

Local Anaesthesia

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Introduction

The ability to anaesthetize areas of the mouth is of great benefit to patients who would otherwise experience unpleasant sensations during many types of dental treatment. The original local anaesthetic (LA) in the 1800s was cocaine,¹ followed by procaine (which goes by the trade name of Novocaine), and eventually by lidocaine, which is still the main LA in use today. Today there are five highly effective and safe LAs in common use. Listed alphabetically, these are articaine, bupivacaine, lidocaine, mepivacaine and prilocaine. LAs reversibly block the generation and propagation of the action potential by binding to sites on the sodium channels of nerve membranes. Thus, their administration eliminates sensations from an area of the mouth.

Technique Overview

For work in the maxilla, LAs can usually be administered adjacent to the teeth to be worked on, by means of a paraperiosteal field block or infiltration. This is due to the relatively porous alveolar bone so that the LA can penetrate more easily and reach its sites of action on nerves that provide sensation to the pulps of the teeth and the gingiva in that area.

The mandible is quite different. The outer layer of cortical bone is thick and non-porous, normally requiring the use of a nerve block.

There are 3 main approaches to achieving anaesthesia in the mandible:

1. the inferior alveolar nerve block, also known as standard mandibular block or the Halstead approach;
2. the Gow-Gates technique;

3. and the Vazirani-Akinosi closed mouth block.

Each technique has its advantages and disadvantages and dentists need to become familiar with all of them.

For the administration of any LA, it is best to have the patient lying in a supine position in order to reduce the likelihood of syncope. Patient anxiety regarding an intraoral injection is common, and an anxious patient who is sitting upright will be predisposed to fainting. Topical anaesthetic may be placed prior to any injection. It should remove the initial sensation of needle penetration, and therefore may be of value. If used, you should allow a few minutes for onset of action. The sensation of needle penetration is also reduced by the retraction of soft tissue such that the mucosa is taut.

With all of the mandibular techniques it is preferable to use a 25 gauge long needle. The 25 gauge is preferable to the smaller gauges for two reasons. First, we must always aspirate prior to a mandibular block in order to avoid injecting into a blood vessel, and aspiration results are most reliable with this gauge. Secondly, there is less deflection, an important characteristic for a deep block. Studies² have shown that patients cannot differentiate among the 25, 27 or 30 gauge, so there is no advantage in using the smaller gauges.

The primary goal of each of the mandibular blocks is anaesthesia of the inferior alveolar nerve, which innervates the pulps of the mandibular teeth on that side, as well as the buccal periodontium anterior to the first molar. For each of the three techniques, this goal is accomplished by depositing anaesthetic within the pterygomandibular space. This anatomical space contains the inferior alveolar nerve as well as the lingual nerve, which is usually also anaesthetized by these techniques. It also contains the inferior alveolar artery and vein, and the sphenomandibular ligament. This space is bounded laterally by the ramus of the mandible, medially and inferiorly by the medial pterygoid muscle, superiorly by the lateral pterygoid muscle, posteriorly by the parotid gland, and anteriorly by the thin buccinator muscle.

With all of the mandibular techniques it is best to begin by palpating the intraoral landmarks, which to an extent are similar.

Inferior Alveolar Nerve Block

The most commonly used technique for mandibular anaesthesia is the inferior alveolar nerve block. This is also known as the standard mandibular block or the Halstead approach. It is indicated when we are carrying out procedures on either one or multiple mandibular teeth in one quadrant. As well, it is indicated for procedures on the lingual soft tissue or the buccal soft tissue anterior to the first molar. For surgery on the molars, a separate buccal nerve block is required.

As the name implies, the nerve anaesthetized by this block is the inferior alveolar nerve, which innervates the pulps of the mandibular teeth in that quadrant, from the third molar to the central incisor. As well, the buccal periodontium anterior to first molar is anaesthetized through its innervation by the mental nerve. In addition, we often anaesthetize the lingual nerve and therefore the anterior 2/3 of the tongue and lingual soft tissues.

The objective of this technique is to place the needle tip above the mandibular foramen, into the sulcus just behind the lingula. This is where the inferior alveolar nerve inserts into the mandibular canal. The lingual nerve lies just anteriorly and medially, and is therefore often anaesthetized along with the inferior alveolar nerve.

Bony Landmarks: Standard Block

The bony landmark is noted by palpating the external oblique ridge, until it is at the greatest depth, which is the coronoid notch. Move your thumb or finger medially until you palpate the internal oblique ridge. You should mentally note this point as the needle must be inserted just medial to this landmark. At this point you may move your finger back laterally to the external oblique ridge again, thereby making the tissue taut and exposing the soft tissue landmarks.

The final point of insertion is the mandibular sulcus, just behind the lingula. It is at this site that the inferior alveolar nerve inserts into the mandibular foramen.

Soft Tissue Landmarks: Standard Block

The finger or thumb on your retracting hand palpates the external oblique ridge until it is at the greatest depth, which is the coronoid notch. Move the finger lingually until you palpate the internal oblique ridge. You should mentally note this point as the needle must be inserted just medial to this landmark. Now, move your finger back laterally to the external oblique ridge again, thereby making the tissue taut and exposing the pterygomandibular raphe and pterygotemporal depression, a triangular shaped depression lateral to the raphe. It is within this depression that the needle will be inserted.

The Injection Technique: Standard Block

For this technique, ask the patient to open his or her mouth as wide as possible. After palpating the soft tissue landmarks, hold the syringe at the correct angle. The syringe approaches from the opposite side, over the contralateral first bicuspid. It is parallel to the mandibular occlusal plane. The needle insertion is made in the pterygotemporal depression, lateral to the pterygomandibular raphe, at a height that will be just above the mandibular foramen. This usually corresponds to a point between the middle and upper portion of your fingernail. Insert the needle gently until bone is contacted. You should contact the medial surface of the ramus in about 25 mm, which corresponds to about 2/3 the length of a long needle.

The needle passes through mucosa, a thin portion of buccinator muscle, and loose connective and adipose tissue. It travels between the medial pterygoid muscle and the ramus of the mandible. It should also be just lateral to the sphenomandibular ligament. Once bone is contacted, you should withdraw ~1mm.

At this point aspirate well and inject a full cartridge of local anaesthetic, unless you are following with a buccal nerve block, in which case you should inject 3/4 of the cartridge. If you contact bone too soon, in other words significantly less than 25mm, you will need to redirect the syringe and carry out the indirect technique. This is accomplished by withdrawing the syringe slightly, moving the barrel more medially over contralateral canine or incisors, and advancing again until bone is contacted. Repeat this procedure as necessary. If you do not contact bone after 25mm, and the needle is almost buried, you should redirect by withdrawing somewhat, but not completely, and move the barrel of the syringe more laterally and advancing again until bone is contacted.

The final position of the needle will be:

- Superior to:
 - The inferior alveolar nerve and vessels.
 - The insertion of the medial pterygoid muscle.
 - The mylohyoid nerve and vessels.
- Anterior to the deep part of the parotid gland.
- Medial to the medial surface of the ramus.
- Lateral to:
 - The lingual nerve
 - The medial pterygoid muscle
 - The sphenomandibular ligament

Successful Anaesthesia: Standard Block

The symptoms of successful anaesthesia for all mandibular blocks include tingling and numbness of the lower lip up to its midline. Tingling and numbness of the tongue on that side indicates lingual nerve anaesthesia. Objectively, you should confirm the signs of successful anaesthesia by probing the gingiva adjacent to the canine area. The onset of anaesthesia usually occurs within 3 to 5 minutes.

Gow-Gates Block

This technique for mandibular anaesthesia was first described by Dr. George Gow-Gates in 1973.³ It was introduced as a means to improve on the 15% failure rate of the standard mandibular block. It is indicated when we are carrying out procedures on either one or multiple mandibular teeth in one quadrant. As well, it is indicated for procedures on the

lingual soft tissue or the buccal soft tissue anterior to the first molar. For surgery on the molars, a separate buccal nerve block may be required. It is particularly indicated if there is a history of failure of the standard mandibular block and evidence of accessory innervation.

The goal of this technique is to deposit local anaesthetic immediately anterior to the neck of the condyle. This is in close proximity to the mandibular branch of the trigeminal nerve after its exit from the foramen ovale. We should, therefore, be able to anaesthetize all of the sensory branches of this nerve, including any accessory nerves.

The nerves anesthetized include the inferior alveolar, lingual, mylohyoid and auriculotemporal nerves. The same tissues are anesthetized as with the standard block, except that ~75% of the time the buccal nerve is often also anesthetized, thereby eliminating the need for a separate buccal injection.

Bony Landmarks: Gow-Gates

The bony landmark is noted by palpating the external oblique ridge, moving your thumb superiorly until you feel the coronoid process. The temporalis muscle inserts onto this landmark. The needle insertion will be just medial to this point. The needle is directed until it contacts the neck of the condyle, just below the insertion of the lateral pterygoid muscle.

Soft Tissue Landmarks: Gow-Gates

For the Gow-Gates block we need to initially locate the extraoral landmarks. An imaginary line should be visualized from the intertragic notch, which is the point immediately inferior to the tragus of the ear, to the corner of the mouth. The syringe will be aligned in this plane during insertion.

The intraoral landmarks should be palpated as with all mandibular nerve blocks. The coronoid notch should be felt. Now move your thumb superiorly to the coronoid process to feel the insertion of the temporalis muscle. It is important to miss this muscle when inserting the needle.

The insertion point is lateral and superior to that for the standard inferior alveolar block. This is on the lateral margin of the pterygotemporal depression and just medial to the medial tendon of the temporalis muscle. The superior boundary for the insertion point is the maxillary occlusal plane. Usually, the needle lies just below the mesiopalatal cusp of the maxillary second molar. This is a reliable landmark, provided that there has been no drifting or rotation of this tooth.

The Injection Technique: Gow-Gates

For this technique, the patient must have his or her mouth open as wide as possible. After palpating the landmarks, hold the syringe at the correct angle. This angle was determined from the extraoral landmarks. It is aligned in a plane joining the intertragic notch and the corner of the mouth, approaching from the contralateral corner of the mouth, with the needle tip aiming for the neck of the condyle. The barrel of the syringe is usually over the contralateral mandibular canine or premolars.

Once inserted, the needle should be slowly advanced until bone is contacted, which should occur in approximately 25mm. This point is the neck of the condyle.

The injection site is bounded by:

- The neck of the condyle posteriorly;
- The lateral pterygoid muscle superiorly;
- The medial pterygoid muscle medially; and
- The ramus laterally

Once contact is made, the needle should be withdrawn 1mm and the full cartridge administered following a negative aspiration. It is important to note that if bone is not contacted, one should not inject but redirect until the neck of the condyle is contacted.

You should ask the patient to keep his or her mouth open for about 1 minute if possible, as it is believed that this keeps the mandibular nerve closer to the site of injection, and therefore improves onset of anaesthesia.

Successful Anaesthesia: Gow-Gates

The symptoms of successful anaesthesia for all mandibular blocks include tingling and numbness of the lower lip up to its midline. Tingling and numbness of the tongue on that side indicates lingual nerve anaesthesia. In addition, with the Gow-Gates block, we anaesthetize the auriculotemporal nerve and, therefore, the skin anterior and superior to the ear will feel a loss of sensation.

Objectively, you should confirm the signs of successful anaesthesia by probing the gingiva adjacent to the canine area. Also, probe the soft tissue buccal to the molars, as 75% of the time we also anaesthetize the buccal nerve. The distance from the final placement of the needle tip is farther from the nerve than is the case with the inferior alveolar nerve block. Therefore, the onset is usually longer, in the order of 5 to 10 minutes.

Closed-Mouth Mandibular Block (Vazirani-Akinosi)

The closed-mouth mandibular block, also known as the Akinosi technique, or the Vazirani-Akinosi technique, after those who first described it,^{4,5} is an alternative mandibular block. It was introduced as a means to improve on the 15% failure rate of the standard mandibular

block. It is indicated when we are carrying out procedures on either one or multiple mandibular teeth in one quadrant. As well, it is indicated for procedures on the lingual soft tissue or the buccal soft tissue anterior to the first molar. For surgery on the molars, a separate buccal nerve block is required. It is particularly indicated if there is limited mandibular opening or difficulty in visualizing the intraoral landmarks used for the standard or Gow-Gates blocks.

The goal of this approach is to fill the pterygomandibular space with local anaesthetic, thereby bathing the inferior alveolar, lingual and mylohyoid nerves. This technique should result in no bony landmarks being hit.

Bony Landmarks: Akinosi

The objective of this technique is to place the needle tip between the ramus and the medial pterygoid muscle. The bony landmark is noted by palpating the coronoid notch and the insertion of the temporalis muscle. The needle is inserted just medial to this point. Therefore, the needle is inserted between the coronoid process of the mandible and the maxillary tuberosity.

Soft Tissue Landmarks: Akinosi

In a superior-inferior plane, this point of insertion is at the height of the mucogingival junction of the maxillary teeth. Intraorally, as with all mandibular blocks, the coronoid notch and coronoid process should be palpated and tissue retracted laterally. In a lateral-medial plane, the point of insertion is lateral to the maxillary tuberosity and medial to the coronoid process. Fibres from the temporalis muscle insert onto the coronoid process and insertion through this process should be avoided in order to minimize sensation in the patient. Therefore, the insertion point should be more medial than lateral and, hence, closer to the maxilla than the coronoid.

The Injection Technique: Akinosi

The patient's mouth is closed for this technique. The needle does not hit bone and you will inject once you have inserted the needle to the proper depth. Therefore, you must position the patient and yourself so that you can see the needle clearly during the entire insertion.

It may help to use a needle which is bent approximately 15° to 30° to the lateral; in other words towards the ramus. This helps minimize the likelihood of the needle being inserted into the medial pterygoid muscle. When bending the needle, the cap should be used to maintain sterility of the needle. In order to minimize the likelihood of breakage, the needle should be bent only once.

Once the needle has been inserted a few millimeters, the position of the syringe should be assessed. At this point, you should ask the patient to bring his or her teeth into occlusion with his or her muscles of mastication remaining relaxed. If the teeth are clenched, they will obliterate the pterygomandibular space and prevent the anaesthetic from reaching the nerves necessary for anaesthesia. If possible, a lateral excursion to that side will help you see the insertion point.

The syringe should be at the level of the mucogingival junction of the maxillary molars, parallel to the maxillary occlusal plane, and as close to the maxillary mucosa as possible without touching it. The syringe is advanced posteriorly, with the bend in the needle drawing the needle tip closer to the ramus.

With the syringe in the correct position, the needle should be advanced slowly 25mm, directing it as laterally as possible, without impinging on the maxillary mucosa. Depending on the degree of bend in the needle, one needs to advance the syringe in an arc-like fashion (the greater the degree of bend, the greater the arc). Once you have inserted the needle 25mm, stop, aspirate well and inject one full cartridge.

No hard tissue should be contacted, but if you hit bone, it often occurs early on and is due to the coronoid process. This may occur if the insertion point was too far lateral, and may be corrected by withdrawing the needle slightly and redirecting it around the obstruction.

No pain should be felt during needle insertion. If pain is felt, it is likely due to penetration into muscle, such as the insertion of the temporalis onto the coronoid process, on the lateral, or due to the medial pterygoid muscle on the medial.

Successful Anaesthesia: Akinosi

The symptoms of successful anaesthesia for all mandibular blocks include tingling and numbness of the lower lip up to its midline. Tingling and numbness of the tongue on that side indicates lingual nerve anaesthesia. Objectively, you should confirm the signs of successful anaesthesia by probing the gingiva adjacent to the canine area. Onset is in the order of 5 to 7 minutes.

Conclusion

The ability to perform each of these 3 techniques greatly increases the likelihood that the dentist will be able to successfully achieve local anaesthesia in the mandibular arch.

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