Comparison of 4% Articaine with 1:100,000 Epinephrine and 2% Lidocaine with 1:100,000 Epinephrine When Used as a Supplemental Anesthetic

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Abstract

A randomized, double-blind trial was conducted to compare the efficacy of 4% articaine with 1:100,000 epinephrine and 2% lidocaine with 1:100,000 epinephrine when used as a supplemental anesthetic. Forty-eight patients with irreversible pulpitis requiring supplemental buccal infiltration for endodontic therapy were given either 4% articaine with 1:100,000 epinephrine or 2% lidocaine with 1:100,000 epinephrine in a double-blind manner. A standard VAS pain scale was used to evaluate the patient's response to pain after a supplemental injection. The mean VAS score after supplemental anesthesia was 15.28 for 4% articaine with 1:100,000 epinephrine and 19.70 for 2% lidocaine with 1:00,000 epinephrine. The mean percentage change in VAS score was 70.5 and 62.2% for articaine and lidocaine, respectively. There was no statistically significant difference in the VAS pain score between 4% articaine with 1:00,000 epinephrine and 2% lidocaine with 1:00,000 epinephrine as a supplemental anesthetic. *(J Endod 2007;33:403–405)*

Key Words

Articaine, irreversible pulpitis, lidocaine, supplemental injection

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Adequate local anesthesia is a critical component of successful patient management in endodontic therapy. The local anesthetic 4% articaine, with 1:100,000 epinephrine, was first introduced into the United States in 2000 (1). Several previous studies reported no significant difference in the anesthetic efficacy between articaine and 2% lidocaine when used for a primary inferior alveolar block, intraligamentary injection, or infiltration injection (2–6). However, articaine has appeared to provide a longer-lasting pulpal anesthesia than lidocaine (4, 7). In contrast, Kanaa et al. (8) found that 4% articaine with 1:100,000 epinephrine was more effective than 2% lidocaine with 1:100,000 epinephrine in producing pulpal anesthesia in lower molars using buccal infiltration injections.

Supplemental injections (with different techniques and/or types of anesthesia) are frequently required in patients with irreversible pulpitis, primarily because pulpal anesthesia resulting from an initial injection is often inadequate for the completion of endodontic procedures (9–12). Mechanisms contributing to the difficulty of obtaining pulpal anesthesia in teeth with irreversible pulpitis were previously described (9, 10, 13–16). In a clinical study of 51 patients with irreversible pulpitis of mandibular teeth, an inferior alveolar nerve block of 2% lidocaine with 1:100,000 epinephrine was only 19% successful for pulpal anesthesia; a supplemental intraosseous injection of 2% lidocaine with 1:100,000 epinephrine increased anesthetic success to 91% (17).

Success rates of achieving local anesthesia in teeth with normal pulps have been reported to range from 75 to 90% (18–20). Nevertheless, the effectiveness of local anesthetics decreases in teeth with inflamed dental pulps (9, 10). It was previously shown that a single (1.8 cc) inferior alveolar nerve (IAN) block injection of local anesthetic is ineffective in 30–80% of patients in teeth with a diagnosis of irreversible pulpitis (10–12). Teeth with irreversible pulpitis demonstrate an eightfold higher rate of local anesthetic failure compared to control teeth with normal vital dental pulps (10).

Supplemental anesthesia is often required to provide the patient with profound anesthesia sufficient for endodontic treatment of teeth with irreversible pulpitis. Some practitioners use the same type of anesthetic agent for the supplemental injection, whereas others apply a different local anesthetic using either the initial anesthetic delivery method or an alternative delivery method. Intraligmental (PDL), intraosseous, and intrapulpal injections were all previously demonstrated to be effective supplemental delivery methods of anesthesia (21–24).

Most studies compared the anesthetic efficacy of articaine and lidocaine as a primary injection (2–6). The purpose of this study was to compare the anesthetic efficacy of 4% articaine with 1:100,000 epinephrine to 2% lidocaine with 1:100,000 epinephrine administered by buccal infiltration as a supplemental anesthetic in teeth that were difficult to anesthetize.

Materials and Methods

The study consisted of 48 patients ($n = 48$) with 22 maxillary and 26 mandibular teeth. Twelve maxillary teeth received supplemental injections of 4% articaine with 1:100,000 epinephrine, whereas ten teeth received supplemental injections of 2% lidocaine with 1:100,000 epinephrine. In the mandible, 13 teeth received 4% articaine with 1:100,000 epinephrine as a supplemental injection and 13 teeth received 2% lidocaine with 1:100,000 epinephrine as a supplemental injection. Included in the study

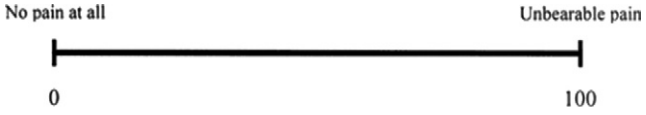

Figure 1. Standard VAS pain scale used for the assessment of pain. The numerical values seen here were not shown on the patients' VAS scale.

were patients in pain with teeth diagnosed as having irreversible pulpitis that were difficult to anesthetize and gave a prolonged response to cold testing. (1,1,1,2-tetrafluoroethane, Hygenic Corp., Akron, OH, USA). Patients categorized as "difficult to anesthetize" were those who were given an initial anesthetic that produced profound lip numbness and elimination of the chief complaint (that is, absence of thermal sensitivity and/or pain on percussion). However, when endodontic treatment was initiated, the patients experienced pain.

All 48 patients were adults over the age of 18 years and were registered patients of the College of Dentistry. They were in good health as determined by a health history questionnaire and confirmed verbally. The research protocol was approved by the New York University Human Subjects Review Committee. Each patient was given written information about the study protocol and informed consent to participate in the study.

Immediately before the study, 25 cartridges (1.8 cc) of 2% lidocaine with 1:100,000 epinephrine and 25 cartridges (1.8 cc) of 4% articaine with 1:100,000 epinephrine were masked to prevent identification. The anesthetic cartridges were assigned a random number as generated by Microsoft Excel Random Number Generator Program. Two master lists containing the identity (type of anesthetic) for each of the 50 cartridges were placed in sealed envelopes and kept by two separate investigators.

Patients presenting with a maxillary tooth requiring endodontic treatment received a buccal infiltration of 1.8 cc (1 cartridge) of 2% lidocaine with 1:100,000 epinephrine. Patients requiring mandibular endodontic treatment received two IAN blocks of 3.6 cc (2 cartridges) of 2% lidocaine with 1:100,000 epinephrine. Two injections were given in an attempt to compensate for the documented poor success rate in achieving profound pulpal anesthesia for mandibular teeth with irreversible pulpitis using a single injection (10–12).

Patients who experienced pain during endodontic treatment were given a double-blind supplemental buccal infiltration of either 1.8 cc of 4% articaine with 1:100,000 epinephrine or 1.8 cc of 2% lidocaine with 1:100,000 epinephrine. The patients were asked to rate the level of pain and discomfort using a standard visual analog scale (VAS) (25) before treatment, 10 minutes after the injection of the initial anesthetic, and 10 minutes after administration of the supplemental anesthetic. Figure 1 represents the VAS presented to the patients. Data collection and tabulation of VAS scores for each patient were performed by a single investigator (KGA), who was blinded to the type of supplemental anesthetic used. After data tabulation was completed and entered into a Microsoft Excel spreadsheet, the master list revealing the identity of each cartridge of anesthetic was opened. A Student's *t*-test was used to compare the anesthetic effect of 4% articaine with 1:100,000 epinephrine to 2% lidocaine with 1:100,000 epinephrine administered as a supplemental anesthesia in teeth difficult to anesthetize.

For those patients who continued to have pain after administration of the blinded supplemental anesthetic, local anesthetic rescue procedures (intrapulpal, PDL injections, and/or supplemental infiltrations using 2% lidocaine with 1:100,000 epinephrine) were used to achieve profound anesthesia. The results of local anesthetic rescue procedures were beyond the scope of this study.

TABLE 1. Mean VAS score in supplemental 4% articaine and 2% lidocaine groups

	Supplemental 4% Articaine Group	Supplemental 2% Lidocaine Group
No. of teeth	25	23
Mean ± SD VAS		
Before anesthesia	66.84 ± 19.23	71.83 ± 23.86
After initial anesthesia	47.48 ± 24.23	44.65 ± 25.30
After supplemental anesthesia (p = 0.20)	15.28 ± 18.53	19.70 ± 17.57
Mean % change in VAS between initial and supplemental anesthesia (p = 0.19)	70.5	62.2

VAS, visual analog scale.

TABLE 2. VAS for maxillary teeth in supplemental 4% articaine and 2% lidocaine groups

	Supplemental 4% Articaine Group	Supplemental 2% Lidocaine Group
No. of teeth	12	10
Mean ± SD VAS after supplemental anesthesia (p = 0.37)	18.83 ± 22.63	16.10 ± 11.03
Mean % change in VAS after supplemental anesthesia (p = 0.40)	72.60	69.19

VAS, visual analog scale.

Results

Forty-eight adult patients, 25 female and 23 male, from ages 22 to 58 years with an average age of 33 years participated in the study. Of the 48 patients in the study groups, 25 received supplemental anesthesia of 4% articaine with 1:100,000 epinephrine and 23 received supplemental anesthesia of 2% lidocaine with 1:100,000 epinephrine.

The mean VAS score after supplemental anesthesia for the 4% articaine group was 15.28 and the mean VAS score for the 2% lidocaine group was 19.70. Statistical analysis using a *t*-test showed no significant difference between the two groups (p = 0.20) (Table 1).

The average mean percentage change in the VAS pain score between initial and supplemental anesthesia was 70.5% for the articaine group and 62.2% for lidocaine group (Table 1). Statistical analysis also showed no significant difference between the two groups (p = 0.19) (Table 1).

A further analysis comparing the VAS score for mandibular and maxillary teeth found no statistically significant difference between the articaine group and the lidocaine group (Tables 2 and 3).

TABLE 3. VAS for mandibular teeth in supplemental 4% articaine and 2% lidocaine groups

	Supplemental 4% Articaine Group	Supplemental 2% Lidocaine Group
No. of teeth	13	13
Mean ± SD VAS after supplemental anesthesia (p = 0.07)	12.00 ± 13.89	22.46 ± 21.35
Mean % change in VAS after supplemental anesthesia (p = 0.21)	68.62	56.83

VAS, visual analog scale.

Discussion

We found no statistically significant difference in the VAS scores between supplemental buccal infiltrations of 4% articaine with 1:100,000 epinephrine and 2% lidocaine with 1:100,000 epinephrine.

The decision to use the standard VAS pain scale rather than a derivation was made to allow the patient to freely gauge his/her level of pain without guidance of additional lines or caricatures used by other VAS-related pain scales. In a meta-analysis of 54 pain assessment tools, the standard VAS pain scale was one of five pain assessment tools that met all the appraisal and selection criteria (26).

The quantification of pain through the use of a standard VAS pain scale does not fully predict the clinical efficacy of different anesthetics. A patient with a lower VAS score after a supplemental injection might require an additional rescue injection. In contrast, a patient with a higher VAS score after a supplemental injection might not require a further rescue injection. The patient's clinical response may be modified by non-odontogenic factors including gender, ethnicity, genetics, emotional, and physiological factors (10). The clinician's approach to the patient may also be a significant variable.

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