

## A Comparison of the Anesthesia Efficacy of Articaine and Articaine plus Morphine for Buccal Infiltration in Mandibular Posterior Teeth with Irreversible Pulpitis

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Article information	Abstract
<p>Article history: Received: 14 May 2013 Accepted: 2 July 2013 Available online: 11 Dec 2013 ZJRMS 2014 July; 16(7): 26-30</p> <p>Keywords: Articaine Morphine Pulpitis Infiltration</p> <p>*Corresponding author at: Department of Endodontics, Faculty of Dentistry, Zahedan University of Medical Sciences, Zahedan, Iran. E-mail: aliabditahere@yahoo.com</p>	<p><b>Background:</b> Successful local anesthesia is the bedrock of pain control in endodontics. Pain control is essential to reduce fear and anxiety associated with endodontic procedure. The aim of study was, identifying and comparison of the anesthesia efficacy of articaine and articaine plus morphine for buccal infiltration in mandibular posterior teeth with irreversible pulpitis.</p> <p><b>Materials and Methods:</b> This randomized double-blind clinical trial included 75 patients with symptomatically irreversible pulpitis in mandibular teeth. Patient divided 3 groups randomly received either a buccal infiltration of 4% articaine with 1:100000 epinephrine or articaine morphine with 1:100000 epinephrine or IAN block of 2% lidocaine with 1:800000 epinephrine. Self-reported pain response was recorded on VAS scale before and after local anesthetic injection during access preparation. For statistical analysis were used <math>\chi^2</math>, <i>t</i>-test, one way ANOVA and Mann Whitney.</p> <p><b>Results:</b> Statistical analysis result show success rate of articaine (68%), articaine morphine (52%) and lidocaine (64%). There was no statistically difference in the success rate between groups.</p> <p><b>Conclusion:</b> Addition of the morphine to articaine does not increase success rate of buccal infiltration.</p>

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### Introduction

Successful local anesthesia is the bedrock of pain control in endodontics. Effective pain control is essential to reduce fear and anxiety associated with endodontic procedure. Lidocaine (also known as lignocaine), the most frequently used local anesthetic, is the gold standard anesthetic agent used for comparison. It is an amide anesthetic with a short onset of action and an intermediate duration of anesthesia when associated with adrenaline. Articaine, also classified as an amide anesthetic, has increased liposolubility and potency because of presence of a thiophene ring. According to some authors, its ability to diffuse can produce pulpal anesthesia in mandibular teeth after infiltration anesthesia. Mandibular molars are usually anesthetized by regional blockade of the inferior alveolar nerve. Furthermore, teeth with inflamed pulps and periradicular areas are particularly difficult to anesthetize, especially in the mandible.

The literature reveals that failures occur more commonly with inferior alveolar nerve blocks (IANBs) than other nerve blocks [1-3]. Clinical studies comparing the success rate of 4% articaine with that of 2% lidocaine have shown that 4% articaine was superior to 2% lidocaine as a general-purpose anesthetic [4-6]. Brandt et al. in a meta analysis study were compared lidocaine and articaine. They concluded that the success rate of articaine infiltration injection more than lidocaine [7]. Opioids are

potent analgesics and are often used in dentistry in combination with acetaminophen, aspirin, or ibuprofen. Most clinically available opioids such as morphine activate  $\mu$  opioids receptors located at several important sites in the brain. Activation of this receptor inhibits the transmission of nociceptive signals from the trigeminal nucleus to higher brain regions, and recent studies indicate that opioids also activate peripheral opioids receptors located in dental pulp [8-10].

Intraligamentary injection of morphine has been shown to significantly reduce pain in endodontic patients with irreversible pulpitis [11, 12]. The first claim in context inflammatory activity by opioids and receptors was introduced by Ferria and Nakamura [13]. Saravanan et al. evaluated the anesthetic efficacy of 4% articaine with 1:100000 epinephrine in inferior alveolar nerve block and infiltration anesthetic techniques and compared with inferior alveolar nerve block of lidocaine in mandibular molar with irreversible pulpitis. They concluded that there is no statistically significant difference among IANB and infiltration of articaine when compared with IANB lidocaine in mandibular molar with irreversible pulpitis. Although they suggested buccal infiltration and IANB of 4% articaine were equally effective, buccal infiltration can be considered a viable alternative in IANB for pulpal anesthesia in mandibular molars with irreversible pulpitis [14]. Bigby et al. compared the anesthetic efficacy of

lidocaine with epinephrine to lidocaine plus meperidine with epinephrine for IANB in patients with mandibular molar with irreversible pulpitis. There was no significant difference between 2 solutions, the success rate for the IANB using the lidocaine solution was 26%, and for the lidocaine meperidine solution, the success rate was 12% [15]. Regard the analgesic effect of peripheral injection of morphine and higher success rate of anesthesia with articaine in buccal infiltration technique, the aim of this study is using combined buccal infiltration of articaine and morphine in mandibular posterior teeth with irreversible pulpitis.

## Materials and Methods

This study was designed as a randomized double-blind clinical trial comparing the anesthetic effectiveness of 4% articaine with 1:100,000 epinephrine and articaine morphine buccal infiltration anesthesia. The Ethics Committee in Zahedan Medical University approved the protocol of the study. The study was conducted during March 2012 May 2012 at the Department of Conservative Dentistry and Endodontic at Zahedan Dental College. Written informed consent was obtained from all the subjects participating in this study. Seventy five healthy adult volunteers aged between 20-50 years with active pain of  $\geq 4$  cm in Visual Analog Scale (VAS) in mandibular molar, prolonged response to cold testing with an ice stick (1,1,1,2 tetrafluoroethane; Hygenic Corp, Akron OH) and an electric pulp tester (Digitest; Parkell, Farmingdale, NY), and absence of any periapical radiolucency on radiographs except for a widened periodontal ligament and a vital coronal pulp on access opening were included for the study. Subjects placed under American Society of Anesthesiologists IV classification of systemic disorders or antecedents of complications associated with local anesthetics, pregnant and lactating women, and subjects under medication to alter pain perception (NSAID, opioids) were excluded from the study.

The study was designed with 2 test group and 1 control group. Subjects were randomly allocated to 1 of the 3 group. All subjects were asked to rate their pain on a VAS. Each subject was informed of the pain ratings on VAS and completed a baseline VAS to establish their preoperative pain level. VAS used was a 10-cm line with various descriptive terms. The subjects placed a mark on the scale where it best described their pain level. To interpret the data, the VAS was divided into the following 4 categories: no pain corresponded to 0 mm on the scale; mild pain was defined as  $>0$  and  $<4$  cm, which included descriptors of faint, weak, and mild pain; moderate pain was defined as  $>4$  cm and  $<7$ cm; severe pain was defined as  $\geq 7$ cm and included the descriptors of strong, intense, and maximum possible. The study subjects were allocated into the 3 study group by using a simple randomization procedure. Test group consisted of subjects who received a buccal infiltration of 4% articaine with 1:100,000 epinephrine (Septanest; Septodont, Saint Maur des

Fosses, France) and 4% articaine plus morphine with 1:100,000 epinephrine in the mucobuccal fold adjacent to mandibular molar. Control group consisted of subjects who received a standard IANB of 2% lidocaine with 1:100,000 epinephrine (Lignospan; Septodont).

All local anesthetic injections were delivered by using a self-aspirating syringe (Sagima, Buenos Aires, Argentina) and 27-gauge long needles (Septoject; Septodont). After reaching the target area, aspiration was performed, and 1.8 mL of solution was deposited at a rate of 1mL/min. All local anesthetic injections were given by a single operator who was not a part of the study process. This operator had no involvement with the study outcome. Under sterile conditions (laminar hood), the articaine morphine solutions were prepared each day of the appointment by technician 0.1 mL morphine was drawn from a vial of morphine using a sterile insulin syringe and then added to articaine cartridge. After administration of the local anesthetic agent to the various test and control groups, subject's self-reported assessment of pain was recorded on VAS. Assessments were done 20 minutes after the local anesthetic administration, following access preparation under rubber dam isolation by using Endo access bur (Maillefer, Dentsply, Ballaigues, Switzerland), and after pulp extirpation by using barbed broach (Medin, Jinonice, Czech Republic). Success was defined as no pain or weak/mild pain during endodontic access preparation and pulp extirpation. If the study subject's self-reported pain on VAS was  $\geq 4$  cm during the access preparation or pulp extirpation, the procedure was stopped, the anesthesia was considered unsuccessful. Analysis was undertaken in SPSS-16 for Windows. The tests were used  $\chi^2$ , one-way ANOVA analysis, and Mann-Whitney *U* test.

## Results

Volunteers recruited for the study included 75 patients with an average age of  $48.7 \pm 96.31$  years. Table 1 shows the distribution of the study population on the basis of sex, mean age, and initial pain score at baseline. There were no significant differences in age, gender, and pain scores before and after treatment among the 3 groups. No adverse reactions were recorded after the 3 anesthetic techniques. All subjects included in the trial had profound anesthesia after 20 minutes. All patients showed a significant decrease in the pain scores after local anesthesia ( $p=0.0001$ ). To evaluate the success rate of anesthesia in the study groups were analyzed using  $\chi^2$  test. The highest decrease pain in lidocaine group and the lowest was articaine morphine group. *t*-test for the pain intensity before and during treatment and pain during the preparation of the access cavity confidence level was 99%.

Statistical analysis result show success rate of articaine (68%), articaine morphine (52%) and lidocaine (64%). There was no statistically difference in the success rate between groups. According to the results of any of the techniques cannot provide 100% success intuitive.

**Table 1.** Comparison of age, sex, pain before and during treatment in the study groups

Value	Lidocaine Control IANB	Articaine	Articaine /morphine
Age (yr)	31.7	34.4	29.8
Sex (F/M)	12/13	9/16	15/10
Pain intensity before treatment (VAS Scale)	7.56±1.66	7.28±1.72	7.68±1.65
Pain intensity during treatment ( after 20 minutes)	1.96±2.50	2.36±2.37	3.38±3.34

To evaluate the intensity of pain during the preparation of the access cavity between the three groups (articaine, articaine morphine and lidocaine) analysis was performed using ANOVA. The mean pain intensity between the groups during treatment was not statistically significant.

## Discussion

Statistical analysis result show success rate of articaine (68%), articaine morphine (52%) and lidocaine (64%). There was no statistically difference in the success rate between groups. As the results showed that the addition of morphine in severe pain can make higher success rate (a significant correlation between the severity of pain before treatment and success rate of articaine morphine). If the acute pain is more because of the inflammatory process in the pulp they concluded that morphine is effective in acute pain. Lidocaine hydrochloride has maintained its status as the most widely used local anesthetic in dentistry since its introduction. Proven efficacy, low allergenicity, and minimal toxicity through clinical use and research have confirmed the value and safety of this drug. Thus, it became labeled the gold standard to which all new local anesthetics are compared. Despite the gold standard status of lidocaine hydrochloride, numerous reports have advocated the use of articaine hydrochloride as a superior anesthetic agent, primarily on the basis of its enhanced anesthetic potency, which is 1.5 times greater than that of lidocaine, with faster onset and increased success rate [16]. Articaine, which is 4-methyl-3 (2-[propylamino] propionamido)-2-thiophene carboxylic acid, methyl esterhydrochloride is the only amide local anesthetic that contains a thiophene ring and an additional ester ring lipid solubility is an intrinsic quality of local anesthetic potency. This quality permits the easier penetration of the anesthetic through the lipid nerve membrane and surrounding tissues. The degree of anesthetic molecules binding to the nerve membrane was suggested to dictate the duration of the anesthetic effect [14]. The more secure a bond is, the slower the anesthetic is released from the receptor sites in the sodium channels, and the greater the duration of the anesthetic effect. Available literature indicates that articaine is equally effective in nerve block anesthetic techniques when compared with other local anesthetics including lidocaine with epinephrine [17]. The success rate for articaine solution in IANB 24% was reported and the success rate of lidocaine solution in IANB 23% was reported [1].

Two studies found no difference in efficacy between 4% articaine with 1:100000 and 1:200000 epinephrine [18, 19]. In study of Hass et al. indicate no difference between articaine solution and prilocaine solution in infiltration

anesthetic technique in mandibular molars (63% vs. 53%) [20]. Haase et al. comparing anesthetic efficacy of articaine versus lidocaine a supplemental buccal infiltration of the mandibular first molar after an inferior alveolar nerve block. Result indicate that success rate of anesthetic supplement of articaine (88%) significantly more than lidocaine (71%) [21]. In this study buccal infiltration of articaine and lidocaine was as a supplemental injection after IANB technique and cause of higher success more than our study. Although IANB is the local anesthesia technique of choice when treating mandibular molars, not all IANB injections result in successful pulpal anesthesia [24]. Success rate of IANB lidocaine in study of Tortamano and et al., Aggarwal et al. and Kreimer was 45%, 26% and 13% respectively [1, 22, 23]. In our study, patients received IANB lidocaine the success rate was 64% that more than upon studies. The literature provides various explanations to the increased incidence of failure of IANB in patients with irreversible pulpitis. Initially, it was considered that there might be local acidosis because of tissue inflammation. The most plausible explanation can be the activation of nociceptors by inflammation [19]. Therefore, many studies have sought to improve the success rate of IANB or to identify alternative methods of anesthesia. Buccal infiltration is usually avoided in the mandibular molar regions because the presence of dense cortical bone impedes adequate diffusion of the anesthetic solution [26-28]. Recently, Kanaa et al. reported that mandibular buccal infiltration is more effective with 4% articaine with 1:100,000 epinephrine than 2% lidocaine with 1:100,000 epinephrine [4]. The results of the present trial indicate that buccal infiltration of articaine produced success rates similar to that of IANB of articaine and that of lidocaine. Articaine contains a thiophene ring instead of a benzene ring found in lidocaine, which might allow the molecule to diffuse more readily. This speculation is corroborated by the claims that articaine is able to diffuse through soft and hard tissues more reliably than other local anesthetics [10]. Our success rate of articaine in infiltration anesthetic technique was 64%, which is similar to that reported by Haas et al. [20] and Kanna et al. [4]. In another study Kanaa et al. comparison of the efficacy of 4% articaine with 1:100,000 epinephrine and 2% lidocaine with 1:80,000 epinephrine in achieving pulpal anesthesia in maxillary teeth with irreversible pulpitis. Anesthetic success rate of articaine was gave 72% and lidocaine was 58%. In the study superiority was buccal infiltration of articaine. In our study slightly superiority was with articaine but no statistically significant difference (68% vs. 64%) [25]. Aggarwal et al. evaluation anesthetic efficacy of supplemental buccal and lingual infiltration of

articaine and lidocaine following an inferior alveolar nerve block in patients with irreversible pulpitis. Patients indicate success rate 33% in control group, 47% in lidocaine supplementary group and 67% in articaine group respectively. In our study success rate of IANB was higher than study of Aggarwal [22].

In their study Jung et al. evaluation of buccal infiltration and inferior alveolar nerve blocks in pulpal anesthesia for mandibular first molars anesthetic success rate of articaine was gave 43% and success rate of buccal infiltration was 54% that success rate of buccal in our study higher than their study [5]. Aggarwal et al. evaluation of local infiltration of articaine plus ketorolac and dexamethasone on anesthetic efficacy of inferior alveolar nerve block with lidocaine in patients with irreversible pulpitis patients indicate success rate 39% in control group, 54% in articaine group, articaine ketorolac 62% and dexamethasone group 54% [26]. Martin et al. compared anesthetic efficacy of 1.8 mL versus 3.6 mL of 4% articaine with 1:100,000 epinephrine as a primary buccal infiltration of the mandibular first molar [27], success rate 1.8 mL articain in buccal infiltration was 50% and 3.6 mL was 70%. Mc Entire evaluation anesthetic efficacy of 4% articaine with 1:100000 epinephrine versus 4% articaine with 1:200000 epinephrine as a primary buccal infiltration in the mandibular first molar [28]. Success rate was given in both group 59-67% that similar to the results of our trial. In our study addition of morphine to the articaine solution did not statistically improve anesthetic success of the buccal infiltration similar Bigby study that addition of

meperidine did not improve anesthetic success of the IANB [15].

Dione et al. compared analgesic effects of peripherally administered opioid in clinical models of acute and chronic inflammation [11]. Injection of 1.2 mg morphine in create of analgesia in the acute pain was unsuccessful. In our study addition of morphine to the articaine solution in acute pain was significantly more effective than moderate pain. Likar et al. evaluation efficacy of peripheral morphine analgesia in inflamed, none inflamed and per neural tissue of dental surgery patients [29]. They found that decrease pain scale after addition of morphine. To summarize, on the basis of the results of the present study, it can be concluded that there is no statistically significant difference among infiltration of articaine and articaine morphine when compared with IANB of lidocaine in mandibular molars with irreversible pulpitis. Hence compared with inferior alveolar block, buccal infiltration can be considered a viable alternative to secure pulpal anesthesia for endodontic therapy.

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### Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

### Conflict of Interest

The authors declare no conflict of interest.

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