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Original Article

Comparative Evaluation of Anesthetic Efficacy of Warm and Conventional 2% Lignocaine for the Success of Inferior Alveolar Nerve Block (IANB) in Mandibular Permanent Molars: A Randomized Controlled Clinical Trial

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ABSTRACT

Objective: To evaluate and compare the anesthetic effectiveness of warm versus conventional 2% Lignocaine in achieving successful inferior alveolar nerve block (IANB) for mandibular permanent molars.
Study Design: Randomized Controlled Trial (ClinicalTrials.gov: NCT06806202)
Place and Duration of Study: Armed Forces Institute of Dentistry, Rawalpindi, Pakistan from Dec 2024 to Mar 2025.
Methodology: A double-blind clinical trial involving 70 patients (35 in each Group) diagnosed with irreversible pulpitis was conducted to compare the efficacy of 2% Lignocaine administered at 25°C (Group A) and 42°C (Group B) for inferior alveolar nerve block (IANB). Pain during injection was evaluated using the Visual Analogue Scale (VAS), and the onset of anesthesia in seconds was determined with an electric pulp tester.
Results: There was a significant difference in pain during administration of anesthesia between Group A (25°C) with median VAS score of 7.00 (IQR: 2.00) and of Group B (42°C) with median VAS score of 2.00 (IQR: 2.00) on Visual Analogue Scale (VAS) with a *p*-value < 0.001. Similarly, the onset time of anesthesia in seconds was significantly shorter in Group B (42°C) with a median of 208.2 seconds (IQR: 11.34) as compared to the Group A (25°C) with a median onset time of 286.8 seconds (IQR: 9.9) with the *p*-value < 0.001. These results suggest that warming the anesthetic solution significantly reduces both pain perception during local anesthesia administration and onset time.
Conclusion: Within limitation of the study it is concluded that warmed Lignocaine is more effective than Lignocaine at room temperature in reducing pain during administration and achieving faster onset of anesthesia in seconds.

Keywords: Endodontics, Inferior alveolar nerve block, Lignocaine, Local anesthesia, Pain Reduction, Visual analogue scale, Warming

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INTRODUCTION

Pain control is the fundamental aspect of dental procedures, particularly in oral surgery and endodontics [1]. Local anesthesia administration is of primary importance for most procedures in dentistry [2]. One of the most frequently used techniques for achieving mandibular anesthesia is inferior alveolar nerve block [3]. Due to its efficacy and safety records, Lignocaine hydrochloride has been the most commonly used anesthetic agent in dentistry. It is safe to use and offers adequate anesthesia in almost all the conditions, medically compromised patients even in pregnancy [4].

Despite its widespread use, the administration of lidocaine can cause pain, influenced by several factors such as the solution's temperature, pH, and the injection technique [5]. In this study it was considered that the increase in temperature of the anesthetic agent can reduce the pain of administration of injection, as it has been proposed that warming up local anesthesia or using topical anesthetics before puncture could lessen the pain associated with local anesthesia administration [6]. Warming local anesthetic solutions to body temperature has been shown to effectively reduce injection pain in procedures such as eye and plastic surgery, suggesting potential benefits for its application in dentistry as well [7]. The pain-reducing effect of warming is attributed to a synergistic mechanism involving the increased permeability of Transient Receptor Potential Vanilloid-1 (TRPV1) channels, facilitating the entry of the anesthetic into nociceptors. Similarly, Herrera JE, et al. suggested in a study indicating that administering the warm local anesthesia (37°C) produces a lower pain intensity and shorter onset of action compared to doing so at room temperature [3]. Afsal et al. concluded that warming the Lignocaine to 42°C helped in faster blockage of

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sodium channels, thus increasing the effectiveness of local anesthesia [9].

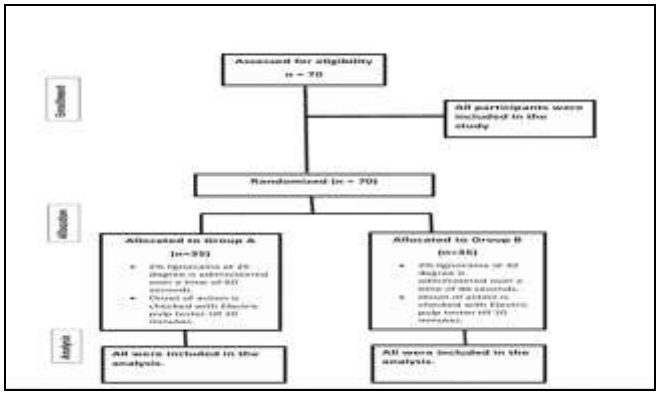

Figure: Patient Flow Chart

There is a notable research gap in local pain management techniques because there hasn't been any recorded study on this subject from Pakistan. A significant clinical problem is still providing effective anesthesia, especially for individuals with different anxiety levels. Therefore, the purpose of this study was to give general dentists and specialists nationwide evidence-based recommendations for enhancing pain management in both anxious and non-anxious patients during the administration of anesthesia. The purpose of this study is to evaluate the anesthetic effectiveness of warm versus conventional 2% Lignocaine in achieving successful inferior alveolar nerve block (IANB) in mandibular permanent molars. Efficacy is evaluated based on two parameters: pain experienced during anesthesia administration and the onset time of anesthesia, measured in seconds.

METHODOLOGY

This study was conducted at Armed Forces institute Of Dentistry, Rawalpindi, Pakistan from December 2024 to March 2025. This trial's procedural and ethical approval was obtained from the Ethical Committee/Institutional Review Board (IRB) of the Armed Forces Institute of Dentistry, Rawalpindi, via letter no. 918/Trg dated 13 May 2020 and was registered on clinicaltrials.gov with the name of "Lignocaine Efficacy in IANB" with RCT registry number (NCT06806202).

Inclusion Criteria: The systematically healthy patients (ASA I, ASA II) of either gender aged between 20-40 years, who had carious exposed permanent molars with acutely inflamed pulp without swelling or draining sinus, and who agreed to attend recall and provide written informed consent.

Exclusion Criteria: Patients who are going to experience IANB for first time, patients on preoperative analgesics and antibiotics, teeth with calcified canals and previously treated teeth, pregnant and lactating mothers, patients who were immunocompromised, anxious and mentally handicapped, patients who were allergic to Lignocaine and non-vital or necrosed teeth by the help of electric pulp tester.

The sample size was established and was estimated to be 70. It was divided into 2 Groups by using scientific random number table with 35 participants in each Group with a level of significance 5%, confidence 95%, and power of test 80% 3 .Mean difference was used based on the visual analog scale, administering anesthesia at 37 °C produced values of 6.63 ± 5.037 mm, and at room temperature, values of 12.870 ± 12.001 mm ($p < 0.05$) for pain and in terms of time of onset of action, it was found that administering anesthesia at 37 °C produced a value of 201.66 ± 85.336 seconds, whereas at room temperature, the value was 286.66 ± 84.292 seconds ($p < 0.05$).

The procedure was explained and an informed consent form was signed by each patient. Demographic details were recorded on data collection forms. Peri-apical radiography, pertinent clinical examination, required testing, and history collection were used to screen patients for inclusion. Patients fulfilling the inclusion criteria were divided into two Groups using scientific random number table. Group A: Patients were administered with conventional 2% Lignocaine (at 25°C). Group B: Patients were administered with warm 2% Lignocaine (at 42°C). Root canal treatment was initiated by administering the IANB, 1.8 mL of the solution Septodont Lignospan Special Lignocaine hydrochloride 2% with adrenaline 1: 80,000 was administered over 60 seconds, using a Septoject 27-gauge needle. This dictated the type of modified local anesthetic solution—conventional or warmed—that was used during the procedure. Traditional 2% Lignocaine was defined as 1.8 ml of commercially available 2% Lignocaine hydrochloride with 1: 80,000 epinephrine. It was warmed to 42°C in a feeder bottle warmer or thermostatically controlled water bath (Philips AVENT). Soon after the inferior alveolar nerve block was performed, the second investigator, who was blinded, asked the patients to rate their level of pain on the VAS scale. A Visual Analogue Scale (VAS) was used to quantify the intensity of the pain. The VAS was a 10-cm horizontal

line with "worst pain imaginable (10)" on the right and "no pain (0)" on the left, anchored at the extremes.

Electric pulp testing (EPT) was then performed every 15 seconds for ten minutes to determine when the anesthesia started. Following rubber dam isolation, access cavity was prepared and pulp therapy was initiated by the first investigator. The pulp therapy was completed as indicated and the teeth was restored using light cure composite resin. Figure flowchart shows the patient flow during the study .It shows two Groups of thirty-five each were randomly selected from a total of seventy participants.2% Lignocaine was given to Group A at 25°C for 60 seconds, and to Group B at 42°C for 60 seconds .An electric pulp tester was used to measure the onset of anesthesia for a maximum of ten minutes .Every participant finished the study and was taken into account for the final analysis.

Statistical Package for Social Sciences (SPSS) Version 27 was used to enter and analyze the data. Normality of the data was checked by Shapiro Wilk test with a *p*-value of <0.05 indicating that the data significantly deviates from a normal distribution. Frequency and percentage was calculated for qualitative variables as gender. Median was calculated for quantitative variables as age, pain on administration of injection based on VAS and onset of anesthesia in seconds. Comparison of two Groups was calculated using Mann Whitney U test. The p value ≤ 0.05 was considered significant.

RESULTS

Seventy patients meeting our inclusion criteria were included in the study, with no participants being lost to incomplete forms or non-response. The mean age of the participants was years. Table-I shows demographic details (age and gender) of study participants. Table-II demonstrates the Group that received warm anesthesia (Group B) with experienced significantly less pain than the Group that received anesthesia at room temperature (Group A). The difference is statistically significant ($p < 0.001$) and clinically meaningful and the onset of anesthesia was significantly faster with the warm anesthetic solution (Group B) with compared to the room temperature solution (Group A) with. Again, the difference is statistically significant ($p < 0.001$).

DISCUSSION

This study investigated the anesthetic effectiveness of warm versus conventional 2% Lignocaine in achieving successful inferior alveolar nerve block (IANB) for mandibular permanent molars. The results showed that warmed anesthesia (42 degree) caused significantly lesser pain during administration of anesthesia and shorter onset of action as opposed to the conventional anesthesia (25 degree), aligning it with prior research linking warmed anesthesia with lesser discomfort and shorter onset of action.

Table-I : Demographic Details of Study Participants (n = 70)

Parameter	Group A (Conventional) (n = 35)	Group B (Warm) (n = 35)	*p*-value
Median Age (years)	27.00(10.00)	31.00(9.00)	<0.001
Gender Male Female	 35 (50.0%) 35 (50.0%)	 35(50.0% 35(50.0%)	–

Table-II: Comparison of Pain and Onset Time between Groups (n=70)

Parameters	Group A (n = 35) Median (IQR)	Group B (n = 35) Median (IQR)	p-value
Pain on administration	7.00(2.00)	2.00(2.00)	<0.001
Time of onset of anesthesia (seconds)	286.8(9.90)	208.2(11.34)	<0.001

Consistent with our findings, Gandhi *et al.* demonstrated that administering warming Lignocaine significantly lessens pain during an inferior alveolar nerve block (IANB) 10. On the Visual Analog Scale (VAS), patients who received Lignocaine warmed to approximately 37°C had lower pain scores than those who received the anesthetic at room temperature. Increased diffusion of the anesthetic solution into neural tissues and decreased thermal discomfort may be to blame for the lesser pain response.

Similarly, Saeed *et al.* compared administering the local anesthetic at room temperature, and at 42°C that resulted in a shorter onset of action and lower pain intensity [11]. Resultantly, the patient and the dentist would develop a positive relationship and sense of confidence due to more comfortable treatment.

Further support comes from Chittora M *et al*. that warming the anesthetic solution significantly reduced injection pain at a precooled site, in a split-mouth randomized trial [12]. The combination of pre-cooling and warm anesthetic probably lessens the sensitivity of the nociceptor and makes the injection less painful.

This evidence collectively underscores the viability of warming anesthesia in achieving effective outcomes while minimizing patient discomfort.

According to Ibrahim et al. the warm LA solution is less painful than the room temperature solution since nerve endings are more sensitive to cold stimulations as compared to warm ones, and a warmer LA solution would less effectively stimulate nerve endings in comparison to a cooler one. A warm solution would also speed up the block's onset, preventing pain signals from spreading before the nociceptive stimulus is fully expressed and appreciated [13]. These findings support the current study's conclusion that warmed anesthesia are preferable for reducing patient's discomfort, during administration of anesthesia. The consistency across these studies highlights the critical role of temperature of anesthesia in optimizing clinical outcomes and patient satisfaction.

A systematic review by Tirupathi *et al*. reflects that pre-heated local anesthetics increase injection comfort by reducing tissue resistance and facilitating smoother needle insertion, as demonstrated by these findings [14]. The anesthetic solution's viscosity decreases at elevated temperatures, making it easier for it to flow through tissues and reducing the amount of pressure required for injection. The clinical benefit of warming anesthetics prior to administration is supported by this possibility of reducing mechanical irritation and improving patient tolerance as concluded in our study.

In a similar study conducted by Kurien et al. in a pediatric department, he concluded warm anesthetics helped to speed up the onset and improve comfort during pediatric procedures, thereby reducing procedural anxiety [15]. In pediatric dentistry, these findings support the use of temperature-modified anesthesia to increase patient cooperation. This consistency across the studies plays a pivotal role in increasing the temperature of anesthesia by providing better outcomes and anxiety control in dentistry.

According to an umbrella review by Nagendrababu *et al*. temperature adjustments improve anesthetic stability and diffusion, which in turn raises success rates [16]. Warm Lignocaine significantly reduced patient discomfort, as demonstrated by the present findings, and is consistent with our research revealing a significant reduction in pain perception during the administration of local anesthesia.

Supporting evidence in anesthesia other than inferior alveolar nerve block, the onset of sensory block in epidural anesthesia is significantly accelerated when local anesthetic is administered at elevated temperature, as showed by Fu-Chao *et al* [17] thereby suggesting that warming accelerates clinical efficacy by increasing anesthetic diffusion and nerve penetration.

In a relevant study, physiological and pharmacokinetic factors may be to blame for the higher success rate with anesthetics. The proportion of the non-ionized, membrane-permeable form increases as the solution is heated, facilitating diffusion across lipid-rich nerve membranes. According to Allen MJ *et al*. elevated temperature lowers the pKa of local anesthetics, thereby increasing the proportion of the active deionized form. This is because the pKa of local anesthetics is temperature-dependent [18].

The overall patient experience can be greatly improved by minimizing injection-related pain and shortening the anesthesia onset time, especially for those who are nervous about dental procedures. Given that pain or extended waiting can exacerbate fear and resistance, this is particularly crucial for young patients and those who suffer from dental anxiety. Clinicians can foster greater cooperation during treatment by creating a cozier and comforting environment with warmed Lignocaine. It leads to higher treatment success rates as a result of improved patient compliance, which also makes procedures run more smoothly. In the end, this small change could improve long-term patient satisfaction and more effective workflows in clinical practice.

LIMITATIONS OF STUDY

This study has some limitations that should be considered when interpreting the results. Anxious patients were excluded to keep pain perception more consistent, but this may limit how well the findings apply to everyday dental practice, where patient anxiety often affects pain levels. The advantages of warming might differ with other anesthetics like articaine or mepivacaine because only Lignocaine was examined. Additionally, the study did not measure the duration of the numbness or the patient's comfort following the injection; instead, it concentrated primarily on the pain experienced during the injection and the onset of anesthesia. These results would be further supported and expanded by more studies conducted at various locations with a larger sample size and a variety of anesthetics.

CONCLUSION

Within limitation of the study it is concluded that warmed Lignocaine is more effective than Lignocaine at room temperature in reducing pain during administration & achieving faster onset of anesthesia.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MAM & SMH: Data acquisition, data analysis, critical review, approval of the final version to be published.

AY & AM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

QUAA & KZ: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Santini M, Da Rosa RA, Ferreira MB, Barletta F, Do Nascimento AL, Weissheimer T, Estrela C, So MV. Medications used for prevention and treatment of postoperative endodontic pain: a systematic review. Eur Endod J 2021; 6(1): 15 http://doi.org/10.14744/eej.2020.85856
2. Bartholomew O, Hogden C, Randall CL, Qian F, Bowers R. Challenges in achieving profound local anesthesia: Insights from a patient survey. JADA Journal of the American Dental Association 2025; 156(7): 530-537. https://doi.org/10.1016/j.adaj.2025.03.015
3. Herrera JE, Quino CF, Cerrate VC, Rodríguez YC. Effect of the temperature of lidocaine 2% with epinephrine 1: 80,000 on pain from injection and onset of action in blocking the inferior alveolar nerve. Revi de Admin 2015; 72(5): 236-242.
4. Kupietzky A, Schwartz S. Local Anesthesia. Wright's behavior management in dentistry for children. First Edition, John Wiley & Sons, Inc. 2021. https://doi.org/10.1002/9781119680987.ch9
5. Karunakar P, Solomon RV, Kumar BS, Reddy SS. Evaluating the pain at site, onset of action, duration and anesthetic efficacy of conventional, buffered lidocaine, and precooled lidocaine with intraoral cryotherapy application in patients with symptomatic irreversible pulpitis: A clinical study. J Conserv Dent Endod 2024; 27(12): 1228-1233. https://doi.org/10.4103/jcde.jcde_625_24
6. Tirupathi SP, Nanda N, Pallepagu S, Malothu S, Rathi N, Chauhan RS, et al. The combined effect of extraoral vibratory stimulus and external cooling on pain perception during intra-oral local anesthesia administration in children: a systematic review and meta-analysis. J Dent Anesth Pain Med 2022; 22(2): 87. https://doi.org/10.17245/jdapm.2022.22.2.87
7. Ing EB, Philteos J, Sholohov G, Kim DT, Nijhawan N, Mark PW, et al. Local anesthesia and anxiolytic techniques for oculoplastic surgery. Clin Ophthalmol 2019; 13(1): 153. https://doi.org/10.2147/OPTH.S188790
8. 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; 9-13. https://doi.org/10.2147/lra.s147288
9. Afsal MM, Khatri A, Kalra N, Tyagi R, Khandelwal D. Pain perception and efficacy of local analgesia using 2% Lignocaine, buffered Lignocaine, and 4% articaine in pediatric dental procedures.J Dent Anesth Pain Med 2019; 19(2): 101-109. https://doi.org/10.17245/jdapm.2019.19.2.101
10. Gandhi N, Shah N, Wahjuningrum DA, Purnomo S, Nooshian R, Arora S, et al. Evaluation of pulpal anesthesia and injection pain using IANB with pre-heated, buffered and conventional 2% Lignocaine in teeth with symptomatic irreversible pulpitis—a randomized clinical study. PeerJ. 2022; 10: e14187. https://doi.org/10.7717/peerj.14187
11. Saeed SA, Mahmood S, Baig NJ, Khan NA, Rasheed N, Kakar NA. Effect of Warming Anesthetic Solution on Pain Perception During Maxillary Infiltration: A Split Mouth Randomized Control Trial. Pak Armed Forces Med J 2022; 72(1): 240. https://doi.org/10.51253/pafmj.v72i1.6860
12. 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(2): 126-133. https://doi.org/10.4103/jisppd.jisppd_52_24
13. Ibrahim A, Habashy L, Hafez SM, Sharaf D. Effect of Pre-Warming Of Local Anesthesia on Reducing Pain Perception during Injection in Children: A Randomized Controlled Clinical TRIAL. Alex Dent J. 2025 https://dx.doi.org/10.21608/adjalexu.2025.349737.1579
14. Tirupathi SP, Rajasekhar S. Effect of warming local anesthesia solutions before intraoral administration in dentistry: a systematic review. J Dent Anesth Pain Med 2020; 20(4): 187-194. https://doi.org/10.17245/jdapm.2020.20.4.187
15. Kurien RS, Goswami M. Comparative evaluation of anesthetic efficacy of warm, buffered and conventional 2% Lignocaine for the success of inferior alveolar nerve block (IANB) in mandibular primary molars: A randomized controlled clinical trial. J Dent Res Dent Clin Dent Prospects 2018; 12(2): 102. https://doi.org/10.15171/joddd.2018.016
16. Nagendrababu V, Duncan HF, Whitworth J, Nekoofar MH, Pulikkotil SJ, Veettil SK, et al. Is articaine more effective than lidocaine in patients with irreversible pulpitis? An umbrellareview. Int Endod J 2020; 53(2): 200-213 https://doi.org/10.1111/iej.13215
17. Fu-Chao Liu, Jiin-TarngLiou, Yuan-Ji Day, Allen H. Li, Huang-Ping Yu. Effect of warm lidocaine on the sensory onset of epidural anesthesia: a randomized trial. Chang Gung Med J 2009; 32: 643-649.
18. Allen MJ, Bunce C, Presland AH. The effect of warming local anaesthetic on the pain of injection during sub-Tenon's anaesthesia for cataract surgery. Anaesthesia 2008 ; 63(3): 276-278 https://doi.org/10.1111/j.1365-2044.2007.05351.x