



## Pain and Anxiety Using Lidocaine and Articaine in Children Undergoing Full Mouth Rehabilitation Under General Anesthesia: A Randomized Controlled Trial

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### ABSTRACT

**Background:** Whilst carrying out dental procedures under general anesthesia, local anesthetics are given intraoperatively to help manage intra- and post-operative pain. The aim was to investigate the possible effect of intraoperative analgesia, namely lidocaine and articaine on post-recovery pain, intra-operative vitals and salivary amylase in children undergoing pulpectomies under general anesthesia.

**Methods:** Twenty-two ASA class I children, aged 4 to 6 years undergoing full mouth rehabilitation under general anesthesia were divided into two groups. Group A had the dental procedures carried out with lidocaine and group B with articaine. Prior to the induction of anesthesia, patients were asked to choose the face that suits their pain suffering on the Wong Baker Faces Pain scale. Saliva was also collected to check for salivary amylase levels. Intra-operative vitals were recorded during the procedure. The pain scale reading and salivary amylase analysis was done post the treatment too. Intra- and inter-group statistical analysis was carried out.

**Results:** Pain levels showed a statistically significant reduction in both groups six hours post-operatively. Salivary amylase levels significantly reduced in children administered lidocaine. Heart rate values decreased intraoperatively for both anesthetic groups. No significant change was seen in end tidal carbon dioxide levels and oxygen saturation (SPO<sub>2</sub>) levels.

**Conclusion:** Use of lidocaine and articaine prior to performing pain-provoking dental procedures under general anesthesia helps in stabilizing vital signs and reducing post-operative pain.

**Keywords:** Anesthesia, lidocaine, Articaine, Pain, Anxiety, Novel

### INTRODUCTION

Pain management is considered to be of utmost importance, especially in pediatric dentistry as this is the age when patients are forming opinions about dental treatment.

Inadequately handled dental pain might drive these patients to delay further treatment and make them more difficult to treat.<sup>(1)</sup> Local anesthetics are widely and universally utilized in dentistry for pain control and can be chemically

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classified into amides or esters.(2) Two commonly used amide local anesthetics are lidocaine and articaine. Even though lidocaine with vasoconstrictor is the preferred anesthetic for children, there has been a noticeable surge in the usage of articaine.(3)

Most dental treatment should be carried out in the dental operatory under local anesthesia (LA). However, this becomes a challenge in children who are fearful or who require extensive treatment.(4) General anesthesia (GA) is used as an advanced type of behavior management technique to give quality dental care to children who are otherwise unable to endure dental treatment in an outpatient environment.(5) Despite the widespread use of general anesthesia in pediatric dentistry, there are no established recommendations for using local anesthetics during these operations, except for the AAPD guidelines which simply mention that there is a postoperative pain reduction after administration of local anesthesia.(6)

Presently, there are only a small number of studies in literature examining the effectiveness of intraoperative LA in treating post-operative pain for children undergoing treatment under GA. Nobel et al found that at the time of discharge children who received LA during treatment were happier than those who did not.(7) This was also supported by Atan et al., who stated that the use of local anesthetic reduced postoperative discomfort.(8) Contrarily, Coulthard et al. found no appreciable variations in postoperative discomfort across groups upon awakening from general anesthesia, 30 minutes after surgery, or 24 hours after surgery.(9)

Conflicting reports are available in literature about the use of local anesthetics, with some focusing primarily on intraoperative effects or postoperative discomfort. Due to the small number of studies in the field and the lack of evidence for conclusive guidelines, further study is required.

Hence, the aim of this study is first to investigate the possible impact of intraoperative analgesia on post-recovery pain, second to investigate salivary amylase levels in dental cases under general anesthesia and lastly, to determine the

impact of using local anesthetics to control physiologic parameters intraoperatively in patients receiving dental care under general anesthesia.

## MATERIALS AND METHODS

This study was modelled as a parallel, double blinded randomized controlled trial that was started after receiving clearance from the Institutional Review Board (IHEC/SDC/PEDO-2001/22/377) at a university. The trial was also registered in the national clinical trials registry (CTRI/2022/07/044144). G\*Power@3.0.10 software was used to compute the study's sample size. With a type I error of 5% (- 0.05) and a power of 95%, a minimum of 10 samples were required in each group. The sample size was calculated as per the study Leong et al.(10) Healthy children (ASA 1) aged four to six years without any history of behavioral issues, who had a def/DMFT greater than four, requiring at least one pulpectomy in each quadrant and who needed treatment under general anesthesia were eligible. Participants were included if they tested negative for COVID-19 three days before the procedure. Patients having a known allergy to lidocaine or articaine, an underlying systemic condition, a respiratory tract infection or those with special needs were excluded.

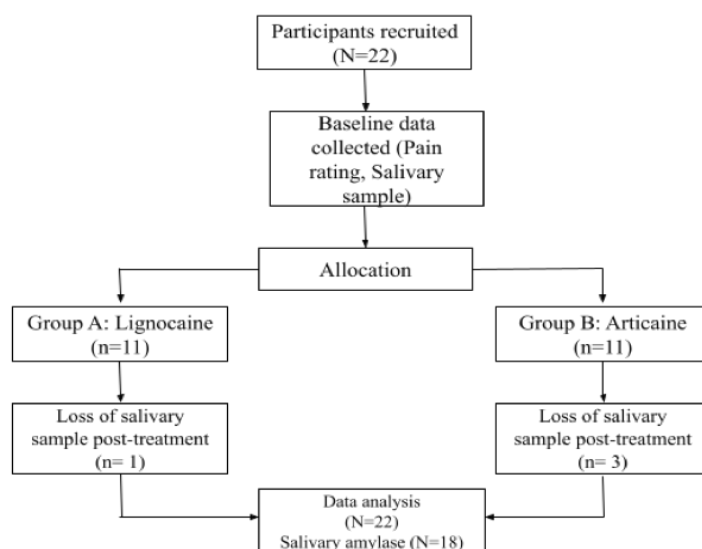
Candidates were chosen from patients who required full mouth dental rehabilitation at the Department of Pediatric Dentistry during GA consultation. All prospective research participants were informed about the study at the consultation meeting. Prior to treatment, consents for research participation, anesthesia, and surgical procedures were all acquired. Dental treatment was provided under general anesthesia at the linked hospital on the same campus.

A total of 22 sealed, brown envelopes containing a written card (Group A or Group B) were prepared. On the day of the treatment, the patients were randomly allocated to either group by the anesthesiologist who was the one to pick the concealed envelope. Only the anesthesiologist and dental assistant were informed about the allocated group; the operator and patient were blinded.

Prior to the treatment, the baseline unstimulated salivary sample of each child was collected in a 20 ml disposable sterile container by asking the patient to spit into it. The child was asked to choose one of six different faces ranging from a happy face at 0 to a crying face at 10 that best represents their pain score based on Wong Baker's Faces Pain Scale. Both these baseline values were recorded one hour prior to the treatment. The standardized general anesthetic protocol for dentistry cases created by the anesthesiologists representing standard general anesthesia practice at the private university setting were adhered to. For all the participants, general anesthesia was induced by a single anesthetist with sevoflurane, after which an IV was inserted and a propofol bolus was administered to allow nasotracheal intubation. After intubating, the throat pack was placed and the anesthetist recorded the baseline vitals. Sevoflurane was then given as a potent agent for maintenance. A rate of 10–20 cc/kg of intravenous fluids was maintained throughout the

procedure.

Intraoperatively, children allocated to Group A were administered 2% Lidocaine with 1:100,000 epinephrine as a inferior alveolar nerve block (IANB) and those in Group B received 4% articaine with 1:100,00 epinephrine (Septanest 4% Articaine With 1:100,000 Epinephrine, Septodont, France) as buccal infiltration. (Figure 1) Patients randomized to the lidocaine group as well as the articaine group were administered LA at all four quadrants up to a maximum dose of 4.4mg/kg and 7 mg/kg respectively. The patients' physiologic readings were observed intraoperatively during cleaning and shaping which is a point of potential stimulation during a lower molar pulpectomy. This stimulating event was stated by the dentist performing the case and a second, blinded dental assistant noted the heart rate, SPO2 and end tidal CO2 at that time. Standard deviation from the patients' pre-local anesthetic baseline vitals was used to examine fluctuations.



**FIGURE 1:** Participant flow

Post-operatively, an unstimulated salivary sample was collected 3 hours after completion of treatment. Wong Baker Faces pain scale rating was recorded 3 hours and 6 hours post the treatment. The child's parent or guardian were informed about the standard set of post-operative instructions prior to discharge encompassing the possibility of anesthetized tissues. Patients were

then discharged home once they met the discharge criteria (conscious, oriented, afebrile, absence of nausea and vomiting, normal urinary output) and were deemed fit by the anesthesiologist.

Salivary samples were biochemically analyzed (Priestest touch plus, Robonik, Robonik Pvt Ltd, India) for salivary amylase levels. Descriptive

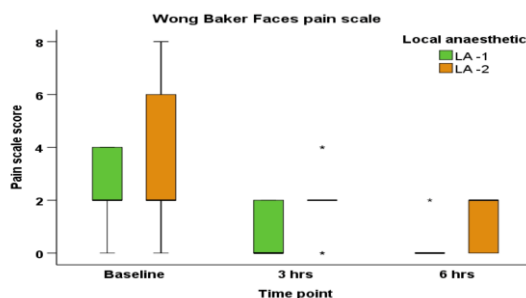
statistics and Kolmogorov-Smirnov and Shapiro-Wilks tests for normality were carried out. Variables that followed normal distribution included salivary amylase levels, heart rate, SPO<sub>2</sub>, and end tidal CO<sub>2</sub>. For these, independent samples t-test was applied for intergroup comparison and paired t-test was applied for intragroup comparison. The other variables (age and Wong Baker Faces pain scale) did not follow normal distribution, for which Mann Whitney U test and Friedman’s repeated measures ANOVA was used followed by Bonferroni adjusted test for pairwise comparison. All the analysis was carried out on SPSS software (IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp. Released 2019). Significance level was fixed as 5% ( $\alpha = 0.05$ ).

## RESULTS

22 children having a mean age of  $4.8 \pm 0.92$  years were recruited for this study, of which 13 were boys and 9 were girls. Data was collected from all 22 patients however, four children could not give enough salivary sample post treatment; one was from group A and three from group B.

### Pain

On comparing baseline scores to scores obtained 6 hours post treatment it was seen that pain levels showed a statistically significant reduction in both groups ( $p < 0.05$ ). However, only the articaine group had a significant reduction in pain score after 3 hours. (Figure 2)



**FIGURE 2:** Wong Baker Faces Pain Scale scores for patients receiving lidocaine and articaine at different time points.

### Salivary Amylase

According to the findings of this research, only the participants who received lidocaine intra-operatively showed a statistically significant

reduction in salivary amylase levels ( $p = 0.007$ ). The intergroup comparison revealed no significant difference between the two groups. (Table 1)

**TABLE 1:** Comparison of salivary amylase levels within and between the study groups.

Time Point	Group A - lidocaine (Mean $\pm$ SD)	Group B - Articaine (Mean $\pm$ SD)	Intergroup Comparison p-value (independent t test)
Baseline/Pre-intervention	179.28 $\pm$ 15.99	160.41 $\pm$ 44.18	0.226
3 hours post intervention	148.39 $\pm$ 25.76	150.73 $\pm$ 58.33	0.910
Intragroup comparison p-value (paired t test)	0.007*	0.260	-

**Intraoperative vitals**

Intra-operatively, no significant difference was seen between and within the two groups in SPO2 or end tidal CO2 levels. However, the heart rate

values were significantly reduced in both groups intraoperatively during the treatment. (p<0.05) (Table 2)

**TABLE 2:** Comparison of intraoperative vitals (Heart rate, SPO2 and End tidal CO2) within and between the two study groups.

Time Point		Group A - lidocaine (Mean ± SD)	Group B - Articaine (Mean ± SD)	Intergroup Comparison p- value
Heart rate	Baseline/Before injection	121.73 ± 20.18	125.91 ± 14.86	0.586
	Cleaning and Shaping	116.09 ± 20.90	121.73 ± 15.36	0.479
Intragroup comparison (p-value)		0.024*	0.002*	-
SPO2	Baseline/Before injection	99.53 ± 0.47	99.00 ± 0.89	0.030
	Cleaning and Shaping	99.45 ± 0.93	99.27 ± 0.79	0.627
Intragroup comparison (p-value)		0.082	0.082	-
End tidal CO2	Baseline/Before injection	33.09 ± 2.51	31.00 ± 2.97	0.089
	Cleaning and Shaping	32.64 ± 2.34	31.36 ± 2.98	0.278
Intragroup comparison (p-value)		0.242	0.531	-

**DISCUSSION**

Pain is a multimodal sensory experience that is unpleasant and strongly influenced by both cognitive processes and emotional responses.(11) For pain to be successfully treated, an accurate diagnostic of the pain source, degree, and kind is required.(12) Evaluation of pain in children remains difficult due to their limited capacity to articulate and describe their discomfort. In this study, children's pain was assessed by displaying the Wong-Baker Faces Pain Rating Scale panel to the children, as opposed to other studies where objective scales such as the FLACC assessment tool (13), Children's Hospital of Eastern Ontario Pain Scale (CHEOPS) (14), and Modified Pain/Discomfort scale (MPDS) (10) have been used for pain assessment. The Wong-Baker Faces Pain subjective tool was used as it avoids the overestimation of pain due to factors such as movement, crying and agitation which act as confounding factors in objective scales. Moreover, this scale was created specifically for children ages three and older to assist them communicate about their pain.(15)

Contrary to our findings, Townsend et al (13) revealed that the intraoral infiltration of 2% lidocaine with 1:100,000 epinephrine for complete dental rehabilitation under general anesthesia did not result in improved pain postoperatively as measured by the FLACC scale, FACES scale, and subjective reports of parents. This could be explained by the use of the buccal infiltration of lidocaine in Townsend's study whereas in our study lignocaine was administered as an IANB thereby having a longer duration of action and causing a reduction in postoperative pain. The duration of action of articaine is longer than lidocaine(16); this was supported by Batista da Silva et al (17) who compared the anesthetic efficacy of 4% articaine and 2% lidocaine both with 1:100,000 epinephrine concentration administered as IANB and revealed that articaine promoted higher anesthesia success and longer duration of anesthesia. Hence, to have a similar duration of anesthesia postoperatively we administered articaine as buccal infiltration and lignocaine as IANB. Our results showed that both anesthetics showed a statistically significant reduction in pain 6 hours postoperatively. This finding of



decreased postoperative pain was also noted by Sammons et al (18) but was no longer significantly different 1 hour post-operatively. This finding could be the result of the local anesthetic being administered by an intraligamental technique which leads to a shorter duration of anesthesia.

In the systematic analysis done by Parekh S et al (4), it was noticed that the majority of the included studies employed short acting local anesthetics and still measured pain longer than several hours following the treatment. Lignocaine and articaine are both classified as anesthetic agents having an intermediate duration of action causing soft tissue to be anesthetized for 3-5 hours (19), hence we measured pain till 6 hours post-treatment.

Previous studies have shown that the baseline anxiety of a child will influence the measurement of pain.(20) Salivary alpha amylase (sAA) levels in the saliva are a non-invasive indicator of sympathetic nervous system activity, which is a reflection of anxiousness and fear in a person. In the present study, we have assessed the level of pre-and post treatment anxiety using sAA levels and not using picture scales as done previously. (14)(21) Subjective scales were not used to assess the level of anxiety as after treatment under general anesthesia a child may be anxious due to other variables such as disorientation and agitation, which can be commonly misinterpreted as pain. Instead, an objective method of assessment was used in this study and it was seen that children who received intraoperative lignocaine showed a statistically significant reduction in salivary amylase levels.

A further component of this investigation was the evaluation of intraoperative physiologic measures. Participants of both groups showed a reduction in heart rates during the cleaning and shaping. El Batawi et al also made note of this observation, reporting significantly greater heart rates in patients undergoing pulpotomy, tooth extraction, and cutting dentinal tissue in those patients who had not received LA.(22) An elevated heart rate during potentially stimulating events might be taken into consideration as a potential sign of intraoperative patient discomfort.

Additionally in this study we noted no statistically significant differences in end tidal carbon dioxide (EtCO<sub>2</sub>) and SPO<sub>2</sub> levels between both the groups. These findings were in agreement with those by Watts et al ,(23) who found a statistically significant difference in EtCO<sub>2</sub> in patients who underwent extractions with and without administration of local anesthesia; they noted that patients who were not administered local anesthesia had higher EtCO<sub>2</sub> levels than those who received local anesthesia. A lower EtCO<sub>2</sub> likely indicates the patient is more comfortable and is taking smaller relaxed breaths.(22) This explains the results found in our study as there was no difference in the EtCO<sub>2</sub> of both groups since local anesthesia was administered to all subjects.

This is the only research that has been done on children who have had oral rehabilitation under completely intubated general anesthesia with a double-blind design. Prior research has only focused on the perception of pain following extractions. The inclusion of endodontic therapy is a key strength of this study since it may have varied implications on how postoperative pain is perceived. Limitations of this study include the limited sample size and lack of evaluation of adverse effects postoperatively. Additionally, we found the postoperative salivary sample collection difficult as some of the participants were agitated or sleeping. It is also crucial to note that very young children may mistake pain with discomfort brought on by the numbness that results from the injection of local anesthetics (LA) for which assessment with objective pain scales may provide varied results . Future studies can focus on post-operative pain control for dental cases depending on the scope and nature of the dental care provided, as well as the validity of pain scales for measuring postoperative dental pain in children.

## CONCLUSION

Lignocaine and articaine can be used to stabilize vital signs and lessen post-operative discomfort before conducting painful dental treatments under general anesthesia. However, the anesthetist must be informed of the concurrent administration of a local anesthetic, particularly

one that contains adrenaline. This study is relevant since there are currently no clinical recommendations for the use of local anesthetic in dental procedures performed under general anesthesia.

### CONFLICTS OF INTEREST

No conflicts of interest

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Nil

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