Evaluation of Buccal Infiltration with Articaine and Inferior Alveolar Nerve Block with Lignocaine for Pulp Therapy in Mandibular Primary Molars

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***Objective**: Failure of inferior alveolar nerve block in achieving profound anesthesia of the pulp due to various reasons has led to the introduction of more potent local anesthetic agents like articaine. This study was conducted to compare the efficacy of buccal infiltration with articaine in achieving pulpal anesthesia of primary molars as compared to inferior alveolar nerve block with lignocaine. **Study design**: 30 patients (4-8 years) with indication of pulp therapy in at least two mandibular primary molars were selected. Patients were randomly assigned to receive nerve block with lignocaine or infiltration with articaine on first appointment and the other solution on second appointment. All the pulpotomies and pulpectomies were performed by a pediatric dentist. Two researchers standing at a distance of 1.5 m recorded the Pain Scores and Sound, Eye, Motor (SEM) scores. After the completion of procedure, the patient was asked to record the Facial Image score and Heft-Parker Visual Analogue Score (HP-VAS). **Results**: Pain Score recorded at the time of injection showed significantly more movements with block as compared to infiltration ($p<0.001$). SEM scores at time of pulp extirpation were also higher for block than infiltration ($p<0.001$). **Conclusion**: Articaine infiltration has the potential to replace inferior alveolar nerve block for primary mandibular molars.*

***Key words:** articaine, buccal infiltration, primary molars*

INTRODUCTION

Painless dentistry is the key towards successful management of children and the role of local anesthesia cannot be overemphasized. Inferior alveolar nerve block (IANB) remains the mainstay in achieving anesthesia for mandibular primary molars. However, failure of IANB to achieve anesthesia of pulp has been reported to be approximately 10%[1,2]. Various reasons have been cited which include improper injection technique by the operator, collateral nerve supply of teeth and variations in the position of nerves[1]. This necessitates the use of supplemental intrapulpal injection to achieve profound anesthesia of the pulp, thus making the experience more painful for the patient. Moreover, use of multiple injections can be a major source of anxiety for a pediatric patient leading to a negative behavior of the child.

Recent evidence has shown that buccal infiltration with articaine can achieve pulpal anesthesia similar to that achieved by IANB[3,4]. Articaine is considered a unique local anesthetic agent because it has both amide and ester group in its structure due to which it is rapidly metabolized. Also, it contains thiophene ring instead of benzene ring which increases its absorption through the hard and soft tissues[5].

Due to these reasons, it has been suggested that articaine infiltration has the potential to replace IANB. Thus this study was conducted to assess the efficacy of buccal infiltration with articaine in achieving anesthesia for pulp therapy in mandibular primary molars as compared to IANB with lignocaine.

MATERIALS AND METHOD

A pilot study on ten patients was initially conducted wherein the over-all average standard deviation in pain scores for lignocaine and articaine was found to be 8.36 and 5.62 respectively and the mean difference in pain score was 4.733. On the basis of these values, the sample size at confidence level 99% was calculated to be 30 per group.

Thirty patients in the age group of 4-8 years were selected from the Out Patient Department of Sri Govind Tricentenary (SGT) Dental

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College, Hospital & Research Institute, Gurgaon which is located in rural area of North India. Selection criteria for the patients included Frankl's behavior rating III and IV, indication of pulp therapy in at least two mandibular primary molars, absence of soft tissue lesion at the site of injection and no history of allergy to local anesthetic solutions. Informed consent from the parents was obtained before recruiting the patients for the study.

Approval to conduct this study was obtained from Institutional ethical clearance committee of SGT Dental College, Hospital & Research Institute, Gurgaon, India.

A crossover design was used for this study wherein both the injection techniques were used in the same patient for pulp therapy of two different teeth over two appointments spaced one week apart. Patients with Frankl's behavior rating III and IV were selected who did not require any additional sedation. Patients were randomly assigned to receive IANB with lignocaine or infiltration with articaine on the first appointment and the other solution on the second appointment. Benzocaine gel was applied at the site of injection. A single researcher injected the local anesthetic for all the patients. 2ml disposable syringes with 27 gauge needle were used to deliver the injections after loading with the corresponding amount of local anesthetic agent. 1.8 ml of 2 % lignocaine hydrochloride with 1: 80,000 adrenaline solution (Xicaine, ICPA) was used to administer IANB while 0.8 ml of 4 % articaine hydrochloride with 1: 200,000 epinephrine (Septicaine, Septodont) was used for buccal infiltration. All the teeth were selected primarily for pulpotomy, but after removal of coronal pulp, 14 of the teeth were treated with pulpectomy because hemorrhage could not be controlled. The pulp therapy procedures for every patient were performed by the same operator on both the appointments.

Two researchers standing at a distance of 1.5 m recorded the Pain Scores and SEM (Sound, Eye, Motor) scores. The second observer was used for calibration of the scores and the values recorded by first observer were used for statistical analysis. The Pain score given by Ram & Peretz[6] (Table 2) was used to assess the pain during injection and SEM score[7] (Table 1) was used to assess the pain during access opening & pulp extirpation. After the completion of the procedure, the patients self-assessed their experience by recording Facial Image (FI) score (Figure 1) and Heft-Parker Visual Analogue Score (HP-VAS) (Figure 2). Blinding could not be done for this study as both the injection techniques were different and identifiable.

The data were compiled and subjected to statistical analysis using SPSS version 16.0. Comparisons between both the techniques were made using Mann-Whitney U test. Differences at $P< 0.05$ were considered statistically significant. Inter-examiner agreement of data was evaluated using this formula for the calculation of kappa value.

Kappa= O-E/ 1-E

where O is the percentage of agreement actually observed and E is the percentage of agreement expected by chance.

For SEM score, inter-examiner agreement was calculated to be 0.806.

RESULTS

30 patients (12 male, 18 female) were included in the study with an average age of 5.41±1.40 years (range 4-8 years).

Evaluation of pain on injection

The various parameters for Pain score are shown in Table 2. The scores for eye squeezing ($p< 0.001$), hand movement ($p<0.001$)

Figure 1: Facial Image Score

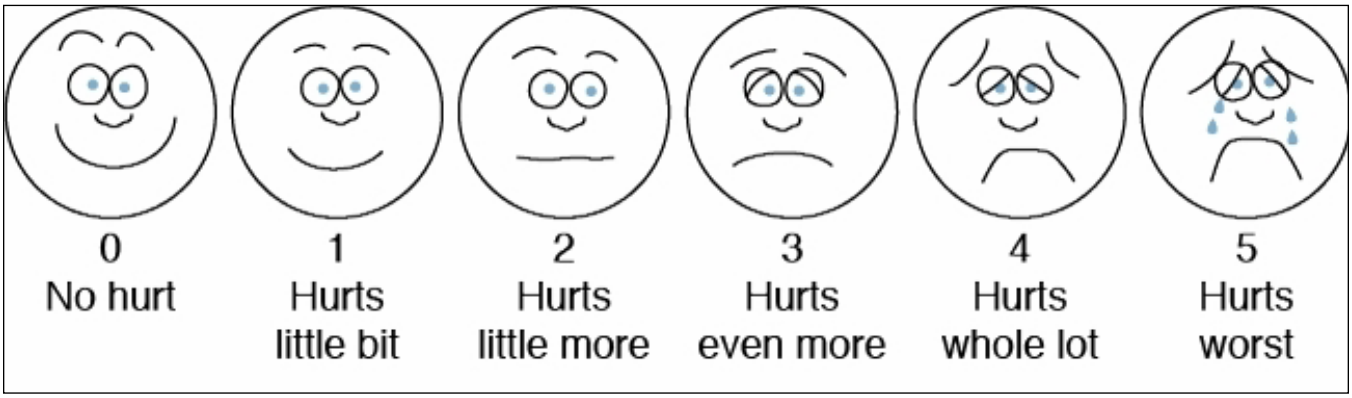

Figure 2: HP-VAS Score

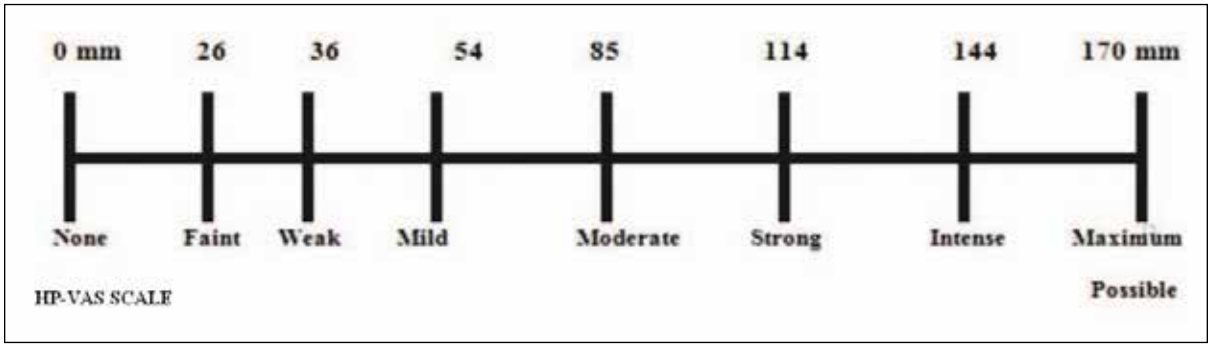

Table 1: SEM scoring criteria

Parameter	Comfort	Mild discomfort	Moderate discomfort	Severe Discomfort
Grade	1	2	3	4
Sound	No sound	Non specific sound (probable pain)	Verbal complaint, louder sound	Verbal complaint, shouting, crying
Eye	No sign	Dilated eye without tear (anxiety sign)	Tears, sudden eye movements	Crying, tears all over the face
Motor	Relaxed body & hand status	Muscular contraction, contraction of hands	Sudden body & hand movements	Hand movements for defence, turning the head to the opposite side

Table 2: Pain related reactions to the local anaesthetic techniques

	IANB Lignocaine	Infiltration Articaine	Chi-square statistic
Eye Squeezing	21	4	p<0.001**
Hand Movement	13	1	p<0.001**
Torso Movement	3	0	p>0.05
Leg Movement	6	0	P<0.05*
Crying	6	1	p>0.05

*Significant **Highly significant

& leg movement ($p<0.05$) were significantly higher during IANB administration as compared to infiltration while the differences in the scores for torso movement & crying were not statistically significant. Thus the pain-related behavior scores were higher for IANB as compared to infiltration.

Evaluation of pain during pulp extirpation

Statistical analysis for SEM scores was performed using ANOVA followed by the calculation of Mann Whitney U value. Table 3 shows the age & sex-wise mean values for SEM scores. The results showed that the scores were significantly higher for IANB as compared to infiltration for both the sexes and age groups, thus implying failure of IANB to achieve adequate pulp anesthesia in some cases. Table 4 shows the SEM scores for both pulpotomy and pulpectomy. The SEM scores were higher for lignocaine for both types of procedures.

Evaluation of overall experience of the patient

Table 5 and 6 show the mean values obtained for Facial image and HP-VAS scores, respectively. The Mann Whitney test results showed that both the scores were higher for lignocaine IANB group as compared to the articaine infiltration suggesting better overall experience of the patients with articaine infiltration.

DISCUSSION

Inferior alveolar nerve block (IANB) is the most commonly used regional anesthesia technique for pulp therapy of primary mandibular molars, but it is frequently associated with failure (10%) to obtain adequate pulp anaesthesia[1,2]. The most common reason for failure is improper technique of injection especially in children where the position of mandibular foramen varies for different age groups[8].

Various alternatives for IANB have been suggested. Mandibular nerve block using Gow-Gates technique and Akinosi technique have been used but they have been found to be technically more difficult and associated with various complications like hematoma and post-injection trismus[1].

Another means of achieving proper anesthesia is the use of supplemental injections like intraosseous, intraligamentary and intrapulpal injections. But these injections have been found to be painful and also administration of multiple injections can compromise the behavior of young children.

Computerized local anesthesia has been suggested to reduce the pain on injection because of the controlled delivery of the drug. Although many studies have reported better behavior of the children with this system[9-12], but some studies show that pain related responses are dependent on the site of injection[11, 13]. Thus the reduction in pain using WAND is more significant for palatal infiltration and intraligamentary injections as compared to buccal infiltrations and mandibular blocks.

To obtain improved pulpal anesthesia, a new concept of Single Tooth Anesthesia (STA) using dynamic pressure sensing technology has been recently introduced which shows promise for achieving profound anesthesia of pulp with minimal pain, but research is still very limited to prove its efficacy[14].

Recent evidence has shown that infiltration with articaine can be an effective measure to obtain anesthesia for mandibular molars. Jung *et al* (2008) found buccal infiltration with articaine to have faster onset and similar efficacy when compared to IANB with articaine[4]. On comparing articaine with lignocaine, it has been found that IANB with lignocaine and articaine have similar efficacy while infiltration with articaine achieves better anesthesia than lignocaine infiltration[15,16]. On comparing 6 different LA agents, Abdulwahab *et al* (2009) found that articaine was the only one which had better pulpal anesthesia than lignocaine after mandibular infiltration[17]. On the other hand mandibular infiltration with lignocaine was found to be effective but not reliable for pulpotomy in a primary molar by Qulis *et al* (1996)[18].

In the present study, failure to obtain adequate pulpal anesthesia after IANB was observed in 6/30 patients and their corresponding SEM scores were more than 6. These patients required additional intrapulpal injections to complete the procedure. This led to higher

Table 3: SEM scores for the two groups

	Males (N=12)		Females (N=18)		Age gp. 4-5 years (N=17)		Age gp. 6-8 years (N=13)		Total (N=30)
	Mean Score	Mann-Whitney statistic	Mean Score	Mann-Whitney statistic	Mean Score	Mann-Whitney statistic	Mean Score	Mann-Whitney statistic	Mann-Whitney statistic
IANB lignocaine	5.00	P<0.01**	5.28	P<0.001**	5.53	P<0.001	4.69	P<0.05*	P<0.001**
Infiltration Articaine	3.25		3.17		3.00		3.23		

*Significant **Highly significant

Table 4: SEM scores for different pulp therapies

	Pulpectomy			Pulpotomy		
	N	Mean score	Mann-Whitney statistic	N	Mean score	Mann-Whitney statistic
IANB lignocaine	6	5.33	P<0.05*	24	5.12	P<0.001**
Infiltration articaine	8	3.38		22	3.00	

*Significant ** Highly significant

Table 5: Facial Image scores for both groups

	Males (N=12)		Females (N=18)		Age gp. 4-5 years (N=17)		Age gp. 6-8 years (N=13)		Total (N=30)
	Mean Score	Mann-Whitney statistic	Mean Score	Mann-Whitney statistic	Mean Score	Mann-Whitney statistic	Mean Score	Mann-Whitney statistic	Mann-Whitney statistic
IANB lignocaine	1.17	P<0.01**	1.06	P<0.01**	5.53	P<0.001**	1.12	P<0.01**	P<0.001**
Infiltration Articaine	0.17		0.22		3.00		0.12		

**Highly significant

Table 6: HP-VAS scores for both the groups

	Males (N=12)		Females (N=18)		Age gp. 4-5 years (N=17)		Age gp. 6-8 years (N=13)		Total (N=30)
	Mean Score	Mann-Whitney statistic	Mean Score	Mann-Whitney statistic	Mean Score	Mann-Whitney statistic	Mean Score	Mann-Whitney statistic	Mann-Whitney statistic
IANB lignocaine	26.50	P<0.01**	18.50	P<0.01**	19.12	P<0.001**	25.08	P<0.05*	P<0.001**
Infiltration Articaine	6.83		3.28		1.35		9.08		

*Significant ** Highly significant

value of SEM scores observed for IANB. In a similar study done by Corbett *et al* (2008) for permanent mandibular molars, articaine infiltration was found to be as effective as lignocaine IANB for pulpal anesthesia[3]. Yilmaz *et al* on the other hand, found mandibular nerve block to be more effective as compared to maxillary infiltration for pulpotomy of primary molars using articaine and prilocaine[19].

Nerve block has been shown to be more painful than local infiltration in previous studies due to higher volume and duration of injection[20]. In our study, pain on IANB was significantly more than infiltration as is evident from eye squeezing and muscular contractions during both the injections.

HP VAS and facial image scores were poorer for IANB as compared to infiltration which could be explained by the combination of various factors like initial pain on injection, failure to achieve pulpal anesthesia and requirement of additional intrapulpal injections.

Thus infiltration with articaine was better tolerated by children as compared to IANB with lignocaine. Additional benefits with infiltration as suggested by Leith *et al* are elimination of inferior alveolar and lingual nerve damage. Also infiltration would be beneficial for children with special healthcare needs like those with coagulation disorders where infiltration can be given without the need of replacement therapy[5].

Although there have been concerns regarding the mental nerve paresthesia caused by articaine infiltration[21,22], Yapp *et al* (2011) after reviewing the literature concluded that a clear causal relationship had not been established between anesthetic agents and neurological complications, such as paraesthesia[23]. A recent

histological analysis done on rats following injections with articaine and lignocaine in anterior portion of mental nerve showed that articaine was not toxic to nervous structure and further studies were required to explain possible relation between articaine injection and parasthesia[24]. In our study, no side effects were observed with articaine except for the prolonged soft tissue anesthesia which lasted for as long as 2-4 hours. Long-term numbness with articaine has been reported by Adewumi *et al* who found the incidence of prolonged numbness to be 40% at 3 hours and 11% at 5 hours. The incidence of soft tissue injuries was 20% with the highest among 3-7 years age group[25]. Thus the clinicians should advise patients and their caregivers regarding behavioral precautions and the possibility of soft tissue trauma while anesthesia persists. Apart from this adverse effect, studies have shown that articaine is safe to be used in children but for age group < 4 years for whom data is still insufficient to advocate its use[26].

CONCLUSION

1. Buccal infiltration with articaine was better tolerated by children than IANB
2. Articaine infiltration provided a more predictive pulpal anesthesia as compared to lignocaine IANB in mandibular primary molars.
3. Even with infiltration, articaine showed prolonged numbness of lip, so the parents need to be cautioned.

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