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Articaine buccal infiltration versus lignocaine inferior alveolar block for pulpal anaesthesia in mandibular second premolars – Randomized control double blinded clinical trial

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ARTICLE INFO

Article history:
Available online 20 April 2017

Keywords:
Articaine
Buccal infiltration
Lignocaine
Mandibular second premolar

ABSTRACT

Introduction: The study was designed as a randomized double blinded cross over trial comparing the anaesthetic efficacy of buccal infiltration of 4% articaine with 1:100,000 epinephrine with that of 2% lignocaine with 1:200,000 epinephrine in inferior alveolar nerve block in mandibular second premolars.

Methods: The study was designed as a cross over trial. Each subject received both the anaesthetic agent and the order of anaesthetic administration was randomized. All the subjects received 1.8 ml of articaine with 1:100,000 epinephrine in buccal infiltration and 1.8 ml of 2% lignocaine with 1:200,000 epinephrine in inferior alveolar nerve block in an interval of one week. Pulp sensibility measures were recorded using an electric pulp tester. Data was analyzed using SPSS version 22.

Results: Among the 46 subjects who completed the trial, 82.6% showed successful anaesthesia following articaine buccal infiltration compared with 89.1% following lignocaine inferior alveolar nerve block. There was no statistically significant difference between the success rates of 4% articaine buccal infiltration and 2% lignocaine IANB.

Conclusions: Study concluded that the buccal infiltration of 4% articaine can be used as a viable alternative anaesthetic technique for inferior alveolar nerve block of 2% lignocaine in mandibular second premolars.

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1. Introduction

Successful pulpal anaesthesia is the key to reduce fear during endodontic procedures.[1] Selection of an appropriate local anaesthetic agent and an apposite technique has a major influence on the success of the pulpal anaesthesia.[2]

Lignocaine, the first commercialized amide local anaesthetic solution, is the gold standard local anaesthetic agent.[3] It has a rapid onset in most of the dental procedures.[4] Inferior

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http://dx.doi.org/10.1016/j.jpfa.2017.03.005

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alveolar nerve block (IANB) using 2% lignocaine is the most commonly employed technique in order to achieve pulpal anaesthesia in the mandibular second premolars.[5] The IANB injection is quite stressful for both the clinician and the patient.[6] It causes post operative trauma such as tongue or lip biting, paraethesia and the lengthy duration of the IANB injection that produces high patient discomfort.[7] Hence, it would be a breakthrough if there was a technique to overcome the post operative disadvantages of IANB.

Articaine is a unique amide local anaesthetic agent that contains a thiophene ring instead of a benzene ring. The anaesthetic efficacy of articaine is similar to lignocaine except that it exhibits an increased liposolubility and high tissue penetrability due to the presence of a thiophene ring.[8] This causes an increased dissemination of the anaesthetic solution into the cortical bone, thereby effectively penetrating the mandibular dense cortical bone. Studies have also shown that articaine is equally effective when compared to other anaesthetics, the success rate ranging from 64% to 87%.[9–13]

Literature reveals a number of methods to study pulpal anaesthesia of painless vital teeth.[14] Among them electric pulp tester is a more objective measurement.[15–18] There is no clinical study that has investigated the efficacy of buccal infiltration of 4% articaine in mandibular second premolars to produce pulpal anaesthesia. Hence, this prospective randomized double blinded cross over trial aims to compare the anaesthetic efficacy of buccal infiltration of 4% articaine with inferior alveolar nerve block of 2% lignocaine for pulpal anaesthesia in mandibular second premolars using the electric pulp tester.

2. Materials and methods

This clinical study was designed as a randomized double blinded cross over trial comparing the anaesthetic efficacy of buccal infiltration of 4% articaine with 1:100,000 epinephrine (Septanest: Septodont, Saint Maur des Fosses, France) with that of 2% lignocaine with 1:200,000 epinephrine (Lignospan: Septodont) in IANB. The trial was registered with the Clinical trial Registry of India. The trial was registered with the Clinical trial Registry of India (REF/2016/09/0123000). The trial adhered to the CONSORT statement. The study was conducted during September 2016 – October 2016 at the Department of Conservative Dentistry and Endodontics at Sri Venkateswara Dental College and Hospital, Chennai. The study has been conducted in full accordance with the World Medical Association Declaration of Helsinki. The study was independently approved and reviewed by the Institution's Review Board of Sri Venkateswara Dental College and Hospital. After obtaining the ethical clearance 54 subjects meeting with the inclusion and exclusion criteria were enrolled for the study. Subjects in the age group of 20–40 years without pain, pathology or any previous treatment history in the mandibular second premolars and normal response to cold testing (Roeko Endo-Frost by Coltene, Germany) and EPT (Elements Diagnostic Unit; Sybron Endo, Anaheim, CA) were selected for the study. Patients with a known sensitivity to amide type Local Anaesthetic, patients with hepatic disease and significant impairment in CVS function, pregnant and lactating women patients, patients with necrotic pulp or previous restorations and under medication to alter pain were excluded from the study. Informed consent was obtained from all the subjects enrolled for the study.

The study was designed as a cross over trial. A pilot study was conducted with 20 subjects. Based on the results of the pilot study, a sample size of 54 was calculated assuming a significance level of 5%. Each subject received both the anaesthetic agent and the order of anaesthetic administration was randomized. Randomization (randomization ratio of 1:1) was done using a computer generated sequence of random numbers that was generated using random allocation software (version 1.0 May 2004). This was done by an operator who is not involved in delivering the local anaesthetic agent. Allocation sequence was concealed from the other operators involved in the study.

All the subjects received 1.8 ml of 4% articaine with (1:100,000) epinephrine in buccal infiltration and 1.8 ml of 2% lignocaine with (1:200,000) epinephrine in inferior alveolar nerve block in an interval of one week. All local anaesthetic injections were delivered using a standard dental aspirating syringe (Sagima, Buenos Aires, Argentina) fitted with a 27 gauge long needle (Septoject, Septodont) by a single operator. This operator had no involvement with testing the outcome.

Pulp sensibility measures were recorded using an electric pulp tester (Elements Diagnostic Unit; Sybron Endo, Anaheim, CA). Both the subject and the operator recording the outcome were blinded to the anaesthetic agent being used. For each subject, in the presence of a conducting medium (Colgate anticavity protection toothpaste), the EPT responses were recorded twice: (i) before administration of the local anaesthetic injection, (ii) 20 min after the administration of local anaesthetic injection. Any response by the patient before maximum stimulation was taken as positive response. No response by the patient to maximum stimulation on two or more consecutive episodes of testing was taken as a negative response. Anaesthetic success was defined as no response to the maximum stimulation on two or more consecutive episodes of testing.

All EPT recordings were made on the mesiobuccal cusp tip of the appropriate mandibular second premolars. The same area of the tooth was tested at each point. To ensure validity of the reading, a control tooth on the contra lateral side of the mandible was tested at the same time. Pulp tester responses were recorded before and after 20 min after local anaesthetic administration. Analysis was undertaken in SPSS version 20. The tests employed were McNemar test and chi square test.

3. Results

Subjects recruited for the study included 27 males and 19 females. Fig. 1 shows the total number of subjects enrolled for the study and provides information on the patients excluded from the trial. Among the 54 subjects enrolled, 46 subjects completed the trial. 8 patients were excluded due to loss of follow up for the second injection. Table 1 shows the age and demographic details of subjects enrolled for the study. No adverse reactions were encountered anytime during the study.

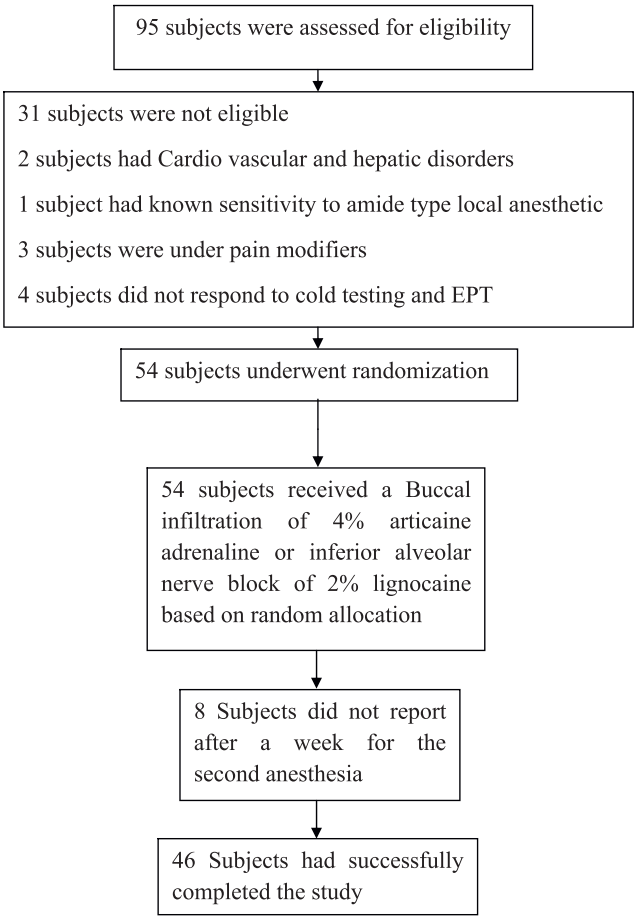


Fig. 1 – Flow diagram showing information on excluded patients.

Table 2 shows the number and percentage of anaesthetic success for 46 subjects. Among the 46 subjects who completed the trial, 82.6% showed successful anaesthesia following articaine buccal infiltration compared with 89.1% following lignocaine inferior alveolar nerve block. Though this difference was clinically significant as 38 subjects out of 46 had successful anaesthesia articaine buccal infiltration when compared to 41 out of 46 following lignocaine IANB, however this difference was not statistically significant.

4. Discussion

The present study compared the efficacy of 4% articaine buccal infiltration and 2% lignocaine IANB, for pulpal anaesthesia in the mandibular second premolars. The present study included a random population of patients that reported to the outpatient department of our institution. To overcome the confounding factors, the study was designed as a cross over trial.

Table 1 – The age and demographic details of subjects enrolled for the study.

Subjects	Number	Mean age (years)
Total number	46	24.63
Males	27	25.15
Females	19	23.89

Table 2 – Number (N) and percentage (%) of successful anaesthesia for 46 volunteers.

Local anaesthetic technique	Anaesthetic success			
	Yes		No	
	N	%	N	%
Articaine	38	82.61	8	17.39
Lignocaine	41	89.13	5	10.87
p-Value	0.250			

Lignocaine is the gold standard anaesthetic agent in dentistry, due to its minimal toxicity and better efficacy.[4] Hence, lignocaine was used for comparison in this study. IANB with 2% lignocaine is the standard anaesthetic technique for pulpal anaesthesia in the mandibular second premolars.[4] The post operative complications such as lip biting, tongue biting, haematoma and the lengthy duration of the anaesthetic technique puts both the patient and the operator in distress.[4] Hence, if these post operative complications can be avoided, it will make painless dentistry a reality. Thus an easier and obvious technique to overcome these drawbacks of IANB would create a tremendous change in endodontics.

Buccal infiltration is usually avoided in mandibular molar region because of the presence of dense cortical bone that prevents the diffusion of the anaesthetic solution.[13,19,20] Articaine is a unique amide anaesthetic that contains a thiophene ring instead of a benzene ring.[4] Studies have shown that articaine is effective in infiltration anaesthetic techniques when compared to lignocaine or mepivacaine or prilocaine.[12,21–31] This may be due to the presence of a thiophene ring that makes it liposoluble and thereby enhancing its tissue penetrability.[4] A thorough literature search revealed that no study has compared the anaesthetic efficacy of 4% articaine with 2% lignocaine in mandibular second premolars. Hence in this study we compared the anaesthetic efficacy of 4% articaine buccal infiltration to 2% lignocaine IANB in mandibular second premolars. Hence in this study we compared the anaesthetic efficacy of 4% articaine buccal infiltration to 2% lignocaine IANB for mandibular second premolars.

In clinical practice, assessing the vitality of the tooth is of paramount importance. The vitality of the tooth is ensured by the electric pulp tester (EPT). The sole aim of the EPT is to stimulate the myelinated Aδ fibres in the pulpal–dentine complex by applying an electric current on the tooth surface.[32] In the present study, the subjects were instructed to report the first detection of a warm, tingling or a painful sensation as the electric current was gradually increased until the subject signalled a sensation to ensure the status of the tooth thus indicating the anaesthetic efficacy of the agents.

Results of the present trial showed that buccal infiltration of articaine produced a success rate of 82.6% while it was 89.1% with lignocaine inferior alveolar nerve block. This difference was not statistically significant. This may be due to the ability of articaine to diffuse through the soft and hard tissues more reliably than other local anaesthetics.

The results of this study also demonstrates that buccal infiltration of 4% articaine for pulpal anaesthesia in the mandibular second premolars showed 82.6% success which is greater than 63% reported by Hass et al.[23] for mandibular molars. This difference in the success rates between the mandibular molars and premolars may be due to the variations in the thickness of the cortical plate in these regions. Oliveira et al.,[1] in his study stated that articaine provided a longer lasting pulpal anaesthesia than lidocaine. Though this aspect was not studied in this trial, it may be a potential aspect for further research.

Though articaine has a better liposolubility than lignocaine, its use in mandibular second premolars with irreversible pulpitis is questionable. However, further studies are required to prove the efficacy of 4% articaine during access opening or other endodontic procedures in mandibular second premolars with irreversible pulpitis.

To summarize, based on the results of the present study, it can be concluded that there is no statistically significant difference between the buccal infiltration of 4% articaine and inferior alveolar nerve block of 2% lignocaine in mandibular second premolars. Hence further studies will be helpful in considering buccal infiltration of articaine as a viable alternative for securing pulpal anaesthesia in mandibular premolars.

Conflicts of interest

The authors have none to declare.

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