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Modified Jorgensen and Hayden Approach to Intraoral Mandibular Anesthesia

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1. Introduction

There is a wide gap between the success rates of maxillary nerve block anesthesia and inferior alveolar nerve (IAN) block. Clinically acceptable anesthesia in the maxilla rarely represents a problem, except in cases of anatomical abnormality or pathological conditions. [1] For maxillary surgical procedures, in the vast majority of cases infiltration anesthesia is all that is required because the cortical plate of the alveolus of the upper jaw is almost always thin and porous enough to make infiltration anesthesia effective.

Procedures on the lower jaw will most often require nerve block anesthesia of the inferior alveolar, lingual, and buccal nerves. The IAN block is the most commonly used block in dentistry, having widespread applications in all fields of dentistry. Unfortunately, anesthetic block of the IAN has high failure rates, varying between 15% and 35%. [1,2] The high failure rate is frequently attributed to differences in the morphology of the mandibular ramus and also the position of the mandibular foramen, however inadequate technique is the most common cause for failure. [3,4] Specifically, improper mouth opening allows the IAN to stay relaxed preventing the close approximation of the nerve with the medial wall of the ramus. Incorrect anterior, posterior or inferior placement of the needle also leads to failure. Because the target for the conventional IAN block is very near the neurovascular bundle, this technique also has a high frequency of positive aspiration, and intravascular injection is possible. [5]

Achieving excellence in pain control is an intrinsic, yet challenging, goal of dentistry. Traditionally, the inferior alveolar nerve block (IANB), also known as the “standard mandibular nerve block” or the “Halsted block,” has been used to provide anesthesia in mandibular teeth. This technique, however, has a success rate of only 80 to 85 percent, with reports of even lower rates. Investigators have described other techniques as alternatives to the traditional approach, of which the Gow-Gates mandibular nerve block and Akinosi-Vazirani closed-mouth mandibular nerve block techniques have proven to be reliable but each of which have merits and draw backs [5].

2. Standard Inferior Alveolar Nerve Block (SIANB)

There are many reasons why the success rate of SIANB is low. One is that the dentist can make mistakes during the technique. These problems are easily resolved by reviewing the anatomical landmarks and the steps to perform the technique involved. Another important reason is the presence of inflamed or infected tissue. Infection areas are acidic, which can influence the beginning of anesthesia. When infection occurs, it is necessary to administer an injection into a deeper location away from infection to avoid this problem. A third reason is that a patient’s anxiety often can cause local anesthetic failure. [6] This problem can be solved by the discussion with his fear of injections patient and, if necessary, considering the use of minimal sedation such as that provided by nitrous oxide. Intravascular injection may be another reason for failure because the local anesthetic can be taken away from the site of action. This problem can be avoided by careful aspiration before any injection [7].

Anatomical variability and accessory innervation can also be a problem in providing successful mandibular anesthesia. Once the needle has penetrated the oral mucosa, the dentist is essentially proceeding in a blind mode and assuming that the patient has the same anatomy learned in the dental school. All patients anatomy, however, are not the same and this anatomic variability can lead to failure of SIANB. [8]

Accessory innervation occurs when the main inferior alveolar nerve trunk is not the only source of innervation to the pulp. This accessory innervation may arise from various sources such as a distinct branch from alveolar nerve [8], mylohyoid nerve, as well as the buccal, lingual or auriculotemporal nerves. This situation can be diagnosed when the patient has signs of a successful mandibular nerve block such as a dormant lip, but the tooth is still sensitive when stimulated with a drill [8,9].

Although some researchers report that the success rates for alternative blocks are higher than those reported for SIANB [8,10] others reported comparable rates [11,12]. However, researchers of the latest study reported that the best rate for SIANB was probably due to the experience of dentists who administer the anesthetic blocks. [12]

The main objective of each block of the mandibular nerve is the inferior alveolar nerve anesthesia, which innervates the pulps of the lower teeth, as well as the buccal periodontium anterior to the mental foramen. This is achieved by depositing the anesthetic within pterygo-

mandibular space. This anatomic space encloses the inferior alveolar nerve and the lingual nerve. The pterygomandibular space also contains the inferior alveolar artery and vein and sphenomandibular ligament. This space is limited laterally by the mandibular ramus, medially and inferiorly by the medial pterygoid muscle, superiorly by the lateral pterygoid muscle, posteriorly by the parotid gland and anteriorly by the buccinator muscle [10,11].

The Gow-Gates and Akinosi-Vazirani methods are indicated when there is anatomical variation or accessory innervation. The Akinosi-Vazirani method is also indicated when the patient has limited mouth opening or whose tongue persistently obstructs the view of the soft-tissue landmarks used in the IANB. These three techniques have similarities, and each has advantages and disadvantages [11].

3. Gow-Gates mandibular nerve block

Gow-Gates initially described what became known as the “Gow-Gates mandibular nerve block” in 1973. The aim of the technique is to place the needle tip and administer the local anesthetic at the neck of the condyle. This is in proximity to the mandibular branch of the trigeminal nerve after it exits the ovale foramen. Before looking inside the patient’s mouth it is necessary to establish the extra-oral reference points. An imaginary line is drawn from the intertragus notch (the point immediately inferior to the tragus of the ear) to the corner of the mouth. Then we align the syringe parallel to this plane during insertion.. Inside the mouth, we have to find the bony landmark by palpating the external oblique ridge of the anterior surface of the ramus in the coronoid notch. The temporal muscle attaches onto the coronoid process, and it is important to feel this muscle when inserting the needle. After palpating the landmarks, we must keep the syringe at the correct angle, as determined previously, with the needle tip aiming for the neck of the condyle. The barrel of the syringe usually is over the contralateral mandibular canine or premolars [12,13].

The intraoral insertion point is lateral and superior when compared with that of the SIANB. This point is on the lateral margin of the pterygotemporal depression and just medial to the attachment of the temporal muscle. The upper boundary of the insertion point is the maxillary occlusal plane. Usually, the needle lies just below the mesiopalatal cusp of the maxillary second molar, which can be a reliable landmark [13].

Just before the needle insertion, we ask the patient to open his mouth as widely as possible. The wide opening is critical to the success of this technique. Once the needle is inserted, is moved forward slowly until it contacts bone (the condyle neck). This contact should occur at a depth of 25 millimeters. If bone is not contacted, we should not apply the injection, but instead redirect the needle until we feel the neck of the condyle. Once contact is made, we remove the needle 1mm and administer a full cartridge of local anesthetic after a negative aspiration. We should not administer less than a full cartridge [12,13].

The final position of the needle tip is just anterior to the neck of the condyle, inferior to the lateral pterygoid muscle, lateral to the medial pterygoid muscle and medial to the ramus. The

nerves anesthetized by Gow-Gates technique include the inferior alveolar and its branches (incisors and mental), lingual, mylohyoid, auriculotemporal and buccal (about 75 percent of the time). Anesthesia of the mylohyoid and auriculotemporal nerves resolve the concern with accessory innervation, as would be the uppermost position of the anesthetic administration. The Gow-Gates technique resulted in a rate of about 2% positive suction compared with 10 to 15% SIANB. [1] This rate may be lower because the inferior alveolar vein and artery are further away than the target site are to SIANB [9, 10,12,13].

After the injection is administered, we should ask patients to keep their mouths open for at least 20 seconds, if possible, to keep the inferior alveolar nerve closer to the site of injection and improve onset of anesthesia. The onset of anesthesia is usually five to 10 minutes, which is longer than that for the SIANB (usually three to five minutes) [13].

4. Akinosi-Vazirani closed-mouth mandibular nerve block

Two dentists independently described the closed mouth mandibular nerve block as an alternative to the IANB. In 1977, Akinosi [14] brought this method to the attention of educators, but they soon realized that this technique had been published by Vazirani in 1960. [15] This is indicated particularly if the patient has trismus or the dentist has difficulty seeing the intraoral landmarks used for the SIANB.

What makes this technique unique is that the patient's mouth is closed. The aim is to place the needle tip between the ramus and the medial pterygoid muscle. Since the mouth is closed, seeing the intraoral landmarks can be difficult. A curve at approximately 15° to 30° angle toward the ramus can help minimize the chance of the needle being inserted into the medial pterygoid muscle [15].

Inside the mouth, the bone reference is essentially the same as it is for the SIANB and Gow-Gates methods. We palpate the external oblique ridge of the anterior surface of the ramus and then move the thumb superiorly to palpate the coronoid. The temporal muscle attaches here, and the needle should not enter this sensitive structure. Thus, in a lateral plane, the insertion point is medial to the coronoid process and lateral to the maxillary tuberosity. In superoinferior plane, this insertion point is at the height of the mucogingival junction of the upper teeth, with the tissue retracted laterally, the dentist should insert the needle in a posterior direction [14, 15].

The syringe should be at the level of the mucogingival junction of the upper molars, parallel to maxillary occlusal plane and as close to the maxillary mucosa as possible without touching it. We move the syringe such that the needle moves laterally and posteriorly. Once the needle is inserted 25 mm (for an average adult patient) to stop the advancement of the syringe and administer one full cartridge after a negative aspiration [10,15].

The purpose of using the Akinosi-Vazirani technique is to fill the pterygomandibular space with local anesthetic, bathing the inferior alveolar, lingual and mylohyoid nerves with anesthetic solution. Using Akinosi-Vazirani technique should result in no bony references being hit. The nerves anesthetized by the Akinosi- Vazirani technique include the inferior

alveolar and its branches (incisive and mental), lingual, mylohyoid and buccal (approximately 75 percent of the time). A separate buccal nerve block is not needed because successful anesthesia of the buccal nerve is common when this technique is used. The beginning of anesthesia is intermediate (five to seven minutes) compared with that of the SIANB and the Gow-Gates technique [10,14,15].

5. Modified Jorgensen & Hayden technique

To achieve mandibular anesthesia, many dentists use an injection technique targeting the mandibular sulcus, similarly described by Jorgensen and Hayden in 1967. [16] This injection remains a proven method for the delivery of local anesthetic safely with minimal discomfort to the patient. However, there are disadvantages associated with standard inferior alveolar nerve block, usually associated with the identification of anatomical landmarks [14,16]. Therefore, we propose a modified Jorgensen - Hayden technique to achieve mandibular anesthesia.

6. Anatomical aspects for modified Jorgensen - Hayden technique

A thorough knowledge of the anatomy of the pterygomandibular space is essential for the successful administration of the inferior alveolar nerve block. Anesthetic solutions deposited low in the pterygomandibular space will not diffuse up to where the inferior mandibular nerve enters the mandibular canal. In addition to the neural aspects of the pterygomandibular space, there are vascular pathways, fibrous tissue elements, muscular structures, and glandular tissue that need to be considered to improve the predictability, effectiveness, and safety of block anesthesia. Greater understanding of the nature and extent of variation in intraoral landmarks and underlying structures should lead to improved success rates, and provide safer and more effective IAN anesthesia.

Pterygomandibular space: The pterygomandibular space is a small fascial-lined cleft containing mostly loose connective tissue. [17] It is bounded medially and inferiorly by the medial pterygoid muscle and laterally by the medial surface of the mandibular ramus. Posteriorly, the parotid gland curves medially around the posterior border of the mandibular ramus to form a posterior boundary of the space, whereas anteriorly, the buccinator and superior constrictor muscles come together to form a fibrous junction, the pterygomandibular raphe. Important structures are positioned in this space: the inferior alveolar nerve (IAN), the inferior alveolar artery (IAA), inferior alveolar vein (IAV), lingual nerve (LN), mylohyoid nerve and the sphenomandibular ligament.

Pterygomandibular raphe: The pterygomandibular raphe (pterygomandibular ligament) is a ligamentous band of the buccopharyngeal fascia, attached superiorly to medial pterygoid plate, and inferiorly to the posterior end of the mylohyoid line of the mandible (Figure 1). It is formed by the junction of the buccinator muscle and pharynx superior constrictor muscle. [16]



Figure 1. Pterygomandibular raphe location.

Coronoid fossa/notch: The coronoid fossa/notch is the region of greatest concavity of the anterior border of the ramus of the mandible (Figure 2). [1]

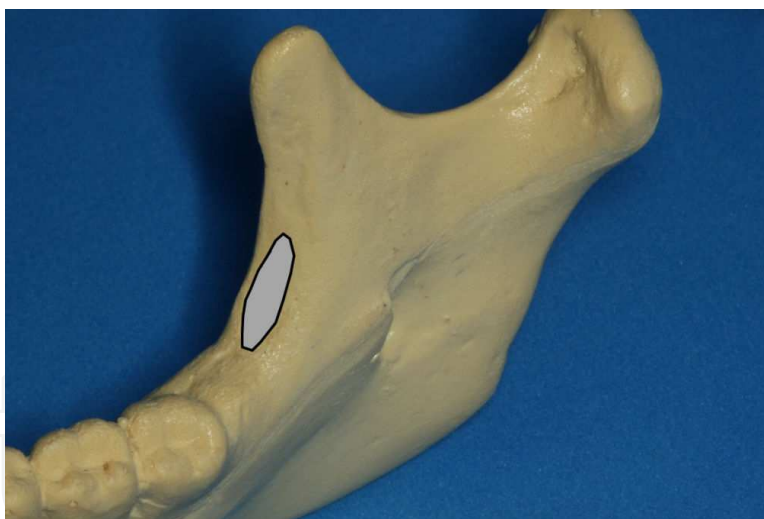


Figure 2. Coronoid fossa location.

Temporal crest: The temporal crest is an extension of the coronoid process, which ends in the retromolar area. [18] An extremely important technical aspect is that on the temporal crest the deep temporal muscle tendon is inserted (Figure 3).

Sphenomandibular ligament: The sphenomandibular ligament is a flat, thin band which is attached superiorly to the spine of the sphenoid bone, and, becoming broader as it descends, is fixed to the lingula of the mandibular foramen. [19] The sphenomandibular ligament has a very important influence on the diffusion of anesthetic solution injected into the area.

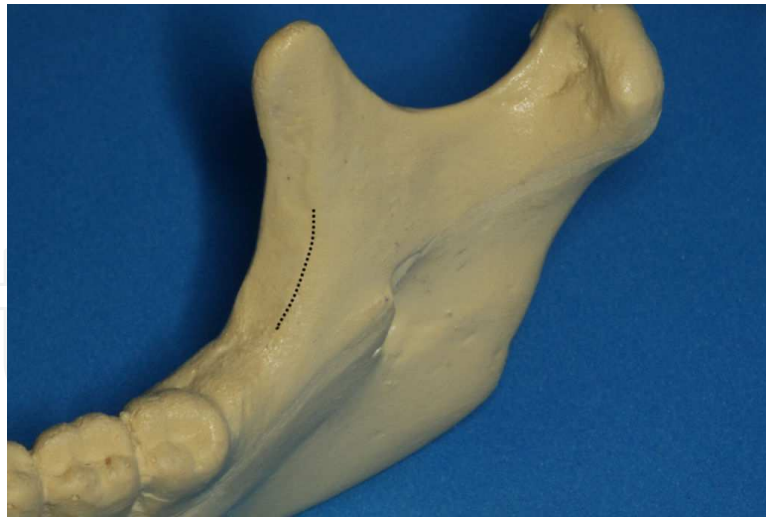


Figure 3. Temporal crest location.

Mandibular foramen: In the center of the medial ramus of the jaw there is a large hole, the foramen of the mandible, which continues inside with the mandibular canal. Serve as a passage way to IAN, IAA and IAV (Figure 4). [18]

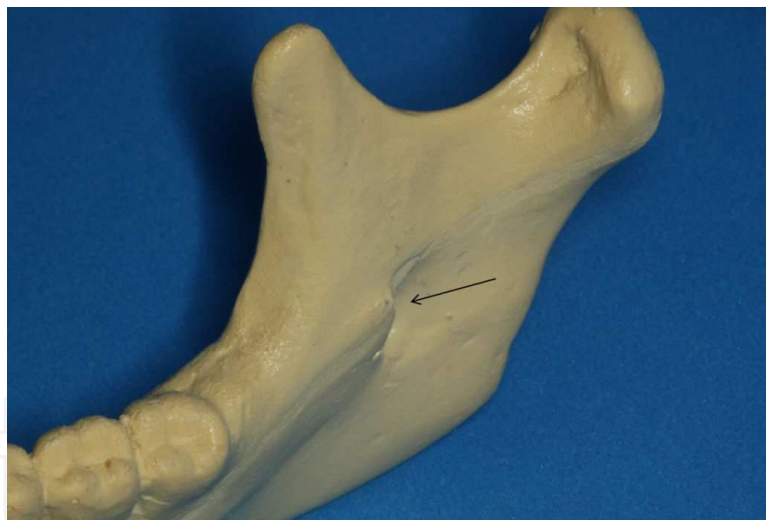


Figure 4. Mandibular foramen location.

Mandibular lingula and mandibular groove: The margin of the mandibular foramen is irregular; presented in front of a prominent ridge, topped by a sharp spine, the mandibular lingula, which gives attachment to sphenomandibular ligament; at its lower and back part there is a notch from which the mylohyoid groove runs obliquely downward and forward, and allocates the vessels and mylohyoid nerve (Figure 5). [19]

Occlusal plane: In 1972 Jorgensen and Hayden [16] reported that if we could trace a line parallel to the occlusal plane, passing through the center of the coronoid fossa, we could reach

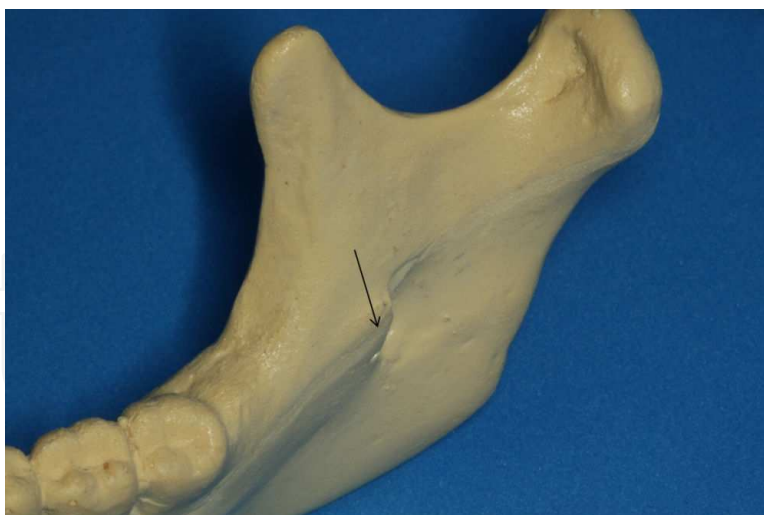


Figure 5. Mandibular lingula position.

a point immediately above the mandibular foramen. According to the literature, a needle inserted 5 mm above the occlusal plane and parallel to it would lie above the lingula in 64% of mandibles and below it in 36%. A needle placed 11 mm above the occlusal plane would be above the lingula in 96% of mandibles. [20]

Contralateral premolars: The premolars on the opposite side of injection are used to help direct the syringe (Figure 6).



Figure 6. Position of the syringe in relation to the opposite premolar teeth.

7. Modified Jorgensen & Hayden technique

Patient positioning and maintenance of aseptic conditions are prerequisites to avoid complications with local anesthesia. The technique is performed with a long needle gauge (25 mm).

We use the index finger to palpate the point of greatest depression of the Coronoid fossa/notch. This will give us a notion of the height of the puncture. We then move the index finger posteriorly, maintaining the cheek and the deep temporal muscle tendon retraction while feeling the temporal crest (Figure 7).

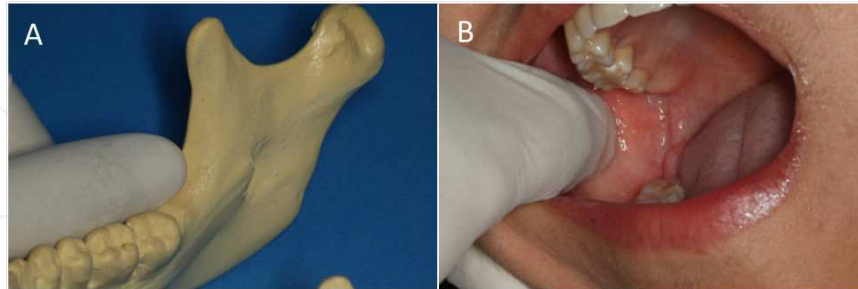


Figure 7. Palpation on the coronoid fossa, delimitating the area of puncture.

This modification is proposed to ensure better delimitation and also narrow the area of puncture, facilitating IAN block. We maintain this position during the technique. The needle is inserted medially to the temporal crest, and laterally to the pterygomandibular raphe. The height of the puncture is center of the fingernail, which corresponds to the center of the Coronoid fossa/notch (Figure 8).

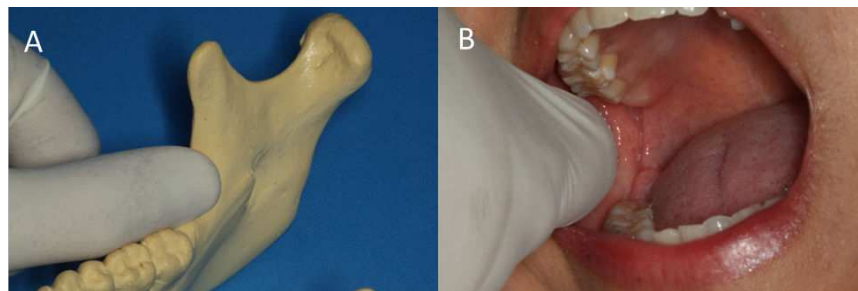


Figure 8. Palpation on the temporal crest.

The syringe is positioned parallel to the occlusal plane and directed between the premolars of the opposite side. The needle is inserted until hitting the bone (Figure 9).

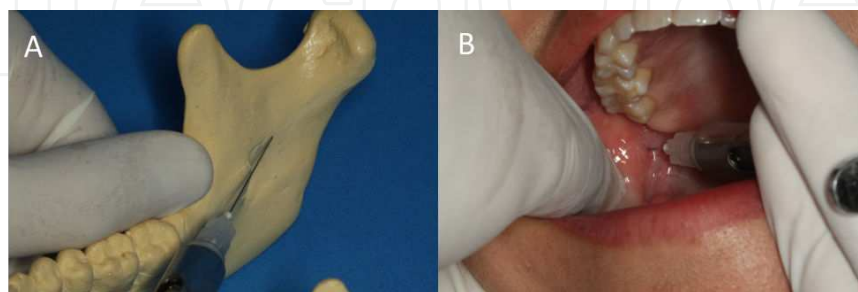


Figure 9. Needle insertion until hitting the bone.

This area is immediately over the mandibular lingula and near the mandibular foramen. The next step is to pull back 1mm to avoid intravascular injection. Then we aspirate and slowly

inject almost all of the anesthetic solution. We then withdraw the needle halfway and inject the remainder of the anesthetic solution to block the lingual nerve. The buccal nerve must be anesthetized separately.

8. Discussion

Anatomical knowledge of pterygomandibular region is very important when we want to perform a successfully IAN block. The correct palpation of the coronoid fossa gives us the appropriate height of the puncture and along with other anatomical references, permits the delimitation of a compartment located between the mandible and sphenomandibular ligament. If we respect the anatomic points, the anesthetic solution will be deposited at a point immediately above the mandibular lingula. The proposed modification of Jorgensen - Hayden Technique facilitates the correct puncture. Also, the restriction in the horizontal plane avoids both excessive and insufficient introduction of the needle - a common cause of failures. Another important aspect of this modified technique is the anesthetic block of the inferior alveolar nerve and also the lingual nerve in a single injection.

9. Summary

The anesthesia of the inferior alveolar nerve is a basic procedure in clinical practice and Dentistry. In order to enhance their practice, every contribution is welcome, allowing achieving a higher success rate in implementation. This chapter draws attention to anatomical guidelines that are easily found in all patients, making it a safer and successful procedure.

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