Anesthetic Efficacy of Buccal Infiltration Articaine versus Lidocaine for Extraction of Primary Molar Teeth

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The aim of this study was to compare the efficacy of articaine versus lidocaine, both containing epinephrine, using a single buccal infiltration for extraction of primary molars. A total of 100 children requiring primary molar extraction received buccal infiltration using either 4% articaine or 2% lidocaine, both with epinephrine, with 50 children in each group. The Wong-Baker Facial Pain Scale (FPS) was used to evaluate pain perception subjectively. The heart rate and the blood pressure values were assessed objectively as an indirect measure of physiological pain perception. The Wilcoxon-Mann-Whitney test was used for comparing mean pain scores, heart rate, and blood pressure in both the groups. Single buccal infiltration with articaine was sufficient for achieving palatal or lingual anesthesia in all the children receiving it while all children in the lidocaine group required supplemental anesthesia. The mean FPS value was found to be higher in lidocaine group and was statistically significant. The mean heart rate recorded during the intervention was less than the mean baseline values in the articaine group, which was found to be statistically significant. For pediatric patients age 7 to 12 years, single buccal infiltration with 4% articaine with 1:100,000 epinephrine is more effective compared to 2% lidocaine with 1:80,000 epinephrine for primary molar extraction.

Key Words: Articaine; Lidocaine; Infiltration anesthesia; Tooth extraction.

An important aspect of patient management in dentistry is pain control, which is mainly achieved using local anesthetic drugs.¹ Lidocaine is the most commonly used local anesthetic in most countries around the world and has served as a gold standard for past 5 decades.^{1,2} In spite of its use as an effective tool for pain control in dentistry, multiple injections can trigger anxiety and induce pain in children.¹ Some nerve blocks, like the greater palatine nerve block and the inferior alveolar nerve block, are generally considered more painful when compared to buccal infiltration, mental nerve block, or periodontal ligament injections.³

Unpleasant treatment experiences negatively influence the child's behavior toward dental treatment.⁴ As dentists, therefore, we should strive to utilize less

traumatic alternative local anesthesia techniques to obviate the pain of multiple injections, if adequate local anesthesia can be obtained, by reducing the number of injections or injecting in less painful sites.^{1,3}

Articaine is unique among local anesthetic agents of the amide group as it possesses both an ester group and a thiophene ring, which allows greater lipid solubility and potency, facilitating greater diffusion across the lipid-rich nerve membrane to access target receptors.⁵ Thus, it can diffuse through soft and hard tissues in a more dependable manner when compared to other local anesthetic agents.^{5,6}

The studies available on the use of articaine for primary molars are mainly related to endodontics and restorative procedures.¹ However, there is a disagreement among researchers on the ability of articaine to produce analgesia in maxillary and mandibular teeth, via single buccal infiltration.³ Thus, the purpose of the study was to evaluate and compare the anesthetic efficacy of articaine and lidocaine using a single buccal infiltration technique for extraction of primary molars and to evaluate their ability to anesthetize palatal and lingual soft tissue.

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MATERIAL AND METHODS

The study was a randomized controlled trial that was conducted at the Department of Pedodontics and Preventive Dentistry, Sharad Pawar Dental College after approval by Institutional Ethics Committee, Datta Meghe Institute of Medical Sciences, Sawangi (M), Wardha, Maharashtra, India. The sample size calculation was done using the software nMaster (version 2.0, Christian Medical College, Vellore, India). The effect size taken was 0.4, which was calculated by using the mean and standard deviation (SD) of the previous research,¹ error probability taken was 0.05, power ($1 - \beta$ error probability) was 0.80, and the allocation ratio N_2/N_1 was one. Total sample size obtained was 100. After derivation of sample size, a total of 100 children age 7 to 12 years, who were indicated for primary molar extraction, were included in the trial. All the participants included were physically and mentally healthy, taking no medications, and had a Frankl behavioral rating as positive or definitely positive.⁷ Children younger than 7 years of age and those allergic to local anesthetics with epinephrine (sulphites or amide local anesthetics) were excluded from the study. Case history was recorded, and a preoperative radiograph was taken before extraction. The procedure and possible discomforts or risks after administering either lidocaine or articaine were fully explained to the accompanying guardian, and their written informed consents were obtained before beginning the procedure. Patients were equally and randomly divided into 2 groups: group A ($n = 50$) and B ($n = 50$). The method of allocation of patients in the groups was the same as used by Oberoi et al⁸ and it consisted of creating 100 slips of equal size and shape, 50 marked with A and 50 marked with B. The slips were folded and pooled in a bowl and shuffled. Each child was asked to pick a slip from the bowl.

The subjects who picked up slips with A marked on it were allocated to group A and received single buccal infiltration using 1.7-mL articaine HCl 4 % with epinephrine 1:100,000 (Septanest, Septodont, France; hereafter referred to as “articaine”), and those whose slips had B marked on it were allocated to group B and received 1.8-mL lidocaine HCl 2% with epinephrine 1:80,000 (Lignospan special, Septodont, Saint-Maur-des-Fosses, France; hereafter referred to as “lidocaine”). A standard cartridge in an Ultra safety plus syringe with a 1-inch long, 30-gauge needle was used for both groups. The administration of local anesthetic agent, strictly followed the technique of suprapariosteal injection for teeth as described below. The procedure was performed by the same clinician who had been calibrated to the technique of administering local anesthetic agent. The clinician, chairside assistant, patient, and their guardian

were all blinded to the anesthetic agent as a standard syringe was used.

The tissue at the injection site was cleaned with sterile dry gauze and the needle was oriented in such a way that the bevel faced bone. Lifting the lip and pulling the tissue taut, the needle was inserted at the depth of mucobuccal fold and was targeted at the apical region of the tooth to be anesthetized. After achieving 2 negative aspirations, approximately 0.6 mL of either articaine or lidocaine was deposited slowly over 20 seconds. The extraction procedure commenced 5 minutes after the administration of anesthesia. Subjective assessment of buccal and palatal soft tissue anesthesia in the case of a primary maxillary molars or buccal and lingual soft tissue anesthesia for primary mandibular molars was assessed by inquiring about the area of numbness from the participant. The cases in which palatal or lingual anesthesia was not reported by the patient were given supplemental palatal or lingual infiltration with 0.2 to 0.3 mL articaine or lidocaine with the same syringe containing the same local anesthetic as used for buccal infiltration. After achieving adequate buccal and palatal tissue anesthesia in the case of the maxilla or buccal and lingual tissue anesthesia in the mandible, the tooth was extracted under aseptic technique.

The Wong-Baker Facial Pain Scale (FPS) was employed in the study for subjective evaluation of pain perception during extraction as it shows good construct and validity.^{9,10} Immediately after the extraction, the participants were questioned about the level of pain they had experienced during the extraction and were asked to select the picture of facial expression that best represented their experience/discomfort. Each face has an assigned numerical value that was recorded and tabulated.

The hemodynamic parameters of heart rate and blood pressure were recorded using an automatic blood pressure monitor (OMRON HEM-7121) before the procedure and during the extraction of the tooth. They were used for objective evaluation and as physiological indicators of pain response.

Statistical Analysis

The data were compiled and subjected to statistical analysis using SPSS 16.0 software (SPSS Inc., Chicago, IL). The data did not follow the normal distribution curve and thus the nonparametric test was applied. The Wilcoxon–Mann–Whitney test was used for comparing the mean pain scores, heart rate, and blood pressure between both the groups.

Mean pain score in both groups.

RESULTS

The total number of participating children were 100, with 50 participants and equal number of 25 males and 25 females in each group. The mean age of the participants was 9.9 years and 9.3 in the articaine and lidocaine groups, respectively. A total of 24 (48%) primary maxillary molars and 26 (52%) primary mandibular molars were extracted following the administration of articaine while in the lidocaine group, a total of 26 (52%) primary maxillary molars and 24 (48%) primary mandibular molars were extracted.

The results of the intervention were evaluated by the same experienced clinician who administrated the local anesthetic agent. Successful subjective palatal and

lingual anesthesia was achieved with single buccal infiltration in all the participants (100%) of the articaine group, and none of them required supplemental injection. All the members of lidocaine group reported lack of subjective numbness and required an additional palatal or lingual anesthetic injection. The statistics of hemodynamic parameters are described in Table 1.

The FPS values (mean $\pm$ SD) were lower in the articaine group (1.52 ± 1.64) than in the lidocaine group (5.6 ± 1.8) and it was statistically significant ($p \leq 0.05$) (Figure 1).

The difference in mean $\pm$ SD of heart rate recorded before and during the intervention in the articaine group was 3.08 ± 6.12 , while in the lidocaine group it was -8.12 ± 19.21 and it was found to be statistically significant ($p \leq 0.05$) (Table 2).

The difference in mean systolic blood pressure recorded before and during the intervention in the articaine group was -1.56 ± 8.48 while in the lidocaine group it was -9.36 ± 11.25 , while the difference in mean diastolic blood pressure recorded before and during the intervention in the articaine group was -7.32 ± 25.15 , while in the lidocaine group it was -13.32 ± 13.60 and they were statistically not significant ($p \geq 0.05$) (Table 2).

DISCUSSION

This study compared the efficacy of 4% articaine with 1:100,000 epinephrine with 2% lidocaine with 1:80,000

Table 1. Descriptive Statistics of Hemodynamic Parameters in the Groups

Variables	Group	N	Mean	SD
Pulse before extraction	Articaine	50	93.88	12.85
	Lidocaine	50	101.64	15.68
Pulse during extraction	Articaine	50	90.80	12.29
	Lidocaine	50	109.76	19.26
Systolic BP* before extraction	Articaine	50	109.20	10.34
	Lidocaine	50	110.44	11.23
Systolic BP during extraction	Articaine	50	110.76	11.82
	Lidocaine	50	119.80	9.78
Diastolic BP before extraction	Articaine	50	68.68	7.82
	Lidocaine	50	71.36	11.47
Diastolic BP after extraction	Articaine	50	76.00	22.96
	Lidocaine	50	84.68	11.89

* BP indicates blood pressure.

Table 2. Comparison of Mean Difference of Hemodynamic Parameter in Both Groups Using Wilcoxon–Mann–Whitney Test

<i>Difference in Variables Before and During Treatment</i>	<i>Group</i>	<i>N</i>	<i>Mean difference</i>	<i>SD</i>	<i>P Value</i>
Pulse	Articaine	50	3.08	6.12	0.003*
	Lidocaine	50	−8.12	19.21	
Systolic	Articaine	50	−1.56	8.48	0.303
	Lidocaine	50	−9.36	11.25	
Diastolic	Articaine	50	−7.32	24.15	0.898
	Lidocaine	50	−13.32	13.60	

* Statistically significant.

epinephrine utilizing buccal infiltration during extraction of primary maxillary and mandibular molars and their ability to anesthetize palatal and lingual tissues.

The Wong-Baker FPS was used as a tool for self-reporting of pain by the participants. It measured the unpleasantness or affective dimension of a child's pain perception after the completion of the procedure. The measurements of heart rate and blood pressure were utilized as physiological parameters as they provide indirect measures of anxiety and pain that are not subjected to observer bias.¹¹ Heart rate and blood pressure both tend to show variations during stressful parts of surgery.¹² The body's reactions to a stressful situation or painful stimulation can be seen as higher heart rate levels and higher systolic blood pressure values.¹³

The ability of articaine to anesthetize palatal and lingual tissue by single maxillary and mandibular buccal infiltration injection was seen in all the cases, which may be attributed to its structure with increased lipid solubility and presumably superior bone and tissue penetration. These results were in accordance with the findings of Hassan et al,¹⁴ whereby satisfactory palatal anesthesia with buccal infiltration of articaine was achieved on maxillary molars. Similar results were obtained by Uckan et al¹⁵ who suggested that maxillary buccal infiltration of articaine provides palatal soft tissue anesthesia; thus it eliminated the need of traumatic and painful palatal injection.

Various other authors have also reported that maxillary molar extraction is possible with only buccal infiltration of articaine; however, these authors studied only behavioral parameters.^{15–17} The findings of the present study was in contradiction to the clinical study conducted by Mittal et al,¹ in which the authors reported the ability of articaine to anesthetize palatal tissue by buccal infiltration injection occurred in only a single case, which led them to conclude that buccal infiltration of articaine was not sufficient to cause

palatal tissue anesthesia. This difference in the findings could be due to the method of injecting local anesthetic solution, the age of the patient, and amount of solution deposited.

The mean FPS value was found to be higher in lidocaine group, which is possibly due to the need for the second infiltration in the palatal or lingual mucosa. The mean FPS values were lower in articaine group as none of the participants in this group required a secondary infiltration, virtually eliminating the need for painful secondary injection. These results were in accordance with various studies that reported lower pain scores for articaine.^{3,5,9,18}

The mean heart rate value in the articaine group during the intervention was less than the baseline value, while it raised from the baseline values in children who received lidocaine. This can be due to the additional epinephrine in the lidocaine group, which may have accounted for the difference. This finding is suggestive of higher levels of pain and anxiety among participants of lidocaine group and less perception of pain and anxiety in articaine group as it provided profound analgesia in palatal as well as lingual mucosa with single maxillary or mandibular buccal infiltration. However, Mittal et al¹ and Kambalimath et al² reported a slight increase in heart rate from baseline values in both their lidocaine as well as articaine groups.

The mean systolic and diastolic blood pressure recorded during the intervention was raised from the baseline values in both the groups, which could be attributed to painful stimulation and manipulation of tissue for extraction. The mean systolic and diastolic blood pressure value of the articaine group recorded during intervention was less than the lidocaine group which may be due to effective analgesia in articaine group. These results were in accordance with results of other studies that reported a slight increase in the systolic and the diastolic blood pressure values recorded during the intervention after administration of study drugs (articaine and lidocaine) from the baseline values.^{1,2,5}

Adverse effects like facial edema, infection, and paraesthesia or accidental lip injury were not reported in any of the 2 groups as children and parents accompanying them were properly instructed against lips biting post extraction.¹⁹

There are, however, some limitations that need to be acknowledged. Primarily, the concentration of epinephrine was higher in the lidocaine group, which may have resulted in higher values of cardiovascular parameters. Since the entire lidocaine group required supplemental injection, 0.9 mL of a 1:80,000 epinephrine containing solution yielded 11.25 mcg, while the 0.6 mL of 1:100,000 epinephrine in the articaine group yielded

only 6 mcg of epinephrine. Secondly, the assessment of soft tissue anesthesia was done by inquiring about the subjective area of numbness. The children's ability to appropriately inform about the numbness of the lingual or palatal tissue was not studied. The utilization of a sharp explorer was avoided as it was assumed it would have raised anxiety and may have altered the further assessment. However, this would have been a more objective criterion of local anesthesia.

In conclusion, for pediatric patients age 7 to 12 years, single buccal infiltration of 4% articaine with 1:100,000 epinephrine effectively provided adequate palatal or lingual local anesthesia for primary molar extraction, while 2% lidocaine with 1:80,000 epinephrine failed to provide adequate palatal or lingual anesthesia based on subjective patient report.

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