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A comparative analysis of 4% articaine and 2% lignocaine in evaluating the efficacy during Dental procedures in pediatric patients: An observation split mouth technique

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Abstract

A troublesome dental experience usually has a negative influence on the child's behavior towards any successive dental treatment. An alternative, less traumatic method of achieving pain control is an important contribution to reduce anxiety and emotional outbursts in children. Thus, management of child during any meddling procedure becomes a challenging task. Local anesthetics play a major role in techniques used for controlling pain.

Aim: The main aim and objective of the study was to compare and evaluate the efficacy of 4% articaine and 2% lignocaine in reducing pain while performing dental procedures in pediatric patients.

Material and Methodology: A split mouth technique was conducted on 25 subjects aged 3-6 years, who visited the Family Dental Clinic, Kulgam, Jammu and Kashmir for the treatment of their teeth. Subjects with deep carious lesions, grossly decayed or pain on mandibular molars (i.e where ever there was need of local anesthesia) were selected for the study. Topical application of local anesthetic spray followed by 4% articaine infiltration on one side and 2% lignocaine on other. Post treatment pain was assessed using visual analog scale.

Statistical analysis: The data collected underwent statistical analysis. Mean, frequencies, standard deviation and standard error was used to describe the descriptive analysis. Continuous variables were compared using student-t test with statistical significant p value of less than 0.05. The graphical representation of the data was done using bar diagrams.

Results: Statistically significant results were obtained while comparing pain, duration and onset of action of 4% articaine and 2% lignocaine.

Conclusion: Within the limitation it was concluded that 4% Articaine when used was found to be more effective and safe local anesthetic drug to be used in any aspects of dentistry and for all age groups, when compared to the properties of other local common anesthetic agents.

Keywords: 4% articaine, 2% lignocaine, local anesthetics, mandibular molars, pulptherapy, extraction

Introduction

In 1991, Clinical Affairs Committee - Pulp Therapy Subcommittee, recommended pulp therapy for immature permanent and primary teeth. The main goal being maintenance of health and integrity of tooth and their supporting tissue while sustaining the vitality of tooth affected [1]. Pulptherapy "a conservative approach for prevention of premature loss of primary teeth," is useful for anticipation of insufficient space for erupting permanent teeth, loss of arch length, impaction and tipping of premolars and molars. Nonetheless pulpectomy is also found to be advantageous for retained primary molars when not severed with progressive root resorption or severe malocclusion. Thus, a suitable procedure rather than an extraction is a reasonable treatment alternative to allow normal shedding of the predecessor tooth or providing a long term survival in instance of retention [2]. However a non-restorable teeth which is indicated for extraction should be followed by the placement of space maintainer.

Pulptherapy procedure requires an initial good anesthetization of the area to reduce the anxiety and fear of long sitting time and pain. Adequate pain control has always been a major concern

of Pedodontist. Clinical properties, onset and duration of action are the important parameters while choosing any local anesthetics [3]. Improvements in the use of local anesthetic dates back from 1884 when cocaine was used followed by lidocaine in 1943 for anesthetic purposes. Swedish chemist Nils Lofgren was to first synthesize lidocaine, which still continues to be used as a gold standard in local anesthetic evolution. In subsequent years, a number of amide anesthetics including prilocaine, and bupivacaine were introduced. Still, till now 2% lignocaine remains one of the benchmark agents for comparing other local anesthetics [4].

Rusching *et al.* in 1969 discovered a newer local anesthetic agent naming Articaine hydrochloride which was first marketed in Germany in the year 1976 under the name of Carticaine. Since its discovery, articaine has been a major subject of interest among dentists due to its unique properties and a number of advantages. The benzene ring present in the solution when substituted with a thiophenic ring increases its potency and lipo-solubility making articaine distinctive from other anesthetic solutions [5]. Beside, all these articaine is the only amide which contains an ester group allowing metabolism both by liver microsomal enzyme and plasma esterase. The protein binding capacity of articaine helps in diffusion and penetration into the bone and tissues with a capacity of more than 95% when compared to other local anesthetics [6].

The mechanism of action of both articaine and lidocaine are found to be similar. With addition of a vasoconstrictor an increase in local vasoconstriction thus, retarding the absorption of local anesthetics and prolonging the duration of action and intensification of the properties can be observed [7]. Thus, the main aim of our study was to compare the efficacy and duration of action of two local anesthetic i.e. 4% articaine and 2% lignocaine in children during the pulpotomy procedure by assessing the pain parameters using visual analog scale.

Material and Methodology

25 randomized controlled subjects reporting to the Family Dental Clinic Kulgam, Jammu and Kashmir from August 2021 to March 2022 were selected for the study. Systematically healthy, Frankel definitely positive and positive subjects with bilateral deep carious lesion in mandibular primary molars (either pulptherapy or extraction was indicated) were selected. Subjects with negative behavior were excluded from the study. Before any enrollment of the study subjects, a brief discussion about the procedure was done with parents and an informed consent was asked to sign after their full satisfaction and acceptance of the study.

Following proper protocols, subjects underwent complete oral and radiographic examination of the teeth involved. A split mouth technique was followed by assessing the groups using a toss of the coin. Left quadrant either with first or second molar involvement were grouped as group 1, where 4% articaine was injected (figure 1) and right quadrant as Group 2, where 2% lignocaine was injected (figure 2). Before the start of the procedure, the pediatric patients were seated comfortably on the dental chair with no obstruction and deviations around. The child was made familiar with the air rotor hand piece, instruments and the chemicals used so that no anxiety prevails among them. After building a strong rapport with the child, local anesthetic spray was used to anesthetize the area so that a minimal or no needle prick pain was felt. On left side of the quadrant 4% articaine solution was injected

with a 27 gauge needle under proper sterile conditions (figure 3a, 3b). Onset of action of anesthesia was evaluated using a straight probe and checking it after 1.5, 2.5, 3.5 and 4.5 minutes. Immediately after obtaining a standard time for obtaining anesthesia, dental procedure was performed and completed. The duration of action was again checked using a probe after 30, 45, 60 and 90 minutes of the local anesthetic administration. The operator standing next to the chair was instructed and trained to observe the facial expression of the child to assess the pain. A visual analog scale play card was given to the child to mark the expression felt during probing to assess the onset and duration of action. Similar procedure on next appointment was followed on the right side of the quadrant which was anesthetized using 2% lignocaine. After completion of the procedure, every patient was rewarded using a small geometry kit.



Fig 1: 4% Articaine with 1:100,000 Epinephrine



Fig 2: 2% Lignocaine Hydrochloride with 1:100,000 Epinephrine



Fig 3a: Representing the 27 gauge needle with Aspirating Dental Injection Syringe



Fig 3b: Representing the 27 gauge needle with Aspirating Dental Injection Syringe

Pain assessment

The visual analog scale was used to assess pain in the study subjects. It consisted of numerical values from 0 to 10, where 0 indicated no pain and 10 indicated worst pain. These markings were represented using a facial expression for easy understanding of the child. 0, 2,4,6,8 and 10 scores were chosen by the child patients. (Figure 4)

Sample size

A sample size of 25 was estimated by using the formula of $n = z^2 * p * (1 - p) / e^2$, where $z=1.96$ for confidence of interval (α) of 95%, p =population, e =margin of error. $Z=1.96$, $p=0.015$, $e = 0.05$. $n = 1.96^2 * 0.015 * (1-0.015) / 0.05^2$. $n = 0.0568/0.0025=22.704 \approx 23$. Thus, the estimated sample size came out to be 23, in-order to increase the strength of the study the sample size was increased to 25 (25 in each group).

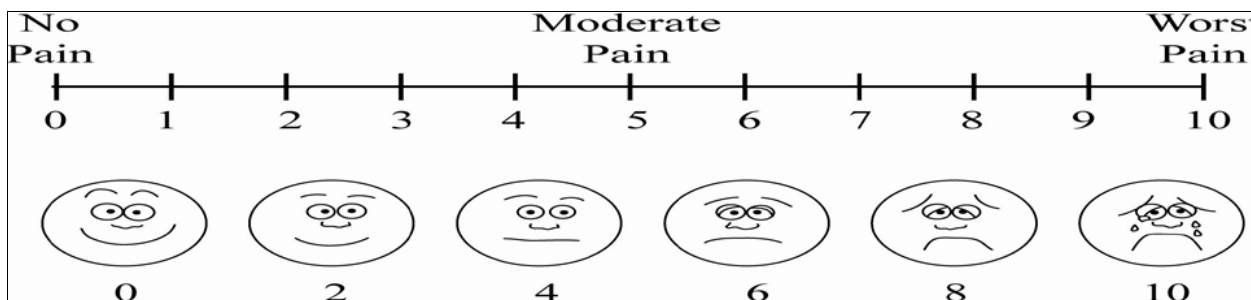


Fig 4: 0, 2,4,6,8 and 10 scores were chosen by the child patients

Statistical analysis

The data collected was analyzed and recorded in preformed per-forma. All the data was then summarized into an excel sheet and analysis was done using SPSS software version 20.0 (IL, CHICAGO, USA). Descriptive data was analyzed using frequency, percentage, mean standard deviation and standard error. Student t was done to analyze and compared continuous variables. The p-value was two tailed and statistically significant at or less than 0.05 values. The data was graphically represented using a bar diagram.

Results

On evaluating the results, of onset of action, the sites with 4% articaine presented positive subjective and objective symptoms within 2.5 minutes of administration of local anesthesia. 7 sites presented positive symptoms within 2.5 minutes, 13 within 3.5 minutes and remaining 5 sites within 4.5 minutes. In case of 2% lignocaine the onset of action

started within 3.5 minutes, with positive 10 sites and remaining 15 sites at 4.5 minutes. Thus, representing the shorter onset of action with sites administered with 4% articaine (Table 2). On comparison within the two groups a statistically significant result was obtained.

When comparing the duration of action among the sites administered with 4% articaine and 2% lignocaine statistically significant results were obtained at an interval of 90 minutes. The shorter duration of action was found with 2% lignocaine, as 12 sites representing fading away of anesthesia within 60 minutes of the administration. (Table 3).

Table 4 represents the pain scores of children obtained after anesthesia (both immediately after administration and after completion of the procedure). Statistically significant result were obtained on comparing pain score with 0 and 2, as maximum number of patients indicated 0 and 2 scores of pain after the administration of the anesthesia.

Table 1: Depicting the descriptive analysis of the study patients

Parameters	Frequency	Percentage	Mean	Sd	Se
Age (year)	3	2	4.680	0.690	0.138
	4	5			
	5	17			
	6	1			
Sex	Male	16	1.360	0.490	0.098
	Female	9			
Tooth number	74-84	17	1.320	0.476	0.095
	75-85	8			
La experience (first visit)	Yes	20	1.200	0.408	0.082
	No	5			

Table 2: Depicting the onset of anesthesia in study patients

Group	Onset of action			
	Frequency/percentage			
	1.5 min	2.5 min	3.5 min	4.5 min
Group 1 (4% articaine)	-	7/28	13/52	5/20
Group b (2% lignocaine)	-	-	10/40	15/60
P-value			<0.000*	<0.000*
Results			Hs	Hs

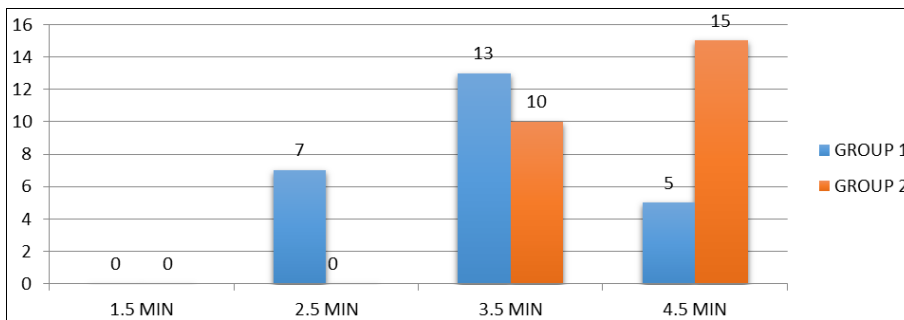


Fig 5: Representing the comparison of onset of action of two groups

Table 3: Depicting the duration of action of anesthesia in study patients

Group	Duration of action			
	Frequency/percentage			
	30 min	45 min	60 min	90 min
Group 1 (4% articaine)	-	-	-	25/100
Group b (2% lignocaine)	-	-	12/48	13/52
P-value	-	-	-	<0.000*
Results				Hs

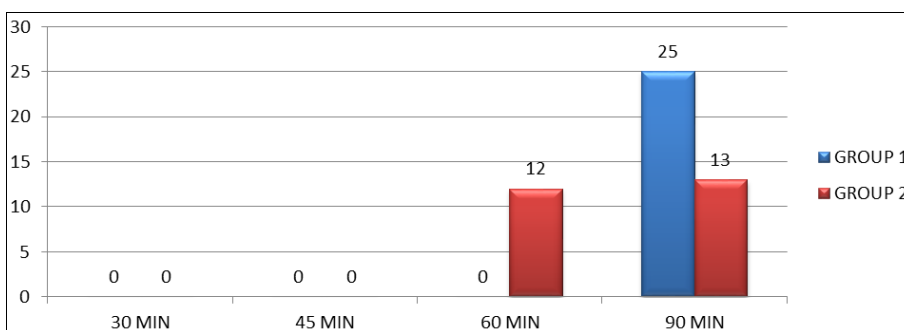


Fig 6: Representing the comparison of duration of action among two groups

Table 4: Depicting the pain score between the two groups

Groups	0	2	4	6	8	10
	Frequency/percentage					
Group 1 (4% articaine)	20/80	5/20	-	-	-	-
Group b (2% lignocaine)	15/60	4/16	1/4	-	-	-
P-value	<0.000*	<0.000*	-	-	-	-
Results	Hs	Hs	-	-	-	-

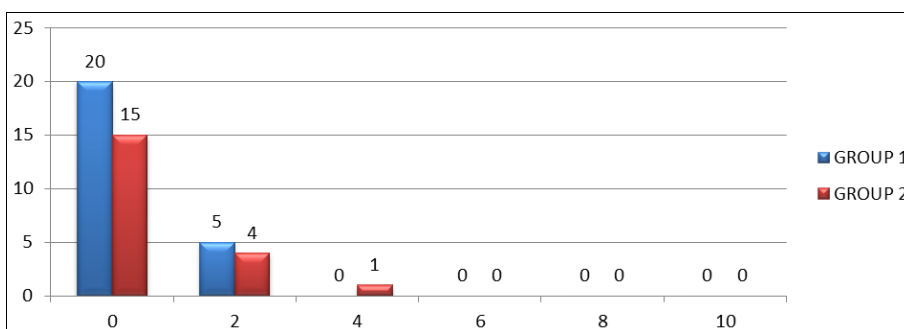


Fig 7: Representing the comparison of pain score among two groups

Discussion

Articaine is amongst the second most commonly used local anesthetic agent in dental practice. It is known for providing a pulpal anesthesia of more than 1 hour and soft tissue anesthesia of 2.25 hours. Articaine is found to be distinctive from other amide local anesthetic due to its unique chemical nature which contains thiopentene ring instead of hexagonal benzene ring. Being the safest of all the anesthetics due to its immediate metabolic rate, it is prone to decreases the risk of

overdosage and systemic toxicity [8]. Literature with evidence has claimed that articaine was found to have no toxic and untoward reactions when injected among 211 pediatric patients [9]. When compared, lignocaine is the most frequently used local anesthetics, which is considered as to be the referral base to evaluate the efficiency of different other local anesthetics. It is known to provide a pulpal anesthesia of 1 hour with soft tissue anesthesia of >3 hours [8]. Various preparations including gel, transdermal patch, sprays are

readily formulated and proposed for use. When a number of local anesthetics agents fail to participate for the comparing standards of local anesthesia. Articaine has been found to be equally or even more efficient than lignocaine since its introduction^[10].

The present study was conducted to evaluate the efficacy of two local anesthetics on pain and comparison was done between the onset and duration of action of anesthesia. Statistically significant results were obtained when 4% articaine and 2% lignocaine were compared. On evaluating the onset of action 4% articaine presented with shortest onset of 2.5 minutes while 2% articaine had an onset of 3.5 minutes. This was in consistent with various studies conducted by a number of authors like Kunal Kumar *et al.*,^[11] Moore *et al.*,^[12] Colombia *et al.*,^[13] Gregoria *et al.*^[14] where they stated that onset of action of 4% articaine was shorter than that of 2% lignocaine.

Duration of anesthesia is directly proportional to the degree of protein binding; nonetheless, the duration is dependent on the injection site and the concentration of vasoconstriction present in the anesthetic solution including other factors. The duration of anesthesia in case of Group 1 was longer than Group 2. The findings of ours study was in consistent with Harveen *et al.* where they concluded that 4% articaine was found to had significantly more duration of action when compared to 2% lignocaine^[15]. In 2005, Costa *et al.*^[16] conducted a similar study where they stated that 4% articaine clinically presented the longest duration of action, which was further conducted by Haas *et al.*^[17] and Vahatalo *et al.*^[18] In another study done to compare the anesthetic efficacy of 4% articaine and 2% lignocaine by Sree Kumar *et al.* concluded that 4% articaine had better duration of action along with anesthetic efficacy^[19].

According to many studies, though articaine is considered as the best and effect alternative to lignocaine, articaine has the potential to cause neuropathies, methemoglobinemia, hypersensitivity, allergy and paresthesia. Malamed *et al.* concluded the overall incidence rates of adverse events in the study for articaine and lignocaine of which 0.7% was hypoesthesia, 0.9% parasthesia, 0.55% headache, 0.3% rash and pain and 0.45% infection.⁵ Thus, many more studies need to be conducted where such relation can be established. Most of the studies conducted between articaine and lignocaine were comparable but statistically insignificant. Articaine was found to have clinically significant differences wherein it was more comfortable to patients with less time of onset larger duration of action, and less bleeding. Hence, proving articaine practically to be more efficient and better anesthetic.

Limitations

Sample size being the main limitation of the study was due less awareness about the importance of deciduous teeth.

Conclusion

Within the limitations it can be concluded that articaine was found to be equally potent as lignocaine and presented with similar properties to lignocaine. Articaine was found to have better acceptability, bone diffusibility and better hemostatic property when compared to lignocaine. A larger group of study population is recommended for authenticity of the study.

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Author's Contribution

Not available

Conflict of Interest

Not available

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Not available

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