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Efficacy of Articaine Infiltration Versus Inferior Alveolar Nerve Block Anesthesia for Primary Mandibular Second Molars Pulpotomy

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Abstract:
Aim of the study:*evaluation of efficacy of buccal infiltration anesthesia using 4% articaine compared to inferior alveolar nerve block using mepivacaine Hcl 2% in mandibular primary second molar pulpotomy regarding pain and behavior management.*
Method:*Fifty patients aged 7-9 years old,who needed pulpotomy for both mandibular 2nd primary molars were selected from the Pediatric Dental Clinic, Faculty of dentistry, Mansoura University. Eachchild chose an envelope from previously prepared 50 envelopes to be assigned for articaine buccal infiltration or mepivacaine using inferior alveolar nerve block technique (IANB) in the 1st visit. Also children chose an envelope to determine whether to begin with the right or left 2nd primary molar.Pain scores were recorded using Modified Behavioral Pain Scale (MBPS).Visual Analogue Score (VAS) was used for pain self-assessment. The cooperative behavior was evaluated twice at each visit using Frankl's scale. Any adverse events after dental treatment were recorded. The data were collected, tabulated and statistically analyzed.*
Results: *No significant difference in pain scores between articaine buccal infiltration and mepivacaine inferior alveolar nerve block during pulpotomy using Modified Behavioral pain scale although patients reported less pain with articaine buccal infiltration using Visual Analogue Scale. There was a better cooperation of the child when articaine infiltration was used. No major adverse events were reported in either of the techniques. Eight patients reported self-inflicted trauma after inferior alveolar nerve block anesthesia.*
Conclusion: *Buccal infiltration anesthesia of 4% articaine has a comparable anesthetic outcome to 2% mepivacaine inferior alveolar nerve block in pulpotomy treatment of the 2nd mandibular primary molars.*
Key Word*: articaine; infiltration; mepivacine; nerve block.*

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I. Introduction

One of the most common challenges in pediatric dentistry is pain control. So, achieving successful anesthesia is very important as the child can easily withdraw cooperation at any sensation of pain or discomfort.Local anesthesia during dental treatment can be achieved by infiltration or nerve block injection. Infiltration technique is much simpler with less complications, but it provides only a small field of operation. Nerve block anesthesia like inferior alveolar nerve block provides anesthesia for larger field, but requires increased depth of penetration and may cause some adverse events like hematoma, nerve damage and needle breakage.(1) Furthermore, inferior alveolar nerve block anesthesia is even more difficult when faced with an uncooperative patient.11`(2)Mepivacaine is one of the most commonly used local anesthetic agents in dentistry. It's an amide type local anesthesia. Successful anesthesia for lower molars with mepivacaine is achieved by blocking inferior alveolar nerve. The dense cortical bone of the mandible makes it difficult for mepivacaine to reach terminal nerve endings, so it's not used in infiltration.Articaine is also an amide local anesthetic agent with a unique chemical structure. Articaine contains a thiophene ring which makes it more potent and more lipid-soluble, thereby diffusing more readily through both hard and soft tissues Articaine has a high affinity for plasma protein binding and contains an ester group. This allows it to be rapidly broken down into its inactive state in two ways; in the liver and the blood serum, thus decreasing systemic toxicity. The increased diffusion potential and potency permits the use of articaine via infiltration technique in mandibular molar area.(3) Since the search for safer ways to deliver local anesthesia to pediatric patients is continuous, there is a need for a well- designed

clinical trials assessing the effectiveness of infiltration anesthesia using articaine for primary mandibular molars in comparison to established inferior alveolar nerve block with mepivacaine.

II. Material And Method

Approval: This study was approved by Ethical Committee of the Faculty of Dentistry, Mansoura university and got code no. M15070519. Agreement for participation in the study and for recording a video during treatment was obtained from the parents in a written consent form

Inclusion criteria for the selected children:

- Age of the patient 7-9years.
- Both lower second primary molars of each patient are indicated for pulpotomy.
- No evidence of soft tissue infection or inflammation near the area ofinjection at depth of sulcus opposite second molars.
- No history of allergy to localanesthesia.
- Free medicalhistory

Sample Size calculation:

Using the following formula, the study's projected sample size should be 28 participants at a 5% level of significance and an 80% power of the study.

$$N= (Z1-_{\alpha/2}+Z1-_{\beta})^{2} * \sigma_1 * \sigma_2 *2 / \delta^{2}$$

$$Z1-_{\alpha/2 =1.96,}\ Z1-_{\beta=0.842}$$

$$\sigma_1=1.73,\ \sigma_2 =1.47$$

Mean pain score among articaine group =6.35
Mean pain score among Mepivacaine nerve block anesthesia =5.52
δ = Expected difference to be detected (0.83)
α = Level of acceptability of a false positive result (level of significance=0.05)
β = Level of acceptability of a false negative result (0.02), 1- β= power (0.80)
To account for missing data and boost the study's power, the actual sample size was expanded to **50 participants.**

pain assessment:

1. **Visual analogue scale (VAS):** This scale is used to rate the intensity of pain by the patient. It's a straight line with one end meaning no pain and the other one means the highest pain. Thepatientmarksa pointthatdescribesthepainheor shefelt [(4)]
2. **Modified behavioral pain scale suggested by Taddio (MBPS):** [(5)]This scale is used for objective evaluation and scoring the behavior of the patient including facial expressions, movement, and crying as shown in table (1).
3. **Frankl's behavioral rating scale:** [(6)]One of the most used scales for evaluation of the co-operative behavior of the child during dental treatment. It classifies the child's behavior into four categories rating the behavior from definitively negative to definitively positive which is assigned by the operator during dental treatment

Examiner calibration:

- A video was recorded during the pulpotomy procedure to record the scores of pain for ten patients.
- The researcher wrote down scores of pain using MBPS after watching the videos.
- The researcher watched the videos again after one week and recorded the pain scores again
- Interclass correlation coefficient was used to measure intra-examiner reliability. It was 79% for facial expression, 100 % for crying, and 89% for body movement which showed non-significant difference between the two scores.

Table (1): Pain levels according to MBPS

Parameter	**Finding**	**Points**
Facial expression	Definitive positive expression (smiling)	0
	Neutral expression	1
	Slightly negative expression	2
	Definite negative expression(furrowed eye browse, eyes closed tightly)	3
Cry	Laughing or giggling	0
	Not crying	1
	Moaning quietly, vocalizing gentle or whimpering cry	2
	Full crying or sobbing	3
	Full crying more than baseline cry (scored only if child was crying at baseline)	4
Movement	Usual movements and activity	0
	Resting and relaxed	0
	Partial movement (squinting arching limb, tensing, clenching)	2
	Attempt to avoid pain by withdrawing the limb where puncture is done	2
	Agitation with complex generalized movements involving the head, torso or other limbs	3
	Rigidity	3

Methodology:

- Each patient included in the clinical trial was assigned to receive articaine buccal infiltration or mepivacaine inferior alveolar nerve block anesthesia in the first visit by choosing an envelope from previously prepared 50 envelopes. Also randomization was done for determining whether to start with right or left side.
- Psychological management of the child before starting the dental procedure was considered.
- Mucosa at the site of injection was dried and the 20% benzocaine topical gel was applied for one minute.
- In case of infiltration with articaine, the researcher injected anesthesia in the depth of mucobuccal fold opposite the lower second molar in between the two roots**.** Injection was done using a short needle 30 gauge.The bevel was directed toward the bone with the needle making 45◦ angle with the buccal aspect of the jaw.The needle was inserted into the soft tissue until the bone was touched (within 2mm) then, 1.5 ml of anesthesia was deposited slowly over 30 seconds.
- Inferior alveolar nerve block anesthesia was performed using the usual technique after application of benzocaine topical anesthesia gel for one minute. The thumb was placed on the occlusal surface of the molars with the ball resting in the retromolar fossa and the tip resting on the internal oblique ridge. placing the middle finger's ball on the mandibular posterior border to support the mandible during injection. Between the two main molars on the opposing side, the researcher pointed the syringe's barrel. A small amount of anaesthetic was injected while the needle was penetrating the skin, and it was then slowly advanced until it reached the bone.
- Application of rubber dam was done. Pulpotomy procedure started 7 min. after block anesthesia and 10 minutes after articaine infiltration.
- A video was recorded during the pulpotomy procedure to record the scores of pain during the two steps of the procedure, caries removal till pulp exposure and pulp amputation. Pain was evaluated using modified behavioral pain scale (MBRS) as in table (1).
- The tooth was restored using amalgam or st.st crown.
- After the dental procedure, the patient was asked to self-assess his experience during the pulpotomy procedure using the visual analoguescale.
- The examiner rated the cooperative behavior of the patient using Flankl's scale at two points. Once, at the beginning of the visit before anesthetic injection and then, during the pulpotomy procedure.
- The parents were advised and asked to watch the patient for any adverse events to be reported the next visit
- Also, the participants were divided into two groups to evaluate each patient's cooperative behavior change between the two treatment visits. Group A included the patients who received articaine infiltration at the first visit. Group B included the patients who received mepivacaine (IANB) in the

first visit.

- In case of failure of anesthesia and the patient is suffering from pain, supplemental or additional anesthesia was given to complete the procedure, but the case was dropped out of the study.

III. Results

As shown in table (2), there was no statistically significant difference between Mepivacaine and Articaine groups regarding modified behavioral pain scale score during caries removal p value > 0.05. Mean facial expression score was 1.88±0.65 with median score =2, ranged from 1 to 3 as compared to 1.80±0.57 with median score 2, ranged from 1 to 3 among Mepivacaine and Articaine groups, respectively. Mean cry score was 1.16±0.43 with median score =1, ranged from 1 to 2 among Mepivacaine group as compared to 1.16±0.37 with median score =1, ranged from 1 to 2 among articaine group. Mean movement score was 1.20±0.98 with median score =2, ranged from 0 to 2 among Mepivacaine group as compared to 1.16±0.99 with median score =2, ranged from 0 to 2 in articaine group.

Table (2): Modified behavioral pain scale score during caries removal among Mepivacaine and Articaine groups.

MBPS at pulp exposure	Mepivacaine group (n=50)	Articaine group(n=50)	Test of significance	p value
Facial expression				
Mean ± SD	1.88±0.65	1.80±0.57	t=0.649	0.518
Median	2.0	2.0		
Min-Max	1.0-3.0	1.0-3.0		
Cry				
Mean ± SD	1.16±0.437	1.16±0.37	t=0.0	1.0
Median	1.0	1.0		
Min-Max	1.0-2.0	1.0-2.0		
Movement				
Mean ± SD	1.20±0.98	1.16±0.99	t=0.201	0.841
Median	2.0	2.0		
Min-Max	0.0-2.0	0.0-2.0		
Total				
Mean ± SD	4.24±1.7	4.12±01.58	t=0.364	0.717
Median	5.0	5.0		
Min-Max	2.0-7.0	2.0-7.0		

The study showed no statistically significant difference between Mepivacaine and Articaine groups regarding modified behavioral pain scale score during pulp amputation, p value > 0.05. Mean facial expression score was 1.64±0.72 with median score =1.5, ranged from 1 to 3 as compared to 1.54±0.61 with median score 1, ranged from 1 to 3 among Mepivacaine and Articaine groups, respectively. Mean cry score was 1.12with median score =1.0, ranged from 1 to 2 as compared to 1.08±0.27 with median score 1, ranged from 1 to 2 among Mepivacaine and Articaine groups, respectively. Mean movement score was 0.86±0.98 with median score =0.0, ranged from 0 to 2 among Mepivacaine group as compared to 0.76±0.98 with median score =0.0, ranged from 0 to 2 among articaine as presented intable (3).

Table (3): Modified behavioral pain scale score suggested during pulp amputation among Mepivacaine and Articaine groups

MBPS at pulp amputation	Mepivacaine group (n=50)	Articaine group(n=50)	Test of significance	p value
Facial expression				
Mean ± SD	1.64±0.72	1.54±0.61	t=0.747	0.457
Median	1.5	1.0		
Min-Max	1.0-3.0	1.0-3.0		
Cry				
Mean ± SD	1.12±0.32	1.08±0.27	t=0.661	0.510
Median	1.0	1.0		
Min-Max	1.0-2.0	1.0-2.0		
Movement				
Mean ± SD	0.86±0.98	0.76±0.98	t=0.507	0.613
Median	0.0	0.0		
Min-Max	0.0-2.0	0.0-2.0		
Total				
Mean ± SD	3.62±1.77	3.38±1.49	t=0.732	0.466
Median	3.0	3.0		
Min-Max	2.0-7.0	2.0-7.0		

Significant high mean VAS was observed among Mepivacaine group; 3.78±1.11 as compared to 3.18±1.08 among Mepivacaine and Articaine groups, respectively p value ≤ 0.05 as shown in table (4).

Table (4): Patient's self-assessment after procedure using (VAS) among Mepivacaine and Articaine groups

VAS	Mepivacaine group (n=50)	Articaine group(n=50)	Test of significance	p value
Mean ± SD **Median** **Min-Max**	3.78±1.11 4.0 2.0-6.0	3.18±1.08 3.0 2.0-5.0	t=2.73	**0.007***

Frankl's behavioral score was significantly improved in the second visit in group A. Mean behavioral score was 3.76±0.52 as compared to 3.20±0.57 in the second and first visits, respectively. On the other hand, the improvement observed in group (B) was insignificant as it's revealed in table (5).

Table (5): Comparison between group A and group B regarding Frankle's behavioral score

	Group A (n=25)	Group B (n=25)
1st visit	Articaine (BI)	Mepivacaine (IANB)
Mean ± SD **Median** **Min-Max**	3.20±0.57 3.0 2.0-4.0	3.28±0.45 3.0 3.0-4.0
2nd visit	Mepivacaine (IANB)	Articiane (BI)
Mean ± SD **Median** **Min-Max**	3.76±0.52 4.0 2.0-4.0	3.44±0.65 4.0 2.0-4.0
Paired t test **P vale**	t=4.3 P≤0.001*	t=1.07 P=0.294
Same **Decreased** **Increased**	7 (28.0%) 2 (8.0%) 16 (64%)	11 (44.0%) 5 (20.0%) 9 (36.0%)

Frankl's score was statistically significantly higher in Articaine group. The mean score was 3.50± 0.54 as compared to 3.18±0.69 in Articaine and Mepivacaine groups, respectively. P value ≤ 0.05 as observed in table (6)

Table (6): Frankl's behavioral scores in Mepivacaine and Articaine groups during the procedure

Frankl's scores	Mepivacaine group (n=50)	Articaine group(n=50)	Test of significance	p value
Mean ± SD **Median** **Min-Max**	3.18±0.69 3.0 2.0-4.0	3.50± 0.54 4.0 2.0-4.0	t=2.57	0.012*

Two patients felt pain after block anesthesia and three patients felt pain after articaine infiltration so, adjunctive intra pulpal local anesthetic injection was done and pulpotomy was completed. Then, these cases were excluded from the study.No major adverse events like syncope, nausea or vomiting were recorded in our study in both groups. Only four patients reported lip biting after mepivacaine (IANB) and one patient after articaine (BI).

IV. Discussion

Pain control is a must in pediatric dentistry as if the child feels pain, the dentist will lose control and co-operation with the child. The most common techniques of local anesthesia in children are IANB and infiltration anesthesia. It's known that infiltration technique is much easier with less pain, but there are doubts about its effectiveness during pulpotomy in mandibular molars. Articaine local anesthesia has the advantage of high penetration capability due to presence of thiophene ring in its chemical structure, so it achieves rapid onset

and more effectiveness compared to other local anesthetic agents. So, in this study we tested the effectiveness of articaine infiltration anesthesia in pulpotomy treatment of the second mandibular primary molar. [3]

This study showed no significant difference in pain sensation between the two groups at pulp exposure and during pulp amputation. This is consistent with the study of Corbett et al. that found no significant difference between articaine infiltration anaesthesia and mepivacaine nerve block, but the later study was performed on 1st permanent molar.[7]

The results also come in agreement with Wright GZ et al. who conducted a study that compared the efficacy of three different local anesthetics using infiltration technique in primary molars. This study compared meivacaine , articaine and lidocaine infiltration for restorative procedures and found no significant difference between the three different agents.[8]

In consistent with our study, Areethmsirkul et al. reported no significant difference in pain scores between buccal infiltration using articaine and IANB using lidocaine during pulpotomy of lower primary molars. This study was conducted on 1st and 2nd primary molars and used sound, eye, motor scale (SEM) for behavioral assessment and faces pain scale for self-assessment. [9]

Moreover, a higher success rate of articaine infiltration was reported by Chopra et al. when compared it with lidocaine IANB in pulp therapy of bilateral primary molars in children of age 4-8 years old. Pain scores was assessed by SEM scale and self-assessment was done by Heft Parker Visual analogue score. This different results may be justified by different children age and different pain scales. [10]

A contradicting result to our study was reported by Daneshvar et al. who compared articaine infiltration and lidocaine IANB in 2nd primary molar pulpotomy. This may be justified by the different comparator as mepivacaine was used instead of lidocaine in our study. Mepivacaine has higher efficacy in inflamed pulp. Also, difference in patient's age and pain scales may affect the results. [11]

Also, Oulis et al. reported higher success rate for IANB than buccal infiltration in primary molars, but the difference in results may be explained by the different study designs as they compared three different anesthetic agents articaine, lidocaine and mepivacaine in both block and infiltration techniques. The pain scores were recorded in different restorative procedures including amalgam restoration, st.st crowns, pulpotomies and extractions. [12]

In this study, the child reported less pain felt using VAS when articaine infiltration was used. This is in agreement with the study of Arce A. which showed less pain reported by the patient using Wong baker faces scale when compared articaine infiltration and lidocaine IANB in restorative care or 1st permanent molar.[13]

No major adverse events like syncope, nausea or vomiting were recorded in our study in both groups. Only four patients reported lip biting after mepivacaine (IANB) and one patient after articaine (BI). This may be explained by the longer duration of numbness felt in case of IANB injection. [14]

This study showed better cooperation of the child during the pulpotomy procedure when using articaine infiltration. Also, there was an enhanced behavior in the second visit in group A where the articaine infiltration was used in the first visit.

This comes in agreement with the study done by Jain K. et al. which compared the efficacy of 4% articaine infiltration and lidocaine IANB for extraction of primary molars. This study showed higher cooperative behavior scores of the child after articaine infiltration.[15]Also, our study is in agreement with the study of Abdellatif AM that related a higher cooperation of the child to the less pain felt during injection when compared the direct and indirect methods of palatal injection for the upper 2nd primary molar extraction. [16]

V. Conclusion

Articaine infiltration local anesthesia is as effective as mepivacaine IANB in pulpotomy treatment of lower primary second molar.The pediatric patient felt less pain when articaine infiltration was used.The patients showed higher cooperation level after articaine infiltration experience

References

[1]. Pogrel MA. Broken local anesthetic needles: a case series of 16 patients, with recommendations. The Journal of the American Dental Association. 2009 Dec 1;140(12):1517-22.
[2]. Council on Clinical Affairs, American Academy of Pediatric Dentistry. Guideline on Use of Local Anesthesia for Pediatric Dental Patients. Pediatr Dent. 2015 Sep-Oct;37(5):71-7.
[3]. Martin E, Nimmo A, Lee A, Jennings E. Articaine in dentistry: an overview of the evidence and meta-analysis of the latest randomised controlled trials on articaine safety and efficacy compared to lidocaine for routine dental treatment. BDJ open. 2021 Jul 17;7(1):27.
[4]. Langley GB, Sheppeard H. The visual analogue scale: its use in pain measurement. Rheumatology international. 1985 Jul;5(4):145-8.
[5]. Taddio A, Nulman I, Koren BS, Stevens B, Koren G. A revised measure of acute pain in infants. Journal of pain and symptom management. 1995 Aug 1;10(6):456-63.
[6]. Lakhani B, Indushekar KR, Garg S, Singh N, Tomer E. Behavior assessment using frankl rating scale and identification of personality in pediatric dental operatory. Journal of Child and Adolescent Behavior. 2017 Sep 10;5(5):1-5.

[7]. Corbett IP, Kanaa MD, Whitworth JM, Meechan JG. Articaine infiltration for anesthesia of mandibular first molars. Journal of Endodontics. 2008 May 1;34(5):514-8.
[8]. Wright GZ, Weinberger SJ, Marti R, Plotzke O. The effectiveness of infiltration anesthesia in the mandibular primary molar region. Pediatric dentistry. 1991 Sep 1;13(5):278-83.
[9]. Areethamsirkul A, Nakornchai S, Apipan B. Efficacy of Articaine Infiltration for Pulp Treatment in Mandibular Primary Molars: A Randomized Split-mouth Clinical Trial. J DENT ASSOC THAI. 2019 Jul;69(3):362.
[10]. Chopra R, Marwaha M, Bansal K, Mittal M. Evaluation of buccal infiltration with articaine and inferior alveolar nerve block with lignocaine for pulp therapy in mandibular primary molars. Journal of Clinical Pediatric Dentistry. 2016;40(4):301-5.
[11]. Daneshvar SH, Dorani D, Daneshvar MM. Comparison of anaesthetic efficacy of 4% articaine buccal infiltration versus 2% lidocaine inferior alveolar nerve block for pulpotomy in mandibular primary second molars. Journal of the Indian Society of Pedodontics and Preventive Dentistry. 2021;39(3):299-302.
[12]. Oulis CJ, Vadiakas GP, Vasilopoulou A. The effectiveness of mandibular infiltration compared to mandibular block anesthesia in treating primary molars in children. Pediatric dentistry. 1996 Jul 1;18:301-5.
[13]. Arce AM. *Articaine Local Infiltration Vs Lidocaine IANB for Restoration of First Permanent Molars in Children* (Doctoral dissertation, University of Illinois at Chicago).
[14]. Minu MO, Ajay RH, Bhat SS, Sargod S, Riyas AK, Suvarna RM, Shabbir A, Hegde N. Comparison of the Local Anaesthetic Effect of 4% Articaine and 2% Lidocaine Administered Using Inferior Alveolar Nerve Block Technique in Primary Mandibular Molar Extractions. Journal of Evolution of Medical and Dental Sciences. 2021 Jan 4;10(1):13-9.
[15]. Jain K, Katge F, Chimata VK, Patil D, Ghadge S, Bhanushali N. Comparative evaluation of anesthetic efficacy of 4% articaine infiltration versus 2% lignocaine inferior alveolar nerve block for extraction of primary mandibular molars: a prospective, split-mouth, randomized controlled trial. Journal of Indian Society of Pedodontics and Preventive Dentistry. 2021 Oct 1;39(4):409-15.
[16]. Abdellatif AM. Pain assessment of two palatal anesthetic techniques and their effects on the child's behavior. Pediatric Dental Journal. 2011 Jan 1;21(2):129-37.

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