

EFFECT OF WARMING TWO DIFFERENT ANESTHETIC SOLUTIONS ON PAIN PERCEPTION DURING DENTAL INJECTION

^{1*}Dr. Y. Dheerusee, ²Dr. Vishnu Rekha Chamarthi, ³Dr. Dhanraj Kalaivanan, ⁴Dr. Sumaiyya Saleem, ⁵Dr. Sai Sarath Kumar Kothimbakkam, ⁶Dr. Santhosh Priya A.K.R.

¹MDS, Postgraduate student Department of Pedodontics and Preventive Dentistry, Sathyabama Dental College and Hospital, Kelambakkam, Kanchipuram, Tamil Nadu, India. Email ID: dheerusreedy@gmail.com

²MDS, Professor and Head Department of Pedodontics and Preventive Dentistry, Sathyabama Dental College and Hospital, Kelambakkam, Kanchipuram, Tamil Nadu, India. Email ID: drvishnurekha@yahoo.com

³MDS, Reader Department of Pedodontics and Preventive Dentistry, Sathyabama Dental College and Hospital, Kelambakkam, Kanchipuram, Tamil Nadu, India. Email ID: dhanrajkalaivanan@gmail.com

⁴MDS, Professor (Assistant) Department of Pedodontics and Preventive Dentistry, Sathyabama Dental College and Hospital, Kelambakkam, Kanchipuram, Tamil Nadu, India. Email ID: sumaiyya.sms@gmail.com

⁵MDS, Professor (Assistant) Department of Pedodontics and Preventive Dentistry, Sathyabama Dental College and Hospital, Kelambakkam, Kanchipuram, Tamil Nadu, India. Email ID: saisarathpedo@gmail.com

⁶MDS, Professor (Assistant) Department of Pedodontics and Preventive Dentistry, Sathyabama Dental College and Hospital, Kelambakkam, Kanchipuram, Tamil Nadu, India. Email ID: santhosh.appiya@gmail.com

*Corresponding Author: Dr. Y. Dheerusee

ABSTRACT

Background: Local anesthetic injections are a major source of anxiety and pain in pediatric dental patients. Various techniques have been proposed to reduce injection-related discomfort, including warming anesthetic solutions. However, limited data exist comparing the pain perception of different prewarmed dental anesthetics in children.

Aim: To evaluate and compare the effect of prewarmed lidocaine and articaine solutions at 42°C on pain perception during dental local anesthetic administration in children.

Materials and Methods: This randomized crossover clinical study included 20 pediatric patients requiring dental treatment. Local anesthetic solutions (lidocaine and articaine) were prewarmed to 42°C for 4 minutes before administration. Each child received one anesthetic at the first visit and the alternate anesthetic at the second visit. Pain perception during injection was assessed using the Wong-Baker FACES Pain Rating Scale. Data were analyzed using the Wilcoxon signed-rank test.

Results: Both warmed anesthetic solutions resulted in reduced pain perception during injection. However, prewarmed articaine demonstrated a significantly lower mean pain score (3.90 ± 1.77) compared to prewarmed lidocaine (5.16 ± 2.03). The difference was statistically significant ($P < 0.001$).

Conclusion: Prewarming local anesthetic solutions effectively reduces pain during dental injections in children. Among the anesthetics tested, prewarmed articaine was associated with significantly less pain on administration compared to prewarmed lidocaine, suggesting its clinical advantage in pediatric dental practice.

KEYWORDS: Local anesthesia, Warming anesthetic solution, Articaine, Lidocaine, Pain perception, Pediatric dentistry

I. INTRODUCTION

The local anesthetic injection is often anxiety-inducing dental procedure for both adults and children.¹ In order to minimize pain during various restorative, endodontic, and small surgical treatments, local anesthetic must be administered; this is more important for children compared to adults.² Many methods have been proposed to lessen injection-related pain. Distractions, reframing, electronic dental anesthetic, and computerized tools like wands are being used.³ One such method like warming local anesthetics was first described as a pain reducing measure by Boggia in 1967.⁴ Theories suggest that colder solutions stimulate nociceptors to a greater degree than warmer solutions, temperature increase more uncharged local anesthetic passes through cell membranes, resulting in a faster onset of effect.^{5,6} Warming the lignocaine solution to body temperature is another method that has been proposed to lessen pain during a local anesthetic injection. This method may be useful in dentistry since it has been shown to successfully lessen pain during injections for plastic surgery and eye surgery. A survey in the United Kingdom found that 34% of maxillofacial surgeons and 8% of general surgeons regularly warmed local anesthetics to reduce pain.⁷ Hogan et al.'s systematic review determined the efficiency of heating anesthetics to reduce pain during injections at different body parts, and they recommended that this effect be examined for infusions of dental anesthetic.⁸ This would have the benefit of lowering anxiety levels, which would improve patient-dentist relationships and lead to increased comfort throughout treatment. Hence the use of prewarmed lignocaine solutions in children has been the subject of very few investigations in Indian scenario. The purpose of this study was to determine the

effectiveness of the use of lidocaine and articaine anesthesia at 42°C in the perception of pain during the administration of dental anesthesia.

II. MATERIALS AND METHODS

The current study was a randomized, controlled, split-mouth study, for which an ethical clearance was obtained from the Ethical Committee of the institution before the study (456/IRB-IBSEC/SIST Dated 10th Dec 2024).

Based on previous study done by Aravena PC et al considering a 5% level of significance, a study power of 0.8, a total of 20 subjects were estimated.⁹ Children who were undergoing pulp therapy participated in the study. Written informed parental consent and child assent was obtained in accordance with ICMR guidelines. On the first visit, the children were subjected to a thorough check up and radiographs were taken. A random crossover design was used. Local anesthetic solution was prewarmed at 42°C for 4 minutes following the method previously described by Chittora et al.¹⁰ Each patient was randomly assigned to receive either warm lidocaine or articaine on the first visit and the alternate local anesthesia on the second visit. For subjective evaluation the Wong-Baker FACES pain rating scale was used.

The statistical analysis was done by using the SPSS Software Version 25.0. The Wilcoxon Signed rank test was used to compare between the two groups. The level of statistical significance was kept as p- value less than or equal to 0.05.



III. RESULTS

The study sample consisted of 20 children with the mean age of 9 years with 12 girls and 8 boys.

Table 1: Comparison of Mean Pain Scores for Prewarmed Local Anaesthetic Solutions

	N	Mean	Std. Deviation	p-value
Lidocaine	20	5.16	2.035	0.001*
Articaine	20	3.90	1.774	

The findings demonstrated that the administration of prewarmed articaine was associated with a significantly lower pain response compared with prewarmed lidocaine, with the difference being statistically significant ($P < 0.001$).

IV. DISCUSSION

The findings of the present study support the hypothesis that administering local anesthetic solutions warmed to 42°C significantly reduces pain perception compared with solutions delivered at room temperature. This observation is particularly relevant in dental practice, where local anesthesia is an integral component of most diagnostic and therapeutic procedures, and patient comfort plays a crucial role in treatment acceptance and cooperation.

Local anesthesia refers to the temporary and reversible loss of sensation in a targeted area, commonly used to prevent pain during medical or dental procedures. It achieves this by blocking voltage-gated sodium channels in nerve fibers, which stops the initiation and conduction of nerve impulses and prevents pain signals from reaching the brain. Lidocaine, an amide-type local anesthetic, works through the same mechanism of sodium channel blockade and is often combined with a vasoconstrictor to prolong its effect. Articaine, also an amide-type anesthetic similarly produces anesthesia by reversibly inhibiting sodium channels in nerves, preventing the transmission of pain.¹¹ Literature stated that nerve endings are sensitive to cold and warming the injection might directly reduce stimulation.¹² Alternatively the warmer injection inhibit pain transmission before the nociceptive impulses are fully appreciated. Becker et al. proposed that the dissociation constant (pKa) of local anaesthetic agents is temperature dependent. Warming the solution lowers the pKa, thereby increasing the proportion of the active, non-ionized form of the drug. This facilitates enhanced diffusion across the nerve membrane, resulting in a more rapid onset of anaesthesia and a reduction in injection pain.¹³ Several studies in the literature have cautioned against warming anesthetic cartridges, suggesting that exposure to elevated temperatures may lead to degradation of the anesthetic agent or the vasoconstrictor, potentially reducing their clinical effectiveness.¹⁴ Although the manufacturer's instructions encourage keeping the cartridges at room temperature, Gill et al stated that lidocaine can tolerate repeated sterilization by autoclave and that epinephrine can withstand repeated warming with no appreciable

degradation, even at extreme temperatures of up to 51.7°C for an accumulated time of 13.25 hours.¹⁵ The findings of the present study demonstrate that prewarming local anaesthetic solutions significantly reduces pain perception during injection. This observation is in agreement with the systematic review and meta-analysis by Hogan et al⁸ which reported a consistent reduction in injection pain when warmed local anaesthetics were used. Similar results have been documented by Gumus et al., Kurie et al., and Aravena et al., all of whom observed improved patient comfort and reduced injection-related discomfort with prewarmed anaesthetic solutions. Although Ram et al. reported no statistically significant difference in pain reduction, the majority of the available evidence including the present study supports the beneficial effect of prewarming local anaesthetics. Thus, prewarming appears to be a simple, cost-effective, and clinically feasible method to enhance patient comfort during dental procedures, particularly in pediatric and anxious patients.

CONCLUSION

Warming local anesthetic solutions prior to administration is an effective strategy to minimize pain during dental injections in children. Among the agents tested, prewarmed articaine provided superior analgesic effect compared to lidocaine. Incorporating this technique into routine pediatric dental practice may improve patient comfort and facilitate smoother dental treatment.

VI. REFERENCES

1. Appukuttan DP. Strategies to manage patients with dental anxiety and dental phobia: literature review. *Clin Cosmet Investig Dent* 2016; 8:35–50.
2. Ghazalgoo A, Saatchi M, Khazaei S, Shadmehr E. The effect of using articaine versus lidocaine for inferior alveolar nerve block on pain after root canal treatment: A Prospective, Randomized clinical study. *Dent Hypotheses* 2018; 9:80-3.
3. Saxena P, Gupta SK, Newaskar V, Chandra A. Advances in dental local anesthesia techniques and devices: An update. *Natl J Maxillofac Surg* 2013;4(1):19–24.
4. Boggia R. Heating local anaesthetic cartridges. *Br Dent J.* 1967; 122:287.
5. Davidson J, Boom SJ. Warming lignocaine to reduce pain associated with injection. *BMJ.* 1992;305:617-618.
6. Kamaya H, Hayes JJ Jr, Ueda I. Dissociation constants of local anesthetics and their temperature dependence. *Anesth Analg.* 1983;62:1025-1030.
7. Courtney DJ, Agrawal S, Revington PJ. Local anaesthesia: to warm or alter the pH a survey of current practice. *J R Coll Surg Edinb.* 1999;44:167-171.
8. Hogan ME, vanderVaart S, Perampaladas K, Machado M, Einarson TR, Taddio A. Systematic review and meta-analysis of the effect of warming local anesthetics on injection pain. *Ann Emerg Med.* 2011;58(1):86–98.
9. Aravena PC, Barrientos C, Troncoso C, Coronado C, Sotelo-Hitschfeld P. Effect of warming anesthetic on pain perception during dental injection: a split-mouth randomized clinical trial. *Local Reg Anesth* 2018; 11: 9-13.
10. Chittora M, Rao D, Panwar S, Samaddar K, Remi RV. A comparative evaluation of the efficiency of warm local anesthetic solution delivered on precooled injection sites with the conventional local anesthetic technique in 7–9-year-old children: A randomized split-mouth cross-over trial. *J Indian Soc Pedod Prev Dent* 2024;42:126-33.
11. Malamed SF. Handbook of local anesthesia.
12. Ram D, Hermida L, B, Peretz A. A comparison of warmed and room-temperature anaesthetic for local anesthesia in children. *Pediatr Dent* 2002. 24(4):333-6.
13. Becker DE, Reed KL. Essentials of local anesthetic pharmacology. *Anesth Prog* 2006;53(3):98–110.
14. Reed KL, Malamed SF, Fonner AM. Local anesthesia part 2: technical considerations. *Anesth Prog.* 2012;59(3):127–137.
15. Gill MA, Kislik AZ, Gore L, Chandna A. Stability of advanced life support drugs in the field. *Am J Health Syst Pharm.* 2004;61(6):597–602.