

Anesthetic Efficacy of 4% Articaine Versus 2% Lidocaine in Lower Central Incisors - A Comparative Study

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ABSTRACT

Introduction: Adequate pain control is the cornerstone of any successful dental treatment. Study was done to assess the efficacy of 4% articaine and 2% lidocaine in achieving anesthesia in Lower central incisors.

Material and methods: This study included 24 patients with otherwise normal mandibular central incisors. Each Patient was administered local anaesthesia during two separate appointments where 1.8 ml of 2% lidocaine with 1:100000 epinephrine was administered in the first visit and 1.8 ml 4% articaine with 1:100,000 epinephrine in the second visit in the labial sulcus adjacent to the mandibular right central incisor. The response of the test tooth was assessed using Endo Ice[®] and Electric Pulp Tester (EPT) for every 5 minutes for up to a maximum of 1 hour after injection or till the tooth became responsive whichever was earlier.

Results: The mean onset of pulpal anesthesia for 2% Lidocaine 8.4 (S.D., 2.5 min), and 4% Articaine is 7.4 (S.D., 3.0 min), respectively. The mean duration of pulpal anesthesia on EPT for 2% Lidocaine and 4% Articaine was 10.41 (S.D., 8.58 min) and 20.6 (S.D., 12 min) respectively and the mean duration of pulpal anesthesia on Endo-Ice 2% Lidocaine and 4% Articaine was 13.75 (S.D., 8.37 min) and 29.16 (S.D., 8.03 min) respectively.

Conclusion: Articaine demonstrated a higher percentage of anesthesia efficacy and duration than lidocaine. The use of 4% Articaine efficacy and duration was about 55% more effective than 2% Lidocaine and Endo Ice[®] was 28% more reliable than EPT.

Keywords: Articaine, Electric Pulp Tester, Endo Ice[®], Lidocaine

INTRODUCTION

Pain control in clinical dentistry is usually well managed using local anaesthetic (LA) drugs. However, clinical situations exist where adequate local anesthesia is difficult to achieve particularly in the mandibular anteriors mainly due to an increased thickness of the cortical bone, accessory innervations with mylohyoid nerve and cross innervations from the contra-lateral inferior alveolar nerve.¹

Two of the most commonly used local anesthetics in dentistry are the tertiary amines, lidocaine and articaine. Lidocaine hydrochloride (an amide group local anesthetic) was first available for clinical use in 1948 and since then it has revolutionised "pain control" in dentistry. It has been widely used due to its proven efficacy, low allergenicity, and minimal toxicity over long term clinical use. Infact, it is considered to be the "gold standard" against which all new local anesthetics are compared for anaesthetic efficacy, allergenicity, and toxicity.² The onset of anaesthesia for 2% lidocaine with 1:100,000 epinephrine is reported between 2

and 3 minutes, with an anesthetic duration of approximately 60 to 85 minutes for pulpal anesthesia, and 120 to 180 minutes for soft tissues.^{3,4}

Articaine is an amide-type drug with an additional ester group and is known to exhibit enhanced anesthetic efficacy with potency 1.5 times that of lidocaine, faster onset and increased success rate owing to superior lipid solubility and protein binding across the nerve membrane. It was approved for use by the United States FDA since 2000.^{5,6} Various studies have reported a significantly faster onset of action and longer duration of anesthesia for articaine in comparison with lidocaine⁷ with a success rate of 75-92% with articaine and 45-67% with lidocaine by single buccal infiltration in permanent mandibular molars.⁸

The purpose of this study was to compare the anaesthetic efficacy and duration following labial infiltration of 2% lidocaine versus 4% articaine (both with 1:100000) epinephrine in mandibular right central incisors.

MATERIAL AND METHODS

The study was conducted at department of Restorative Dental Sciences, King Khalid University College of Dentistry Abha, after obtaining the approval from Scientific Research Committee of the Institution. The study population was sourced from patients attending the Out Patient Department and comprised of 24 adult volunteers of over 18 years with a vital permanent mandibular right central incisor.

Exclusion criteria was patients who were below 18 years of age, suffering from any bleeding disorders, facial anaesthesia or paraesthesia, allergies to local anaesthetic drugs and teeth that responded negatively to baseline pulp testing or with key test teeth missing.

The subjects were comfortably seated on a conventional dental chair and examined under artificial illumination using sterile gloves. The clinical examination was carried out to ensure that the test tooth was free of any dental caries, restorations, and periodontal disease, and that none had a history of trauma or sensitivity. The relevant data were entered into the proforma and an informed consent was

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How to cite this article: Abdulaziz Saad Abu-Melha, Abdullah Hussain Altheeb, Abdulaziz Amer Alasmari. Anesthetic efficacy of 4% articaine versus 2% lidocaine in lower central incisors - a comparative study. International Journal of Contemporary Medical Research 2018;5(4):D34-D36.

DOI: 10.21276/ijcmr.2018.5.4.44

obtained from each subject for carrying out the diagnostic procedures.

The following local anaesthetic regimens were administered by labial infiltration in the mucolabial fold of mandibular right central incisor (tooth # 41) over two visits, at least one week apart during two separate appointments.

During the first visit, labial infiltration of one carpule (1.8 mL) of 2% lidocaine with 1:100000 epinephrine was administered and during the second visit, labial infiltration of one carpule (1.8 mL) of 4% articaine with 1:100,000 epinephrine was administered. Both the infiltrations were administered by the same investigator at a rate of 15 seconds per 0.9 mL. This investigator had no participation in measuring outcome.

After each infiltration the efficacy of anaesthesia was determined by pulp testing with Endo Ice® and Electric Pulp Tester (Vitality Scanner™ 2006) (SybronEndo, Orange, CA, USA) by an investigator blinded to the injections administered.

The EPT was calibrated to automatically deliver a non-linear increasing voltage (maximum voltage of 270 volts at an output impedance of 140 K Ohms) set at 0-80 digital reading. To ensure proper functioning of the pulp tester, an unanaesthetised maxillary right central incisor was tested before injection and at 10 and 30 minutes post-injection. To facilitate conduction between teeth and tip of the apparatus a conductive gel was applied on the labial surface of the tooth interface. As a criterion to determine establishment of pulpal anesthesia, two consecutive negative responses to the maximum output (80 reading) of the pulp tester was considered as an acceptable level of anaesthesia.

A cold vitality test using Endo-Ice® (1, 1, 1, 2 tetrafluoroethane; was performed. Endo Ice spray (-50°C) was used to ice cotton or endo frost pellets and applied on middle one third of buccal surface of mandibular right central incisors.

Testing was performed on the mandibular right central incisor twice before injection, at five-minute intervals after injection until 60 minutes or till the tooth regained responsiveness. The timings were measured by stopwatch. The onset (time from the end of injection to the absence of pulpal response) and duration of pulpal anesthesia (time recorded before two positive responses to the pulp tester) and the anesthesia success (two consecutive readings of 80 mA without response (a minimum of 10 minutes of pulpal anesthesia) and onset of pulpal anesthesia ≤ 10 minutes were measured

STATISTICAL ANALYSIS

Data were analysed in SPSS (SPSS 17.0, SPSS Inc., and Chicago, IL). Descriptive statistics like mean and percentages were used to interpret the data.

RESULTS

Twenty Four volunteers completed the investigation (12 males, 12 females; mean age 24 yrs, SD = 1.4 yrs). No side effect was found among the patients after administration of anesthesia. There was no significant difference based on gender and age between the two groups. The mean onset of pulpal anesthesia for 2% Lidocaine 8.4 (S.D., 2.5 min), and 4% Articaine is 7.4 (S.D., 3.0 min), respectively. The mean duration of pulpal anesthesia on EPT for 2% Lidocaine and 4% Articaine on was 10.41 (S.D, 8.58 min) and 20.6 (S.D, 12 min) respectively and the mean duration of pulpal anesthesia

Type of local anesthesia	Onset*	Duration tested by EPT*	Duration tested by ENDO-ICE*
Lidocaine	8.4 (±2.5)	10.41 (±8.58)	13.75 (±8.37)
Articaine	7.4 (±3.0)	20.6 (±12.0)	29.16 (±8.03)

*Mean(±S.D)in minutes

Table-1: Mean Anaesthetic Onset and Duration for Lidocaine and Articaine on EPT and Endo Ice

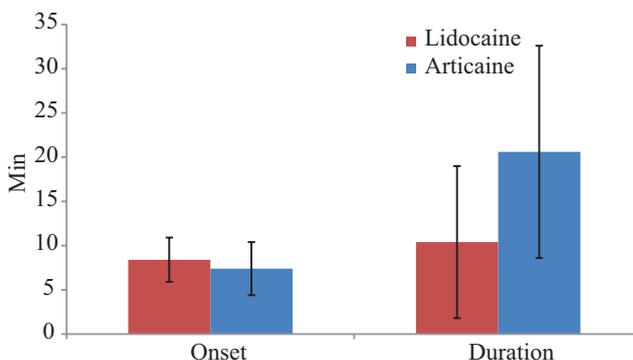


Figure-1: Comparison of Anaesthetic Onset and Duration for Lidocaine and Articaine on EPT (Mean and Standard Deviation)

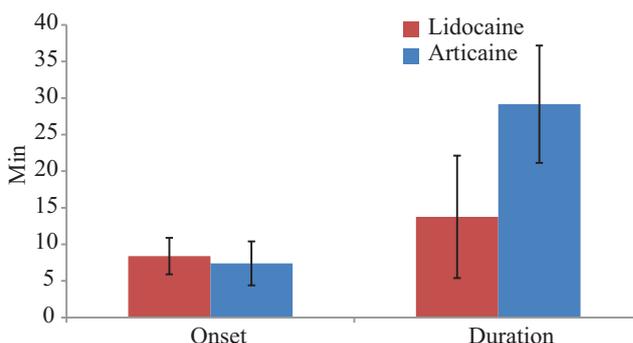


Figure-2: Comparison of Anaesthetic Onset and Duration for Lidocaine and Articaine on Endo Ice (Mean and Standard Deviation)

on Endo-Ice 2% Lidocaine and 4% Articaine was 13.75 (S.D., 8.37 min) and 29.16 (S.D., 8.03 min) respectively. (Fig 1 and 2, Table 1)

Anaesthetic efficacy and duration with 4% Articaine was about 55% more effective than 2% Lidocaine and the use of Endo Ice® was 28% more reliable than EPT.

DISCUSSION

Management of pain during dental procedures has always been a challenge and area of continued interest. Achieving effective pulpal anaesthesia (shorter onset and long duration) greatly influences the treatment success and outcome. Two of the most commonly used local anesthetics in dentistry are the tertiary amines, lidocaine and articaine with articaine emerging as a local anesthetic of choice due to its comparable safety and potency in comparison to lignocaine.

This study was conducted to compare the anaesthetic efficacy and duration following labial infiltration of 2% lidocaine versus 4% articaine (both with 1:100000) epinephrine in mandibular right central incisors. The mean onset of pulpal anesthesia for 2% Lidocaine 8.4 (S.D., 2.5 min), and 4%

Articaine is 7.4 (S.D., 3.0 min), respectively. The mean duration of pulpal anesthesia on EPT for 2% Lidocaine and 4% Articaine on was 10.41 (S.D, 8.58 min) and 20.6 (S.D, 12 min) respectively and the mean duration of pulpal anesthesia on Endo-Ice 2% Lidocaine and 4% Articaine was 13.75 (S.D., 8.37 min) and 29.16 (S.D., 8.03 min) respectively. (Fig 1 and 2, Table 1) Anaesthetic efficacy and duration with 4% Articaine was about 55% more effective than 2% Lidocaine and the use of Endo Ice® was 28% more reliable than EPT.

Our study found that articaine has a shorter onset of anaesthesia with a clinically significant difference of over one minute and a longer duration of anesthesia in comparison to lidocaine, but was statistically insignificant. (p value 0.25) These findings are similar to that of Vahatalo et al 1993⁹, Malamed 2000¹⁰, Tortamano et al 2013¹¹ who found a similar statistically insignificant difference with a shorter onset of anaesthesia with 4% Articaine. Studies by Costa CG et al 2005¹² and Sierra Rebolledo 2007³ reported statistically similar findings, although the onset of anaesthesia was within less than 3 minutes in their study sample probably because their study involved maxillary infiltration and inferior alveolar nerve block respectively which require less time for onset of anaesthesia in comparison to infiltration in the mandible in our study. Further, the higher time values of over 7 minutes in our study could possibly be due to infiltration anaesthesia in mandibular anatomy and cross innervations from the contralateral nerves which could have resulted in a higher time for anaesthesia to begin. It is also important to note that the success of onset of anesthesia and duration may vary considerably depending on the type and volume of anesthetic solution, the technique, and the site of injection.¹³⁻¹⁷ Additionally, variations in anesthetic efficacy among studies could probably be due to differences in methodology particularly the definition and interpretation of anaesthesia.¹⁸⁻¹⁹ No postoperative complications, other than pain, were reported in our present study. Studies have reported bruising and swelling in 4% and 5% of volunteers for articaine and lidocaine, respectively.⁸

CONCLUSION

Articaine demonstrated a higher percentage of anesthesia efficacy and duration than lidocaine. Although there is a difference of clinical significance in the duration of pulpal anaesthesia, these values were not statistically significant due to the small sample volume. Studies with larger numbers of subjects are necessary to evaluate and validate this hypothesis.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 07-04-2018; **Accepted:** 10-05-2018; **Published:** 19-05-2018