WHY DOES LOCAL ANESTHESIA NOT WORK EVERY TIME?

Dr. Reshma Dodwad (Assistant Professor)
Department of Pedodontics

Abstract: This article describes the reasons why local anaesthesia may fail. It offers strategies to help to overcome failure of local anaesthesia in dentistry.

Introduction
Local anaesthesia is the principal method of pain control in dental practice. It is usually an effective and safe means of eliminating discomfort during potentially painful procedures. Unfortunately, the techniques available do not provide success in every case.

This article discusses the reasons why local anaesthesia may be ineffective and suggests methods of overcoming failure.

REASONS FOR FAILURE
Other than poor operator technique, the reasons why a local anaesthetic injection might fail include:

- Pharmaceutical reasons;
- Treatment reasons;
- Anatomical reasons;
- Pathological reasons;
- Psychological reasons.

Pharmaceutical Reasons
There are two methods by which local anaesthetic solutions may lose their efficacy: When they are used after their expiry date; When improperly stored. Management of the first problem is obvious, however, the second problem may not be so apparent. The storage of local anaesthetic cartridges in heaters or in direct sunlight hastens the oxidation of epinephrine (adrenaline). This leads to decreased effectiveness. Ideally, cartridges should be stored in the dark at no higher than room temperature. If they are stored in a refrigerator they should be allowed to return to room temperature before injection in order to reduce discomfort.

Treatment Reasons
When discussing failure of anaesthesia it is pertinent to mention that the success of an injection is partly determined by the subsequent treatment. The efficacy of anaesthesia varies between operative procedures. The most difficult treatment for which to provide success is endodontics; extractions are more likely to be pain-free.

Anatomical Reasons
There are a number of anatomical factors that influence the efficacy of dental local anaesthesia:
- Barriers to local anaesthetic diffusion;
- Variations in position of foramina;
- The position of the tooth in the jaw;
- Accessory nerve supply.

Barriers to Local Anaesthetic Diffusion
This is the reason why infiltration anaesthesia is limited in the mandible as the dense cortical plate prevents entry of anaesthetic solution into the cancellous space. The thick bone of the zygomatic buttress around the upper first molar can present an obstacle to diffusion of local anaesthetic after buccal infiltration in this region. This problem is overcome by injecting mesial and distal to the buttress or by the use of
regional block techniques. Block techniques that will anaesthetize the first maxillary permanent molar include the maxillary nerve block and the maxillary molar nerve block. Intraligamentary anaesthesia achieves its effect by local anaesthetic solution entering the cancellous bone via perforations in the socket walls, the so-called cribriform plate. The number of bony perforations varies between sites and they are few in the lower incisor region. That is why intraligamentary anaesthesia has a poor success rate with mandibular anterior teeth.

Variations in Position of Foramina

It is not just poor technique that causes ‘misses’ when delivering regional block anaesthesia. Target areas, such as the mandibular foramen, are not constant structures and vary in location between individuals. A panoramic radiograph can aid positioning of the needle as it may demonstrate the location of the Mandibular foramen.

The Position of the Tooth in the jaw

Not all teeth are equally susceptible to the effects of local anaesthesia. It was mentioned above that the number of perforations in the cribriform plate, which differs between the teeth, governs the efficacy of intraligamentary anaesthesia. The efficacy of regional block anaesthesia also varies between the teeth. Studies that have investigated the effectiveness of inferior alveolar nerve blocks in providing pulpal anaesthesia have shown variations in success between molar and anterior mandibular teeth. Molar teeth show greater incidences of pulpal anaesthesia. There are two explanations for this. First, the position of the nerves supplying different teeth will vary within the-inferior alveolar nerve bundle; those in the centre of the bundle will be more difficult to anaesthetize. Secondly, there may be more accessory supply in the anterior part of the mouth. Certainly, the lower incisors may receive bilateral supply to their pulps. At this point it is worth considering accessory supply as a cause of failure of local anaesthesia.

Accessory Nerve Supply

In addition to the superior alveolar nerves in the upper jaw and the inferior alveolar nerve in the mandible, it has been suggested that there are other nerves that could supply the dental pulps with sensation. In the upper jaw the greater palatine and nasopalatine nerves could perform this function. In the mandible the nerves implicated include:

- the lingual nerve;
- the long buccal nerve;
- the nerve to mylohyoid;
- the auriculotemporal nerve;
- the cervical nerves.

How is accessory nerve supply opposed? In the maxilla the use of palatal injections is the method of choice. In the mandible, accessory nerve supply may be countered by:

- combinations of regional blocks;
- use of ‘high’ blocks;
- use of intraligamentary or intraosseous injections;
- use of intrapulpal anaesthesia
  - use of infiltration injections.

Pathological Reasons

Teeth with inflamed pulps are more difficult to anaesthetize compared to non-inflamed teeth. It
has been suggested that teeth with irreversible pulpitis are eight times more likely to experience failure of local anaesthesia compared to non-inflamed control teeth. There is evidence that increasing the local anaesthetic concentration is a means of overcoming hyperalgesia. Five percent lidocaine is an extremely effective local anaesthetic. Why do we not use it? The reason is the potential for toxicity. Toxicity can present both systemically and locally. The major problem locally is damage to the nerve. The viability of nerves in cell culture is compromised by exposure to local anaesthetic solutions in concentrations above 2%. There is clinical evidence that dental local anaesthetics presented as 4% solutions (prilocaine and articaine) are more likely to produce long-lasting paraesthesias compared to 2% lidocaine. Thus the use of greater concentrations is problematic, particularly in relation to block anaesthesia.

Inject More Solution
This may be the most effective method of overcoming the problem of hyperalgesia. Certainly, repeating the initial injection is known to overcome failure in about 75% of cases. In addition to repeating the initial injection, the deposition of more solution at other sites along the nerve, using technique combinations such as intra-igamentary infiltration and regional block, will also help overcome accessory nerve supply as described above. This is useful, as the more nerve exposed to local anaesthetic, the greater the efficacy.

The concern with injecting more solution is that attention must be paid to the potential for overdose producing systemic toxicity. Sensible dose limitations must be employed to protect the patient. If the maximum dose chosen does not

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The concern with injecting more solution is that attention must be paid to the potential for overdose producing systemic toxicity. Sensible dose limitations must be employed to protect the patient. If the maximum dose chosen does not
anaesthetize the tooth, then another method of anaesthesia, such as general anaesthesia, is needed. Alternatively, a temporizing approach can control the pain to allow another attempt at a later stage.

**Psychological Reasons**

Successful local anaesthesia is more difficult to achieve in the anxious patient. Conscious sedation can be helpful in cases of failed local anaesthesia. In addition to reducing anxiety, methods such as inhalation sedation can make the receipt of local anaesthesia more comfortable. Also, the use of intravenous conscious sedation can reduce gagging which might make administration easier some individuals. Another useful aspect of conscious sedation is that it can offer pharmacological protection against local anaesthetic overdose. It is also important to stress that the normal maximum doses should not be exceeded. Although conscious sedation is useful as an adjunct to overcome failure of local anaesthesia, it should never be considered an alternative to good pain control.

**CONCLUSIONS**

Local anaesthetic failure occurs in dental practice. An understanding of the anatomy of the nerve supply to the teeth and the effects of inflammation can explain why this occurs. Strategies such as technique combinations, increasing the amount of local anaesthetic and use of conscious sedation can help overcome failure.

**REFERENCES**