

IMPORTANT CLINICAL FACTORS RELATED TO LOCAL ANESTHESIA

Before reviewing the specifics of local anesthesia, we would like to provide an overview of some factors that are important to clinical anesthesia.

How do we traditionally confirm anesthesia clinically?

Traditional methods to confirm anesthesia usually involve questioning the patient ("Is your lip numb?"), soft tissue testing (e.g., lack of mucosal responsiveness to a sharp explorer) or simply commencing with treatment. The problem with these approaches is they may not be effective for determining pulpal anesthesia.¹⁻⁴

Objective means of determining pulpal anesthesia in nonpainful, vital teeth.

A more objective measurement of anesthesia, in nonpainful vital teeth, is obtained with an application of a cold refrigerant or by using an electric pulp tester. Clinically, application of cold or the electric pulp tester can be used to test the tooth under treatment for pulpal anesthesia prior to beginning a clinical procedure.⁵⁻¹⁰

Determining pulpal anesthesia in painful, vital teeth.

However, in painful, vital teeth (e.g., irreversible pulpitis), the lack of response to pulp testing may not guarantee pulpal anesthesia even if there is vital tissue present in the pulp chamber.^{5, 9, 10} Therefore, if a patient experiences pain when the endodontic procedure is started, after negative pulp testing, supplemental anesthesia is indicated.

Naturally, if the chamber is necrotic and the canals are vital, no objective test can predict the level of clinical anesthesia. However, as suggested by Hsiao-Wu, et al.¹⁰, cold testing adjacent teeth for anesthesia may provide evidence of anesthesia in the working area.

Previous Difficulty With Anesthesia

Patients who report a history of previous difficulty with anesthesia are more likely to experience unsuccessful anesthesia.¹³ These patients will generally identify themselves with comments such as "Novocaine doesn't work on me" or "A lot of shots are needed to get my teeth numb." A good clinical practice is to **ask** the patient if they have had previous difficulty achieving clinical anesthesia. If they have had these experiences, supplemental injections should be considered.

Failure in Patients With Pain

Endodontic patients who are in pain and have pulpal pathosis have additional anesthetic problems. There are a number of explanations for failure. One explanation is that conventional anesthetic techniques

do not always provide profound pulpal anesthesia. Another explanation relates to the theory that the lowered pH of inflamed tissue reduces the amount of the base form of anesthetic to penetrate the nerve membrane. Consequently, there is less of the ionized form within the nerve to achieve anesthesia. However, this explanation of local influences on the anesthetic solution does not explain the mandibular molar with pulpitis, which is not readily blocked by an inferior alveolar injection administered at some distance from the area of inflammation. Therefore, it is difficult to correlate local influences with failure of the inferior alveolar nerve block. Another explanation for failure is that nerves arising from inflamed tissue have altered resting potentials and decreased excitability thresholds.^{14, 15}

Wallace and co-authors¹⁴ demonstrated that local anesthetic agents were not sufficient to prevent impulse transmission due to these lowered excitability thresholds. Another factor would be the tetrodotoxin-resistant (TTXr) class of sodium channels that have been shown to be resistant to the action of local anesthetics.¹⁶ A related factor is the increased expression of sodium channels in pulps diagnosed with irreversible pulpitis.¹⁷ Finally, patients in *pain* are often apprehensive, which lowers their pain threshold. Therefore, practitioners should consider supplemental techniques, such as intraosseous^{9, 11, 18, 19} or periodontal ligament injections¹² when an inferior alveolar nerve block fails to provide pulpal anesthesia for patients with irreversible pulpitis.

MANDIBULAR ANESTHESIA

Conventional Inferior Alveolar Nerve Block

As a frame of reference, we will review the expected outcomes following administration of a conventional inferior alveolar nerve block to asymptomatic patients using 1.8 mL of 2% lidocaine with 1:100,000 epinephrine. While anesthesia requirements vary between dental procedures, the following discussion will concentrate on *pulpal* anesthesia.

Anesthetic Success

One way to define anesthetic success is the percentage of subjects who achieve two consecutive 80 readings (with an electric pulp tester) within 15 minutes and continuously sustain this lack of responsiveness for 60 minutes.^{1-4, 20-24} In other words, the objective is to achieve anesthesia within 15 minutes and have anesthesia that lasts 1 hour. This objective is equally important to restorative dentistry as it is for endodontic treatment. What then is the percentage of anesthetic success? For the first molar it was 53%, for the first premolar it was 61% and for the lateral incisor it was 35%.^{1-4, 20-24} Therefore, success occurs most often in the molar and premolar teeth. It is important to realize that 100% of the subjects in these studies^{1-4, 20-24} had profound lip numbness.

Anesthetic Failure

Anesthetic failure has been defined as the percentage of subjects who never achieved two consecutive 80 EPT readings at any time during a 60-minute period. These patients have the highest potential for pain during a dental procedure. How often does failure occur? For the first molar it was 17%, for the first premolar it was 11% and for the lateral incisor it was 32%.^{1-4, 20-24} Again, 100% of these subjects had profound lip numbness.

Slow Onset

In most cases following the conventional inferior alveolar nerve block injection, the onset of pulpal anesthesia usually occurs within 15-16 minutes^{1-4, 20-25}. However, in some patients onset will be delayed.

Slow onset is defined as the percentage of subjects who achieved an 80 EPT reading after 15 minutes. Slow onset occurs about 19-27% of the time in mandibular teeth; about 8% of patients have onset after 30 minutes.^{1-4, 20-25} In contrast to the onset of pulpal anesthesia, the onset of lip numbness occurs usually within 5-9 minutes.¹⁻⁴

Duration

Duration of pulpal anesthesia in the mandible is very good.^{1-4, 20-24} Therefore, if patients are anesthetized initially, anesthesia usually persists for approximately 2½ hours with 2% lidocaine with 1:100,000 epinephrine.²³

What Does Lip Numbness Mean?

The presence of soft tissue anesthesia (usually measured by “lip numbness” or lack of mucosal responsiveness to a sharp explorer) does not adequately indicate pulpal anesthesia.^{1-4, 20-24} This is in contradiction to the traditional view. However, the lack of soft tissue anesthesia is a useful indicator that the block injection was not administered accurately for that patient. Missed blocks occur about 5% of the time, and should prompt the clinician to re-administer the nerve block before continuing with treatment.