Anesthetic Efficacy of Supine and Upright Positions for the Inferior Alveolar Nerve Block: A Prospective, Randomized Study

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Abstract

Introduction: It has been recommended to place patients in an upright position after administration of an inferior alveolar nerve block (IANB), theoretically allowing the anesthetic to diffuse in an inferior direction and resulting in better pulpal anesthesia. The purpose of this study was to compare an upright versus a supine position on the success of pulpal anesthesia when an IANB was administered in asymptomatic teeth. **Methods:** One hundred ten asymptomatic subjects were randomly given IANBs by using 2% lidocaine with 1:100,000 epinephrine while they were in an upright position and supine position at 2 different appointments spaced at least 2 weeks apart. Pulpal anesthesia was measured in the molars, premolars, and incisors with an electric pulp tester in 4-minute cycles for 60 minutes. Anesthetic success was defined as the subject achieving 2 consecutive 80 readings within 15 minutes of the injection and sustaining the 80 reading for 60 minutes. Success was analyzed by using a mixed model logistic regression. **Results:** Pulpal anesthesia for the supine position was not statistically more successful than the upright position in the second molars (73% vs 65%), first molars (59% vs 54%), lateral incisors (28% vs 23%), and central incisors (11% vs 8%), respectively. The supine position significantly improved success in the second premolars (63% vs 53%) and first premolars (75% vs 64%). **Conclusions:** The supine and upright positions were equally successful in the molars and anterior teeth. The supine position was more successful in the premolars. However, clinically, neither position for the IANB administration would provide complete pulpal anesthesia. *(J Endod 2017;■:1–4)*

Key Words

Inferior alveolar nerve block, patient positions–upright and supine, pulpal anesthesia

Significance

Neither the supine nor upright positions for the inferior alveolar nerve block would provide complete pulpal anesthesia.

The inferior alveolar nerve block (IANB) is not always successful in achieving pulpal anesthesia (1). There have been many attempts to improve the success of the IANB (1). For example, studies have tried increasing anesthetic success by using solutions without vasoconstrictors, an articaine solution, increased volumes of lidocaine and epinephrine, increased concentrations, buffered anesthetic solutions, and alternate injection locations (Gow-Gates and Akinosi-Vazarani techniques) (1). Generally, the results have not proven to be completely effective (1).

Malamed (2) recommends placing the patient in an upright or semi-upright position after administration of an IANB. Perhaps the upright position allows more of the anesthetic to diffuse in an inferior direction, resulting in better pulpal anesthesia. Takasugi et al (3) investigated whether the upright position was better for mandibular molar extractions when compared with a supine position. By using an anterior approach to the IANB, they concluded that the position of the patient did not have an effect on the success of the anesthesia.

Further studies are needed to objectively evaluate the success of patient positioning for an IANB. Therefore, the purpose of this prospective, randomized study was to compare the success of pulpal anesthesia for the IANB when placing the patient in an upright position or a supine position.

Materials and Methods

One hundred ten adult asymptomatic subjects who were in good health as determined by a health history and oral questioning participated in this study. Exclusion criteria were as follows: subjects who were younger than 18 years and older than 65, history of significant medical problems (American Society of Anesthesiologist class III or higher), taken central nervous system depressants or any analgesic medication within 8 hours, pregnancy, allergy to lidocaine, or unable to give informed consent. The Ohio State University Human Subjects Review Committee approved the study, and informed consent was obtained from each subject.

In a crossover design, the subjects randomly received an IANB with the subject in a supine position or with the subject in an upright sitting position at 2 separate appointments spaced at least 2 weeks apart. With the crossover design, there were 220 IANBs

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administered, and each subject served as his or her own control. An equal number of IANBs were administered on the right side and the left side. The same side randomly chosen for the first IANB was used again for the second IANB.

The test teeth chosen for the experiment were the first and second molars, first and second premolars, and central and lateral incisors. The contralateral canine was used as the unanesthetized control to ensure that the electric pulp tester was operating properly and that the subject was responding appropriately during each experimental portion of the study. Clinical examinations indicated that all teeth were free of caries, large restorations, and periodontal disease. None of the teeth had histories of trauma or sensitivity.

Before the experiment, the 2 positions for the IANBs were randomly assigned 6-digit numbers from a random number table. Each subject was randomly assigned to 1 of the 2 positions for the IANB to determine which would be administered at each appointment.

At the beginning of each appointment and before any injections were given, the experimental teeth and control contralateral canine were tested 3 times with an electric pulp tester (Kerr, Analytic Technology Corp, Redmond, WA) to record baseline vitality. The tooth to be tested was isolated with cotton rolls and dried with gauze; toothpaste (Crest Cavity Protection; Procter & Gamble, Cincinnati, OH) was applied to the probe tip, which was placed midway between the gingival margin and the occlusal or incisal edge of the tooth. The current rate was set at 25 seconds to increase from no output (0) to the maximum output (80). The number associated with the initial sensation was recorded. Trained research personnel performed all pre-injection and post-injection tests.

The IANB was administered with the subject in 2 positions, upright or supine. The upright position was defined as the position where the subjects' mandibular occlusal plane was parallel to the floor when the mouth was in an open position. The back of the dental chair was set to a 75° angle to the floor, as measured by using a protractor equipped with a weighted string. The operator was standing during the administration of these IANBs. The supine position was defined as the position where the subject was reclined so that their feet were slightly higher than their head and their body was parallel with the floor. The operator was sitting during the administration of these IANBs. The principal investigator (C.C.) administered all IANBs.

Before each injection, topical anesthetic gel (20% benzocaine; Patterson Dental Supply, Inc, St Paul, MN) was passively placed with a cotton tip applicator for 60 seconds at the injection site. A standard IANB injection (4) was administered with the C-CLAD (Computer-Controlled Local Anesthetic Device, STA; Milestone Scientific Inc, Livingston, NJ) and a 27-gauge 1½-inch needle (Sherwood Medical Co, St Louis, MO). The needle was attached to the end of the sterile plastic C-CLAD tubing. A cartridge of 2% lidocaine with 1:100,000 epinephrine (Xylocaine; Dentsply Pharmaceutical, York, PA) was placed into the unit's handpiece assembly, and this was placed into the cartridge holder with a quarter turn in a counterclockwise direction. By depressing the foot pedal, the C-CLAD automatically initiated a priming cycle, removing air from the tubing.

For the injection, the needle was inserted through the mucosal tissue, and the computer-assisted injection system was activated at a slow rate. One chime from the computer-controlled injection system corresponded to 1 second, allowing audible monitoring of the elapsed injection time. The principal investigator then slowly placed the needle to the target site during a 10-second time period. Aspiration was performed, and the anesthetic solution was deposited during a 1-minute time period on the slow setting (ControlFlo), and then the C-CLAD was activated to the faster rate (RapidFlo), and the remaining solution was deposited for a total deposition time of 1 minute 52 seconds. A total of 1.4 mL anesthetic was deposited because a small portion of solution from a standard cartridge was lost during the purge cycle, and some of the solution remained in the cartridge and tubing. The needle stayed in place while a trained research assistant exchanged the empty anesthetic cartridge for a new cartridge of 2% lidocaine with 1:100,000 epinephrine. The C-CLAD then went through the priming cycle, and 0.4 mL that was in the tubing was deposited into the pterygomandibular space. The contents of the second cartridge (1.4 mL) were delivered at the faster delivery rate (RapidFlo). A total of 3.2 mL anesthetic solution was delivered.

After the IANB, the patient remained in either the supine or upright position until the end of the appointment. Each subject was asked if his or her lip was numb every 5 minutes for 15 minutes. If profound lip numbness was not recorded within 15 minutes, the block was considered unsuccessful. The subject was then reappointed. This occurred once in the upright group and once in the supine group.

At 5 minutes after the initiation of the IANB, the first and second molars were pulp tested. At 6 minutes the first and second premolars were tested. At 7 minutes the lateral and central incisors were tested. At 8 minutes the control canine was tested. This cycle of testing was repeated every 4 minutes. The reliability of the subject was tested at every third cycle by testing the control tooth (the contralateral mandibular canine) by using a non-activated pulp tester. All testing was stopped at 60 minutes after injection.

No response from the subject at the maximum output (80/80 reading) of the pulp tester was used as the criterion for pulpal anesthesia. Anesthesia was considered successful when 2 consecutive 80 readings were obtained within 15 minutes of the injection, and the 80 reading was continuously sustained for 60 minutes. With a nondirectional alpha risk of 0.05, a sample size of 110 subjects was required to demonstrate an odds ratio of 2.50 (supine versus upright) in anesthetic success with a power of 0.918.

The data from this study were collected and statistically analyzed. Comparisons between the supine and upright positions for anesthetic success were analyzed by using a mixed model logistic regression with subject as a random variable. Comparisons were considered significant at $P < .05$.

Results

One hundred ten adult subjects, 55 men and 55 women ranging in age from 20 to 36 years, with an average age of 26 years, participated in this study.

Table 1 demonstrates the percentages of successful pulpal anesthesia for the IANB for the supine and upright positions. Historical data (1) are included for comparison. Also included in Table 1 is a logistic regression analysis for success by tooth and position. There were no significant differences ($P > .05$) in anesthetic success for the molars and central and lateral incisors, but the premolars were significant ($P < .05$). Figure 1 shows the incidence of pulpal anesthesia (80 readings) by tooth for the 2 positions.

Discussion

Although Malamed (2) recommends placing the patient in an upright or semi-upright position after administration of an IANB, we wanted to examine whether the upright position during the IANB injection and throughout the post-injection period would result in better pulpal anesthesia.

Anesthetic success ranged from 11% (central incisor) to 75% (first premolar) for the supine position and from 8% (central incisor) to 65% (second molar) for the upright position (Table 1, Figure 1). Except for the premolars, the results of the current study for the supine position are similar to the results of previous studies (Historical data, Table 1) that used a supine position. The upright position was also similar to the historical data (Table 1).