A Comparison of Different Volumes of Articaine for Inferior Alveolar Nerve Block for Molar Teeth with Symptomatic Irreversible Pulpitis

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Abstract

Introduction: Achieving anesthesia in mandibular molar teeth with irreversible pulpitis is very difficult. The aim of this study was to compare the efficacy of 1.8 mL and 3.6 mL articaine for an inferior alveolar nerve block (IANB) when treating molars with symptomatic irreversible pulpitis. **Methods:** In a randomized, double-blind clinical trial, 82 first mandibular molar teeth with symptomatic irreversible pulpitis randomly received conventional IANB injection either with 1 (1.8 mL) or 2 cartridges (3.6 mL) of 4% articaine with 1:100,000 epinephrine. The patients recorded their pain before and during access cavity preparation as well as during root canal instrumentation using a Heft-Parker visual analog scale. No or mild pain was considered as successful anesthesia. Data were analyzed by *t* and chi-square tests. **Results:** Eighty patients were eligible to participate in this study, which showed that 3.6 mL articaine provided a significantly higher success rate (77.5%) of IANBs compared with 1.8 mL of the same anesthetic solution (27.5%) although neither group had 100% successful anesthesia ($P < .001$). **Conclusions:** Increasing the volume of articaine provided a significantly higher success rate of IANBs in mandibular first molar teeth with symptomatic irreversible pulpitis, but it did not result in 100% anesthetic success. *(J Endod 2015;41:1408–1411)*

Key Words

Anesthesia, articaine, inferior alveolar, irreversible pulpitis, mandibular molar, nerve block, symptomatic, volume

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Root canal treatment is a procedure in which pulp tissue and bacteria are removed from the root canal system (1). A major concern for dentists during root canal treatment is to provide profound anesthesia during the procedure (2). Numerous studies have been performed to assess methods to overcome pain and discomfort during root canal treatment using various techniques, equipment, and anesthetic solutions (3–8).

Teeth with irreversible pulpitis have shown greater difficulty in achieving anesthesia during endodontic treatment. In addition, achieving anesthesia in mandibular molar teeth with irreversible pulpitis is more difficult compared with other posterior teeth with the same condition (9). An inferior alveolar nerve block (IANB) is the most common anesthetic technique used to provide anesthesia for mandibular molars (10).

Lidocaine is the mostly widely used anesthetic agent in dentistry (11, 12). Articaine is an anesthetic solution that was approved by the Food and Drug Administration for use in dentistry in the United States in 2000 (13). Articaine is claimed to provide faster onset and longer duration of pulp anesthesia compared with lidocaine (14). Several investigations have compared the anesthetic efficacy of articaine with other anesthetic agents (15–19). The results of these studies have shown no significant difference between articaine and lidocaine when used for IANB injections (15–18).

It is a mistake if a dentist assumes that soft tissue anesthesia is a sign of successful pulp anesthesia. Soft tissue anesthesia after the administration of an IANB only indicates that the injection has been administered at the correct site, but it does not guarantee pulp anesthesia. Successful pulp anesthesia success is only achieved if no or minimal pain is reported by the patient during access cavity preparation and root canal instrumentation (9). One of the suggested methods to overcome the failure of anesthesia after the administration of an IANB is to increase the volume of the anesthetic solution (20–25). Most of the previous investigations have reported that increasing the volume has no significant effect on anesthesia success. However, these studies have only used lidocaine as the anesthetic solution (20–23, 25). The aim of this investigation was to compare the anesthetic success of IANBs with articaine in teeth with symptomatic irreversible pulpitis without spontaneous pain when either 1.8 mL or 3.6 mL was used.

Materials and Methods

The protocol of this study and the informed consent document were approved by the Ethics Committee of Kerman University of Medical Sciences, Kerman, Iran (no. KA/92/476). The sample size calculation, which was based on a type I error of 0.05 and a power of 0.8, indicated that ideally a sample size of 30 in each group would be required to detect a 20% difference in the success rate of 2 test groups.

The inclusion criteria were as follows: healthy adult patients 18–65 years old having a mandibular first molar tooth with symptomatic irreversible pulpitis and a normal periapical radiographic appearance. The teeth were tested with an electric pulp test (Parkell Inc, Farmingdale, NY) and a cold test (Roeko Endo Frost; Roeko, Hangenav, Germany) to determine pulp sensibility. The teeth were diagnosed as having symptomatic irreversible pulpitis if the patients had lingering pain and a prolonged response to the cold test (more than 10 seconds).

The exclusion criteria were as follows: a history of sensitivity to 4% articaine or epinephrine, systemic diseases, pregnancy, any type of medication that could potentially interact with the anesthetic solution, and spontaneous pain.

Eighty-two patients were eligible to participate in this prospective, randomized double-blind study. All patients received treatment in the postgraduate clinic of the Endodontic Department of Kerman Dental School from September 2014 to May 2015. All patients signed an informed consent form. The patients were randomly divided into 2 groups of 40 patients each. To randomize the patients, odd and even numbers (1–80) were written on pieces of paper and kept in sealed envelopes. The first practitioner (M.P.) who performed the local anesthetic injection opened an envelope, and based on the number (group 1: odd number 1.8 mL articaine [Artinibsa; Inibsa, Barcelona, Spain] and group 2: even number 3.6 mL articaine), the patient was assigned to 1 of the groups. To provide a double-blind investigation, each patient received either 2 cartridges of the anesthetic solution or a cartridge of the anesthetic solution followed by a mock injection. Another practitioner (R.A.) performed the cold test and the rest of the treatment including access cavity preparation and root canal instrumentation. Hence, the second practitioner and the patients were not aware of the volume of anesthetic solution used.

The patients were asked to rate their pain using a Heft-Parker visual analog pain scale (VAS) before administration of the anesthetic solution, after the cold test, and during the endodontic treatment (26). The VAS scores were divided into 4 categories: no pain corresponded to 0 mm, mild pain was defined as being >0 mm and ≤54 mm, moderate pain was >54 mm and <114 mm, and severe pain was ≥114 mm.

A topical anesthetic gel (20% Benzocaine; Premier, Philadelphia, PA) was passively placed at the injection site with a cotton tip applicator for 1 minute before injection. Then, a conventional IANB was administered using an aspirating syringe with a side-loading cartridge system (Dena Instruments; Forgeman Instruments Co, Sialkot, Pakistan) and a 27-G 31-mm needle (C-K ject; CK Dental, Kor-Kyungji-do, Korea). All injections were given by 1 clinician (M.P.). Ten minutes after injection, the patients were asked whether they had lip numbness. Any patient without lip numbness at this stage was excluded from the study.

Thereafter, the teeth were isolated with a rubber dam, and caries was removed followed by the preparation of an endodontic access cavity. Before starting the treatment, each patient received an explanation regarding the Heft-Parker VAS. The patients could stop the practitioner at any stage of treatment (ie, access cavity preparation, pulp chamber opening, or root canal instrumentation) if they felt more than mild pain by raising their hand. They were then given the VAS to rate the pain they felt during the procedure. At the end of each stage of treatment, the practitioner stopped work and asked the patients to rate their pain if they had not already raised their hand during treatment. No or mild discomfort (faint, weak, and mild pain) was considered as success, whereas moderate or severe pain was considered as failure of anesthesia. Fifteen minutes after the administration of the IANB, the teeth were re-evaluated with a cold test. If the patients reported sensitivity to the cold test before commencing caries removal and access cavity preparation or if higher than mild pain was recorded on the VAS at any stage of treatment, then supplemental anesthesia (intraperiodontal ligament or intrapulp injection) was used to provide patient comfort throughout the treatment. In each tooth, after establishing the working lengths, root canal instrumentation was completed with RaCe rotary instruments (FKG Dentaire, La Chaux-de-Fonds, Switzerland).

Categorized data were analyzed using chi-square and *t* tests. *P* values <.05 were considered as significant.

Results

Two of the 82 patients who initially participated in the study were excluded because the patients were unwilling to continue the treatment procedure. No side effects, such as syncope, central nervous system reaction, cardiovascular reaction, methemoglobinemia, or allergic reactions, were reported by any of the patients. No significant difference was found between the age and sex of the patients in the 2 groups ($P = .648$ and $P = 1.00$, respectively).

The total success rate of IANB anesthesia in group 2 was 77.5%, which was significantly higher ($P < .001$) than that in group 1 (27.5%). No significant difference was found between the groups either 15 minutes after the injection or during dentin penetration and root canal instrumentation (Table 1). However, the patients in group 1 reported significantly more pain compared with group 2 when the pulp was exposed during access cavity preparation ($P < .001$). Table 1 shows the success rate of anesthesia in each group during the various stages of treatment.

Discussion

The results of the present study have shown that increasing the volume of articaine improved anesthesia success after IANB injection ($P < .001$) for mandibular first molar teeth with symptomatic irreversible pulpitis.

Conflicting results regarding IANB anesthesia success have been reported after the use of different volumes of anesthetic agents (20–25, 27). Most investigations have reported no significant difference in the success rate of IANB anesthesia with higher volumes of lidocaine (20–23, 25). In contrast, 2 studies have reported significantly higher success rates when the volume of lidocaine was increased for IANB injections (24, 27). Some of the previous studies regarding different volumes of anesthetic solutions for IANBs have evaluated teeth with healthy pulps (20, 21, 23, 27), whereas some others have tested different volumes of lidocaine in teeth with irreversible pulpitis (22, 24, 25). The present study was in accordance with a previous investigation that showed a significant positive effect of increasing the volume of anesthetic agents for mandibular molar teeth with irreversible pulpitis (24), but it was in contrast to 2 other studies (22, 25).

It has been generally accepted that pain management in teeth with spontaneous pain and symptomatic irreversible pulpitis is very difficult during endodontic procedures, including access cavity preparation and root canal instrumentation (9). Previous investigations have evaluated different volumes of anesthetic in teeth with spontaneous pain and conditions requiring emergency treatment (24, 25), whereas the present study only included teeth with symptomatic irreversible pulpitis diagnosed by lingering pain after a cold test without spontaneous pain. Hence, it can be assumed that the degree of inflammation in these teeth was less than in the other studies. Patients with spontaneous pain might expect some pain during treatment

TABLE 1. Number of Cases and Percentage of Failure of Anesthesia during Access Cavity Preparation and Root Canal Instrumentation

	Failure number (%)		
Stage of procedure	1.8 mL	3.6 mL	*P* value
15 minutes	0	0	1.00
Dentin	2 (5.0)	0	.494
Pulp	23 (57.5)	7 (17.5)	<.001
Instrumentation	4 (10.0)	2 (5.0)	.08
Final success	11 (27.5)	31 (77.5)	<.001