

REVIEW ARTICLE

Causes Of Failure Of Dental Local Anaesthesia – A Review

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ABSTRACT

Failure of local anesthesia is one of the most commonly occurring, yet unavoidable aspect of routine dental practice. Many factors, both anatomical and technique dependent, are responsible for local anesthetic failure. For successful anesthesia, gainful knowledge of these causes and their timely management is a necessary prerequisite. This article reviews the causes of these failures so that the management becomes envisioned and simple.

Keywords: Local anesthesia, dentistry, failure

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INTRODUCTION

Local anesthesia has been used in dentistry for more than 100 years, but still remains to be an annoying technique in case of incomplete results or ineffectual anesthesia.^{1,2} The achievement of successful local anesthesia is a continual challenge in dentistry.³ Local anesthesia failure is evident in 10% of inferior alveolar nerve block cases and 7 % of local anesthesia cases in total. Possible causes include erroneous selection of local anesthesia, individual structural variations, accessory innervations, practical errors and apprehensive patients.⁴ To minimize anesthetic failure, a sound knowledge of the anatomy of the head, particularly the neuroanatomy of the maxillary and the mandibular regions of the face, different anesthesia techniques, common causes of failure and their rectification is must.

The variables affecting the success rate of a nerve block can broadly classified into

- A. Operator dependent
 - Choice of technique and solution
 - Poor technique
- B. Patient dependent
 - Anatomical factors
 - Pathological
 - Psychological
 - Surgical factors

Pharmacodynamics of local anesthetics is well understood today and therefore, pharmacological causes of failure are not included. Even though, a few drugs could hypothetically reduce efficacy, they are of no concern.⁵

Choice of technique and solution

When referring to incorrect technique performance, mandibular block should be specially mentioned. If injection is too deep, the

solution may be deposited in the parotid space, with anesthesia and temporary paralysis (until the anesthetic is reabsorbed) of the facial nerve but no anesthesia of the mandibular nerve. If injection is too low, lingual anesthesia will result, with deficient anesthesia of the teeth and bone structures. If injection is too mesial, the solution will be instilled in the pterygoid muscle, with deficient anesthesia secondary to incorrect block, and trismus. In the case of an excessively superficial injection, the anesthetic solution is deposited in the pterygomandibular space – distant from the mandibular foramen – and inadequate anesthetic performance results. When injecting high up, the solution is deposited in the sigmoid notch or condylar neck, without resulting anesthesia.^{5,6} Intraoral landmarks used routinely for nerve blocks can be deceptive and can contribute to failure so alternative techniques such as Gow-Gates that utilize extra oral landmarks can be used. The technique provides a true Mandibular nerve block.^{7,8} Lastly, intravascular injection precludes good anesthetic results, and may moreover cause systemic complications.⁹

Solution

Defective anesthetic solution can hamper field and profoundness of anesthesia in spite of using the correct delivery technique.⁵ Local anesthetic solutions are a fine composition of agents including vasoconstrictor, antioxidant for vasoconstrictor, preservatives, etc. These agents are sensitive to light and temperature variations and deteriorate over time. It is thus imperative to check for expiry date and storage conditions of anesthetic solutions. A plastic cartridge with local anesthetic stored above 37⁰ C will most likely lead to anesthetic failure. Additionally, procedures such as intraligamentary injections requiring high pressure for depositing anesthetic solution, risk fracture of carpule on injection and failure of solution deposition and subsequent failure to achieve anesthesia or adequate anesthesia.^{6,9,10}

Psychological factors

Fear and apprehension in patients can pose a challenge for dental treatment. Anxiety causes a patient to refer pain even if complete anesthesia

has been achieved. In such patients sedative techniques can be helpful as successful anaesthesia is easier to achieve in relaxed patients. Anaesthetic response varies among individuals. In fact, 1% of the population may refer no response at all, while another 1% may refer an exaggerated response and 70% tend to respond as expected.^{5,6}

Anatomical factors

Anomalous anatomical variants and anatomical relations

Age

Anatomy of the facial structures varies with individual, age and the development of face. A tangential line can be traced to the occlusal surface of the last molar. This line can be used as a reference line for all the age groups. With this reference line, Spix's spine is one centimeter above this line in adults, at the level of this line in children (relatively lower than adults) and at a point higher than in adults in edentate individuals. As a precaution in edentate individuals, the plane should be kept absolutely horizontal in order to avoid anesthetic solution being instilled below the mandibular foramen.^{1,6,9}

Bifid inferior alveolar nerve

The existence of bifid mandibular canals has been determined from extraoral panoramic radiographs by a number of authors and there have been several investigations in the past of the prevalence of bifid mandibular canals but relatively few recent reports. Malamed has stated that the 80 to 85 per cent success rates for the IAN block reported by Kaufman et al.⁹ In a study evaluating 3612 panoramic radiographs, 0.9% (33 individuals) were reported to have furcation in the main trunk of IAN in the canal or having a duplicate canal. Another similar study later, comprising evaluation of 6000 panoramic radiographs reported a very similar prevalence of 0.95% of bifid mandibular canals.⁹ In contrast, Grover and Lorton reported a prevalence of only 0.08 per cent after studying 5000 panoramic radiographs of US army recruits. In more recent times, Sanchis et al. showed a prevalence of 0.35 per cent from the analysis of 2012 panoramic radiographs.¹¹ The incidence has been variably

reported from 0.08% to 0.9%. The condition has been postulated as one of the possible reasons for the failure of mandibular anesthetic techniques for inferior alveolar nerve block.¹²

As there are many possible reasons for failure to obtain profound mandibular anaesthesia. We need to differentially diagnose these causes and manage them accordingly. Conventionally, the presence of profound soft tissue anaesthesia of the ipsilateral lip, chin and teeth is indicative of an effective IAN block. If a patient experiences only soft tissue anaesthesia around the injection site, but not of the ipsilateral lip or chin, then a problem with LA technique is likely to be the cause of the failure. However, if there is soft tissue anaesthesia of the lips and chin but not the teeth, one should consider anatomical variation. It would seem prudent to assess any available panoramic radiographs of patients for the presence of unusual mandibular anatomical features before administration of local anaesthetic is commenced. If anatomical variation is suspected, based on radiographic findings and a history of failure to obtain anaesthesia after the delivery of a standard IAN block, alternative methods of achieving local anaesthesia should be considered.¹¹

Retromolar foramen

Sutton identified nerve fibers in the retromolar foramen. He investigated the presence of retromolar foramen with or without the existence of a bifid IAN canal. In a similar series of study of 249 Afro-Americans and 226 Caucasians, Pyle et al reported a prevalence of 7.8% for the presence of retromolar foramen. This prevalence was devoid of any significant difference in terms of race or sex. Sawyer and Kiely reported a 7.7% prevalence of the retromandibular foramen based on their study of 234 adult mandibles irrespective of sex.^{6, 13} Branches of the mylohyoid nerve enter the mandible through the retromandibular foramina, which are associated with the lingual cortical bone in the vicinity of the second premolar tooth. This nerve carries sensation from the premolar, canine and incisor teeth. One study also implicates the mylohyoid in innervation to the first molar. The mylohyoid nerve may arise from the inferior alveolar nerve anywhere from 5 to 23 mm above the mandibular foramen and

enters the mandible at a point distant to the mandibular foramen during administration of an inferior nerve block most often does not block the mylohyoid nerve. Therefore performing a mylohyoid nerve block in vicinity of the retromental foramen is recommended.¹ This anatomical variant provides accessory innervation that causes mandibular block to fail.^{6,13,14}

Accessory mental foramen

The accessory mental foramen is commonly located apical or proximal to the mental foramen. The foramen also transmits mental nerve fibers. Review of the available studies reveals a very contradictory data concerning its existence. Shanklad in a study of 138 mandibles reported a 6.62% prevalence of the accessory mental foramina. While a very small, only 2.5% was reported by Parameswaran and Udayakumar, no such accessory foramina were reported by Grover and Lorton in a series of 5000 panoramic radiographs. Investigating the frequency/race ratio in four population groups, Sawyer et al reported 1.4% American Caucasians and 1.5% Asian Indians with this anatomical variant.^{1,5,6,9}

Bone density

Bone density particularly in advanced age increases in the mandibular teeth, thus leading to deficient anesthesia when using periapical infiltration techniques. Whereas the opposite applies in children, where infiltrative approaches are more commonly used due to the lower existing bone density. The buccal cortical plate of the mandible is most often is sufficiently dense to preclude effective infiltration anesthesia in its vicinity.¹ For this very reason infiltration techniques do not work well in mandible than in maxilla.^{6,9}

Accessory innervations

The mandibular branch of the trigeminal gives off the mylohyoid nerve. The mylohyoid nerve is responsible for supplying motor innervation to the mylohyoid and the digastric muscles. Occasionally it may possess a sensory component along with the motor component and may provide accessory innervation in the region of the

IAN and thereby resulting in inferior alveolar nerve block failure. The first cervical branch may also present with corresponding innervations, with the nerve fibers reaching gingiva, dental areas and bone in the region posteriorly.^{6, 9, 14} The mylohyoid nerve may arise from the inferior alveolar nerve anywhere from 5 to 23mm above the level of the mandibular foramen and enters the mandible at a point distant to the mandibular foramen. Therefore, deposition of the local anesthetic in the vicinity of the mandibular foramen during administration of an inferior nerve block most often does not block the mylohyoid nerve.¹

Nerve anastomoses

In both, the maxilla and the mandible, anterior teeth can present with anesthetic failure because of the existing contralateral innervations. In a series of 38 patients, Yonchak et al anesthetized the inferior alveolar nerve unilaterally and bilaterally and evaluated the percentage of nerve anastomosis. (Table 1). They found significant difference in the number of central and lateral incisors presenting with anesthetic failure due to cross innervation. Rood, additional to crossing of the inferior alveolar nerve, attributed this situation to accessory innervations from the buccal and the facial nerves and the nerves from the cervical plexus. (Table 1).⁶ Some studies have proposed that the midline crossover of the branches of the mental nerves in the mandible might allow innervation of the incisors of the contralateral side.^{1,15}

PATHOLOGICAL FACTORS

Factors precluding access

Anatomical changes because of trauma or surgery can impede the access to the nerve. The most important cause that can preclude the access is trismus. Trismus can be present because of a number of causes and is the most likely factor precluding access in the practice. Even with the mouth closed, buccal infiltrations are possible in the maxilla but would be relatively ineffective in the mandible. In patients with trismus, Akinosi closed mouth technique offers the best way to achieve inferior alveolar nerve anesthesia. The

extraoral approaches though present can be questioned and must be avoided in the practice. Although it is possible to anesthetize the nerve supply to teeth using alternate techniques in patients with trismus, the appropriateness and benefits of administering the anesthetic must be questioned by the clinician.^{2,6}

Inflammation and infection

Normal tissue pH is maintained at 7.4 by the active tissue buffering capacity. Inflammation and infection causes this normal pH to decrease. The local anesthetic solution when injected into this tissue with lowered tissue pH, the local anesthetic molecules are present in the charged cationic form and do not completely dissociate into the lipophilic free base form (unionized form) that ultimately diffuse through the lipid nerve sheaths. The 'anesthetic wash-out' in areas of inflammation due to increased blood supply along with vasodilation significantly reduces the anesthetic molecules further reducing the already scarce lipophilic free base form. Nonetheless, these explanations fail to clarify lack of profound regional block anesthesia where the anesthetic solution is deposited 4 to 5 cm away from the inflamed area. The most probable justification is inflammation making the nerves hyperalgesic.^{2,6,16}

Hematoma

Hematoma is one of the complications of intraoral regional anesthesia. Hematoma is an effusion of blood into the surrounding tissues as the result of blood spillage of blood from a traumatized, lacerated blood vessel. Hematoma formation may occur as a complication of the PSA nerve block and also the inferior alveolar nerve block. Positive aspirations were reported from 2.6 per to 30 percent of inferior alveolar nerve injections in different series of patients. Failure to obtain adequate anesthesia was associated with possible hematoma formation manifested by palpable swelling in the pterygomandibular space, the patient though may present with subjective signs but the anesthesia is incomplete. Failure to obtain anesthesia under such circumstances might be due to the dilution of the local anesthetic solution by the blood, and

to some extent the anesthetic may be inactivated.¹⁷

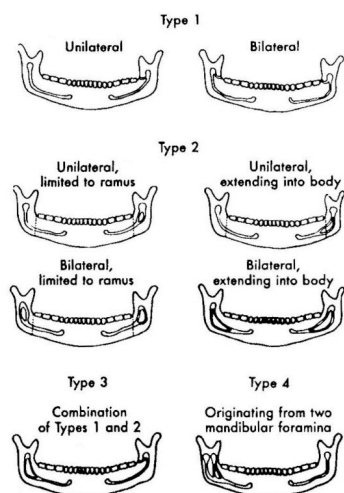


Figure-1: Variations of bifid mandibular canals.⁹

	Unilateral	Bilateral
Central incisor	39%	66%
Lateral incisor	50%	74%
Canine	68%	76%

Table-1: Efficacy of mandibular block for assessing cross innervation of anterior sector teeth.⁹

CONCLUSIONS

Failed local anaesthesia is an inevitable aspect of dental practice. Most practitioners will experience it less often than they achieve success. It is very important to understand the precise reason for anaesthesia failure. The reasons offered above, based on an understanding of the basic aspects, should help overcome most cases encountered in the day to day practice of anaesthesia failure.

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