Comparison of Anesthetic Efficacy OF 2% Lidocaine Inferior Alveolar Nerve (IANB) Block Versus Primary Buccal Infilteration with 4% Articaine in Symptomatic Irreversible Pulpitis(SIP) IN Mandibular First Molars

Comparison of Anesthetic Efficacy OF 2% Lidocaine Inferior Alveolar Nerve (IANB) Block Versus Primary Buccal Infilteration with 4% Articaine in Symptomatic Irreversible Pulpitis(SIP) IN Mandibular First Molars

UNIQUE PROTOCOL ID : SS-ENDO-IANBART-2025

Date of document : 07 .02. 2026

NCT Number : Not assigned yet

Resident name : Dr Sadia Shehzadi
BDS ,FCPS II Resident Operative and Endodontics
Armed Forces Institute of Dentistry AFID CMH, Rwp
RTMC : 2023-115-4828
Correspondence : sadiashehzadi321@gmail.com
Phone number : 0334-2073051

Supervisor : Major General Nadeem Ahmad Rana
BDS(Pb), MCPS ,FCPS
RTMC : DSG-S-083-216
Classified specialist in Operative dentistry
Commandant AFID, CMH Rawalpindi

Signatures of resident: _____ signatures of supervisor :_____

Introduction: The inferior alveolar nerve block (IANB), commonly referred to as the mandibular nerve block, is one of the most frequently employed techniques in dental practice and a cornerstone for achieving regional anesthesia in the mandibular arch. Despite its widespread use, the IANB is associated with a notable failure rate of 20–25%, even when administered correctly (1). This high failure rate highlights the complexity of the technique, which involves the precise deposition of local anesthetic solution into the pterygomandibular space to block the inferior alveolar nerve before it enters the mandibular foramen. The anatomical landmarks, such as the coronoid notch and pterygomandibular raphe, are technique-sensitive and require a thorough understanding and skill for accurate localization (2).

IANB is effective in anesthetizing the mandibular teeth, lower lip, buccal mucoperiosteum, and anterior two-thirds of the tongue on the ipsilateral side. However, it is not without complications. These range from trismus and hematoma formation to rare events such as needle breakage and transient facial paralysis. Additionally, factors such as individual variability in anatomy and the density of cortical bone contribute to its unpredictable efficacy. This necessitates the exploration of alternative methods to achieve reliable anesthesia for dental procedures (3).

Buccal infiltration (BI), a simpler and less technique-sensitive alternative, has garnered interest in recent years. Articaine, a 4% local anesthetic solution, has demonstrated higher success rates when used for buccal infiltration compared to the IANB with 2% lidocaine. Anaesthetic success after buccal infiltration of 4% articaine was 76.9% compared to 62.8% who received IANB of 2% lignocaine (4) For instance, Bartlett and Mansoor reported a 76.9% success rate with articaine buccal infiltration versus a 62.8% success rate with lidocaine IANB (5). In contrast, Komsic et al reported a 53.5% success rate with articaine buccal infiltration compared to a 62.8% success rate with lidocaine IANB (6). Additionally, the buccal cortical plate has been observed to have a mean thickness ranging from 1.4 mm to 2.3 mm, depending on anatomical location and population demographics, further influencing anesthetic diffusion and efficacy. Articaine's superior efficacy is attributed to its ability to penetrate the buccal cortical plate, which varies in density and porosity among individuals and populations (7). However, its effectiveness may be influenced by anatomical factors such as the thickness of the cortical bone, especially in the second molar region (8).

The majority of previous studies on this topic have focused on pediatric populations or regions outside South Asia, yielding mixed results (9). There remains limited data on the comparative efficacy of articaine BI and lidocaine IANB in adult patients with symptomatic irreversible pulpitis in the mandibular molar region, particularly in the Pakistani population.

The rationale for this study is to address the gap in the literature by evaluating the efficacy of 4% articaine buccal infiltration compared to 2% lidocaine IANB for pulpal anesthesia in symptomatic mandibular first molar teeth in a sample of the Pakistani population. Unlike prior research, which often relied on subjective assessments and overlooked confounding factors such as anxiety and stress that lower pain thresholds, this study employs a standardized methodology to objectively evaluate outcomes. (Corah's Dental anxiety scale High and severe anxiety /phobic≥13 or ≥15 eliminated from study)Additionally, it aims to assess the necessity for supplemental anesthesia, thus providing critical insights for improving clinical protocols .

OBJECTIVE:

To compare the anesthetic efficacy of 2% lidocaine administered via inferior alveolar nerve block (IANB) versus 4% articaine administered via primary buccal infiltration in achieving pulpal anaesthesia for the treatment of mandibular first molars with symptomatic irreversible pulpitis, measured by the success rate of pain elimination during endodontic procedures.

OPERATIONAL DEFINITIONS :

1. **Anesthetic Efficacy**
   The ability of a local anesthetic technique to achieve successful pulpal anesthesia, defined as the absence of pain during endodontic procedures and two consecutive nonresponsive EPT readings at any time during 60 minutes period on mandibular first molars with symptomatic irreversible pulpitis, as reported by the patient.
2. **Inferior Alveolar Nerve Block (IANB)**
   A local anesthetic technique involving the deposition of 2% lidocaine with epinephrine (1:80,000) near the mandibular foramen to anesthetize the mandibular nerve, providing sensory blockade to mandibular teeth, soft tissues, and tongue on the ipsilateral side.
3. **Primary Buccal Infiltration**
   A local anesthetic technique involving the deposition of 4% articaine with epinephrine (1:100,000) into the buccal mucosa near the apex of the mandibular first molar, allowing the anesthetic to penetrate the cortical bone and provide pulpal anesthesia.
4. **Symptomatic Irreversible Pulpitis**
   A clinical condition characterized by spontaneous, lingering pain in a mandibular first molar, confirmed by a positive response to thermal or electric pulp testing, indicative of irreversible inflammation of the pulp.

NullHypothesis(H_0):

There is no difference in the anesthetic efficacy of 4% articaine primary buccal infiltration

and 2% lidocaine inferior alveolar nerve block in achieving successful pulpal anesthesia for endodontic therapy in mandibular first molars with symptomatic irreversible pulpitis.

AlternateHypothesis(H_1):
4% articaine primary buccal infiltration demonstrates better anesthetic efficacy compared to 2% lidocaine inferior alveolar nerve block in achieving successful pulpal anesthesia for endodontic therapy in mandibular first molars with symptomatic irreversible pulpitis.

MATERIAL AND METHODS

STUDY DESIGN: Single blinded Randomized Controlled Trial

SETTING: Operative Dentistry Department, AFID, CMH Rawalpindi

DURATION: 6 Months to 1 year after approval of Research Proposal

SAMPLE SIZE: By using WHO calculator, sample size is 330, having 165 in each group with level of significance 5%, power of test 80%. Population proportion for group 1 (IANB) is 62.8%.Population proportion for group II (BI) is 76.92% (4).

Group 1: n= 165

Patients receiving 2% Lidocaine inferior Alveolar Nerve Block with 1:80,000 epinephrine using 0.4x42mm needle at the rate of 1.8ml per 60seconds

Group 2: n= 165

Patients receiving 4% Articaine with 1:100,000 Primary Buccal infiltration using 0.4x25mm needle at the rate of 1.8ml per 60seconds

SAMPLING TECHNIQUE: Consecutive non- random Sampling

SAMPLE SELECTION:

Permission will be taken from Ethical Research Committee of Armed Forces Institute of Dentistry.

Inclusion criteria:

- Systemically healthy patients classified as ASA I, aged 18–55 years.
- Permanent mandibular first molar tooth requiring endodontic therapy.
- Diagnosed with symptomatic irreversible pulpitis without swelling or sinus.
- Normal periapical radiographic appearance (no evidence of periapical pathology).
- Moderate pain as assessed by the Heft-Parker VAS (>54 mm and <114 mm).
- Lingering pain or prolonged response to cold testing (lasting more than 10 seconds).
- Positive response to electric pulp testing.
- Outcome assessed must be pulpal anesthesia

Exclusion criteria:

- Pregnant or lactating mothers.
- Teeth with reversible pulpitis, previously treated, or with calcified canals.
- Teeth with severe periodontal disease or periapical radiolucency.
- Patients who have taken analgesics or anti-inflammatory drugs within 6 hours before the treatment visit.
- Patients on medications that could potentially interact with the anesthetic solution (e.g., antihypertensives, anticoagulants).
- History of allergy to 4% articaine, lidocaine, or epinephrine.
- Systemic diseases, immunocompromised states, or significant anxiety/mental health disorders.
- History of vasovagal syncope on local anesthetic administration.

DATA COLLECTION:

Study will be conducted after the approval from Institutional Ethics Review Committee, AFID and after obtaining informed consent from all participants (ANX "A"). (Attached at the end). A total of 104 entitled patients reporting to Operative Dentistry Department, Armed Forces Institute of Dentistry will be invited for participation in this study. The study population will include patients presenting with symptomatic irreversible pulpitis in permanent mandibular first molars, requiring endodontic therapy.
Demographic details (including name, age, gender, contact) will be obtained on data collection forms. (Annex-B).

Before starting the treatment, each patient will receive an explanation regarding the Heft-Parker Visual Analogue Scale (HP VAS) and will be asked to rate their baseline pain on a self-reported questionnaire. Pain intensities will be categorized as no pain (0 mm), mild pain (1–54 mm), moderate pain (55–114 mm), and severe pain (>114 mm). Corah's Dental anxiety scale High and severe anxiety /phobic≥13 or ≥15 eliminated from study . A 20% Benzocaine gel will be applied topically at the injection site for 2 minutes using a cotton tip applicator, ensuring that the application is uniform and does not anesthetize surrounding tissues. The injection site and needle will be dried using a sterile gauze, and the tongue and buccal surfaces of the lips will be isolated with cotton rolls to prevent inadvertent spread of the topical anesthetic.

Patients will be randomly allocated to one of two groups using a computer-generated randomization sequence to minimize selection bias. In Group 1, patients will receive an inferior alveolar nerve block (IANB) using 1.8 mL of 2% lidocaine with 1:80,000 epinephrine administered via the anterior technique in the pterygomandibular space. In Group 2, patients will receive a primary buccal infiltration using 1.8 mL of 4% articaine with 1:100,000 epinephrine injected adjacent to the mandibular first molar, bisecting the approximate location of the mesial and distal roots over a 1-minute period. All injections will be

administered by a single clinician to ensure standardization, and the same type of syringe and needles (27G) will be used in both groups.

Fifteen minutes after injection, symptoms of soft tissue anesthesia will be evaluated. In Group 1, lip numbness will be assessed to confirm successful anesthesia. If profound lip numbness is not observed, the block will be considered unsuccessful, and the patient will be excluded. In Group 2, anesthesia will be confirmed by probing the buccal soft tissue. Following this confirmation, the affected teeth will be isolated with a rubber dam, and pulpal anesthesia will be reassessed using an electric pulp tester (EPT). Patients will also rate their pain levels using the HP VAS. If moderate or severe pain (VAS ≥ 55 mm) is reported, supplemental anesthesia, such as intraligamentary or intrapulpal injections, will be administered, and these cases will be documented as failures.

The endodontic procedure will then proceed with caries removal, access cavity preparation, and canal instrumentation. At each stage of the procedure, the patient will be asked to rate their pain or signal discomfort by raising their hand. The effectiveness of anesthesia will be evaluated both objectively, based on the EPT reading, and subjectively, using the HP VAS. Success will be defined as no response at the maximum EPT output of 80, and mild or no pain (VAS <55 mm or <36% of the total VAS scale) during the procedure. Failure will be recorded if the EPT reading is below 80, or the patient experiences moderate to severe pain (VAS ≥55 mm or ≥36% of the total VAS scale) at any stage of the treatment.

By ensuring randomization, blinding the outcome assessor, and standardizing the administration of local anesthesia, this study aims to control potential confounding variables and reduce bias. The success and failure of anesthesia will be assessed based on predefined objective and subjective criteria, ensuring consistency and reliability of the outcomes.

Pain Assessment

Pain intensities recorded on a self-report questionnaire using Heft-Parker VAS.

The scores are divided into 4 categories:

- **No pain**: 0 mm (0%)
- **Mild pain**: >0 mm to ≤54 mm (0–36% of the total VAS scale)
- **Moderate pain**: >54 mm to <114 mm (36–76% of the total VAS scale)
- **Severe pain**: ≥114 mm (>76% of the total VAS scale)

Pain perception was assessed at different stages of endodontic treatment using the Heft-Parker Visual Analogue Scale (VAS). The evaluation was carried out before administration of local anesthesia, 15 minutes later with electric pulp testing, during access cavity preparation, on pulp chamber opening, and finally during root canal instrumentation. The VAS scores, ranging from 0 to 170 mm, allowed classification of pain intensity as none, mild, moderate, or severe, providing a standardized measure of patient discomfort throughout the procedure.

DATA ANALYSIS:

The data will be analyzed using IBM SPSS Statistics version 23.0.

Descriptive statistics : Quantitative variables like age,Corah's DAS , percentage, duration of numbness and pain/VAS score will be expressed in terms of mean and standard deviation.

Qualitative variables such as gender, behaviour, efficacy, tooth number and side/quadrant will be expressed in terms of frequency and percentage.

Both groups will be compared by using chi-square test. Effect modifiers such as age, gender, side/quadrant tooth number, duration and behavior will be controlled through stratification and Chi-square test will be applied accordingly. $\mathbf{p \leq 0.05}$ will be considered significant .

References:

1. Jalalzadeh SM, Asgary S. Mandibular foramen position and its relationship to inferior alveolar nerve block failure in patients with irreversible pulpitis: A cone-beam computed tomography study. J Endod. 2022 Jun;48(6):719-26.
2. Ghorbanzadeh S, Sadighi A, Khademi A, Seif A, Arjomandzadegan M. Comparing Gow-Gates and inferior alveolar nerve block techniques in achieving pulpal anesthesia in mandibular molars with irreversible pulpitis: A double-blind randomized clinical trial. J Dent Anesth Pain Med. 2023 Apr;23(2):127-34.
3. Jasim HH, Al-Sultan AM, Ismail HI. Efficacy of articaine versus lidocaine for inferior alveolar nerve block in patients with mandibular molars with symptomatic irreversible pulpitis: A meta-analysis. J Endod. 2021 Aug;47(8):1277-84.
4. Zain M, Rehman Khattak SU, Sikandar H, Shah SA, Fayyaz. Comparison of Anaesthetic Efficacy of 4% Articaine Primary Buccal Infiltration Versus 2% Lidocaine Inferior Alveolar Nerve Block in Symptomatic Mandibular First Molar Teeth. J Coll Physicians Surg Pak. 2016 Jan;26(1):4-8. PMID: 26787022.

5. Gandhi SA, Das S, Das A, Agnihotri Y, Mohan RV, Dasu Subramanian VR. Anaesthetic efficacy of lidocaine and articaine in inferior alveolar nerve block combined with buccal infiltration in patients with irreversible pulpitis. J Pharm Bioallied Sci. 2021 Jun;13(Suppl 1):S731-S734 .
6. Komsic J, Vujkov S, Neskovic I, Blagojevic D, Tadic A, Petrovic B, et al. Comparative evaluation of alveolar nerve block with 2% lidocaine-epinephrine and 4% articaine-epinephrine buccal infiltration in mandibular premolar and molar region in children: A double-blind, randomized trial. Children (Basel). 2025 Feb;12(2):215.
7. Shahi S, Nezafati S, Asgary S. Pulpal anesthesia with articaine vs. lidocaine for mandibular molars with symptomatic irreversible pulpitis: A systematic review. Int Endod J. 2023 Mar;56(3):300-10.
8. Ahmad N, Ullah H, Khan N. Frequency and factors affecting the failure of inferior alveolar nerve block: A prospective observational study. Cureus. 2023 May;15(5):e39012 .
9. Yu J, Liu S, Zhang X. Can buccal infiltration of articaine replace traditional inferior alveolar nerve block for the treatment of mandibular molars in pediatric patients? A systematic review and meta-analysis. Med Oral Patol Oral Cir Bucal. 2021 Nov;26(6):e754-61 .

Annex- A

"COMPARISON OF ANESTHETIC EFFICACY OF 2% LIDOCAINE INFERIOR ALVEOLAR NERVE (IANB) BLOCK VERSUS PRIMARY BUCCAL INFILTERATION WITH 4% ARTICAINE IN SYMPTOMATIC MANDIBULAR FIRST MOLARS

Patient consent form:
I have

• Been informed and understood the procedure and protocol of the study.

• My question and queries were answered to my satisfaction.

• Been informed of the possible risks and side effects of the procedure being conducted.

• Understood that the project is for the purpose of research and will fulfill any treatment requirements as well.

• Understand that the project may involve randomization of participants.

• Been informed that the confidentiality of the information will be maintained and safeguarded. Given permission for medical practitioners, other health professionals, hospital or laboratories outside this hospital, to release information concerning my dental problem and treatment which is needed for this trial and understood that such information will remain confidential.

• Been assured that I am free to withdraw at any time without comment or penalty.

• Agreed to participate in the study project with my free will and wish.

Name and signature of **participant:** _____
Date: _____
Signature of Resident **(Investigator):** _____

(ANNEX- B)

DEPARTMENT OF OPERATIVE DENTISTRY

ARMED FORCES INSTITUTE OF DENTISTRY

RAWALPINDI

S. No.___ Hospital Registration No. _____ Gender: M/ F: ___ Age _____ Name _____ Contact No _____ Tooth # ____ Duration _____ Corah's DAS :_____ , Operator's Name : _____ Anesthetic agent_____ Group _____ Duration for which LA remained effective after the treatment _____

Pain Assessment

Pain intensities recorded on a self-report questionnaire using Heft-Parker VAS.

The scores are divided into 4 categories:

No pain 0 mm

Mild pain >0 mm and ≤ 54 mm

Moderate pain >54 mm and < 114 mm

Severe Pain ≥ 114 mm

Stage of Treatment	Heft-Parker VAS
Before LA administration	
10-15 min later with EPT	
Access cavity prep	
Pulp chamber opening	
Root canal instrumentation	

Response at 10-15 mins with EPT : Responsive /Non responsive

Response at pulp chamber opening with EPT :Responsive / Non responsive

Efficacy of Local anesthetic agent : Yes/No

DEPARTMENT OF OPERATIVE DENTISTRY & ENDODONTICS
ARMED FORCES INSTITUTE OF DENTISTRY (CMH RAWALPINDI)

NO DUPLICATION CERTIFICATE

It is to certify that the study title COMPARISON OF ANESTHETIC EFFICACY OF 2% LIDOCAINE INFERIOR ALVEOLAR NERVE (IANB) BLOCK VERSUS PRIMARY BUCCAL INFILTERATION WITH 4% ARTICAINE IN SIP IN MANDIBULAR FIRST MOLARS is being undertaken by Dr. Sadia Shehzadi RTMC No. DSG2023-115-4828 FCPS II resident of operative and endodontics , has never been conducted at Armed Forces Institute of Dentistry (AFID) , CMH Rawalpindi and there is no duplication of this study.

Major General Nadeem Ahmed Rana
BDS . MCPS .FCPS
Classified Specialist in operative and endodontics
Commandant AFID,CMH Rawalpindi
RTMC # DSG-S-083-216)

Supervisor Signature _____ Resident signature _____

To,
The Director R & RC,

College of Physicians and Surgeons Pakistan (CPSP) Regional Centre, Islamabad

Respected Sir,

Enclosed herewith please find the research proposal titled ‘’COMPARISON OF ANESTHETIC EFFICACY OF 2% LIDOCAINE INFERIOR ALVEOLAR NERVE (IANB) BLOCK VERSUS PRIMARY BUCCAL INFILTERATION WITH 4% ARTICAINE IN SIP IN MANDIBULAR FIRST MOLARS - a prerequisite for FCPS II in the subject of Operative dentistry and Endodontics.
Prepared by Dr.SADIA SHEHZADI RTMC Registration No: DSG-2023-115-4828
FCPS I Roll No: 910085
FCPS II Session of: July, 2023

Name of Supervisor: Major General Nadeem Ahmed Rana .
Qualification: BDS,MCPS, FCPS
Designation : Classified Specialist in Operative and endodontics
Commandant AFID,CMH Rawalpindi
Name of Training Institute: Armed Forces Institute of Dentistry (AFID) , CMH Rawalpindi
Department: Operative and endodontics

Supervisor Signature: _____ Official stamp_____

Dated : _____

Yours sincerely
Dr.Sadia Shehzadi
Resident Operative dentistry &Endodontics
AFID,CMH Rawalpindi