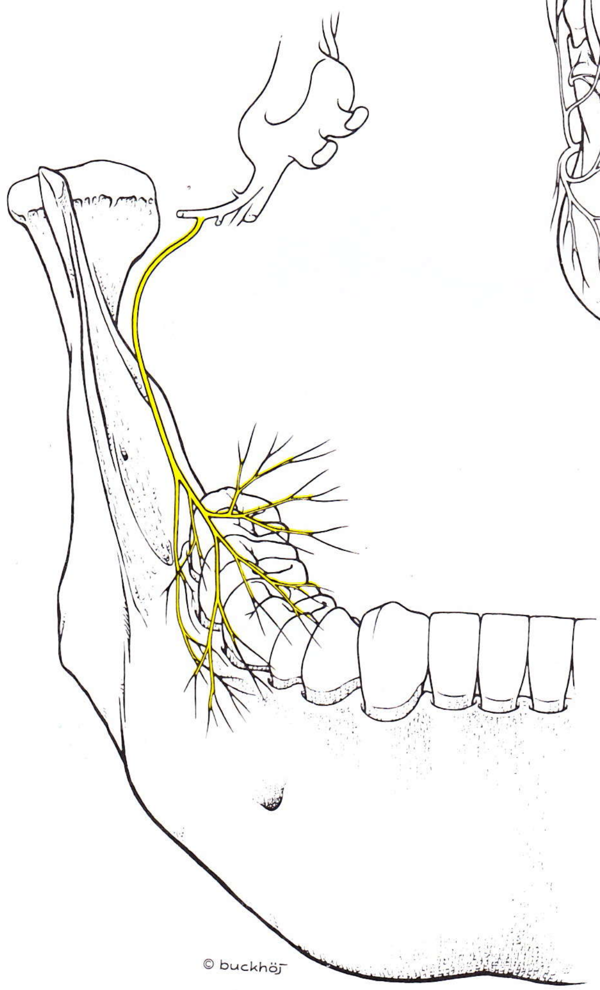
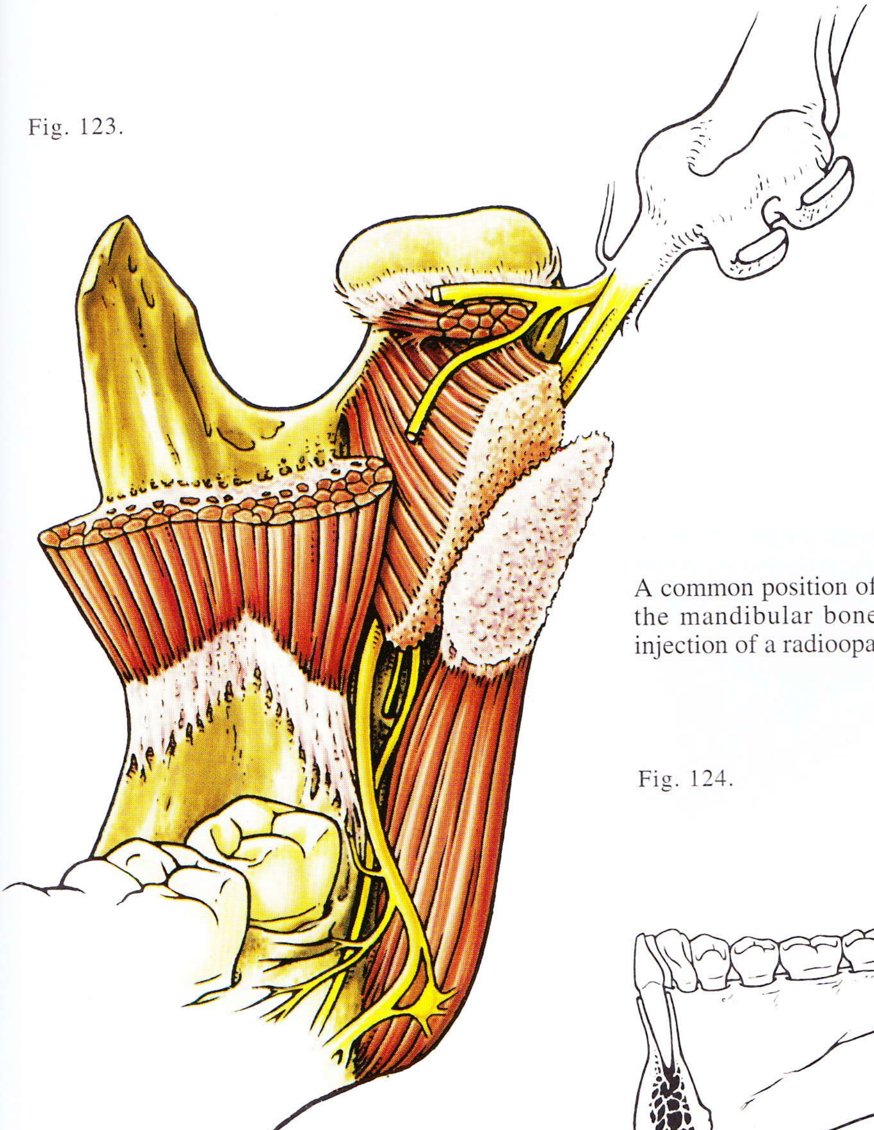


Fig. 121.

Special considerations

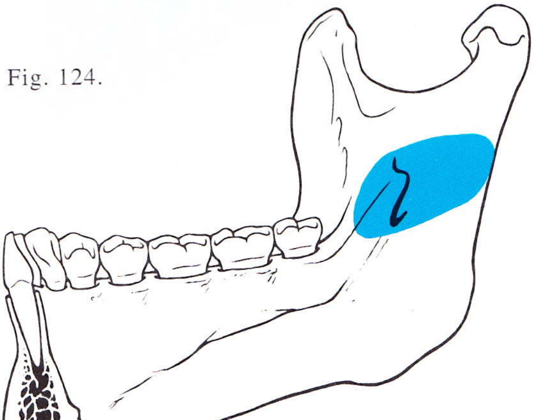
The soft tissues in the vicinity of the injection site form a space, the actual position of which varies, somewhat, from patient to patient. It should be indentified and filled with anaesthetic solution (Fig. 123).

Fig. 123.



A common position of this space, projected over the mandibular bone. Here demonstrated by injection of a radioopaque solution (Fig. 124).

Fig. 124.



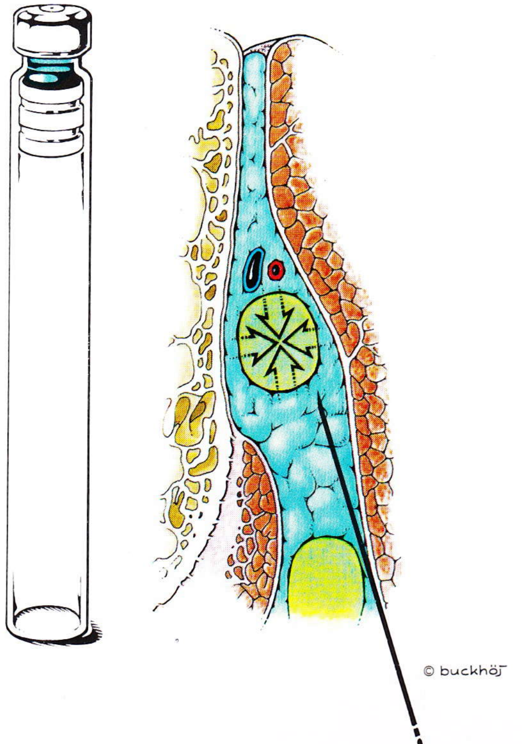


Fig. 125.

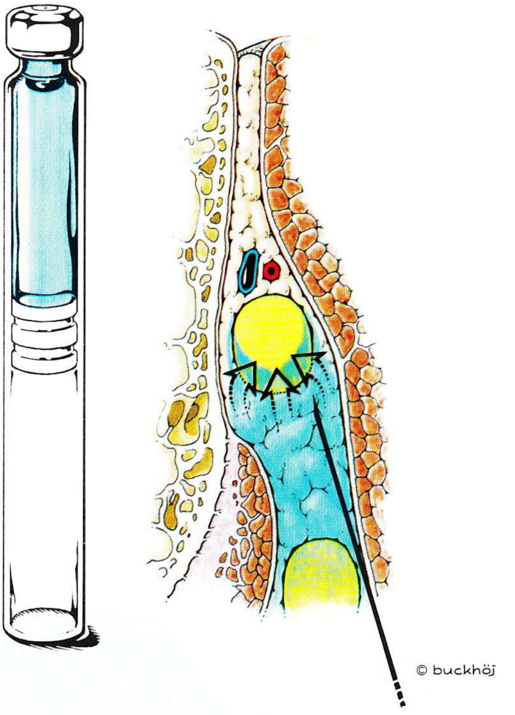


Fig. 126.

Minimum dosage calculations suggest that the full content of a cartridge is necessary to achive a reliable mandibular block (Fig. 125). Lesser volumes give inconsistent results (126).

Operative aspects

Cavity preparations and pulp surgery

In these cases a mandibular block is used and no blocking of the lingual nerve is necessary. Ischaemia in the pulp cannot be expected.

Surgical procedures

Regional anaesthesia of the inferior alveolar nerve should be supplemented by a deposition of solution at the lingual nerve.

The buccal soft tissues surrounding the molars are anaesthetized by blocking the buccal nerve.

The inferior alveolar nerve block

Direct method

The patient's mouth should be widely opened to ensure good visualization of the anatomical landmarks (Fig. 127).

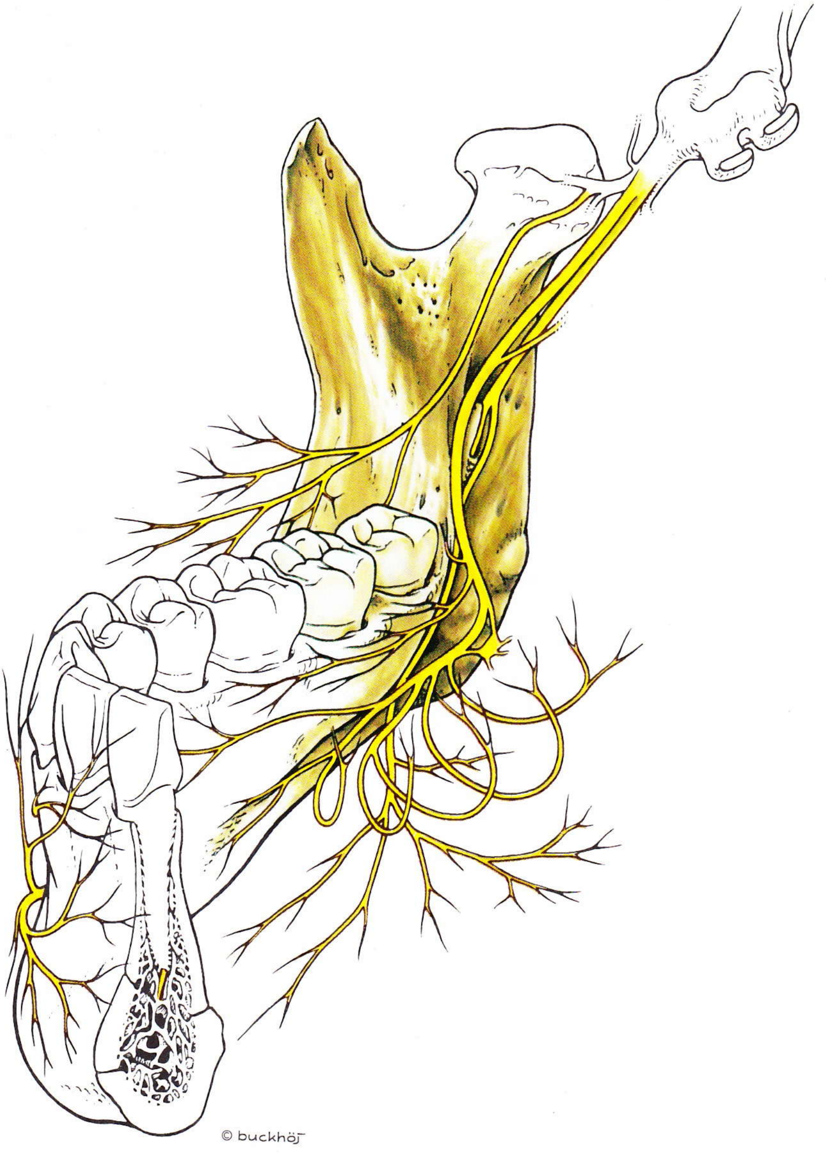


Fig. 127.

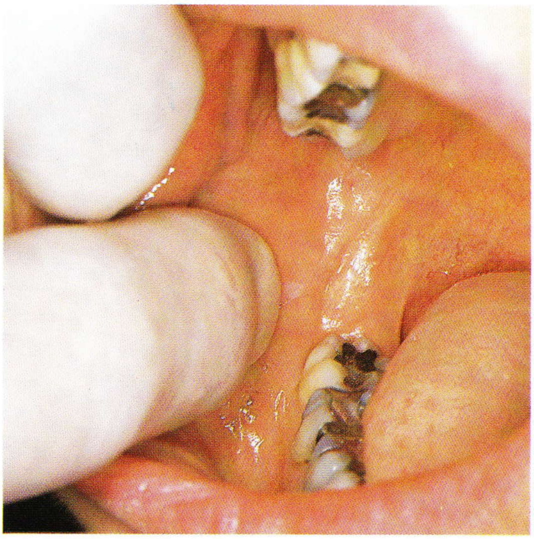


Fig. 128.

The coronoid process is palpated with the index finger at its greatest depression called the coronoid notch. The finger then slides posteriorly until a ridge of bone, the internal oblique, is palpated (Fig. 128).

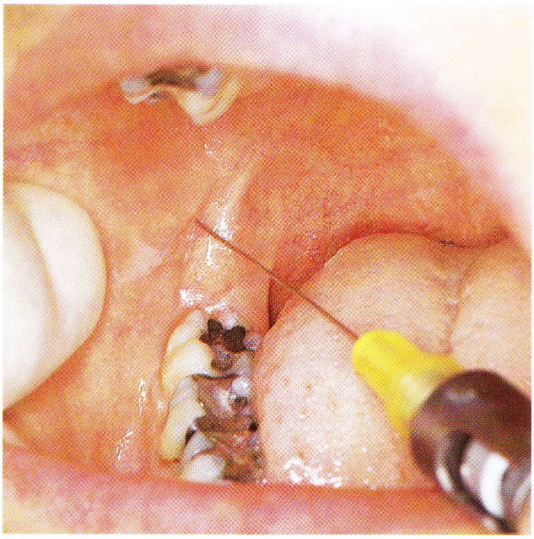
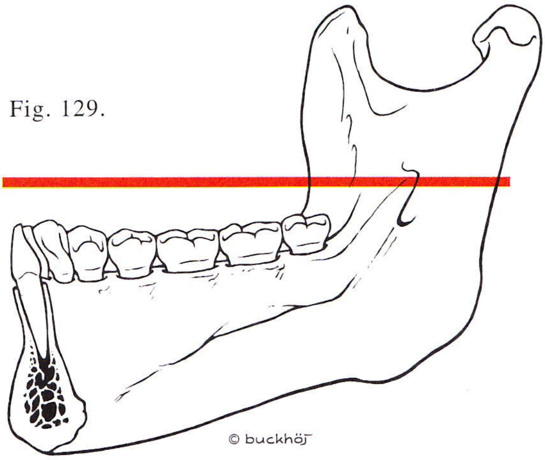


Fig. 130.

With the syringe directed from the premolar region of the opposite side, the needle is inserted at the level of the index finger (Fig. 130).

Fig. 129.



In adults, the injection point lies about 1 centimeter above the occlusal surfaces of the molars and just medially to the index finger but laterally to the pterygomandibular plicae (Fig. 129).

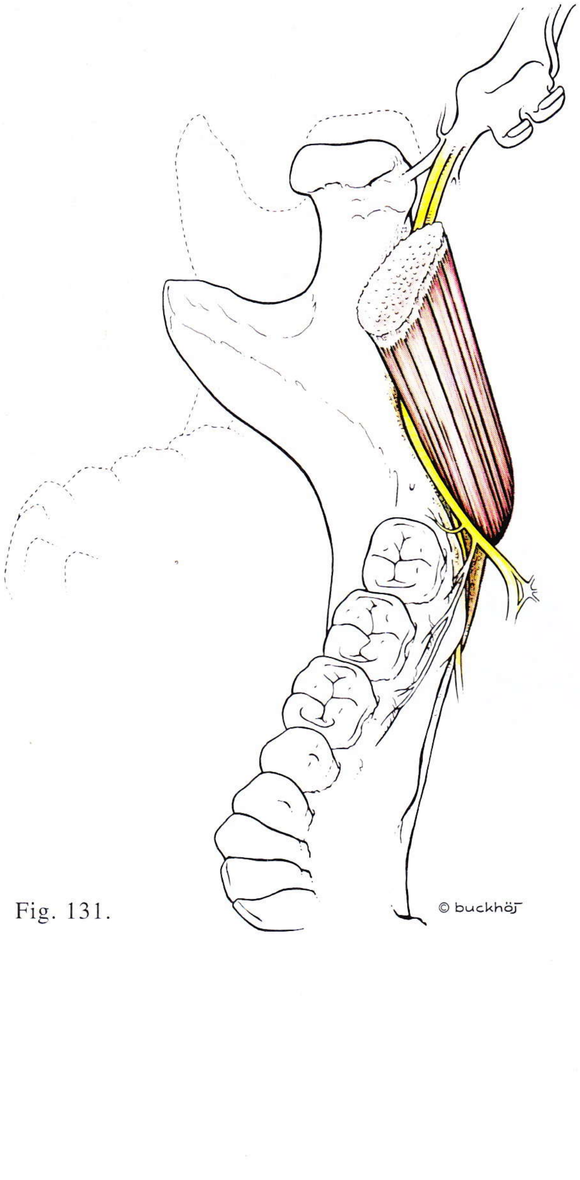


Fig. 131.

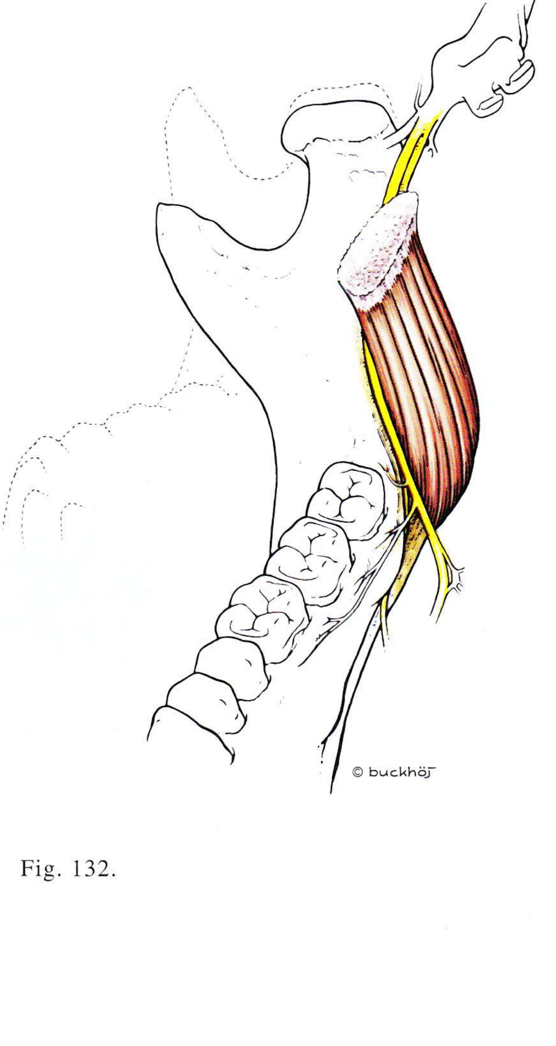


Fig. 132.

The medial pterygoid muscle is stretched and tense if the mouth is widely opened, and particularly the tense lateral aspects of the muscle may hinder proper placement of the needle (Fig. 131).

After insertion of the needle, instruct the patient to reduce the degree of mouth opening somewhat. This relieves some of the pterygoid tension (Fig. 132).

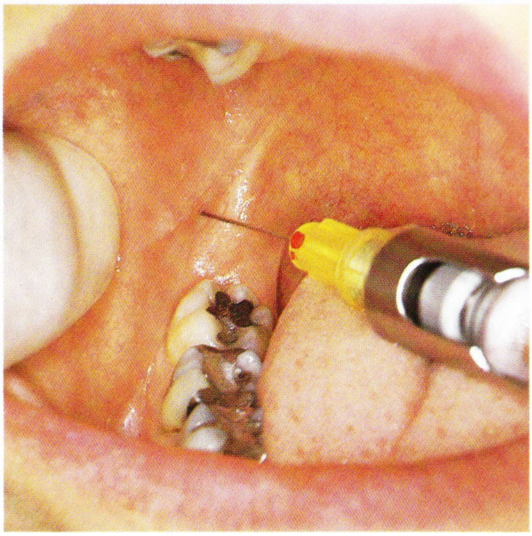


Fig. 134.

The needle is now advanced posteriorly to a depth of 2.5 cm for the average sized adult. Bone should be contacted to ensure correct position within the pterygomandibular triangle. The syringe is held in the original horizontal position relative to the occlusal plane (Figs. 133-134).

Fig. 133.

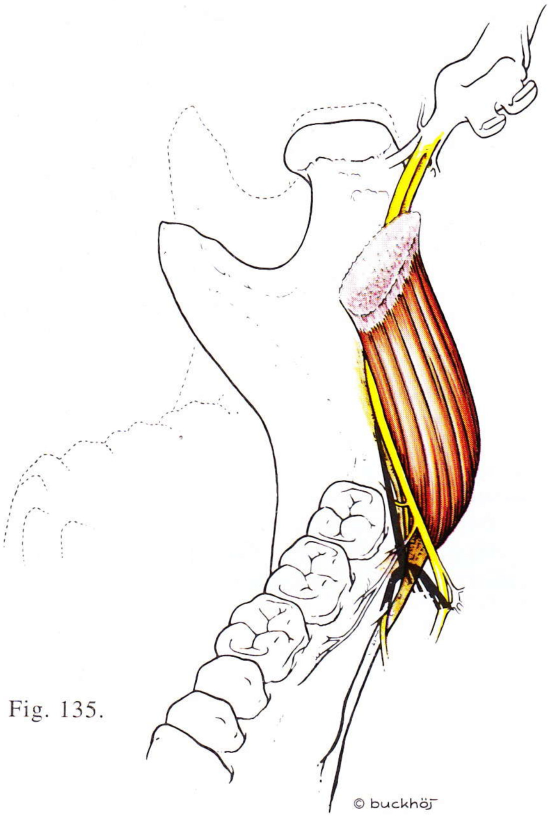


Fig. 135.

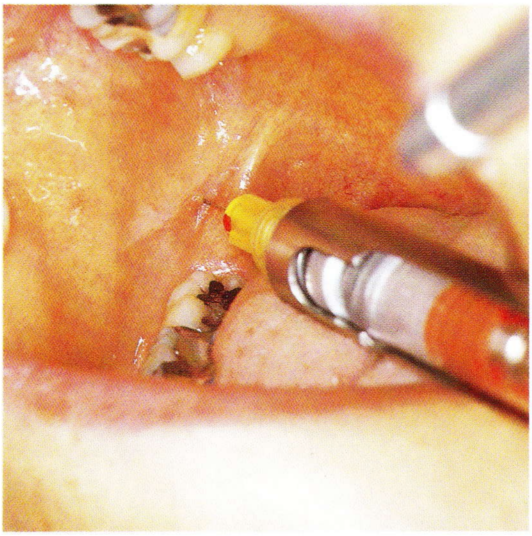


Fig. 136.

When the needle meets resistance from the middle section of the ramus withdraw the syringe slightly (1-2 mm) (Figs. 135-136) Carefully aspirate and inject very slowly 1.5 ml of solution (Fig. 137).

Fig. 137.

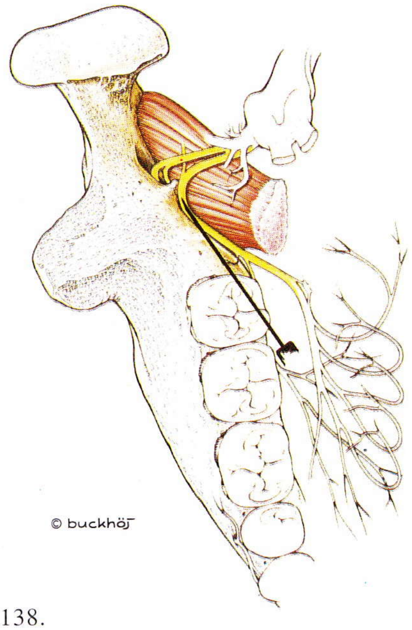


Fig. 138.

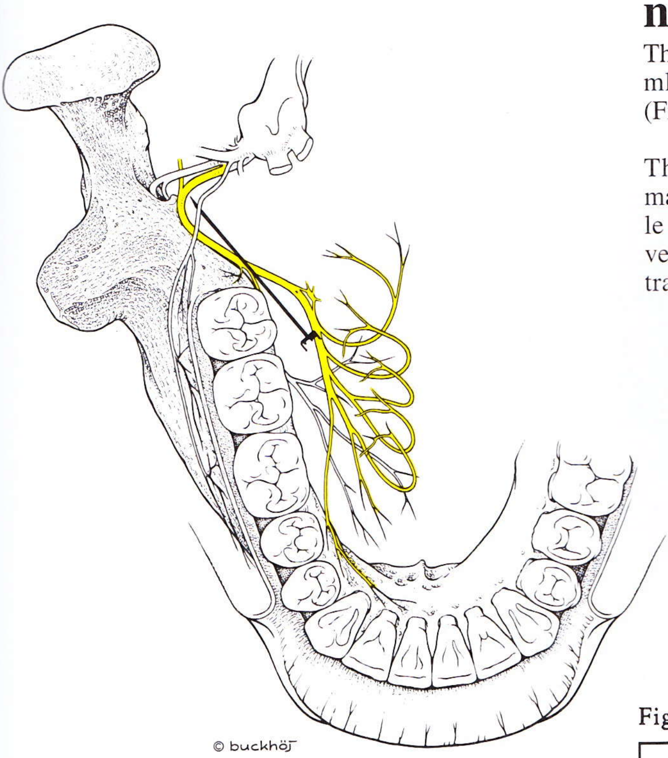


Fig. 139.

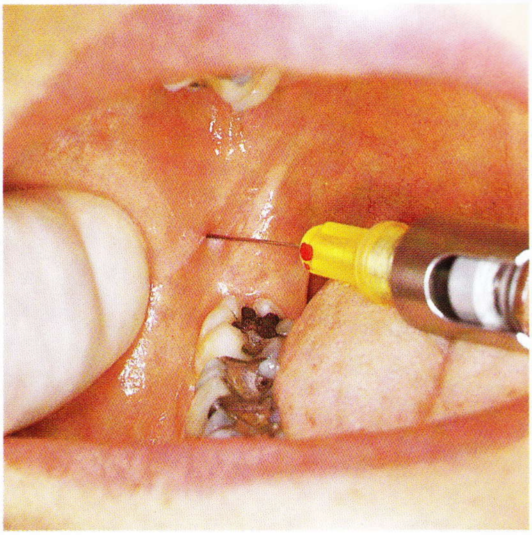


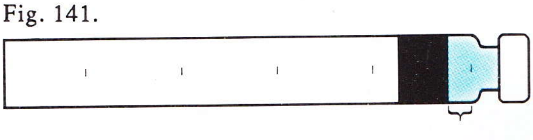
Fig. 140.

Blocking of the lingual nerve

The lingual nerve is blocked by injecting 0.4-0.5 ml of solution at the mandibular temporal crest (Figs. 138 and 141).

The injection is made in conjunction with a mandibular block. When withdrawing the needle from the mandibular foramen the lingual nerve is blocked at a point 0.5 cm mesially and ventrally to the lingula (Figs. 139 and 140).

Fig. 141.



Blocking of the buccal nerve

The buccal nerve can be anaesthetized by infiltration. The mucosa is punctured just above the buccal fold near the third molar (Fig. 142).

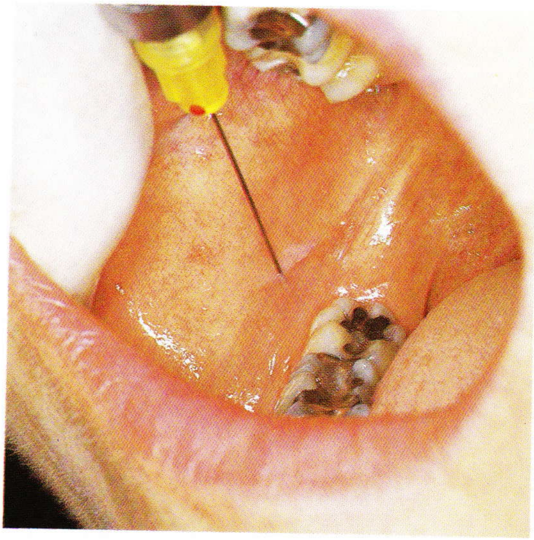


Fig. 143.

The needle is then guided horizontally under the mucosa in a distal direction towards the mandibular ramus, while simultaneously injecting a total of about 0.5 ml (Figs. 143 and 144).

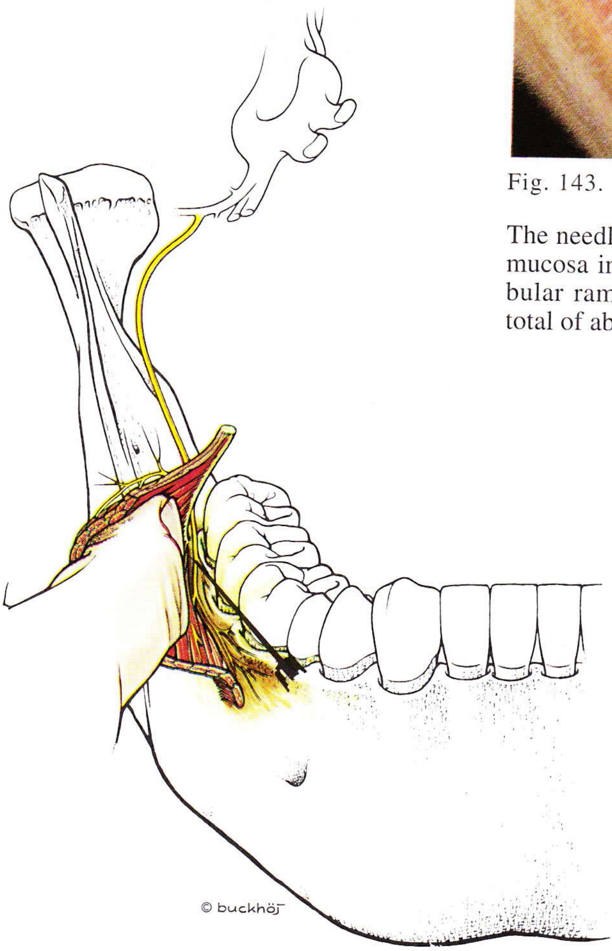
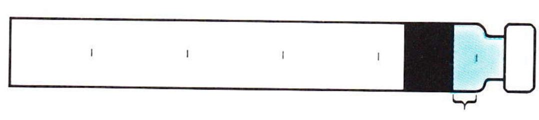


Fig. 142.

Fig. 144.



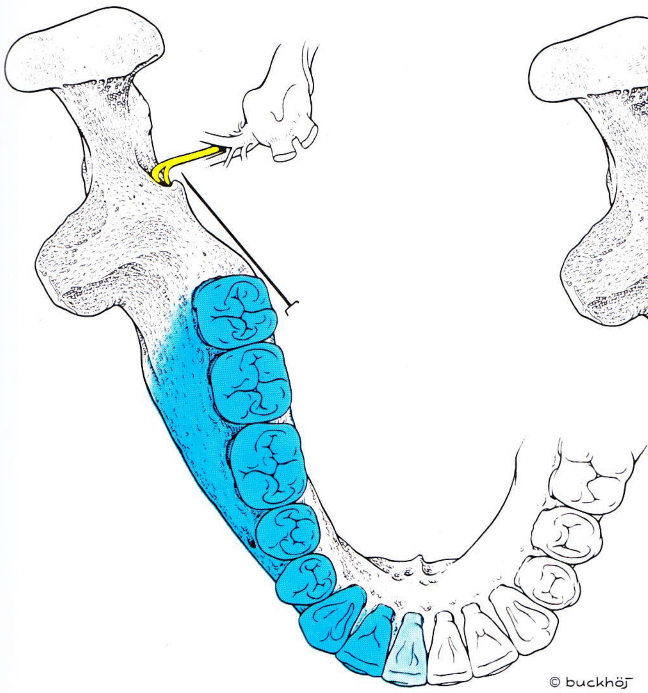


Fig. 145.

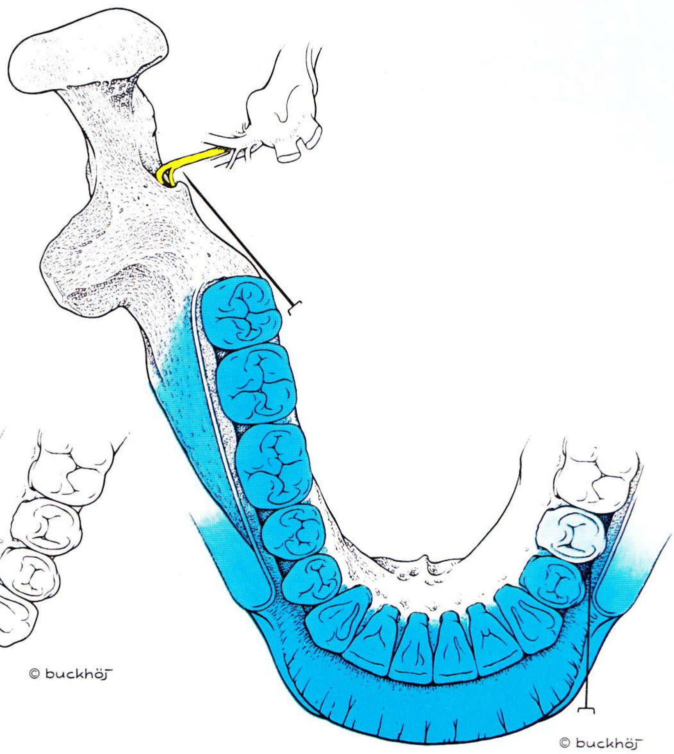


Fig. 146.

Spread of analgesia

A successful injection at the mandibular foramen will anaesthetize the molars, premolars, canine and incisors on the same side of the mandible (Fig. 145).

The coloured area shows the spread of anaesthesia in the teeth, buccal gingiva, and the soft tissues after supplementary block of the contralateral mental nerve (Fig. 146).

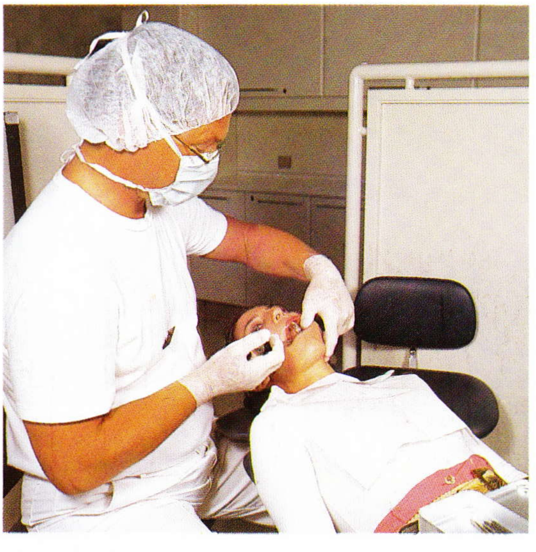
Failure of anaesthesia

Variation between patients

The duration of operative anaesthesia may be unexpectedly short. It is clearly important that the treatment must be begun as quickly as possible after the injection. Too long of a delay may result in incomplete anaesthesia. Infiltration anaesthesia should be estabished within 2 minutes, and regional block (mandibular), within 5 minutes.

In young children, small volume injections are given. Both diffusion and absorption of the anaesthetic may be expected to be more rapid, and, again, there is the factor of biological variation. Duration of anaesthesia may be short, and the latency period is also likely to be shorter than in an adult. The treatment must be begun as soon as possible (about 2 minutes after injection), especially after infiltration.

Fig. 147.



Intravascular injection

If part or all of the injection is made intravascularly, there will be little or no anaesthetic effect (see also page 92).(Fig. 148).

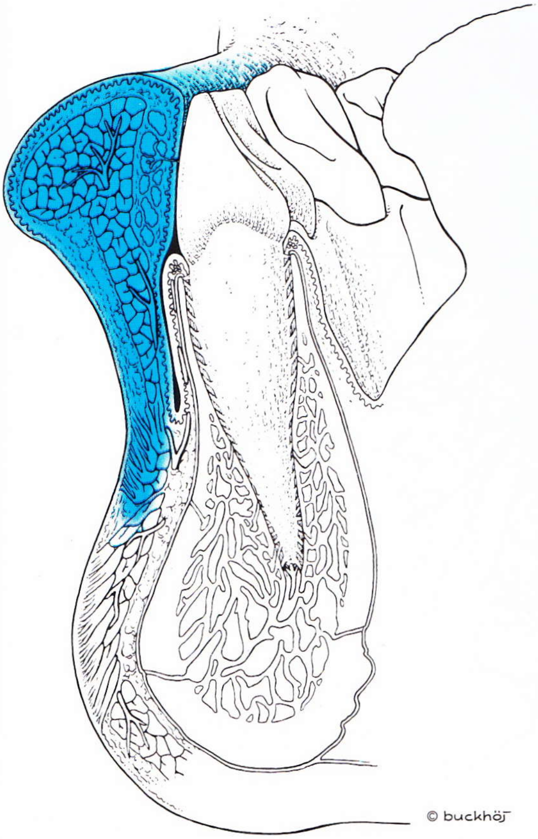


Fig. 148.

Injection into muscles

The correct placement of the needle point for infiltration anaesthesia is very near the bone and the tooth apex. If the point lies in muscle, the diffusion distance, and the diffusion barrier, are both increased. Anaesthesia may well be inadequate.

Individual reactions

Always bear in mind that a dose adequate in one patient, may be inadequate in another, not alone because of biological variation, but also because of negative conditioning or experience, anxiety or fear. The dentist must be a good psychologist. Practise understanding and re-assurance, and, in some difficult instances, have recourse to premedication.

Some reasons for failure of mandibular block

Bone contact must be established before injection. If this is not assured, the needle point may lie in the tissue medial to the mandibular ramus - that is, in the medial pterygoid muscle (Fig. 149). The block is likely to be ineffective, and there is danger of severe and persistent postoperative complications: local irritation of the muscle and trismus.

If the needle is passed yet deeper in this same incorrect plane, the parotid gland or the great vessels of the head and neck may be penetrated. The certain establishment of bone contact ensures against these contingencies.

If the needle point touches the mandibular nerve, the patient experiences parasthesiae - an electric shock spread over the area of the nerve distribution. The needle must be withdrawn 0.5-1.0 mm. The nerve may be damaged by intraneural injection, and the symptoms are often peristent.

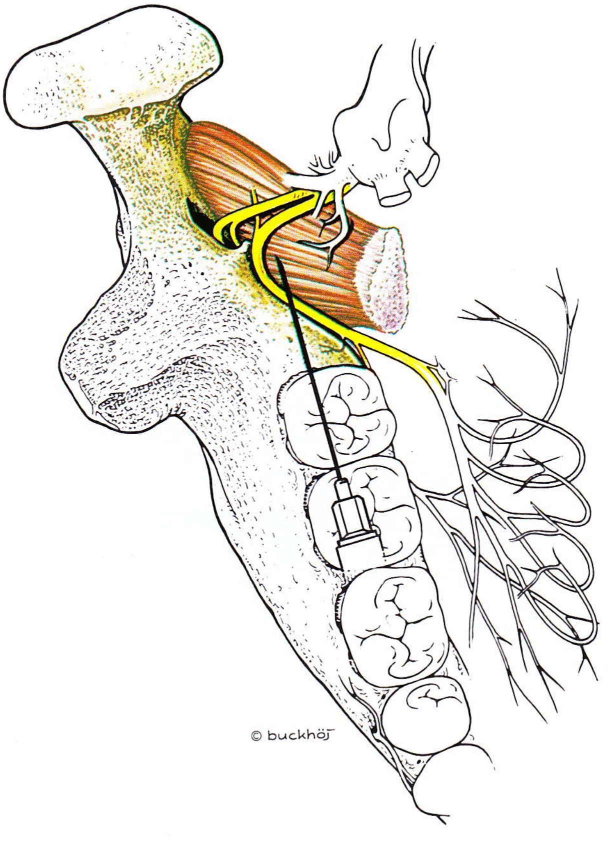


Fig. 149.

Fig. 150.

Injections into infected areas

These injections should be avoided because the infection may be exacerbated or spread. pH in an infected area tends to be low, and anaesthetic solutions are less potent at low pH.

The problem of lack of anaesthesia by concomitant infection is most frequently encountered in pulpitis cases, and by acute apical processes.

Do not infiltrate the infected area, but make regional blocks of the relevant nerves at some distance from the inflamed area (Fig. 150).

Complications

General complications

Competently administered local anaesthesia is very safe, the incidence of side effects and complications, rare. Despite this rarity, the practioner must be familiar with both the manifestation and treatment of all possible reaction. The patient's past and present history must be known, relevant illness and consumption of medicaments must be registered, and any previous negative experience by the patient of local anaesthesia must be noted. The patient's general disposition and attitudes are also important.

Observe the patient closely. Practise prophylaxis, and treat any complications immediately. The modern recline position is, in itself, a guard against vasovägal attacks, blood pressure fall, hypoxia, and fainting.

Remember that the intra-oral region is a trigger zone of many reflexes, all of which may be fired by injection and other manipulation in the mouth.

General complications can be grouper under four headings

1. Psychogenic
2. Toxic
    a) overdose
    b) reduced tolerance
3. Allergy
4. Drug interaction

Should loss of consciousness occur, immediate steps must be taken. Cerebral hypoxia causes irreversible brain damage within very few minutes. The dentist's reactions must be automatic.

Psychogenic complications

Psychogenic reactions account for the vast majority of complications experienced in a dental surgery. Patients are often under not inconsiderable strain, anxious, if not actually frightened. These states may be physically mani-fested by palpitations, cold sweat, restlessness, excitation, and fainting.

These reactions are alarming, and may be misinterpreted as signs of toxicity. Usually they are not. Fainting, for example, is most often of vasomotor origin. Observation of the sequence of events, and particularly of the state of the patient before treatment is begun, is very important. Thus, so far as possible, check that the patient has tolerated the needle puncture, before giving the injection. This sometimes allows a definite cause effect relationship to be established.

Patients with orthostatic hypotension tolerate even small change in blood pressure poorly. Stress alone in such patients may induce a fainting attack.

Pain superimposed on anxiety may also induce fainting, and nervous patients react to psychic stress by holding the breath in an acute stress situation e.g. injection. The oxygen available to the tissues is (further) reduced, and, again, fainting is a likelihood. Encourage, and ensure, that the patient breathes normally during the injection.

Other patients may display atypical faints, similar to those induced by toxicity - clonic convulsions, rolling of the eyes, rigidity. The symptoms also reflect hypoxia secondary to blood pressure fall, which always precedes a fainting, and again, a psychogenic cause is the more likely.

Lower the head, elevate the legs, and give oxygen.

Toxic complications

The pharmacology is considered elsewhere. Local anaesthetic overdosage, or very rarely a hypersensitivity reaction, may induce symptoms similar to those appearing due to toxicity. There may be convulsions, loss of consciousness and respiratory depression, or cardiovascular phenomena may predominate, presenting as circulatory collapse.

Despite the fact that dental local anaesthetic solutions are highly concentrated, and injected into extremely vascular areas, toxic reactions are very rare. They may also be of such short duration that they are not even observed.

To avoid a toxic reaction, the practitioner must be completely familiar with the local anatomy, aspiration must be made before injection, and injection must be made slowly. Take it step by step, observing the patient with some vigilance. Use a stop watch to control the injection rate, and be prepared to stop the injection, instantaneously.

Allergy

Amino-amide local anaesthetics (lidocaine, prilocaine, mepivacaine and articaine) have largely replaced the ester types (e.g. procaine, tetracaine), and this has entailed that allergic reactions are rarely seen today. About 2.000,000 dental local anaesthetic injections are given every day using the amide group members, but reports of allergic reactions are very few and isolated. Thus, complications occurring in the dental surgery are very unlikely to be caused by local anaesthetics.

A preservative for the vasoconstrictor called sodium metabisulphite is present in all local anaesthetics containing a vasoconstrictor. This substance is a potential allergen.

Reports of unusual reactions should not be nonchalized. If the history could fit, then the patient should be referred for allergic testing. This can be done at most hospitals. If the findings are negative, the patient is, virtually certainly, not at risk.

Drug interaction

Drug interaction is a relatively new problem in medicine and dentistry. In many cases, unexpected effects may be observed. In some patients the administration of two drugs will counteract each other, while in others potentiation will occur. Potentiation of the blood pressure respon-se to noradrenaline, even in small dosage, occurs in patients who are under treatment with tricyclic antidepressants.

This interaction is clinically important. Especially if the local anaesthetic solution, containing noradrenaline, is administered intravascularly. Fatal reactions have been reported.

Solutions containing adrenaline will only potentiate the blood pressure response to a lesser degree, which is of minor clinical importance. Felypressin (Octapressin©) has been found not to potentiate tricyclics.

Other vasoconstrictors have not been investigated in this respect, so their safety in patients on tricyclic agents is yet unproven.

MAOI (Monoaminooxidaseinhibitors) are potentiated by indirectly acting sympaticomimetic amines, (e.g. tyramine) but not by catecholamines (adrenaline and noradrenaline). Thus, dental local anaesthetics, in general use, can be given with safety.

Some patients may be taking beta blocker drugs for conditions such as high blood pressure or migraine disorders. There are different categories of beta-blocker drugs and the type to be watchful of are the non-cardioselective group. If a patient is taking one of these drugs and epinephrine is used in the local anaesthetic, there is the potential for an exaggerated increase in blood pressure. This could be a potential hazard. Judicial use of vasoconstrictor and careful monitoring of blood pressure is required for these patients.

Long lists of drugs which may possibly interact with dental local anaesthetics have been published, often in connection with advertising. This author is sceptical!

Treatment of general complications

Staff in all dental surgeries should be trained to handle emergencies. An absolute minimum requirement is a mask attached to a balloon with which artificial respiration can be given. The patient can be ventilated intermittently and harassed personnel have just time to call help or make the emergency telephone call (Fig. 151).

Primarily, the vital functions must be maintained. Keep a clear airway, ventilate the patient, and give heart massage if necessary (Fig. 152).

Medicaments are best given by experienced medical personnel - a frightened dentist may do more harm than good - but there is one exception. If the patient's state is one of anaphylactic shock, adrenaline (epinephrine) may be life-saving, and it must be given quickly, ideally as an i.v. injection, or as an injection into the tongue.

The following emergency procedures should be practised.

Lowered head position

An unconscious patient must immediately be placed in the supine position with the head lower than the body. Blood will thus flow from the lower extremities to the brain. In most cases this overcomes cerebral hypoxia and consciousness returns. If the legs are elevated above the level of the heart, this will increase the volume of circulating blood and tend to raise the blood pressure.

If consciousness is not restored practically immediately by these procedures with the patient in the chair, he should immediately be placed on the floor. The non-elastic floor is a far more effective place for resuscitation procedures than the soft dental chair.

Free airways

Any loose objects in the mouth (dentures, cotton rolls, saliva ejector, etc.) must be removed at once. If the patient vomits, the mouth must be cleaned, to avoid regurgitation, a very serious complication. A high capacity suction apparatus is very useful as it will remove fluid and particles without getting obstructed.

Fig. 151.

Fig. 152.

Artificial respiration

A patient in respiratory arrest must be ventilated immediately, by the mouth to mouth or mouth to nose method, if necessary, but better with oxygen given through a standard bag and mask resuscitator, which are marketed by several firms. This gives more freedom of action for communi-cation of the necessary measures, and it is more effective.

Cardiac arrest

The patient is rapidly placed on the floor if there is room in the operatory. If respiration stops, the pulse must be examined without delay. The simplest way is to feel for the carotid artery in the neck. An ambulance must be called immediately. If no pulse is felt, cardiopulmonary resuscitation must be commenced. The procedures, themselves, are simple, and all personnel should be familiar with them, and practised in their use.

Local complications

Contaminated needle

Infection may be transmitted, most important serum hepatitis.

Too rapid injection

The tissues may be torn. This causes postoperative pain, and necrosis may also occur, particularly in the firmly adherent palatal tissues.

Too large injection volume

This may also tear the tissues, especially of the palate. Give no more than absolutely necessary.

Infected area

All injections into an infected area should be avoided. This can generally be done by infiltrating mesially and distally to the tooth to be operated upon, or by making a regional block instead of an infiltration, as is the rule for accident cases in hospital dental surgery.

Ion-contamination of solutions

If vials are used, a faulty syringe-filling technique entails risk of copper ion contamination of the solution.

When cartridge syringes are left lying for some hours after loading and before use, copper ions are freed from the needle canal. These cause local irritation at the injection site. Oedema develops but may not become apparent until 2-3 days after the treatment. This may persist for a week or longer, and is experienced and can be reported by the patient as persistence in soft tissue anaesthesia.

Laceration of a nerve

Nerves may be lacerated when making regional blocks. The needle penetrates the nerval sheath which may be damaged. If parasthesiae are elicited the needle should always be withdrawn a little. If injection is made without withdrawal the risk of damage is greater.

Injections into restricted spaces, bony canals (the mental and palatal foramina and canals) are especially dangerous. The nerves are easily damaged as are the investing venous and arterial plexi. Local irritation and prolonged anaesthesia will result.

Laceration of an artery or a vein

Except in the hard palate, arteries are seldom penetrated by the needle because of the rather tough character of the artery walls. The risk is much greater with veins. Intravasal injections are most common in mandibular blocks and in tuberosity injections, where the veins form a plexus near the nerves. Mandibular blocks cannot be avoided, but tuberosity injections should be replaced by local infiltrations in the posterior maxillary region.

If a vein has been punctured, there will be an immediate swelling in the injection area due to blood leaking out into the tissues.

Generally no risk are involved and within a week the haematoma will have disappeared. Aspiration is of course necessary to avoid a rapid absorption of the local anaesthetic solution into the circula-tion, but it will not help in preventing the haematoma if the vein has already been lacerated.

Injection into an artery causes ischemia distal to the puncture. The effect may be due to contraction of the vessel by vasoconstriction or to reflex vasospasm.

Laceration of the periosteum

The periosteum is richly vascularized and rich in nerve supply. It is very sensitive to physical and chemical trauma. Therefore one should be very careful to avoid any rough manipulation with the needle. A contact should of course always be kept with the bone for orientation during, for instance, the start of a mandibular block injection. The dentist must therefore have a delicate touch when making these injections. The symptoms from a rough needle contact with the periosteum will be initial pain on injection and/or postoperative pain in the injected area. Sometimes a swelling will also be observed.

Trismus

More or less pronounced trismus and pain may sometimes occur after a mandibular injecton. The symptoms usually appear one or two days post-operatively and may persist over a fairly long period. It may be due to intramuscular injection into the medial pterygoid muscle. A simulta-neous infection will accentuate the local side effect.

Bleeding at the injection point

When a solution with a low vasoconstrictor content is used, there may be slight bleeding at the point of injection. The slight local ischaemic effect of these solutions cannot inhibit bleeding to the same extent as solutions with higher vasoconstrictor content. The bleeding stops spontaneously after a short time.

Facial paresis

This is caused by introducing the needle too deeply in a mandibular injection, and the solution is injected at the posterior margin of the ramus. The paresis is manifested by the patient's inability to frown, and move the lips on the affected side. Recovery is usually as quick as a normal recovery from a local anaesthetic, but, occasionally, the symptoms persist for a longer period.

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You've reached the back cover... Good luck with your exams!