

STUDIES EVALUATING MECHANISMS OF FAILURE WITH THE INFERIOR ALVEOLAR NERVE BLOCK

Accessory Innervation

Judging from clinical and anatomical studies,^{94,95} the mylohyoid nerve is the accessory nerve most often cited as a cause for failure with mandibular anesthesia. Clark et al⁸⁸ compared the inferior alveolar nerve block alone to a combination injection of the inferior alveolar nerve block plus the mylohyoid nerve block, which was aided by the use of a peripheral nerve stimulator. The investigators found that the mylohyoid injection did not significantly enhance pulpal anesthesia of the inferior alveolar nerve block. Therefore, the result of the study does not lend much credibility to the notion that the mylohyoid nerve is a major factor in failure with the inferior alveolar nerve block.

Accuracy of the Injection

It has been theorized that an inaccurate injection contributes to inadequate mandibular anesthesia. Hannan et al²⁰ used a medical ultrasound unit to guide needle placement for inferior alveolar nerve blocks. While they found that the nerve block administered with ultrasound was accurate, it did not result in more successful pulpal anesthesia. Therefore, accuracy of needle placement is not the primary reason for anesthetic failure with this block. Two studies performed 30 years ago reached similar conclusions. Berns and Sadove,⁹⁶ and Galbreath⁹⁷ used radiographs to locate the mandibular foramen and found that accurate needle location did not guarantee successful anesthesia. Twenty-five percent of accurate blocks resulted in anesthetic failure. The authors speculated that migration of the anesthetic solution followed the path of least resistance and this was determined by fascial planes and structures encountered in the pterygomandibular space. These studies provide an important clinical point—the lack of pulpal anesthesia is not necessarily due to an inaccurate injection.

Needle Deflection

Needle deflection has been theorized as a cause for failure with the inferior alveolar nerve block.⁹⁸⁻¹⁰⁰ Various authors,⁹⁸⁻¹⁰³ using *in vitro* methods, have reported that beveled needles, when passed through substances of varying densities, will deflect toward the nonbeveled side. That is, the needle will deflect away from the bevel. Recently, Hochman and Friedman¹⁰⁰ developed a bidirectional needle rotation technique using the computer-assisted Wand® (CompuDent, Milestone Scientific Inc., Deerfield, IL). The bidirectional technique rotates the Wand® handpiece assembly and needle in a manner similar to rotation of an endodontic hand file. The technique was found to reduce needle deflection during needle insertion. Kennedy et al¹⁰⁴ compared the anesthetic efficacy of the conventional inferior alveolar nerve block administered with the needle bevel oriented away from the mandibular ramus (so the needle would deflect toward the mandibular foramen), to the bidirectional needle rotation technique administered using the computer-assisted Wand® anesthesia system in patients diagnosed with irreversible pulpitis. There were no significant differences between the success rates (50% for the conventional and 56% for the bidirectional technique) of the two techniques. Neither technique resulted in an acceptable rate of anesthetic success in patients with irreversible pulpitis.

Needle Bevel and Success

In asymptomatic subjects, Steinkruger and co-authors¹⁰⁵ found the orientation of the needle bevel (away or

toward the mandibular ramus) for an inferior alveolar nerve block did not affect anesthetic success or failure. Therefore, the use of commercial needles with markers to indicate needle bevel is not necessary.

Cross Innervation

Cross innervation from the contralateral inferior alveolar nerve has been implicated in failure to achieve anesthesia in anterior teeth after an inferior alveolar injection. Experimentally, cross innervation occurs in incisors,^{89, 106} but plays a very small role in failure with the inferior alveolar nerve block.

Why Don't Asymptomatic Patients Achieve Pulpal Anesthesia With the Inferior Alveolar Nerve Block?

The central core theory^{107, 108} may be our best explanation. The theory states that nerves on the outside of the nerve bundle supply molar teeth, while nerves on the inside supply anterior teeth. The anesthetic solution may not diffuse into the nerve trunk to reach all nerves to produce an adequate block, even if deposited at the correct site. The theory may explain the higher experimental failure rates in anterior teeth with the inferior alveolar nerve block.^{1-4, 20-25}

Studies That Have Increased the Success of Mandibular Anesthesia in Asymptomatic Patients

Use of the Supplemental Intraligamentary Injection

Childers and co-authors¹⁰⁹ studied the contribution of the supplemental intraligamentary injection after an inferior alveolar nerve block. Using 2% lidocaine with 1:100,000 epinephrine and a high-pressure syringe, anesthetic success (no response to pulp testing) was significantly increased for 23 minutes in the first molar. The short incidence of anesthesia was related to the small amount of anesthetic solution administered.

Use of the Supplemental Intraosseous Injection

Dunbar,¹¹⁰ Guglielmo,²⁷ Stabile¹¹¹ and co-authors studied the contribution of the supplemental intraosseous injection after an inferior alveolar nerve block. Using common local anesthetic agents with vasoconstrictors and the Stabident® intraosseous system, anesthetic success (no response to pulp testing) was significantly increased for 60 minutes in the first molar. The intraosseous injection was more successful than the periodontal ligament injection¹⁰⁹ due to the greater amount of anesthetic solution delivered with the intraosseous injection. Additionally, the intraosseous injection significantly decreased the incidence of slow onset of pulpal anesthesia to 0% when compared to the inferior alveolar nerve block alone (18% incidence).¹¹⁰ Therefore, when pulpal anesthesia is required in asymptomatic teeth, the addition of the intraosseous injection to the inferior alveolar nerve block in the first molar will provide a quick onset and a high incidence of pulpal anesthesia for 60 minutes.

Gallatin and co-authors¹¹² found that the use of 3% mepivacaine as a supplemental intraosseous injection following an inferior alveolar nerve block resulted in statistically increased pulpal anesthesia for 30 minutes. The shorter duration of the 3% mepivacaine, when compared to 2% lidocaine with 1:100,000 epinephrine,¹¹⁰ was related to the lack of a vasoconstrictor.

Speed of Injection and Success

Kanaa and co-authors¹¹³ found a slow inferior alveolar nerve block injection (60 seconds) resulted in higher success rates (electric pulp testing) than a rapid injection (15 seconds).