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# EFFECT OF 4% ARTICAINE INFILTRATION VERSUS 2% LIDOCAINE NERVE BLOCK AFTER PREMEDICATION BY IBUPROFEN ON ANESTHETIC EFFICACY IN ENDODONTIC TREATMENT OF ACUTE IRREVERSIBLE PULPITIS: A RANDOMIZED CLINICAL TRIAL (PART I)

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## *ABSTRACT*

**Introduction**: The purpose of the present study was to assess effect of 4% articaine infiltration versus 2% lidocaine nerve block after premedication by ibuprofen on anesthetic efficacy in endodontic treatment of first permanent molar with acute irreversible pulpitis, in a randomized, single-blind study.

**Subjects and Methods**: Fifty two patients were included in the study with 26 patients in lidocaine group and 26 patients in articaine group. Patients were given one 600 mg tablet of ibuprofen as a premedication one hour before anesthetic administration. Electric pulp tester reading was recorded before and after anesthesia. Then root canal treatment was done in single visit. Patient rated pain on Visual Analogue Scale (VAS) preoperatively, during access cavity, cleaning and shaping and postoperatively after 6, 12 and 24 hours. Number of analgesic tablets taken was recorded. Chi square test was used to compare between categorical data.

**Results**: There was no statistically significant difference in percent of successful cases between lidocaine (53.8%, 76.9%) and articaine groups (50%, 57.7%) in access and cleaning and shaping, respectively. There was no statistically significant difference in number of patients needed supplemental intrapulpal anesthesia. Most patients reported no or mild pain after 24 hours in both groups and only one tablet was taken when needed.

**Conclusions:** lidocaine inferior alveolar nerve block (IANB) is similar to articaine infiltration in mandibular molars with acute irreversible pulpitis, thus making infiltration with articaine a viable alternative to IANB. Furthermore, supplemental intrapulpal anesthesia proved to be an effective method in controlling pain and finalizing treatment successfully.

**KEYWORDS:** Articaine, Lidocaine, Infiltration, Nerve block, Pulpitis, Ibuprofen.

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## INTRODUCTION

Pulpal pain is the most common pain in the orofacial region. Pain control especially during the early stages of endodontic therapy, is very critical and makes both dentist and the patient confident during treatment[1].

Local anesthesia is the primary method used in dentistry to control patient pain. Achieving anesthesia in mandibular molars with irreversible pulpitis is much more difficult in comparison with teeth having normal healthy pulps. Lack of profound anesthesia in teeth with inflamed pulp (irreversible pulpitis) can hinder or cause discomfort during treatment steps[2].

The conventional method for anesthetizing mandibular teeth is an inferior alveolar nerve block (IANB) with 2% lidocaine[3]. Failures occurring with IANB requires the use of some adjunctive methods hoping to increase success of pulpal anesthesia for endodontic procedures, these include supplemental intrapulpal, intraosseous and intraligamentary anesthesia[4,5]. Furthermore, preoperative administration of non narcotic analgesics such as steroidal and non steroidal anti-inflammatory drugs (NSAIDs) as ibuprofen before IANB can effectively help in achieving a deep anesthesia during endodontic treatment of patients with irreversible pulpitis[2,6].

Articaine hydrochloride is an anesthetic agent which has enhanced anesthetic potency and faster onset that allows its use as buccal infiltration for mandibular molars[7-10]. The anesthetic efficacy of 4% articaine is not superior to 2% lidocaine when given by IANB[11-13]. However, using articaine with only buccal infiltration and without premedication was equally effective to IANB[14].

Thus, the purpose of the present study was to assess effect of 4% articaine infiltration versus 2% lidocaine nerve block after premedication by ibuprofen on anesthetic efficacy in endodontic treatment of acute irreversible pulpitis in a randomized clinical trial (RCT).

## SUBJECTS AND METHODS

Fifty-two emergency patients with age range (18-45) were enrolled in the study such that they experienced pulpal pain in their first mandibular molar diagnosed to be symptomatic irreversible pulpitis. They were attending endodontic clinic, Faculty of Oral and Dental Medicine, Cairo University. All patients were in good health as determined by medical history. Patients' signs and symptoms gave tentative diagnosis of acute irreversible pulpitis in mandibular first molar tooth. Patients exhibited intermittent pain after thermal stimuli or spontaneous pain which was sharp or dull, diffuse or referred with no pain on biting. Odontogenic pain was confirmed clinically by presence of deep restorations, caries or pulp exposure. There was no pain on palpation or percussion. Periapical radiograph revealed no periapical involvement. The protocol of this study was approved by Endodontic department, evidence based committee, post graduate committee and Ethics Committee of Cairo University Faculty of Oral and Dental Medicine.

Patients were classified randomly into two groups according to the local anesthetic use: Group A: lidocaine (Safco Dental Supply Co., Buffalo, NY, United States) and Group B: articaine (Ubistesin, 3M™ESPE™, Bracknell, United Kingdom), by using random allocation Microsoft excel software. Allocation concealment was phone-based, such that the investigator would call the supervisor to know the intervention assessment for the patient. Informed consent was obtained for each patient.

The degree of preoperative pain was rated by VAS scale[15] and degree pulp sensitivity was detected by Electric pulp tester (DENJOY DENTAL CO., LTD, Changsha city, China). The experimental tooth and the contra lateral tooth were tested with the electric pulp tester to determine tooth sensitivity and obtain baseline information. The value at the initial sensation was recorded. Tooth-paste was applied to the probe tip, which was placed on the tip of mesiobuccal cusp tip of the tooth being tested.

Every patient was given one tablet of Ibuprofen 600 mg (Brufen 600, Abbott Laboratories, Illinois, USA) one hour before anesthesia. All local anesthetic injections were delivered by using a self-aspirating syringe and 27-gauge long needles. Regarding group A: 26 patients were given standard IANB 2% lidocaine. After reaching the target area, aspiration was performed, and 1.8 mL of solution was deposited. While in group B: 26 patients were given mandibular infiltration injection by using a cartridge of 4% articaine. 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 and advanced within 2–3 seconds until the needle was estimated to be at or just superior to the apices of the tooth. After 10 minutes[16], the patient was questioned for lip and soft tissue numbness and the electric pulp tester reading was recorded.

Access cavity preparation was performed using round bur size 3 and tapered stone with round end (Mani, INC, Utsunomiya Tochigi, Japan). Afterwards, the tooth was isolated with a rubber dam. Patients were instructed to rate any discomfort (no or mild pain) on the VAS scale through access cavity preparation or pulp extirpation. If patient felt any pain (moderate or severe), this was recorded, then the subject was given supplemental intrapulpal anesthesia with the same anesthetic solution to effectively complete the procedure without pain. Determination of working length was done by the apex locator (Root ZX mini, J morita corporation®, Suita City, Japan) and confirmed radiographically. Cleaning and shaping was done through rotary system using Revo-S files (Micro-Mega®, Besançon, France). The canals were irrigated using sodium hypochlorite (2.5%) between each instrument. Obturation was carried out using lateral compaction technique. After obturaion a cotton pellet was placed in the pulp chamber and the access cavity was sealed with temporary filling to avoid coronal leakage. In Post-trial care patient was referred to an operative or a fixed prosthodontics specialist for fixed restoration placement after completion of the root canal treatment.

Patients were asked to rate their postoperative pain on VAS at 6, 12 and 24 hours from the treatment and number of analgesic tablets was recorded (if taken). In case of severe pain, the patient was instructed to take one capsule of ibuprofen 600 mg to be repeated every 8 hours if needed.

Primary outcome was the pain felt during access cavity preparation which was assessed by VAS. Success was defined as no/mild pain during access cavity preparation[15]. Secondary outcomes were first: pain felt during radicular pulp extirpation (success in radicular extirpation was defined as no/mild pain[15] ) and need of supplemental anesthesia, second: post operative pain which was assessed by VAS and the number of analgesic tablets taken postoperatively if needed.

All the data was collected and tabulated. Statistical analysis was performed by Microsoft Office 2013 (Excel) and Statistical Package for Social Science (SPSS) version 20. The significant level was set at $P \leq 0.05$. Chi square test was used to compare between categorical data.

## RESULTS

Mean and standard deviation of age in lidocaine group was 33.23±8.95, while in articaine group it was 31±7.47, with no statistically significant difference between the two groups (P=0.334).

In lidocaine group there was 12 male patients (46.2%) versus 14 female patients (53.8%), while in articaine group there was 10 male patients (38.5%) versus 16 female patients (61.5%), with no statistical significant difference between the two groups (P=0.575).

Percentages of successful cases in access cavity was slightly higher in lidocaine compared to articaine both representing almost half of the cases, with no statistically significant difference between 2 groups, *P*=0.781 (Table 1, Figure 1). Patients who experienced moderate or severe pain received intrapulpal anesthesia to complete

treatment successfully in both groups, there was no statistically significant difference between both groups in number of those patients (P=1).

Percentages of successful cases in cleaning and shaping was higher in lidocaine reaching almost ¾ of the cases compared to 57.7% in articaine; with no statistically significant difference between 2 groups, *P*=0.139 (Table 1, Figure 1). Patients with moderate or severe pain received intrapulpal anesthesia to complete treatment successfully in both groups, but there was no statistically significant difference between both groups in number of those patients (P=0.262).

TABLE (1) Count and results of Chi square test in both groups for no/mild pain (Success) during access and cleaning and shaping:

| Success (pain less than score 3) | Lidocaine N/total | Articaine N/total | P value |
|---|---|---|---|
| Access preparation | 14/26 | 13/26 | 0.781 |
| Cleaning and shaping | 20/26 | 15/26 | 0.139 |

***Level of significance <0.05***

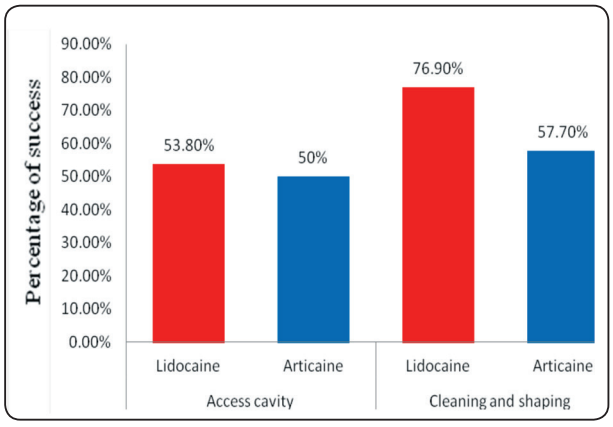


Fig. (1) Column chart showing percentage of successful cases during access cavity and cleaning and shaping

There were 11 successful cases (42%) in lidocaine and 10 (38.5%) in articaine who did not need intrapulpal anesthesia in both access and cleaning and shaping with no statistically significant difference (P=0.85).

At 6, 12 and 24 hours, pain was generally described as no or mild. Scores of lidocaine were higher than articaine and there was no statistically significant difference with *P* values 0.151, 0.823, and 0.619, respectively. Median of number of analgesic tablets taken was one in both groups.

## DISCUSSION

In the present study 4% articaine infiltration was used versus 2% lidocaine IANB after ibuprofen 600mg premedication in treatment of acute irreversible pulpitis. Up to authors' knowledge no previous studies used ibuprofen premedication with primary articaine infiltration.

Lidocaine hydrochloride has maintained its status as the most widely used local anesthetic in dentistry since its introduction. It became the gold standard to which all new local anesthetics are compared. Although IANB is the local anesthesia technique of choice when treating mandibular molars, not all IANB injections result in successful pulpal anesthesia[3,11]. Various explanations to the increased incidence of failure of IANB in patients with irreversible pulpitis were reported[5]. Initially, it was argued to be due to local acidosis because of tissue inflammation. But the most possible explanation for the failure of IANB, can be the activation of nociceptors by inflammation[5]. Accessory innervation also is a possible factor that can lead to failure in IANB. Thus in the present study, two percent lidocaine with 1:100,000 epinephrine was administered by IANB to serve as a gold standard to articaine infiltration.

Articaine was found to be successful when administered by buccal infiltration as a primary technique for mandibular molars[8]. In the present

study, four percent articaine with 1:100,000 epinephrine was administered by buccal infiltration rather than IANB. The rationale behind using articaine in infiltration rather than IANB for mandibular molars is that articaine is 4-methyl-3(2-[propylamino]propionamido)- 2-thiophene carboxylic acid, methyl ester hydrochloride is the only amide local anesthetic that contains a thiophene ring and an additional ester ring[9]. 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[7]. Articaine contains a thiophene ring instead of a benzene ring found in lidocaine, which might allow the molecule to diffuse more readily. This speculation proved that articaine is able to diffuse through soft and hard tissues more reliably than other local anesthetics[10]. Kanaa *et al*[8] reported that mandibular buccal infiltration is more effective with 4% articaine than 2% lidocaine. Poorni *et al*[14] found that 4% articaine is equally effective in nerve block and infiltration anesthetic techniques when compared with 2% lidocaine. Therefore, Buccal infiltration with 4% articaine can be considered a viable alternative for IANB for pulpal anesthesia for endodontic therapy[14].

Ibuprofen 600mg was given 1 hour before anesthesia. Ibuprofen acts by inhibition of COX1 and COX2 and blocking the continued production of prostaglandins, thus reducing its release and increasing the efficacy of anesthesia[17]. Ibuprofen has been shown to be effective for managing pain of inflammatory origin, as it binds to plasma proteins and exhibits increased delivery to inflamed tissues[18]. Therefore it can increase the efficacy of local anesthetics. Ianiro *et al*[6] found higher success rates in anesthetic efficacy of 2% lidocaine after premedication by ibuprofen 600mg when given thirty minutes before injection. Seymour and Ward[19] compared various doses of ibuprofen (200 mg, 400 mg, and 600 mg) for management of postoperative pain, and they found higher pain relief in patients who had taken 600 mg dose and this gives support to using it in the present study. No studies addressed the premedication of articaine infiltration by NSAID.

Electric pulp tester (EPT) was used to check pulpal response before and after administrating anesthesia success. Martin *et al*[20] also recorded reading 10 minutes after articaine infiltration. Tortamano *et al*[13] recorded pulp tester reading 10 minutes after IANB by lidocaine or articaine. The EPT has been used as an indicator of the effectiveness of local anaesthesia by Meechan *et al*[21], Modaresi *et al*[2]. Dreven *et al*[22] evaluated the electric pulp tester as a measure of pulpal anesthesia before endodontic treatment in teeth with pulpal diagnosis of normal, reversible pulpitis and irreversible pulpitis.

In this study VAS was used to evaluate pain intensity in access cavity preparation, cleaning and shaping and postoperative pain. It was explained in detail to the volunteers. The failure of VAS is between 4% and 11%, but this can be reduced if the tool is carefully explained to the patient[23].

Results showed that success rates during access cavity were approximately half of the patients in both groups; 53% in lidocaine group and 50% in articaine group. Literature reported that the range of success rates with lidocaine IANB was from 45% to 78%[13,24] while with articaine infiltration was from 40% to 70%[20,25].

Success rate of the present study is higher than that reported by Monteiro *et al*[25] in which success rate of articaine group (40%) was higher than lidocaine group (10%). This might be attributed to the difference in descriptive score taken for success where their success was considered if only “no pain” in treatment which is not in accordance with the present study where success was considered if there was “no and/or mild pain” as also previously used[12].

In lidocaine group success rate in access cavity was similar to that was reported by Ashraf *et al*[12], both were 53%. While, in cleaning and shaping,

the success rate (76.9%) was higher than that was reported by Poorni *et al* (65.4%)[14] and Tortamano *et al*[13] (45%), who both did not use ibuprofen premedication.

In the current study, the success rate in lidocaine group (53%) is higher than that reported by Aggarwal *et al*[26] and Shahi *et al*[27], 27% and 25%, respectively, though they also used ibuprofen premedication before lidocaine IANB. This difference may be due to different epinephrine concentration and lower dose of ibuprofen taken compared with the present study. Though, Oleson *et al*[28] used two anesthetic cartridges of lidocaine IANB, their success rate was still low (41%). Differences in results may be due to higher dosage of ibuprofen taken in the present study.

On the other hand, in the present study success rate with lidocaine IANB was lower than that reported by Poorni *et al*[14]; 69.2% which may be attributed to their higher sample size. Also it was lower than that of Parirokh *et al*[24] (78%) which may be attributed to higher epinephrine concentration which was 1:80,000 rather than the used 1:100,000 in the current study. Also Ianiro *et al*[6] reported higher success rate (76.9%) than the present study, possibly because they used combination of acetaminophen and ibuprofen as premedication and as well as their administration of two cartridges of lidocaine.

In the current study, success rates of articaine in access cavity (50%) and cleaning and shaping (57.7%) was similar to that reported by Martin *et al*[20], Nydegger *et al*[29], which were 50%, 55%, respectively. However success rates were lower than that were reported by Poorni *et al*[14] in access cavity (69.2%) and cleaning and shaping (65.4%), possibly due to their higher sample size. Also the success rates reported by Kanaa *et al*[8], Robertson *et al*[30], 64.5%, 76%, respectively, were higher than the present study and this may be because they evaluated anesthetic efficacy on healthy pulps not inflamed pulps as the current study.

Success rates of anesthesia either with lidocaine or articaine, was not sufficient to be used as a sole primary technique with approximately half of the patients, therefore supplemental anesthesia (intrapulpal) was used to increase the success rates and complete treatment painlessly as previously recommended[25]. In the present study, 100% of patients were treated successfully in single visit after intrapulpal anesthesia even if they reported moderate or severe pain. Monteiro *et al*[25], Aggarwal *et al*[26] and Tortamano *et al*[13] used intrapulpal anesthesia to complete treatment and reported increased success rates after its use.

In conclusion, within the limitation of the present study, the following can be concluded: lidocaine inferior alveolar nerve block (IANB) is similar to articaine infiltration in mandibular molars with acute irreversible pulpitis, thus making infiltration with articaine a viable alternative to IANB and supplemental intrapulpal anesthesia is an effective method in controlling pain and finalizing treatment successfully.

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