

Evaluation of local anaesthetic failures in dental practice

Priya Yadav* V Raj Kumar†

*M.D.S, Associate Professor, Department of Periodontics,

†M.D.S, Senior Lecturer, Department of Oral & Maxillofacial Surgery, PDM Dental College and Research Institute, Bahadurgarh, Haryana, India.

Contact: drraj.drroj@gmail.com

Abstract:

A profound anaesthesia is important for the success of any surgical procedure. The failures in local anaesthetic action can be attributed to various factors. These include Intravascular injection, unusual anatomy, bone density, accessory innervations, double or accessory mental foramen, cross innervation, inability to achieve anaesthesia in presence of tissue inflammation, inactive anesthetic solutions, incorrect technique, and lack of patient co-operation.

Introduction:

The Maxillary anaesthesia: Most problems with maxillary anesthesia can be attributed to individual variances of normal anatomical nerve pathways through the maxillary bone. The pulpal sensory fibers of the maxillary teeth are primarily carried in the anterior, middle, and posterior superior alveolar nerves, which also supply the buccal soft tissues. The accessory pulpal innervation fibres is by nasopalatine and greater palatine nerves. The failures in maxillary anaesthesia can be attributed to accessory and cross innervations and inadequate needle penetration.

Mandibular anaesthesia

Successful anesthesia of mandibular teeth is quite difficult to achieve consistently. Success rates of 80% to 85% has been reported for the inferior alveolar nerve block, the most frequently administered mandibular injection. Reasons for these low success rates are usually due to the greater density of the inferior buccal alveolar plate, limited accessibility to the alveolar nerve,

P- ISSN
0976 – 7428

E- ISSN
0976 – 1799

*Journal of
International
Oral Health*

Oral & Maxillofacial
Surgery

Review Article

Received: Aug, 2010
Accepted: Nov, 2010

Bibliographic listing:

EBSCO Publishing

Database, Index

Copernicus, Genamics

Journalseek Database

and the wide variation in anatomy.

CAUSES OF FAILURES OF ANESTHESIA

Inferior alveolar nerve block

- Unable to find a bony landmark with the needle.
- Unable to direct the needle satisfactorily due to tough tissue in the pterygomandibular space.
- Awkward tongue, either excessively large or due to lifting posteriorly. Some patients seem unable to allow the tongue to rest passively.
- Difficult anatomy where posterior teeth have been lost and alveolar resorption has been excessive.
- Needle curved when withdrawn- This is usually a sign that the dentist has struggled to manipulate the needle within the tissues.
- Deposition of anesthetic *too low* (below the mandibular foramen).
- Deposition of anesthetic *too far anteriorly* (laterally) on the ramus. This is diagnosed by a lack of anesthesia except at the injection site and by the minimum depth of penetration prior to contact with bone (i.e., the needle is usually less than halfway into tissue).
- Accessory innervation to the mandibular teeth

Buccal nerve block

1. Inadequate volume of anesthetic retained in the tissues but buccal nerve block failure is usually rare

Gow Gates mandibular block

1. *Too little volume.* The greater diameter of the mandibular nerve may require a larger volume of anesthetic solution. Deposit up to 1.2 ml in the second injection if the depth of anesthesia is inadequate following the initial 1.8 ml.
2. *Anatomical difficulties.* Do not deposit anesthetic unless bone is contacted.

Vazirani-Akinosi closed mouth mandibular block

1. This can be due to the flaring nature of the ramus. If the needle is directed medially, it will rest medial to the sphenomandibular ligament in the pterygomandibular space, and the

injection will fail. This is more common when a right handed administrator uses the left-side Vazirani-Akinosi injection or a left-handed administrator uses the right-side Vazirani-Akinosi injection . It may be prevented by directing the needle tip parallel with the lateral flare of the ramus and by using a 27-gauge needle in place of the 25-gauge.

2. Needle insertion point too low.
3. Underinsertion or overinsertion of the needle. As no bone is contacted in the Vazirani-Akinosi technique, the depth of soft tissue penetration is somewhat arbitrary. Akinosi recommended a penetration depth of 25 mm in the average-sized adult. In smaller or larger patients this depth of penetration should be altered.

Incisive nerve block

1. Inadequate volume of anesthetic solution in the mental foramen, with subsequent lack of pulpal anesthesia. To correct this re inject into the proper region and apply pressure to the injection site.
2. Inadequate duration of pressure following injection. It is necessary to apply firm pressure over the injection site for a minimum of 2 minutes in order to force anesthetic solution into the mental foramen and to provide anesthesia of the second premolar, which lies distal to the foramen.

Discussion:

Improper technique

When referring to incorrect technique performance, special mention should be made of mandibular block. If injection is too low, lingual anesthesia will result, with deficient anesthesia of the teeth and bone structures. If injection is too deep, the solution may be deposited in the parotid space, with anesthesia and temporary paralysis of the facial nerve but no anesthesia of the mandibular nerve. If injection is too mesial, the solution will be instilled in the pterygoid muscle, with deficient anesthesia 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. Intravascular injection may cause systemic complications².

Anatomic variations

Retromolar foramen

Sutton described about the nerve fibres present in the retromolar foramen while investigating about retromolar foramen with or without the presence of bifid inferior alveolar nerve. Pyle et al.¹², in a series of 249 Afro-Americans and 226 Caucasians, reported a 7.8% prevalence of the foramen, without significant differences in terms of race or sex. Sawyer and Kiely¹³ studied 234 adult mandibles and found 7.7% prevalence of the retromolar foramen irrespective of male female predilection. This accessory innervation also causes local anaesthesia to fail.

Bifid inferior alveolar nerve

Zoógrafos et al.¹¹ studied 700 panoramic X-rays, with the description of three types of mandibular canal distributed as follows in order of increasing frequency, type III (canal below the mandibular margin); type II (canal between the apexes of the second molar and the mandibular margin); and type I (canal in intimate contact with the apexes of the first and second molar).

Langlais et al.⁵, in a series of 6000 panoramic X-rays, recorded 57 bifid canals (0.95%), while Sanchis et al.⁶ obtained seven images suggestive of a bifid canal in a series of 2012 panoramic X-rays. Nortjé et al.⁷, in 3612 patients, identified 33 bifid canals (0.9%), of which 20 were bilateral and 13 unilateral. These findings indicate that bifid canals are not so unusual, though in any case the prevalence is in the range of 1%.^{3,5,8}

Rajchel and Ellis⁹ found the greatest distance from the cortical zone vestibular to the mandibular canal between the first and second molar, with vestibular displacement of the nerve at second molar level

towards the mental foramen. Oliver⁴ defines the inferior alveolar nerve in a position apical and lingual to the third and second molar, and posteriorly vestibular to the roots of the premolars until the nerve emerges from the mental foramen. A double or bifid inferior alveolar nerve represents a possible cause of failure in inferior alveolar nerve block.^{3,4}

Skeletal factors, such as class of occlusion and the width of the ramus, change the location of the lingula relative to the intraoral landmarks. Another crucial skeletal anatomical variant is the width of the internal oblique ridge. It is on this ridge that the practitioner's finger must rest for all mandibular block procedures, including the conventional, the Vazirani-Akinosi and the Gow-Gates. If the patient has wide internal oblique ridge and the practitioner's finger is not resting on this ridge of bone, it is very difficult to negotiate the needle past this bony ridge to approach the inferior alveolar nerve. Another skeletal anatomical factor is the position of the mandibular foramen. The position of foramen can vary both in its anterior - posterior position and its inferior - superior position. Accessory nerves can enter the mandible in various lingual locations on the ramus or on the alveolar ridge. The mylohyoid nerve can send branches through and thus directly supply accessory innervation to any of the mandibular teeth. Cross innervation is another cause of anaesthetic failure.

Inflammation and infection-Local anaesthetic pKa - pH factors and tissue pH factors

The presence of inflammation decreases local anesthetic efficacy, especially in dental anesthesia. Although inflammatory acidosis is most frequently cited as the cause of such clinical phenomena, this has not been experimentally proved. Infection generates an acid pH that interferes with anesthetic dissociation, while inflammation can induce a primary area of hyperesthesia, which in turn increases patient sensitivity². In the event of anaesthetic failure, block techniques involving anesthetic solution injection at a distance from the

inflammatory site are required, with the avoidance of infection spread²⁴. Even when the technique is correctly performed, the presence of inflammation causes anesthesia to fail in 30-45% of cases as per the study conducted by Potonick and Bajrovic²³. Vandermeulen²⁵ reported tachyphylaxis by repeated anesthetic administration in cases of inflammation and infection.

The higher the pKa of the local anaesthetic, the longer its onset of action due to the fewer lipid soluble particles initially available to cross the nerve sheath. Higher pKa equates to decreased potency. A factor that dentists can influence is pH. There are two separate issues with respect to pH. The pH of the tissues where the local anaesthetic is being injected and the pH of the local anaesthetic itself. The normal tissue pH is 7.4, but if there is an infection in the area of injection, the pH will be lower (in the acidic range). The effect of this infection is similar to the high pKa of the local anaesthetic; that is, it shifts the equilibrium toward the charged hydrophilic side and thereby lessens the initial amount of lipophilic particles available. This equilibrium, in turn, increases the time to onset of anaesthesia. If the infection is severe and the pH of the tissue is quite low, few lipophilic particles will be available, and the local anaesthetic might not work at all. Local anaesthetics with a vasoconstrictor contain the preservative sodium metabisulphite. This preservative is quite acidic, and in high concentrations it can lower the overall pH of the local anaesthetic solution to 4 or 5. The higher the concentration of the vasoconstrictor, the more preservative is required and the lower is the pH.

Jaw size discrepancy and the needle

In dental practice, two popular lengths of needles are available for routine injections. The short needle is approximately 25 mm or one inch long, and the long needle measures approximately 35 mm or 1 5/8 inches long. Short needles cannot be recommended for mandibular block injections in adult patients. The depth required for a mandibular block for the average-sized adult is 25 mm. Thus to reach the injection end point with a short needle,

the practitioner must inject to the hub. One complication of this is needle breakage and it can cause one to lose the orientation and angulation, which could mislocate the injection. Furthermore, if the patient is larger than average, the final depth will not be achieved unless the practitioner pushes the needle into the tissues beyond the hub. If the practitioner is performing a Vazirani-Akinosi mandibular block, which has an average depth of 25 mm to 27 mm, it becomes even more difficult to achieve the final depth. Long needles afford the practitioner the ability to observe the length of needle that is remaining outside the tissues once the final depth has been achieved. For the average-sized adult, the practitioner would observe 10 mm of needle remaining outside the tissues once the final position has been attained using a long needle for the conventional mandibular nerve block.

Deflection of the needle

When a needle is inserted into tissue, it deflects due to the density of the tissue pushing against the bevel of the needle. The deeper the needle is inserted and the thinner the needle (the higher the gauge), the more the needle deflects. Because a 4-mm deflection is enough to mislocate any block injection, there is valid reason for using more stable, lower-gauge needles. The orientation of the bevel is also important while injections are given.

Volume factors

Number of factors can contribute to inadequate volume of local anaesthesia and the resulting local anaesthetic failure. When a mandibular block is given, the practitioner must wait 3 to 4 minutes to allow the anaesthetic to act. If a procedure is commenced before the time required for complete anaesthesia, the patient will experience discomfort and pain. If local anaesthetic is deposited too far medially away from the inferior alveolar nerve, it is blocked from travelling laterally by the sphenomandibular ligament and its associated fascia. Local anaesthetic cannot cross this barrier, and it is important to inject lateral to the ligament. If the local anaesthetic is deposited into a vessel, no anaesthesia is obtained. The other factor, is the thickness of the nerve. Thicker nerve requires a

longer onset time. The conventional mandibular nerve block takes 3 to 4 minutes for complete anaesthesia, compared to the 10 to 12 minutes for the Gow-Gates block. The other important reason for the longer onset time is simply the longer distance the drug has to travel in a Gow-Gates versus a standard block. The next factor to consider is the actual volume of the local anaesthetic. Thicker nerves, larger patients and accessory innervation may require more volume of local anaesthesia.

Degradation of the local anaesthetic or Vasoconstrictor

All local anaesthetic cartridges and bottles have an expiry date on their label. A number of factors can lead to the premature breakdown of an anaesthetic and the vasoconstrictor within a cartridge including extreme temperatures, excessive light and oxygen exposure. To maximize the shelf life of the contents inside the cartridge, the local anaesthetic molecule should be stored at room temperature away from sunlight and room light. Repeated autoclaving will also decrease the shelf life. Local anaesthetics should not be purchased in excess so that the expiry date arrives before the solution can be utilized.

Unco-operative patients

Profound anaesthesia can be difficult to obtain with dental-phobic patients. Many of these patients may have fear about the treatment injection. In such situations, the practitioner must strive to elicit the patient's co-operation through reassurance and explanation. If the patient's anxiety is strong enough then conscious sedation may be considered.

Conclusion:

Failures in local anaesthesia may result from any of the causes described above. The most important thing to be ascertained by the operator is to identify the exact cause of the failure. Many authors attribute anesthetic failure to a lack of knowledge or inexperience on the part of the dental professional. If the failure is due to anatomical variation, for example in mandibular blocks

involving bifid canals, it is advisable to perform a higher anesthetic technique, such as that proposed by Gow-Gates.²⁴. In cases of accessory innervation, failure is to be expected in 10-20% of cases if only the inferior alveolar nerve is blocked, without associated reinforcement of the first molar lingual due to the mylohyoid nerve.

In the upper jaw, particularly in the region of the incisors, the possible existence of nerve anastomosis should be considered, with the instillation of anesthetic solution in the contralateral side.²⁴ One thing that's consistent in anatomy is of course its inconsistency, hence the only solution to this problem while administering local anaesthesia is in fact constant practice and patience.

References:

1. Vinckier F. What is the cause of failure of local anesthesia? Rev Belge Med Dent 2000; 55: 41-50.
2. Wong MK, Jacobsen PL. Reasons for local anesthesia failures. J Am Dent Assoc 1992; 123: 69-73.
3. Grover PS, Lorton L. Bifid mandibular nerve as a possible cause of inadequate anesthesia in the mandible. J Oral Maxillofac Surg 1983; 41: 177-9.
4. Granollers M, Berini L, Gay C. Variaciones de la anatomia del nervio dentario inferior. Revision bibliografica. Anales de Odontoestomatologia 1997; 1: 24-9.
5. Langlais RP, Broodus R, Glass BJ. Bifid mandibular canals in panoramic radiographs. J Am Dent Assoc 1985; 110: 923-6.
6. Sanchis JM, Penarrocha M, Soler F. Bifid mandibular canal. J Oral Maxillofac Surg 2003; 61: 422-4.
7. Nortje CJ, Farman AG, Grotepass FW. Variations in the anatomy of the inferior dental mandibular canal: A retrospective study of panoramic radiographs from 3612 routine dental patients. Br J Oral Surg. 1977; 15: 171-2.
8. Wyatt WM. Accessory mandibular canal: literature review and presentation of an

- additional variant. *Quintessence Int* 1996; 27: 111-3.
9. Rajchel J, Ellis E, Fonseca RJ. The anatomical location of the mandibular canal its relationship to the sagittal ramus osteotomy. *Int J Adult Orthodon Orthognath Surg* 1986; 1: 37-47.
 10. Goaz PW, White SC, eds. *Oral radiology principles and interpretation*. St. Louis: Mosby 1987: 174-99.
 11. Zografos J, Kolokoudias M, Papadakis E. The types of the mandibular canal. *Hell Period Stomat Gnathopathoprosopike Cheir* 1990; 5: 17-20.
 12. Pyle MA, Jasinevicius TR, Lalumandier JA, Kohrs KJ, Sawyer DR. Prevalence and implications of accessory retromolar foramina in clinical dentistry. *Gen Dent* 1999; 47: 500-3.
 13. Sawyer DR, Kiely ML. Retromolar foramen: a mandibular variant important to dentistry. *Ann Dent* 1991; 50: 16-8.
 14. Sakland WE. The position of the mental foramen in Asian Indians. *J Oral Implantol* 1994; 20: 118-23.
 15. Parameswaran A, Udayakumar P. Bifid root and root canal in mandibular second premolar and its management: a case report. *Fed Oper Dent* 1990; 1: 25-7.
 16. Grover PS, Lorton L. Bifid mandibular nerve as a possible cause of inadequate anesthesia in the mandible. *J Oral Maxillofac Surg* 1983; 41: 177-9.
 17. Sawyer DR, Kiely ML, Pyle MA. The frequency of accessory mental foramina in four ethnic groups. *Arch Oral Biol* 1998; 43: 417-20.
 18. Bennett S, Townsend G. Distribution of the mylohyoid nerve: anatomical variability and clinical implications. *Aust Endod J* 2001; 27: 109-11.
 19. Yonchack T, Reader A, Beck M, Meyers WJ. Anesthetic efficacy of unilateral and bilateral inferior alveolar nerve blocks to determine cross innervation in anterior teeth. *Oral Surg Oral Med Oral Pathol* 2001; 92: 132-5.
 20. Rood JP. The nerve supply of the mandibular incisor region. *Br Dent J* 1977; 143: 227-30.
 21. Fleury AA. Local anesthesia failure in endodontic therapy. The acute inflammation factor. *Compendium* 1990; 11: 210-4.
 22. Nusstein J, Reader A, Nist R, Beck M, Meyers W. The anesthetic efficacy of the intraosseous injection in irreversible pulpitis. *J Endodon* 1996; 22: 196.
 23. Potocnik I, Bajrovic F. Failure of inferior alveolar nerve block in endodontics. *Endod Dent Traumatol* 1999; 15: 247-51.
 24. Peñarrocha M, Martínez JM, Sanchís JM, eds. *Anestesia local en Odontologia*. Valencia: Coleccion odontologica 1999: 249-61.
 25. Vandermeulen E. Pain perception, mechanisms of action of local anesthetics and possible causes of failure. *Rev Belge Med Dent* 2000; 55: 29-40.
 26. Meechan JG, Donaldson D, Kotlicki A. The effect of storage temperature on the resistance to failure of dental local anesthetic cartridges. *J Can Dent Assoc* 1995; 61: 143-8.
 27. Meechan JG, McCabe JF, Carrick TE. Plastic dental local anaesthetic cartridges: a laboratory investigation. *Br Dent J* 1990; 169: 54-6.
 28. Budenz AW, Osterman SR. A review of mandibular anesthesia nerve block techniques. *J Calif Dent Assoc* 1995; 23: 27-34.
 29. Gow-Gates GA. Mandibular conduction anesthesia: A new technique using extraoral landmarks. *Oral Surg Oral Med Oral Pathol* 1973; 36: 321-8.
 30. Sillampaa M, Vuori V, Lehtinen R. The mylohyoid nerve and mandibula anesthesia. *Int J Oral Maxillofac Surg* 1988; 17: 206.

Source of Support: Nil

Conflict of Interest: Not Declared