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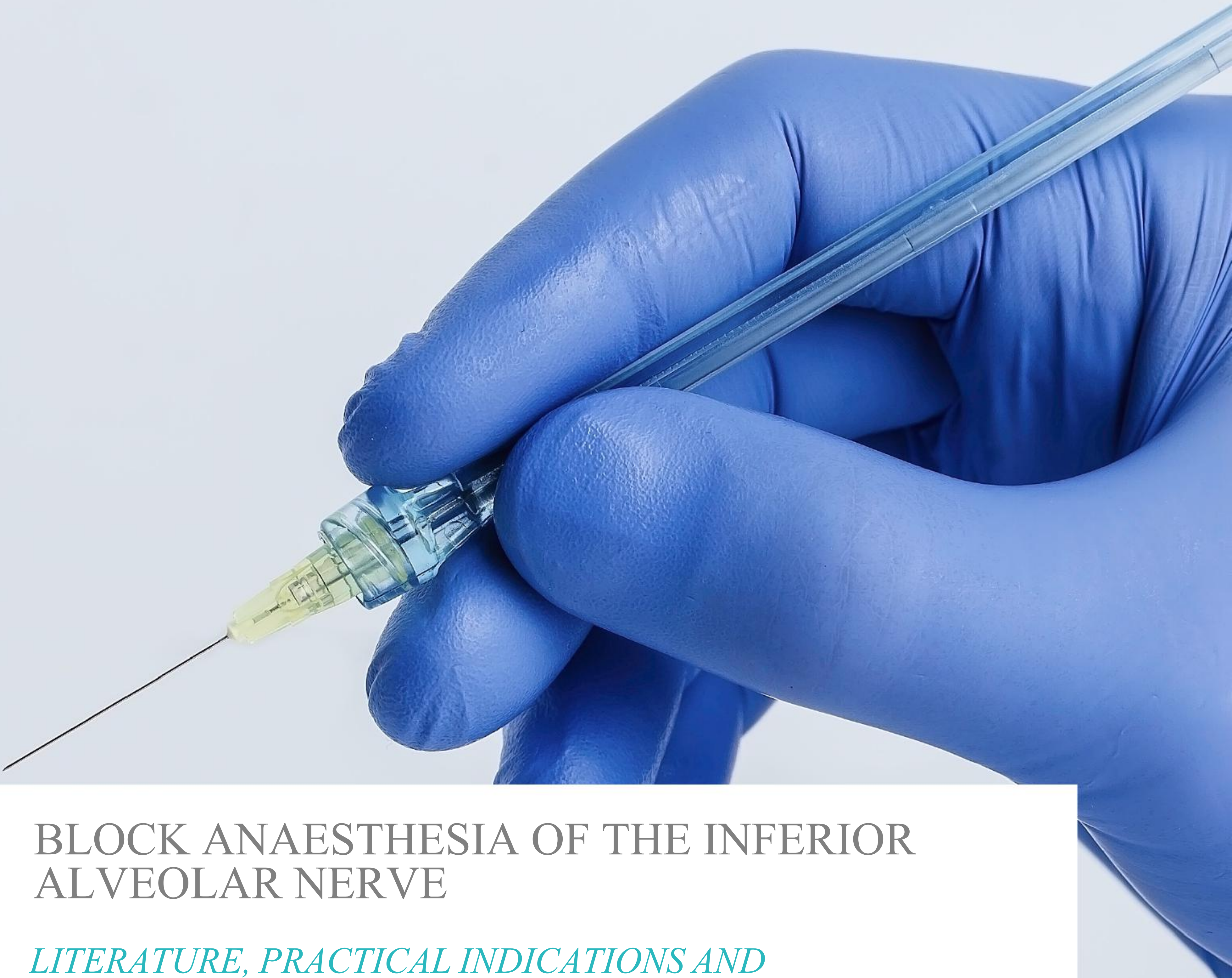

BLOCK ANAESTHESIA OF THE INFERIOR ALVEOLAR NERVE

LITERATURE, PRACTICAL INDICATIONS AND CLINICAL ALTERNATIVES

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BLOCK ANAESTHESIA OF THE INFERIOR ALVEOLAR NERVE

LITERATURE, PRACTICAL INDICATIONS AND CLINICAL ALTERNATIVES

Purpose of this monograph Introduction

The purpose of this text is to analyze and discuss some key points for achieving successful anaesthesia in the mandible, analyzing some critical issues and suggesting solutions and trends in light of the literature and progress enabled by technologies. We will also evaluate the contribution that The Wand, a device for computerized anaesthesia, is able to offer compared with traditional methods

- Biological principles on which anaesthesia is based
- Anatomy of the inferior alveolar nerve and exceptions
- Biological principles and expected effects
- Techniques for block anesthesia
- Direct technique
- Indirect technique
- Vazirani-Akinosi
- Gow-Gates
- Inferior Alveolar Nerve Block in children
- Side effects and IAN lesions due to block
- Alternatives: intraligamentary instead of block

Some dental procedures require prior deep anaesthesia capable of being as effective as minimally invasive. In these cases, it is not enough to resort to infiltration anaesthesia, and it is necessary to be able to convey the anaesthetic to areas that enable achievement of a block.

The introduction of this concept in dentistry can be attributed to Halsted and Hall who, in 1884, documented the first injection technique at the level of the mandibular foramen [1].

Today the inferior alveolar nerve block (IANB) is commonly used in dental procedures involving mandibular teeth. The anaesthesia commonly called nerve block is used for extraction of impacted third molars for periodontal surgery,, for endodontic and restorative procedures for molars and premolars. Although IAN block is frequently used, there are several failures and incomplete achievement of a state of anesthesia, with failure rates of between 15 and 20% recorded by studies in the literature [24]. It is clear that the correct use of local anaesthetic techniques and pain management are essential for successful dental treatment.

Biological principles on which anaesthesia is based

At the base of the success of anaesthesia of any type, there is knowledge of anatomical variables, the active principles used, and biological criteria.

The ionised form of the anaesthetic drug once injected splits to enter through the double layer of the nerve cell membrane. This molecule blocks the channel of sodium, a transmembrane protein, and in this way conduction of the nociceptive stimulus is also stopped [5]. The local anaesthetic performs its action more on the Na^+ channels in the open or inactive configuration and can act on both unmyelinated and myelinated fibres endowed with Schwann's sheath [6]; the type of fibre influences the area that must be covered by the anaesthetic for it to perform its action, since in the unmyelinated fibres the sodium channels are much closer together and so blocking conduction will therefore be easier for the anaesthetic, even involving only a small portion.

The effectiveness of the anaesthetic molecules is influenced by various factors, one of the most important being the pH level. If the pH is high, there will be a greater non-ionised liposoluble portion of the anaesthetic and this will be able to perform its action more quickly. The condition of pH acidity, characteristic of inflamed tissues, on the other hand, negatively affects onset time [7]. Having performed their task, local anaesthetics are eliminated and their excretion is influenced by factors such as:

- Age
- Hepatic function
- Cardiovascular problems
- Renal function: influential in the elimination of pharmacologically active metabolites.

Anatomy of the inferior alveolar nerve and exceptions

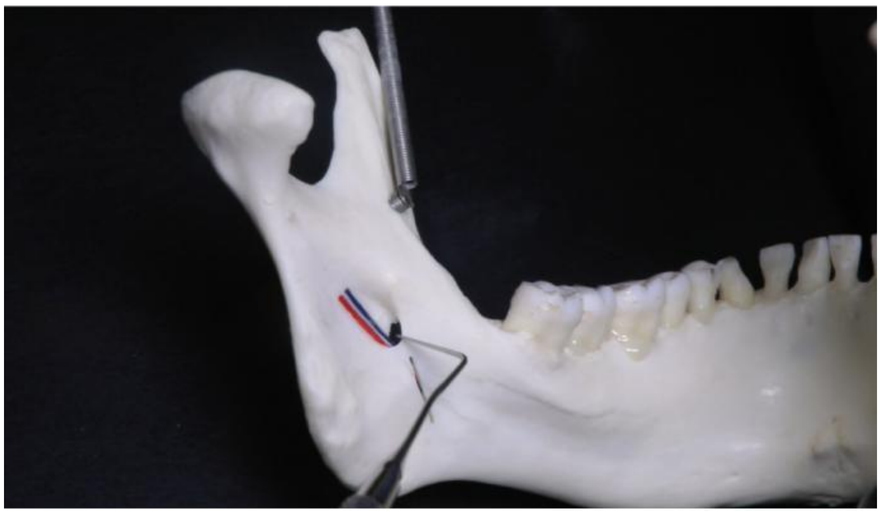
The mandibular nerve is the third branch of the trigeminal nerve; it contains both sensitive (the greater part) and motor fibres. The nerve splits into two nerves, one anterior and one posterior. A sensory nerve, the buccal nerve and a number of motor nerves, the pterygoid nerves, the deep temporal nerves and the masseteric nerve emerge from the anterior trunk. Three branches instead emerge from the posterior trunk: the auriculotemporal nerve (only sensitive), the lingual nerve (only sensory) and the inferior alveolar nerve (sensory and motor). The nerve extends deeply into the lateral pterygoid muscle and emerges from beneath this muscle, heading towards the entrance hole of the mandibular canal. Shortly before penetrating the mandibular canal, it releases the mylohyoid (motor) nerve. Inside the mandibular canal, the inferior alveolar nerve transmits only sensory-type stimuli and emits the various nerves for the alveoli. Continuing, the nerve releases the mental nerve for the skin of this area, the lower lip and part of the gingival tissues at the level of the canines and incisors. The last tract of the lower alveolar nerve heads to form the incisive nerve.

Anatomical variability of the mandibular canal and inferior alveolar nerve

Different anatomical conformations of the mandibular canal occur with a frequency that has not been clearly established by the literature; in fact, studies have found a very variable percentage of bifid canal ranging between 0.08 and 65% [8; 9]. Trifurcation of the alveolar canal has even been reported with further uncertain percentages. Identifying courses and conformations that differ from the norm is essential for avoiding complications, such as achieving a partial anaesthetic effect. Through orthopantomography it is possible to recognise case histories that deviate from the norm, but in some cases two-dimensional analysis is not sufficient. In operations such as extraction of the third molars, CBCT can be decisive in planning of the operation and shed light on any abnormalities of course and formation of the nerve component [10; 11]. A 2013 study [12] aimed to classify cases of bifidity of the mandibular canal and evaluate the relationship of the nerve with the roots of the third molars, if this anomaly was present, through use of the cone beam. To do this, we started from a "historical" study by Langlais et al. of 1985 [13] which, by analysing 6000 OPTs, had drawn up a classification of bifid canals into 4 groups and found 1% of bifid canals. What emerged in evaluating 75 cone beams of patients in which the presence of bifid channel was certain is that this conformation in most cases is found monolaterally and that this canal has a close relationship with the apexes of the lower eighth level of the distal sector of the mandible.

Localization of the mandibular canal

Use of the inferior alveolar nerve (IAN) block can sometimes lead to failures, but the lack of anaesthesia can be easily explained with inadequate knowledge of the methods for ascertaining the correct anatomical location of the entrance of the mandibular canal. The position of the foramen may in fact vary greatly [14]. The success of this procedure is related to the deposition of anaesthetic material very close to the nerve before entering the mandibular foramen. Some authors have also indicated that IAN anaesthesia can also be achieved through the deposition of anaesthetic material in the pterygomandibular space thanks to subsequent diffusion of the local anaesthetic, thus also reducing the risk of perforating the large blood vessels in the area [15].



Many studies have discussed the position of the mandibular foramen [16-18]. Its position has been studied in relation to the dimensions of the anterior ramus of the mandible at the level of the ramus and to changes of these dimensions with age, as well as correlated to the occlusal plane position.

Practical instructions for finding the foramen of the mandibular canal

In particular, we highlight what emerged from a 2012 study by Thangavelu et al. [16], which analysed 102 dry mandibles of 93 subjects with teeth and 9 without teeth, looking for landmarks and measurements that could help clinicians in identifying the correct point in which to perform the injection for the IAN block. This work found an average frame distance of 19 mm from the coronoid notch of the anterior edge of the ramus. It has also been found that the position of the foramen is usually not in the centre of the ramus but is displaced posteriorly by 2.75 mm. Superiorly-inferiorly, on the other hand, the mouth of the mandibular canal is located 5 mm below the point that identifies half of the height of the ramus. Another important indication comes from the occlusal plane; in fact, it was found that the foramen is on average displaced a few millimetres below the occlusal plane of the lower molars.

Techniques for troncular anaesthesia: direct technique

The administration of local anaesthetics in the vicinity of the mandibular foramen causes the block of the inferior alveolar nerve and often of the lingual nerve that is nearby, causing anaesthesia of:

- body of the mandible and inferior part of the ramus
- all mandibular teeth
- floor of the mouth
- two anterior thirds of the tongue
- gingiva on the lingual side of the mandible
- gingiva on the labial surface of the mandible
- mucosa and skin of the inferior lip and chin

Many techniques for blocking the inferior alveolar nerve have been described in the literature and each has its own advantages and disadvantages. Although there are some techniques commonly used throughout the world, others, although dated, are not mastered by most. Certain techniques are certainly not of interest to the general dentist in everyday life, but it is good to know them to solve rare situations in which common methods are not enough.

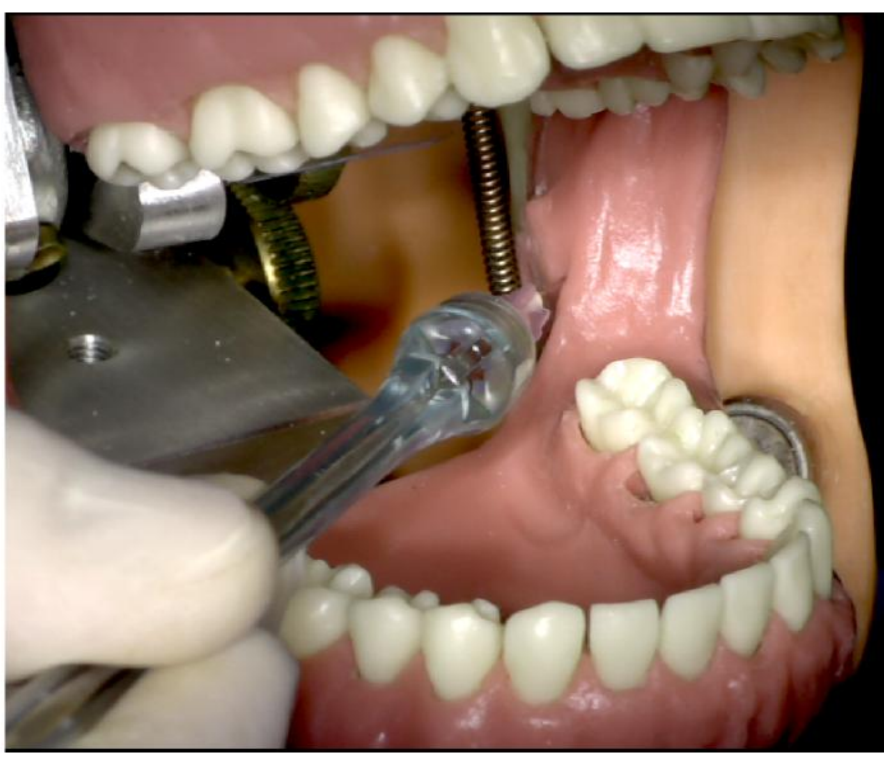
Despite its crucial importance, the IAN block is associated with a failure rate of 15-20%, so it is by far the anaesthetic technique in dentistry with the highest failure rates [19].

At the clinical level, the indications given by the literature can be simplified in order to obtain a repeatable workflow. The most important reference points used are the coronoid notch and the pterygomandibular raphe. As a site for inserting the needle, Malamed proposes a point that lies on an imaginary line drawn between these two reference points. Having taken this distance and divided by 4, we move one quarter from the raphe and place ourselves above the occlusal table of the inferior molars with an inclination that follows the form of the contralateral premolars. The inclination of the needle in the sagittal plane is about 45 degrees.

The needle is gently inserted into the mucosa and a few drops of anaesthetic solution are deposited in the area; penetration continues until coming into contact with the bone, the moment in which the patient can feel a pungent painful symptom [20]. The approach to the periosteum must necessarily be very slow and delicate since the needle can also be damaged on contact.

To prevent the needle from breaking, it is advisable to use a slight rotary movement that permits advancing with less interference from the tissues (a procedure also recommended for the use of The Wand device). The depth of penetration of the needle usually varies between 19 and 25 mm; if the needle is inserted more than 25 mm this may indicate that its location is then more posterior than is necessary, while if inserted less than 19 mm it will probably be placed in a location too anterior to our target [21].

Before injecting, aspiration should be carried out and, if negative, the injection will be carried out very slowly [22].



The criticality of correct aspiration

Rapid absorption of the local anaesthetic may produce high concentrations of the drug at blood level; this risk lurks when a block is performed [23]. Both the central nervous system and the cardiovascular system are particularly sensitive to high plasma concentrations of local anaesthetics; furthermore, the addition of epinephrine has an additional influence on cardiovascular function [2426].

Proper aspiration must therefore be performed before a local anaesthetic is injected to establish whether the needle finds itself inside a blood vessel. If blood appears in the syringe, the tip of the needle is in a dangerous position, i.e., inside a vessel. It must be withdrawn, repositioned and a further aspiration attempted. It should also be remembered that there may be other reasons for a negative aspiration; this procedure must be therefore performed on two planes in order to be more certain that the position is correct.

The aspiration process is also affected by the device with which it is performed and for this reason you would do well to consider this aspect when choosing the instrument with which to perform the anaesthesia.

A 2016 study ("Movement control during aspiration with different injection systems via video monitoring — an in vitro model”) assessed that the control of hand movements is better and therefore the risk of false negatives less when a device is used that does not needs hand movements for aspiration; in this sense, a device fitted with a control by means of a special pedal such as The Wand meets the needs of clinicians and patient safety [27]. In order to validate this concept, we can analyse the design of the study and the results obtained. Two experienced and two inexperienced operators used 5 different devices, finding these needle displacement values at the time of injection with respect to the act of aspiration.

- 2 ml syringe for dispensing liquids: 2.85 mm

- 5 ml syringe for dispensing liquids: 2.36 mm

- Syringe with the possibility of active aspiration maneuvere: 2.45 mm

- Syringe with the possibility of passive aspiration maneuvere: 2.01 mm

- The Wand, computerised anaesthesia system with simplified aspiration: 0.91 mm

The Wand therefore shows a deviation with respect to the point in which the preliminary aspiration is performed, which is far less than the other devices used in the study. Also in this sense, it shows itself to be a particularly safe instrument for avoiding accidental injections into blood vessels.

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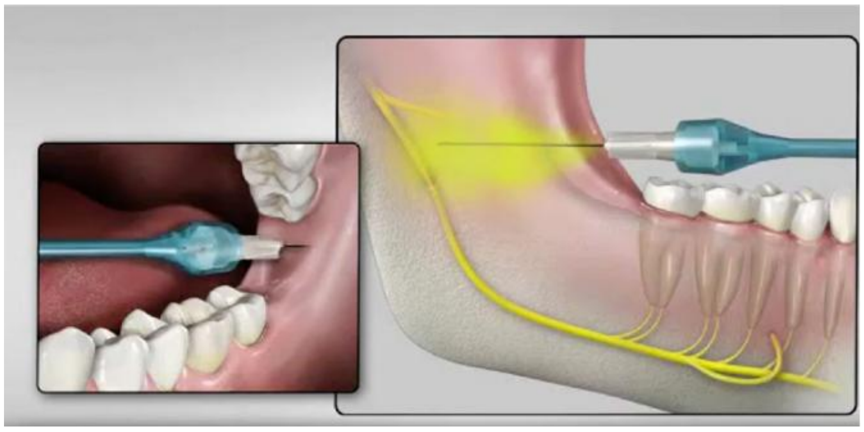


Techniques for block anaesthesia: indirect technique

The indirect technique requires that the needle not be inclined at 45 degrees to the sagittal plane and that it penetrates the pterygomandibular space with the syringe parallel to the direction of the ipsilateral mandibular arch.

A 2016 study aimed to compare the efficacy of the direct and indirect technique for IAN anaesthesia.

Analyzing the onset time in a subjective as well as objective manner, it appears that the direct method takes less time to reach clinical efficacy from the point of view of analgesia. If we also compare duration of the anaesthesia, the direct technique emerges as winner of the comparison. This is probably due to the fact that the inoculation point falls closer to the target than with the indirect technique. There do not seem to be significant differences from the point of view of positive aspiration rates, which never occurred in the study in question, but the percentage of which in the literature is estimated at 10-15% [28].

In literature there are many works that investigate what might be the technique with the highest success rates when it comes to IAN blocking, but no "ideal" technique for protection against failure, incomplete anaesthesia and/or complications appears to emerge.

In this regard, the analysis carried out by Hesham Khalil's 2014 review – which briefly traces the main changes proposed in terms of block anaesthesia of the inferior alveolar nerve and analyses its weak points and strengths – is interesting.

Some authors then "patented" techniques that combine the principles of the direct and indirect technique; for example, in 2013, a technique was proposed in which the needle was pre-curved before injection. In this case the syringe was positioned parallel to the homolateral arch, as in the indirect technique, but the bent needle reached the point of inoculation at about 45 degrees as in the direct technique [29].

Two methods which correctly performed appear to increase success rates are the Vazirani-Akinosi and Gow-Gates techniques; these are often little known and used because they are considered complex, but they sometimes allow the treatment of complex conditions or special needs.

Vazirani-Akinosi technique

The Vazirani-Akinosi technique is a particular method of nerve block in the mandibular region, to be carried out with the mouth closed. The technique spread after Joseph Akinosi's 1977 publication; a similar procedure, however, had been described by Vazirani in 1960, even before introduction of the Gow-Gates technique. According to Malamed, the injection currently in use therefore pays homage to both authors [30].

The area of distribution of the anaesthesia includes a) the corresponding dental arch, b) the body of the mandible and the inferior part of the ramus, c) the gingiva/mucosa and vestibular periosteum, anterior to the mental foramen and d) the region of distribution of the lingual nerve: anterior 2/3 of the tongue and floor of the mouth, gingiva/mucosa and lingual periosteum.

The main indication, already mentioned, is trismus: a classic case is contraction of the masticatory musculature which prevents performing effective inferior alveolar anaesthesia, for example, in cases of pulpitis or abscess of a lower molar. This method may also be proposed in less extreme cases of patients with limited mandibular opening.

The technique also has some practical advantages such as, for example, the lower aspiration rate (<10%) than that of the usual alveolar nerve anaesthesia.

Technique for performing the inferior alveolar nevus block according to Vazirani-Akinosi:

Malamed recommends using a long needle, 25 or 27 G. The insertion area is the soft tissues lining the medial border of the mandibular ramus, at the level of the mucogingival line next to the upper third molar. The point is therefore particularly close to the maxillary tuberosity and is cranial with respect to the site of the conventional technique and caudal with respect to that of the Gow-Gates technique. It is the point where the inferior alveolar, lingual and mylohyoid nerves run downwards.

The patient is placed supine or semi-seated and the operator palpates the coronoid notch, then spreads the soft tissues of the cheek and upper vestibule. The syringe is inserted parallel to the occlusal plane and moves in a posterior and slightly lateral direction, the latter being designed to follow the flaring of the mandibular ramus. In the past it was suggested bending the needle towards the medial side of the mandibular ramus: the method recommended today is the original one, with the needle aligned with the body of the device used to perform the injection. The soft tissues are about 25 mm deep, there is no contact with the bone, and the tip of the needle is located in the centre of the pterygomandibular space. The need to conduct the second phase of the procedure "blind" is perceived by some authors as the main disadvantage of the method. Onset of the anaesthetic effect on the dental pulp can be seen within about 5 minutes.

Gow-Gates technique

The name refers to a dentist, George A.E. Gow-Gates who, in 1973, decided to share the technique of preanaesthesia of the inferior alveolar nerve he had been using with full satisfaction for thirty years. In fact, the author reported data of a 99% success rate. Though not wanting to compete with the results reported by its creator, several clinicians welcomed the new idea: with failure rates of around 20%, in fact, the classic method of inferior alveolar nerve anaesthesia may well represent one of the most frustrating clinical phases, both for professionals and for patients.

It must be stressed that the Gow-Gates technique is not really an alternative to the usual method. It is in fact a block of the mandibular nerve, that is, it involves the entire third branch of the V pair of cranial nerves and, of course, all its downstream branches: in addition to the inferior alveolar nerve, the lingual, mylohyoid, mental, incisive, auricolotemporal and vestibular nerves.

Once applied effectively, therefore, no supplement will be necessary for any intervention on the mandibular arch. In this sense, there are no real differences between the Gow-Gates technique and the alveolar nerve block. The same is true for the contraindications: the most significant concerns those patients who have difficulty in opening the mouth. Some authors report problems concerning the operators who, if they are confident with the traditional technique, could find themselves in difficulty in approaching the learning curve of the new technique.

One advantage that can be observed is a higher success rate, a further advantage is the percentage of positive aspirations, equal to about 2%, and therefore much lower than the 10–15% of the conventional technique.

In operational terms, Malamed recommends using a long 25 G needle. The patient, supine with neck hyperextended (possibly semi-supine), is encouraged to open the mouth as wide as possible.

Both extraoral and intraoral landmarks stand out. On one side, the inferior border of the tragus (triangular notch) and angle of the mouth; on the other, the mesio-palatal cusp of the superior second molar indicates the level at which the needle is inserted. The point of penetration is the mucosa of the mesial aspect of the mandibular ramus, distal to the same superior second molar. Positionally, this is near the neck of the condyle, just below the insertion of the external pterygoid muscle. The technique involves insertion to a depth of approximately 25 mm, until contact is made with the bone: after having retracted the needle by 1–2 mm, the aspiration test is carried out. If negative, the anaesthetic solution is slowly injected.

Alveolar nerve block in children

In children, management of fear and behavior that results is fundamental for the success of dental procedures. Having a child as relaxed and calm as possible while administering local anaesthesia is essential for successful therapy.

IAN block is sometimes the local anaesthesia technique chosen when treating deciduous molars.

The depth of the anaesthesia is the main advantage of this technique, but the compliance required is high and it is not always possible to prevent the child from feeling pain at the time of injection. In this sense it is interesting to note that a study in adolescents compared the perception of pain during block anaesthesia performed with a conventional syringe or with The Wand's computerized local anaesthesia delivery system [31]. It emerged that use of The Wand device results in a reduction in the pain perceived during execution of the IAN block, an indispensable premise for obtaining collaboration especially in pediatric dentistry patients.

In fact, for the inferior alveolar block, the child is called on to open the mouth as much as possible and the needle is inserted deep into the tissues, a situation that could cause them discomfort and make them lose confidence in the treatments being given before even starting them.

Furthermore, the procedure can be complicated by the position of the foramen which varies with age, adding a further unknown factor to a technique already plagued by a high failure rate.

The procedure follows the same maneuvers described for the adult.

Sometimes, in order not to traumatize the child, as well as achieve better results in a minimally invasive manner, it is possible to resort to a simple infiltration for therapies for deciduous molars. Some studies have assessed the efficacy of mandibular infiltration as a possible alternative to the mandibular block for the treatment of primary molars and no significant differences were found between infiltration and IAN block [32:33].

Another type of anaesthesia appears to be even more appreciated by young patients: intraligamentary PDL anaesthesia. A study based on 80 children aimed to evaluate the efficacy of PDL injection in analgesia in the case of pulpotomies.

This article, showed with a randomized double-blind protocol, involved subjects between the ages of 3 and 7 who needed a pulpotomy in mandibular deciduous molars in two quadrants. The teeth of these children were anaesthetised using the intraligamentary technique on one side of the mandible and block of the alveolar nerve on the other.

Signs of discomfort, including body tension and eye movement, complaints and crying were recorded and evaluated. The results showed that the analgesia rate between the two techniques is comparable in these situations and that therefore intraligamentary anaesthesia is to be considered a valid alternative to the inferior alveolar nerve block in this type of procedure [34].

It should also be recalled that in children an anaesthesia that lasts for a long time after the operation can lead to biting lesions. Long-acting local anaesthetics and inferior alveolar nerve block in children can cause loss of sensation in a large area. In both the superior and inferior maxilla, it is advisable to use drugs with an effect that does not last for a long time after the end of the operation [35].

Side effects and complications: IAN lesions after troncular block

A review of the subject confirms that lesions of the inferior alveolar nerve caused by block anaesthetic blocks have an incidence of 1: 26.762 [36]. However, the real incidence is difficult to measure without large surveys of the population. It may therefore be that throughout your professional career you will not run into this problem, but since the common devices for anaesthesia do not allow any method for preventing such lesion, it is necessary to know the risk and weigh up the possibility of using another type of approach when possible.

Although the exact mechanism that causes damage to the nerve is still unclear, there are three main causes responsible for lesion of the IAN during anaesthesia [37]:

- Needle trauma: a small portion of patients experience an electric shock when inserting the needle due to direct contact with the nerve. Several studies have shown that the vast majority of these contacts do not cause obvious damage; however, it is possible that the needle traumatizes the nerve [38]

- Hemotoma in this case the hypothesis is that the needle can penetrate a small blood vessel and cause a hemotoma. Bleeding would put pressure on the nerve fibers, the magnitude of which would determine the severity of the damage.

- Toxicity of the anaesthetic drug: in the final analysis, lesion of the nerve during block anaesthesia could be correlated to specific active ingredients or to certain concentrations of local anaesthetics [39]. This last aspect has been studied in depth and a study by Perez-Castro et al. showed that higher concentrations of active ingredient increase the rate of cytotoxicity of the molecule [40]. Epidemiologically, several reports have highlighted the increased incidence of persistent nerve lesions linked to IAN blocks with the introduction of high concentration local anaesthetics, particularly when articaine was used [41].

All these considerations also apply to the lingual nerve, where trauma due to injection through troncular block is more frequent than of the IAN itself.

IAN lesion management

These lesions are associated with paresthesia and in some cases with persistent and disabling neuropathic pain. The problem with these lesions is that the nerve remains almost intact from the macroscopic aspect and surgery is not appropriate insofar as the injured region cannot be identified; thus, in most cases, the approach consists in giving pharmacological therapies for pain control and in frequent monitoring for controlling spontaneous remissions. 81% of the lesions heal within 2 weeks, while when the symptom lasts over 8 weeks the risk of a permanent compromise is high [36].

The most widely used pharmacological treatments are benzodiazepines and tricyclic antidepressants which can be effective drugs in the treatment of dysesthesia. However, patients presenting hypoesthesia or persistent pain symptoms will be referred to micro-surgery procedures. Although this particular complication is a rare occurrence, it is important to be aware of it, use cautiously high concentration anaesthetics (for which several articles report increased toxicity) and recognize the need for an early referral to a specialist in case of lesion for optimal management.

The Wand for performing block anaesthesia safely and effectively

In the light of what has been said, use of block anaesthetic is undoubtedly a procedure that is essential for knowing how to master best and implement techniques and use instruments capable of improving outcomes. In this sense, since its design, The Wand has always had particular features, designed to improve the success rate of the procedure and make it safer. We refer in particular to the following aspects:

- The bi-rotational insertion movement that makes it possible to reach the chosen site more precisely by reducing the deflection to a minimum during advancement inside the soft tissues

- The possibility of aspiration through a simple touch of the pedal does not force the doctor to move with respect to the position reached and thus avoids injecting into a blood vessel due to incorrect reinsertion. This makes the procedure safer.

- Less use of anaesthetic thanks to the controlled pressure that makes it possible to better dose the dispensed quantities and the indicators that clearly indicate advancement of the procedure.

- The possibility of adopting the multi-cartridge mode for using more than one injection cartridge without moving from the previously reached correct position.

Alternatives to the use of block anaesthesia: intraligamentary anaesthesia in adults and children

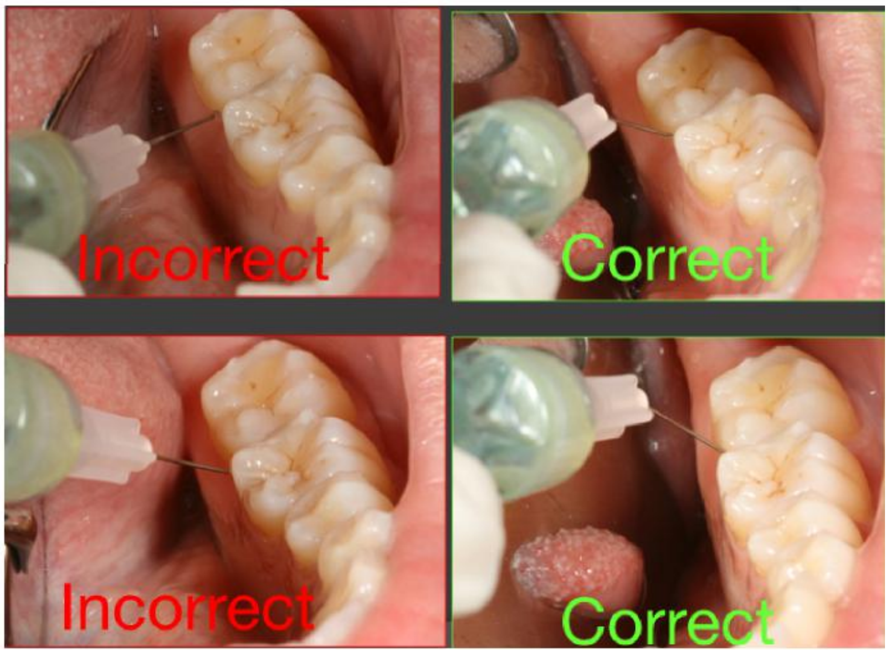
Several studies in the literature evaluate the efficacy of intraligamentary anesthesia adopted for elements of the inferior arch for which block anaesthesia is normally used; finally, we would like to highlight a work carried out by the StyleItaliano community group (http://www.styleitaliano.org/the-wand-sta-in-the-treatment-of-mandibular-teeth-a-multicentric-study).

Although it is not an article yet published in scientific literature, the analysis performed by them on mandibular elements clearly shows the usefulness of being able to take advantage of a single tooth anaesthesia method and its effectiveness through the computerized system of The Wand.

The intraligamentary technique has been used for many years mainly as a means for obtaining complete anaesthesia of a tooth where infiltration orblock anaesthesia have failed to achieve complete analgesia. This clearly suggests that this procedure was reserved for those cases that were already facing difficulties in pain management.

In the past, the technique envisaged that the needle penetrates the gingival sulcus with the opening of the needle facing the root of the tooth in a mesial or distal position. Advancement in the sulcus was slow until it met resistance, after which the anaesthetic was injected with strong pressure and this usually caused pain to the patient; the recommended amounts of anaesthetic have always been very low (0.2 ml per root), the needle to be used short and the prescribed injection speed reduced. Conceptually, therefore, this type of anaesthesia has always set itself the goal of involving only the tooth involved in the procedure

, without giving sensations of numbness to the lip and surrounding tissues and reducing the need for block anaesthesia also in the treatment of maxillary molars.



A 1982 historical study by Malamed et al. demonstrated the effectiveness of this approach, observing how a high success rate was achieved in the protocol used, with low incidence of adverse reactions and duration of adequate pulp anaesthesia for ending preventive therapies [42].

From that moment the literature certainly investigated the method and the race began to create an instrument that was able to maximize the positive effects of this approach, reduce discomfort during injection and simplify the procedure, making it applicable in most treatments. The Wand computerized anaesthesia delivery instrument was created to meet these needs. The Wand allows you to perform all types of anaesthesia, not just intraligamentary; rather, it allows you to make palatal blocks that are otherwise difficult to execute painlessly. Returning to the focus of this chapter, however, it must be said that the procedures for performing intraligamentary anaesthesia are similar to those described above and also recommended by Malamed in his text [43] dedicated to the PDL anaesthetic injection technique, but the reliability of the therapy is increased thanks to several improvements.

The intraligamentary technique performed with the Wand device is called single tooth anaesthesia (STA). STA constitutes a particular form or, rather, a development of intraligamentary anesthesia (PDL), with which it therefore shares the biological assumptions. Conceptually, it provides a concentrated action at the level of a single dental tooth and control through use of a computerized system (also called CCLAD).

The introduction of STA represents a weapon of considerable importance in daily practice. It actually provides a solution to the two main problems of intraligamentary anaesthesia, namely the difficulty of manually controlling pressure and lack of landmarks. In fact, the system envisages constant control of pressure (Dynamic Pressure Sensing - DPS).

This guarantees a reduction in pain during administration, not only in comparison with the classical PDL anaesthesia, but also compared with conventional anaesthesia. Furthermore, it is the instrument itself that directs the operator to the point where the anaesthetic has to be effectively delivered to achieve the effect; this therefore also makes it possible to reduce the quantities of local anaesthetic used per single procedure and reduce the risks - fortunately rare - associated with it.

Finally, perhaps the most important thing: STA anaesthesia is not the last possibility for the clinician when all other anaesthesias have failed, but in most cases it can guarantee complete analgesia without using other procedures.

For this reason, STA anaesthesia can be considered the first and only anaesthesia used in all the treatments for which it is indicated, including therapies against deciduous and permanent maxillary teeth for which block anaesthesia has historically been used.

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