Anesthetic Efficacy of 4% Articaine with 1:100,000 Epinephrine versus 4% Articaine with 1:200,000 Epinephrine as a Primary Buccal Infiltration in the Mandibular First Molar

Mayes McEntire, MS, DMD, John Nusstein, MS, DDS,* Melissa Drum, MS, DDS,* Al Reader, MS, DDS,* and Mike Beck, MA, DDS†*

Abstract

Introduction: No study has compared 4% articaine with 1:100,000 epinephrine with 4% articaine with 1:200,000 epinephrine in a mandibular buccal infiltration of the first molar. The authors conducted a prospective, randomized, double-blind, crossover study comparing the degree of pulpal anesthesia obtained with 4% articaine with 1:100,000 epinephrine and 4% articaine with 1:200,000 epinephrine as a primary infiltration in the mandibular first molar. **Methods:** Eighty-six asymptomatic adult subjects randomly received a primary mandibular buccal first molar infiltration of a cartridge of 4% articaine with 1:100,000 epinephrine and a cartridge of 4% articaine with 1:200,000 epinephrine in 2 separate appointments. The authors used an electric pulp tester to test the first molar for anesthesia in 3-minute cycles for 60 minutes after the injections. **Results:** The two 4% articaine formulations showed no statistically significant difference when comparing anesthetic success, onset of anesthesia, or incidence of pulpal anesthesia. **Conclusions:** The anesthetic efficacy of 4% articaine with 1:200,000 epinephrine is comparable to 4% articaine with 1:100,000 epinephrine in a primary mandibular buccal infiltration of the first molar. *(J Endod 2011;37:450–454)*

Key Words

Articaine, infiltration, mandibular, 1:200,000 epinephrine

From the *Division of Endodontics and †Division of Oral Biology, The Ohio State University, Columbus, Ohio.

Dr McEntire is currently in private practice limited to endodontics, Columbia, South Carolina.

Supported by an AAE Foundation grant.

Address requests for reprints to Dr Melissa Drum, Division of Endodontics, College of Dentistry, The Ohio State University, 305 West 12th Avenue, Columbus, OH 43210. E-mail address: drum.13@osu.edu

0099-2399/$ - see front matter

doi:10.1016/j.joen.2010.12.007

A number of studies have shown the superiority of 4% articaine with 1:100,000 epinephrine to 2% lidocaine with 1:100,000 epinephrine when used as a primary buccal infiltration of the mandibular first molar (1–5) and as a supplemental buccal infiltration of the first molar after an inferior alveolar nerve block (6, 7).

Only a few studies have compared 4% articaine with 1:100,000 epinephrine with 4% articaine with 1:200,000 epinephrine. Tofoli et al (8) and Santos et al (9) found that 4% articaine with 1:100,000 epinephrine was equivalent to 4% articaine with 1:200,000 epinephrine in inferior alveolar nerve blocks. Moore et al (10) also found no difference in clinical efficacy between 4% articaine with 1:100,000 and 1:200,000 epinephrine for inferior alveolar nerve blocks and infiltrations of the maxillary first premolar.

Hersh et al (11) compared the pharmacokinetics and cardiovascular effects of 4% articaine with 1:100,000 epinephrine with 4% articaine with 1:200,000 epinephrine. They found heart rate and systolic blood pressure were significantly elevated with 4% articaine with 1:100,000 epinephrine when compared with 4% articaine with 1:200,000 epinephrine. They concluded that 4% articaine with 1:200,000 epinephrine might be preferable in patients with cardiovascular disease and in those taking drugs that enhance the systemic effects of epinephrine.

No study has compared 4% articaine with 1:100,000 epinephrine with 4% articaine with 1:200,000 epinephrine in a mandibular buccal infiltration of the first molar. Therefore, the purpose of this prospective, randomized, double-blind, crossover study was to compare the degree of pulpal anesthesia obtained with 4% articaine with 1:100,000 epinephrine and 4% articaine with 1:200,000 epinephrine as a primary infiltration in the mandibular first molar. We also recorded the pain of injection and postoperative pain.

Materials and Methods

Eighty-six adult subjects participated in this study. All subjects were in good health and were not taking any medication that would alter pain perception as determined by a written health history and oral questioning. Exclusion criteria were as follows: younger than 18 or older than 65 years of age; allergies to local anesthetics or sulfites; pregnancy; history of significant medical conditions (American Society of Anesthesiologists class II or higher); taking any medications (over-the-counter pain relieving medications, narcotics, sedatives, antianxiety or antidepressant medications) that might affect anesthetic assessment; active sites of pathosis in area of injection; and inability to give informed consent. The Ohio State University Human Subjects Review Committee approved the study, and written informed consent was obtained from each subject.

With a crossover design, 86 subjects received 2 injections consisting of a primary mandibular first molar infiltration of 1.8 mL of 4% articaine with 1:100,000 epinephrine (Septocaine; Septodont, New Castle, DE) and 1.8 mL of 4% articaine with 1:200,000 epinephrine (Septocaine) in 2 separate appointments spaced at least 1 week apart.

With the crossover design, 172 infiltrations were administered for the first molar, and each subject served as his or her own control. Eighty-six infiltrations were administered on the left side, and 86 infiltrations were administered on the right side. The same side chosen for the first infiltration was used again for the second infiltration. The test tooth chosen for the experiment was the mandibular first molar. The

mandibular, contralateral canine was used as the control to ensure that the pulp tester was operating properly and that the subject was responding appropriately. A visual and clinical examination was conducted to ensure that all teeth were free of caries, large restorations, crowns, and periodontal disease and that none had a history of trauma or sensitivity.

Before the injection at both appointments, the experimental tooth and the contralateral canine (control) were tested 2 times with the electric pulp tester (Analytic Technology Corp, Redmond, WA) to ensure tooth vitality and obtain baseline information. The teeth were isolated with cotton rolls and dried with an air syringe. Toothpaste was applied to the probe tip, which was placed in the middle third of the buccal surface of the tooth being tested. The value at the initial sensation was recorded. The current rate was set at 25 seconds to increase from no output (0) to the maximum output (80). Trained personnel who were blinded to the anesthetic formulations administered all preinjection and postinjection tests.

Before the experiment, the 2 anesthetic formulations were randomly assigned 6-digit numbers from a random number table. Each subject was randomly assigned to each of the 2 anesthetic formulations to determine which formulation was to be administered at each appointment. Only the random numbers were recorded on the data collection sheets to further blind the experiment.

Under sterile conditions, the anesthetic cartridges were masked with opaque labels, and the corresponding 6-digit codes were written on each cartridge. All anesthetic solutions were checked to ensure that the anesthetic solution had not expired. The infiltration injections were administered by using the masked cartridges and a standard aspirating syringe equipped with a 27-gauge 1½-inch needle (Monoject, St Louis, MO).

Before the infiltration injection, each subject was instructed on how to rate the pain for each phase of the injection: needle insertion, needle placement, and deposition of anesthetic solution by using a Heft-Parker visual analogue scale (VAS). The VAS was divided into 4 categories. No pain corresponded to 0 mm. Mild pain was defined as greater than 0 mm and less than or equal to 54 mm. Mild pain included the descriptors of faint, weak, and mild pain. Moderate pain was defined as greater than 54 mm and less than 114 mm. Severe pain was defined as equal to or greater than 114 mm. Severe pain included the descriptors of strong, intense, and maximum possible. During each phase of the injection, the principal investigator informed the subject when each phase of the injection was complete. Immediately after the infiltration, the subject rated the pain for each injection phase on the VAS.

Before each injection the mucosa was dried, and 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 mandibular infiltration injection was administered by using a cartridge of 4% articaine with 1:100,000 epinephrine or a cartridge of 4% articaine with 1:200,000 epinephrine. The target site was centered over the buccal root apices of the mandibular first molar. The 27-gauge needle was gently placed into the alveolar mucosa (needle insertion phase) and advanced within 2–3 seconds until the needle was estimated to be at or just superior to the apices of the tooth (needle placement phase). The anesthetic solution was deposited during a period of 1 minute (solution deposition phase). All infiltrations were given by the senior author (M.M.).

The depth of anesthesia was monitored with the electric pulp tester. At 1 minute after the initial infiltration injection, pulp test readings were obtained for the mandibular first molar. At 3 minutes, the contralateral mandibular canine was tested. The testing continued in 3-minute cycles for a total of 60 minutes. At every third cycle the control tooth, the contralateral canine, was tested by an inactivated electric pulp tester to test the reliability of the subject. If the subject responded positively to an inactivated pulp tester, then they were not reliable and could not be used in the study.

All subjects were asked to complete postinjection surveys after each appointment by using the same VAS as previously described, immediately after the numbness wore off and again each morning on rising for the next 3 days. Patients were also instructed to describe and record any problems, other than pain, that they experienced.

No response from the subject at the maximum output (80 reading) of the pulp tester was used as the criterion for pulpal anesthesia. Anesthesia was considered successful when 2 consecutive 80 readings with the pulp tester were obtained within 10 minutes of the initial injection. With a nondirectional alpha risk of 0.05 and a power of 85%, a sample size of 86 subjects was required to demonstrate a difference in anesthetic success of ± 15 percentage points. The time for onset of pulpal anesthesia was recorded as the first of 2 consecutive 80 readings.

Group comparisons between the anesthetic formulations for anesthetic success were made by using the McNemar test. Multiple McNemar tests adjusted by using the step-down method of Holm were used to assess differences in incidence of pulpal anesthesia. Between-group comparisons for onset time were made with the Wilcoxon matched-pairs signed rank tests. Between-group comparisons for needle insertion, needle placement, solution deposition, and postoperative pain were made by using multiple Wilcoxon matched-pairs signed rank tests adjusted by using the step-down method of Holm. Comparisons were considered significant at $P < .05$.

Results

Eighty-six adult subjects, 43 men and 43 women ranging in age from 18–43 years, with an average age of 26 years, participated in this study.

Table 1 demonstrates the percentages of successful pulpal anesthesia. For both anesthetic formulations, anesthetic success ranged from 59%–67%. There was no significant difference between the 4% articaine formulations containing 1:100,000 or 1:200,000 epinephrine. The mean time of onset of pulpal anesthesia for 2 anesthetic formulations was 4.6–4.7 minutes (Table 1). There was no significant difference between the 2 formulations.

TABLE 1. Subjects Who Experienced Anesthetic Success and the Time of Onset of Pulpal Anesthesia for 4% Articaine with 1:100,000 Epinephrine and 1:200,000 Epinephrine

	4% Articaine with 1:100,000 epinephrine	4% Articaine with 1:200,000 epinephrine	*P* value
Anesthetic success*	67% (58/86)	59% (51/86)	.1671
Time of onset of pulpal anesthesia*(min)	4.7 ± 3.3	4.6 ± 3.3	.9193

n = 86 for anesthetic success; n = 45 for onset of pulpal anesthesia.

*There was no significant difference ($P > .05$) between the 2 anesthetic formulations.