"ASSESSMENT OF ANESTHETIC EFFICACY OF ANGULATED NEEDLE APPROACH, HALSTED AND FISCHER 1-2-3 INFERIOR ALVEOLAR NERVE BLOCK TECHNIQUE FOR EXTRACTION OF MANDIBULAR TEETH- A RANDOMIZED CONTROL TRIAL"

By

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LIST OF ABBREVIATIONS

IAN	INFERIOR ALVEOLAR NERVE
IANB	INFERIOR ALVEOLAR NERVE BLOCK
SMA	STANDARD MANDIBULAR ANESTHESIA
BM	BUCCAL NERVE
LNB	LINGUAL NERVE BLOCK
LA	LOCAL ANESTHESIA
ANA	ANGULATED NEEDLE APPROACH
QAS	QUALITY OF ANESTHESIA SCORE
NRS	NUMERICAL RATING SCALE
ASA	AMERICAN SOCIETY OF ANESTHESIOLOGISTS (CLASSIFICATION SYSTEM)

ABSTRACT

Title: Assessment of anesthetic efficacy of Angulated Needle Approach, Halsted and Fischer 1-2-3 inferior alveolar nerve block technique for extraction of mandibular teeth- a Randomized Control Trial

Background: Local anesthesia is essential for pain control in dental surgery, with the inferior alveolar nerve block (IANB) being the standard technique for anesthetizing the mandibular teeth, gingivae, and lower lip. Despite its widespread use, conventional methods like Halsted's direct technique and Fischer's indirect technique often yield inconsistent success rates (reported failures ranging from 13% to 48%), even when performed by experienced clinicians, due to the challenges of precise anatomical targeting. To address these limitations, newer approaches—such as needle angulation modifications and single-path, multi-depth injections—have been developed to enhance precision and efficacy. This study evaluates the angulated needle technique as a potential improvement over traditional IANB methods, comparing its accuracy and anesthetic effectiveness both during and after mandibular tooth extractions.

Aim: Assessment of anesthetic efficacy of Angulated Needle Approach, Halsted and Fischer 1-2-3 inferior alveolar nerve block technique for extraction of mandibular teeth

.**Materials and Methods**: Sample size of 91 participants using standard formula was calculated. Participants were allocated into 3 groups as group I: Halsted and group II: Fischer and Group III: Angulated. Quality of Anesthesia was measured using Sick's Scale and intra-op and post-op pain was calculated using Visual Analog Scale(VAS). The statistical test to be done for the following parameters were: Descriptive statistics,

Normality of data assessed by Shapiro – Wilk test, Student Paired *t*-test/ Wilcoxon Matched Pairs test for baseline and post intervention comparison of groups, Intergroup comparison with Unpaired t-test/ Mann-Whitney U test. Statistical significance to be accepted at a confidence level greater than 95% ($p < 0.05$).

Results: The study included 60.22% and males were 39.78% with most common treatment being surgical extraction of mandibular impacted third molar with 45.16%. Quality of Anesthesia has success rate was observed in Group 3 with 90.32%(28 out of 31). The Quantity of injected Anesthesia results show highly significance differences in which Group 3 required substantially less anesthesia (1.69 ± 0.17). Post-hoc Tukey tests revealed that Group 3's dosage was significantly lower than both Group 1 ($p = 0.0002$) and Group 2 ($p < 0.0001$), while Groups 1 and 2 did not differ significantly from each other ($p = 0.1123$). Analysis showed significant pain score differences between groups ($p<0.01$), with Group 3 demonstrating superior intraoperative pain control (median=1.0) versus Groups 1-2 (median=3.0). Post-hoc tests revealed Group 2 performed significantly worse ($p<0.01$ versus both groups), while Group 3 maintained consistently better analgesia throughout surgery. Onset time analysis revealed highly significant differences ($F=97.36$, $p<0.0001$), with Group 1 showing fastest onset (93.7±7.03s) and tightest variability (IQR=6.0), while Groups 2 (129.89±25.11s) and 3 (161.68±20.61s) demonstrated progressively slower, more variable responses (all pairwise $p<0.0001$). Group 1's rapid, consistent onset profile suggests clinical superiority when fast anesthesia is required.

Conclusion: Thus, our study concluded that treating patients in Angulated Needle Approach is highly effective in pain reduction and in achieving low Quality of Anesthesia Score and can be used as an effective alternate to Halsted and Fischer 1-2-3 inferior alveolar nerve block technique.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF GRAPH

INTRODUCTION

Its use for more than 100 years has served a vital purpose in alleviating pain during various orofacial surgical procedures and significantly improving patient comfort during the intervention. Its achievement in clinical history is possible through the effort of American surgeon William Halsted. Halsted's pioneering experimentation with cocaine as a local anesthetic, first injected close to the inferior alveolar nerve (IAN), set the stage for contemporary anesthetic techniques.To further confirm the efficacy of his new technique, Dr. Halsted successfully experimented by inducing mandibular anesthesia on his colleague, Dr. Hall. This successful test not only verified the safety and effectiveness of the procedure but also established the general acceptance of its use within the medical community. In demonstrating the everyday utility of local anesthesia for orofacial surgeries, Halsted forever changed the face of pain management and established a new standard of surgical comfort and safety. His work has left a lasting legacy on current medical procedures, allowing patients to have procedures done with minimal pain and maximum effectiveness.[1]

Without doubt in the modern era, basic principles of Halsted's direct technique remain, as the dominant method used. This method, referred to as the Standard Mandibular Anesthesia Technique (SMA), is still commonly used.

In dentistry, Halsted's direct technique remains influential in contemporary practices. For example, when giving local anesthesia for dental treatment, dentists tend to use the principles laid down by Halsted. The Standard Mandibular Anesthesia Technique (SMA) is a good example of this long-standing approach. By adhering to certain guidelines and protocols, dental practitioners can successfully numb the lower jaw region to make patients comfortable during treatments.

In addition, the global popularity of the SMA attests to its effectiveness and dependability in practice. Dentists worldwide rely on this method to provide accurate and repeatable outcomes, causing patients minimal discomfort with a variety of dental treatments. Consequently, the SMA has evolved as the backbone of contemporary dentistry, a testament to Halsted's long-standing impact on the discipline.

Finally, the persistent application of Halsted's direct approach, specifically as best represented by the Standard Mandibular Anesthesia Technique (SMA), is a testament to the importance of tried and tested principles in informing current dental practice. Through observing these basic practices, dental operators maintain a lineage of excellence and patient-focused professionalism in practice.[33;10] This method needs to involve meticulous placement of a needle into the pterygomandibular space next to the mandibular foramen for local anesthetic administration. The method achieves effective delivery of anesthetic fluid to block neural transmission within the region of choice. In many mandibular surgeries, this technique is designed to provide local solution for lingual nerve block (LNB) and inferior alveolar nerve block (IANB), in addition to extra buccal nerve (BN) analgesia.[2,3,4]

The Fischer (1-2-3) indirect technique subsequently developed in dentistry, with the use of needle placement through three separate insertion points.[5] Research always proves the efficacy of mandibular local anesthesia, and Halsted's traditional injection method still retains its status as the gold standard for inferior alveolar nerve block (IANB).[6,7,1]

Conventional mandibular anesthesia methods' success is mostly dependent on the practitioner's anatomical awareness and technical skill. One of the most important things is finding the initial puncture site of the buccal mucosa needle for accurate

placement in relation to the mandibular foramen during local anesthetic solution (LA) injection into the pterygomandibular space[8].

Despite being a frequently used nerve block in dentistry, inferior alveolar nerve anesthesia sometimes fails to achieve complete pain control. Reports on unsuccessful standard mandibular anesthesia (SMA) cases remain inconsistent.[9] and these anesthesia failures have become a significant challenge for dental professionals performing IAN blocks, with studies indicating a failure rate of approximately 30% for standard mandibular anesthesia techniques[10,11,12,13].

Failure to successfully conduct standard mandibular anesthesia (SMA) can vary from infrequent failures to chronic clinical difficulty, threatening a practitioner's ability to consistently anesthetize some teeth - as low as 19% success for lower lateral incisors.[14]

In an attempt to enhance IANB success rates and improve needle positioning around the mandibular foramen, investigators have created adapted techniques.[15] Various investigations have investigated pre-bending the syringe needle in a curve as a means to increase IANB success rates in mandibular anesthesia. English literature describes this adapted technique as a valid method of delivering reliable inferior alveolar nerve blockade. Contemporary literature presents rare documentation on angulated needle mandibular nerve block techniques. Our research tested the clinical efficacy of this novel IANB technique with angled needle penetration.

Pre-bending of a syringe needle to form a curved tip has been found to be an important feature in providing accurate and effective conduction anesthesia in the mandible. Pre-bending makes it easier to access the receiving nerve, and this enhances the whole success of the anesthetic block. In the context of mandibular anesthesia,

specifically for the Inferior Alveolar Nerve Block (IANB), there is a discernible lack of literature on the use of an angulated needle for the administration of local anesthetics in mandibular conduction anesthesia.

This research is the first systematic appraisal of the efficacy of the angled-needle method for IANB administration. Through examination of this new technique, we seek to provide clinical evidence for its possible benefits in successful mandibular nerve blockade by optimized needle placement. The findings of this research may in the future transform existing dental anesthetic practice by presenting a new approach that maximizes accuracy and effectiveness in administering anesthesia for the mandible.

In addition, the use of an angulated needle can provide benefits such as enhanced visibility of the needle, better maneuverability, and greater precision in aiming at the precise nerve locations for the administration of anesthesia. This new technique has the potential to reduce the risk of complications and enhance patient comfort during mandibular anesthesia procedures. With advancements in the field of dental anesthesia, investigating other types of approaches such as the angulated needle technique might help with making further strides in the area of mandibular conduction anesthesia.

NEED FOR THE STUDY

- Local Anesthesia is a key component of dental surgery, acting as a vital step in the relief of pain and discomfort caused by the procedure. Through the provision of a painless and relaxing experience for both the patient and practitioner, it significantly contributes to the success of the surgical intervention.

- Anesthesia for the mandibular teeth, lower lip, and mandibular gingivae is achieved using the inferior alveolar nerve block (IANB) anesthesia method.

- Even in the clinical setting, the effectiveness of these methods is still quite modest under the able leadership of an expert clinician. Expertise in these methods is dependent on the clinician, who must exercise exacting care in the application of technique and in a deep understanding of anatomical subtleties. The clinician's identification of the exact buccal mucosa location for needle placement in relation to the mandibular foramen is most critical for the maximum effectiveness of local anesthesia on the nerve.

- Deficiencies in local anesthesia achievement with nerve blocks, especially inferior alveolar nerve blocks, have been reported in studies. Nine out of every ten dentists admitted some level of anesthetic failure during restorative procedures. Results from general practitioners surveyed indicated failure in 13.1%. The failure rate among individual dentists ranged from 0% to 48.6%. After initial failures, it was routine practice for dentists to provide supplementary injections. Eighty-eight percent of dentists who had failed reported having at least one unsuccessful mandibular block.

- Clinicians sometimes face difficulty in obtaining ideal anesthetic results using conventional methods, as the success rates tend to be suboptimal. Therefore, many professionals have sought to introduce new approaches to increase the effectiveness of inferior alveolar nerve blocks.

- This reflects several interesting aspects. The close relationship of the needle tip location to the mandibular foramen is directly proportional to the success of mandibular block injection.

- Efforts have been made to reduce the rate of failures, whereby researchers have outlined a method of inferior alveolar nerve block (IANB) with administration of a local anesthetic solution into the pterygomandibular space by means of needle arching manipulation and adjusting the approach angle from the classical method.

- Although a few authors have tried to employ a straight needle single path technique, whereby the needle enters the site once and injects the anesthetic solution at different depths to anesthetize the inferior alveolar, lingual, and buccal nerves.

- For purposes of this research, it is our intention to compare the accuracy and effectiveness of the angulated needle technique, a new procedure for Inferior Alveolar Nerve Block (IANB), to the classic direct and indirect procedures, namely Halsted and Fischer's techniques, both intraoperative and postoperative intra- as well as extraoperationally with and after extraction of specified teeth.

HYPOTHESIS:

NULL HYPOTHESIS:

- Angulated Needle Technique is not effective in reducing patients pain levels undergoingmandibular extraction under local anesthesia.

ALTERNATE HYPOTHESIS:

- Angulated Needle Technique is effective in reducing patients pain levels undergoing mandibularteeth extraction under local anesthesia.

AIMS AND OBJECTIVES

AIM OF THE STUDY:

- Assessment of anesthetic efficacy of Angulated Needle Approach, Halsted and Fischer 1-2-3 inferior alveolar nerve block technique for extraction of mandibular teeth

OBJECTIVES:

- To evaluate the anesthetic efficiency of angulated needle approach, Halsted and Fischer 1- 2-3 inferior alveolar nerve block technique in patients undergoing surgical extraction of mandibular teeth under local anesthesia by assessing QAS score (quality of anesthesia score)
- To assess the preoperative, intraoperative and postoperative pain and discomfort levels using the NRS (Numerical Rating Scale).

REVIEW OF LITERATURE

1. Milos Tijani, Kristina Buric, Simona Stojanovic, Nikola Buric [31 March 2020] has conducted an assessment for evaluating the anesthetic efficacy of the angulated needle approach (ANA) for the inferior alveolar nerve block (IANB). In this study they have studied 3 groups which are; Group I received direct IANB; group II received indirect IANB; group III received the IANB with ANA; from which the study was performed to assess the quality of anesthesia score (QAS), numerical pain intensity score (NRS), onset time of full anesthesia (OT), and also the peri anesthetic complications were measured. However, the results of this study yielded the completion of all oral surgeries, as evaluated by the quality of anesthesia score in 93.3 % of the patients, and over 90% and 80% in groups I and II, respectively, with the lowest experienced pain; furthermore, the most successful in group III in terms of the quality of anesthesia score, and the painless work expressed by the numericalrating score.
2. Suhael Ahmed, Naeesa Tabassum, Sarah Alyousef, Omar Al Dayel [17th January 2016] A prospective randomized analytical clinical study was conducted of alternative inferior alveolar nerve block along with long buccal and lingual nerve blocks, by injecting local anesthesia into the pterygomandibular space by single penetration without redirecting the needle was performed on 207 patients undergoing simple extractions and surgical extractions of mandibular molars over a period of 2 years. Out of 207 patients who were included in the study, anesthesia was successful in 202 patients (97.5% success rate). The study concluded that the new technique provided a high success rate which does not involve deflecting the needle to anesthetize

lingual nerve and was easier to master without causing any discomfort to the patient.

3. Vladan Lazarević, Dušica Banković-Lazarević [January 2009] published a paper to present the intraoral approach to maxillary nerve anesthesia using a curved needle. The study was done by using the standard disposable syringe with an intramuscular needle (22G, 40 mm in length), the protective cap as a lever, the needle was curved at 90 degrees, starting from the midpoint and the curved part of the needle in the frontal plane perpendicular to the nasion axis in the ventral-dorsal direction was maintained during the conduction of an anesthesia. This Intraoral approach with the new technique of maxillary nerve anesthesia was conducted in 65 adult patients with various indications and the success of the technique was analyzed based on the questionnaires specifically designed for each patient, it was confirmed that full analgesia of soft tissues in the projection zone of n. maxillaris was achieved and that the procedure was less traumatic for the patient.

4. Vivek Agarwal, Anurag Jain and Debipada Kabi [7 July 2009] a randomised control trial in which they studied the anesthetic efficacy of supplemental buccal and lingual infiltrations of articaine and lidocaine after an inferior alveolar nerve block in patients with irreversible pulpitis done in eighty seven adult random volunteers who reported in dental emergency department in that all patients received standard IANB injections using 1.8ml of 2% lidocaine with 1:200,000 epinephrine, twenty five patients did not receive supplemental infiltrations and was put into as control. Thirt one patients received buccal and lingual infiltraions of 2% lidocaine with 1:200,000 epinehrine and thirt one patients received buccal and lingual infiltrations of 2% lidocaine with 1:200,000 epinephrine at 2 minutes after the IANB. Out of Eighty four

volunteers three patients, one from each group did not have profound lip numbness at 15 mins and were excluded from the study. The control group gave a success rate of 33%, buccal and lingual infiltration of lidocaine significantly increased the success rate by 47% and 67% by using articaine infiltrations. The study concluded the supplemental buccal and lingual infiltration of 4% articaine or 2 %lidocaine increases the success rate of inferior alveolar nerve block in patients with irreversible pulpitis, although none of the techniques provided an acceptable success rate.

5. Ashish Chakranarayan, B. Mukherjee [19 October 2011] a prospective analytical study was carried out at the Division of Oral & Maxillofacial Surgery, Dental Centre, INHS Kalyani, Eastern Naval Command, Vishakhapatnam, (AP) India from Jan 2009 to Jan 2010 and they studied a method on inferior alveolar nerve block by injecting a local anesthetic solution into the pterygomandibular space by arching and changing the approach angle of the conventional technique and estimated its efficacy. In all cases a side loading stainless steel aspirating syringe with a 2 cc cartridge with a 27 gauge 25 mm long (Septo-jet) needle was used The needle was then inserted from the same side a little posterior to that in conventional technique and parallel to the mandibular occlusal plane to a depth of 4 to 5 mm, following which using the embedded tip as pivot the uninserted portion of the needle was arched postero-medially which changed the angle of approach of the needle tip from acute to almost perpendicular to the medial surface of the ramus. The needle was further inserted maintaining the arch till bone was contacted on the medial surface of the ramus. In the arched needle technique, the flexibility of the fine bore needle is utilized to change the approach angle of the needle tip. The study concluded the success rate of 98 percent this technique and the authors

have successfully used this technique on more than ten thousand patients for all procedures requiring mandibular anesthesia however the technique is equipment specific and may not be meant for inexperienced operators.

6. Eliezer Kaufman, Philip Weinstein, Peter Milgrom [JADA Vol.108, February 1984] evaluated the extent of problems with local anesthetics in clinical practice, 200 Washington State general practitioners were randomly selected from the Washington State Dental Association directory, and surveyed. A single- page questionnaire asked dentists to report the number of patients seen in the past five typical practice days and to recall the number of patients who did not experience numbness (drilling without pain) for each of the six types ofinjections (for e.g., mandibular block). It asked about the use of additional injections,premedication, N2O/O2, and intravenous (IV) sedation.

7. Todorovic et al conducted a study published on 10 December 1985 which examined three different mandibular anaesthesia techniques: direct intraoral, Gow-Gates, and Akinosi. The comparison was based on various factors including onset time, duration, pain levels, aspiration rate, and overall anaesthetic effectiveness. All three techniques were generally found to be painless, with no significant variances in the duration of anaesthesia. The direct intraoral method exhibited the highest success rate in achieving anaesthesia, albeit with a higher occurrence of positive aspirations. On the other hand, the Gow-Gates technique effectively numbed the external branches of the buccal nerve, despite having a slower onset. In contrast, the Akinosi approach did not present any distinctive advantages over the other two methods.Although each technique displayed its own strengths, none emerged as distinctly superior across all parameters. The elevated aspiration rate associated with the direct intraoral method underscores the importance of precise administration, while

the delayed onset of the Gow-Gates technique may necessitate additional attention in clinical scenarios. Notably, the tuberosity approach did not offer significant advantages over the alternative methods. It is evident that further research is imperative to refine these techniques, with a specific focus on aspiration rates, onset timing, and anaesthetic efficacy. A more extensive sample size and the inclusion of additional variables, such as patient-specific factors, are essential in determining the most optimal approach for mandibular conduction anaesthesia.

8. K. Thangavelu et al in his study demonstrates that the inferior alveolar nerve block (IANB) is an effective alternative technique for achieving mandibular anesthesia. The newly designed painless IANB method showed a high success rate in anesthetizing the inferior alveolar nerve, making it a reliable option for mandibular surgical procedures. The evaluation using a sharp dental explorer confirmed effective anesthesia within 3 to 7 minutes.Given its simplicity, effectiveness, and minimal discomfort, this technique presents a valuable alternative to conventional IANB, particularly in cases where the standard approach fails. The findings support its potential for broader clinical application, improving patient experience and surgical outcomes. Further research and clinical adoption may help refine and optimize this technique for routine dental practice.

9. Alejandro Sierra R. et al in this study provides valuable insights into the anesthetic efficacy of 4% articaine versus 2% lidocaine (both with epinephrine 1:100,000) in the truncal block of the inferior alveolar nerve during surgical extraction of impacted lower third molars. The findings indicate that 4% articaine offers superior clinical performance, particularly in terms of duration of anesthesia. Articaine provided a significantly longer anesthetic effect

(220.86 min) compared to lidocaine (168.20 min) (p = 0.003), which can be beneficial in prolonged surgical procedures, reducing the need for additional anesthesia.Additionally, although latency time, the amount of anesthetic solution required, and the need for re-anesthetizing the surgical site showed clinical advantages in favor of articaine, these differences did not reach statistical significance. Both anesthetic solutions were effective in controlling intraoperative pain, as demonstrated by comparable pain scores. This suggests that while articaine may have a longer-lasting effect, lidocaine remains a reliable and effective anesthetic option.Given the prolonged duration of action and potential practical advantages of articaine, it may be a preferable choice for extensive dental procedures requiring longer anesthesia. However, further research with larger sample sizes is needed to confirm these findings and explore potential differences in safety, postoperative analgesia, and patient-reported comfort.

10. J.P. Rood in his article published on 14 January 1977 states that achieving effective anesthesia in the mandibular region requires an understanding of the complex sensory nerve plexus. Even after successful inferior dental and lingual nerve blocks, residual pain can occur due to cross-innervation, particularly from the opposite mandibular nerve via the labial mental plexus. In such cases, infiltration anesthesia is preferable over additional nerve blocks, ensuring more comprehensive pain control, especially for surgical procedures.The success of an inferior dental block is dependent on both the volume and concentration of the anesthetic used. A minimum of 1.0 ml of 2% lignocaine with 1 in 80,000 adrenaline is essential to effectively block nerve impulses. While smaller volumes may lead to incomplete anesthesia, excessive amounts can cause unnecessary tissue pressure. Additionally, in the presence of acute

inflammation, where sensory nerve action potentials are heightened, a higher concentration of lignocaine is often required to achieve adequate analgesia.These findings emphasize the importance of precise anesthetic techniques and tailored approaches in clinical practice. By optimizing anesthetic administration based on anatomical and pathological considerations, dental professionals can improve patient comfort and procedural success.

11. I. Potocnik et al. address the challenges associated with the inferior alveolar nerve block (IANB), the standard method for mandibular anesthesia in dental procedures. Despite its widespread use, achieving satisfactory analgesia with IANB, particularly in cases involving acutely inflamed mandibular molars, remains a significant clinical issue. Clinical studies indicate that IANB fails in approximately 30% to 45% of cases, even when the technique is properly executed. The article explores potential factors contributing to these failures, focusing on anatomical and physiological considerations. Anatomical variations, such as nerve positioning or alterations in the surrounding structures, may prevent the effective deposition of anesthetic agents. Additionally, inflammation can induce physiological changes that alter the nerve's responsiveness to the anesthetic, thereby compromising the block's efficacy. The authors suggest that these anatomical and inflammatory factors are key to understanding the high failure rates of IANB and propose that further research is needed to refine current techniques or develop alternative approaches. This study emphasizes the importance of considering individual patient variations and the impact of inflammation in the pursuit of more effective and reliable methods for mandibular anesthesia in clinical practice.

12. Peter D. Olch's article provides an insightful overview of William Halsted's groundbreaking contributions to dentistry and surgery, particularly in the field

of anesthesia. Halsted was the first to systematically demonstrate the practical benefits of local anesthesia in dental and oral procedures. His pioneering work extended beyond dentistry, as he successfully applied anesthetic techniques to critical nerve sites such as the brachial plexus, posterior tibial, and internal pudendal nerves. He also introduced the concept of intradermal infiltration for skin anesthesia, which became a foundation for modern anesthetic practices.Beyond his contributions to anesthesia, Halsted played a pivotal role in advancing surgical techniques. He developed the radical mastectomy for breast cancer, an improved method for thyroidectomy, and innovative surgical treatments for vascular aneurysms. His meticulous, aseptic approach to surgery helped shape modern surgical protocols, emphasizing precision and patient safety.Olch's article effectively highlights Halsted's lasting impact on medicine. However, a deeper discussion of the long-term influence of his techniques and how they evolved over time would further enhance the article's depth. Additionally, exploring the challenges Halsted faced in gaining acceptance for his methods would provide a more comprehensive perspective on his legacy.

13. Tim C. Krafft's study systematically investigates the potential for lingual nerve damage resulting solely from mandibular block anesthesia. The research involves a retrospective analysis of clinical records from 12,104 patients who received mandibular block anesthesia without any concurrent surgical intervention. The majority of these patients (72.4%) underwent restorative procedures such as fillings and crown preparations, while 27.13% received periodontal treatments, and 0.30% underwent other forms of dental care.The study's findings indicate a low incidence of lingual sensory disturbances, occurring in only 18 out of 12,104 cases (0.15%). Notably, 17 of these patients

experienced complete sensory recovery within six months, whereas one patient (0.008%) exhibited a slight yet persistent sensory deficit beyond one year. These results suggest that while lingual nerve impairment due to mandibular block anesthesia is a recognized complication, it is both rare and largely transient. Krafft's study contributes to the existing body of literature by providing empirical evidence supporting the safety of mandibular block anesthesia. However, further research is warranted to explore predisposing factors, such as anatomical variations or injection technique, that may influence nerve injury risk. Additionally, preventive strategies to mitigate potential complications should be considered in future studies.

14. Brian Dunne's study addresses the limitations of the conventional inferior alveolar nerve block (IANB), which is technically challenging and has high failure rates. The review aims to assess whether newer local anesthetic techniques reduce the need for IANB. A comprehensive literature search was conducted, including PubMed and manual searches, to evaluate techniques based on success rates, onset times, and complications.The study highlights several randomized controlled trials (RCTs) that compare primary methods for mandibular pulpal anesthesia. Due to heterogeneity in the literature, a systematic review or meta-analysis was not feasible. However, the available evidence (level IIb) suggests that intraosseous and buccal infiltration techniques, especially with 4% articaine, offer superior success rates, faster onset, and fewer complications compared to IANB.The conclusion emphasizes the need for standardized testing methods to reduce the heterogeneity of the literature and improve future research. Intraosseous and buccal infiltration techniques are effective alternatives to IANB for mandibular pulpal anesthesia,

and further studies are needed to refine these methods for broader clinical adoption.

15. Allen L. Sisk's article in his study evaluates the Akinosi mandibular block technique compared to conventional nerve block techniques for local anesthesia during impacted third molar extractions. Using a within-subject experimental design, the study found that both techniques had equivalent success rates and provided acceptable anesthesia quality. Notably, the Akinosi technique achieved buccal nerve anesthesia in 80% of cases. The results suggest that the Akinosi technique is a viable alternative to traditional mandibular block methods, offering comparable effectiveness. This technique may be particularly useful in clinical scenarios where traditional methods pose technical challenges, making it a reliable option for oral surgeons seeking effective anesthesia in mandibular procedures.

16. G.B. Rollman's study critically examines the limitations of traditional pain assessments that focus on a single subjective measure of "pain." By evaluating the ability of subjects to discriminate between different pain states, the study highlights the complexity of pain perception, which encompasses multiple sensory and cognitive dimensions. Twelve participants were exposed to two levels of electric shock and asked to assess pain intensity, aversiveness, and confidence in distinguishing stimulus strength using various rating scales. The findings revealed that participants could readily differentiate between high and low levels of pain but often described them as equivalent in terms of pain intensity or aversiveness. Notably, the weakest discrimination occurred in terms of subjective pain intensity. Rollman concludes that pain research should adopt a multidimensional approach, as ignoring individual differences in how subjects represent and report pain can lead to ambiguities in the literature,

particularly in studies utilizing threshold measures, signal detection theory, and magnitude estimation techniques. This underscores the importance of considering diverse pain experiences when evaluating psychophysical indices of pain.

17. R. Schumache and I. Velden applied Signal Detection Theory (SDT) to investigate the effects of experimentally induced anxiety on oral pain perception. They hypothesized that a true increase in pain, as opposed to a heightened tendency to report pain, would be reflected in improved discriminability between adjacent pain stimuli. Six participants underwent discrimination tasks with varying electrical stimuli, ranging from pain threshold to tolerance levels. In the anxiety condition, three participants were informed they might occasionally receive a very strong shock, increasing their state anxiety. The results confirmed that anxiety increased discriminability for strong pain stimuli but decreased it for weak pain stimuli. This reduction in discriminability likely reflected a disturbance in the discriminatory process due to anxiety, rather than a decrease in pain perception. Control participants showed little to no change in pain perception.

18. Thomas A. Montagnese et al. conducted a comparative analysis of the Gow-Gates technique and the standard inferior alveolar nerve block (IANB) in terms of both subjective and objective outcomes. Forty subjects received both injections, with evaluations performed 10 minutes after administration. The study found no significant differences between the two techniques, except for the subjective report of tongue numbness. Both techniques resulted in high levels of perceived overall and lip numbness among participants. However, objective testing using an electric pulp tester revealed that only 38% of subjects receiving the standard IANB and 35% of those receiving the Gow-Gates

technique exhibited no response to the maximum output, suggesting incomplete pulpal anesthesia in a majority of cases. These findings highlight that while both techniques may provide effective subjective numbness, their ability to achieve complete and reliable pulpal anesthesia remains limited. The results imply that further research is needed to optimize techniques for consistent and comprehensive mandibular anesthesia in dental procedures.

19. Stanley Malamed's article explores the challenges in achieving consistent mandibular anesthesia, particularly through the conventional inferior alveolar nerve block (IANB). Despite its widespread use, the IANB is associated with a high failure rate, with studies indicating that failure rates can reach 81%, especially in cases involving lateral incisor anesthesia. The article attributes this failure to various factors, such as the thickness of the cortical bone and soft tissue, which cause needle deflection, difficulty in locating the inferior alveolar nerve, and the possibility of accessory innervation. These issues result in inadequate anesthetic outcomes, causing both clinician frustration and patient discomfort. Malamed emphasizes the importance of seeking alternative techniques to enhance the success rate of mandibular anesthesia. He highlights the development of new methods and devices that may address the limitations of IANB and improve its reliability. Ultimately, Malamed calls for further innovation in anesthesia techniques to ensure effective pain management and improve dental treatment outcomes.

20. In his article, Stanley Malamed discusses the Gow-Gates approach to mandibular intraoral block anesthesia, introduced in the United States in 1973. This technique represented a significant advancement in local anesthesia methods after many years of relying on the conventional inferior alveolar nerve block (IANB). Malamed presents a clinical evaluation based on over 4,000

cases and several years of application. The Gow-Gates technique is now commonly taught at most dental schools in the United States. According to the article, this method offers several advantages over the traditional IANB, including a higher success rate, a lower rate of positive aspiration, and fewer post-injection complications. These benefits make the Gow-Gates technique a reliable alternative for achieving effective mandibular anesthesia, reducing common issues associated with IANB, such as inadequate anesthesia and injection-related discomfort. The article provides a thorough review of the technique's clinical efficacy, supporting its increasing adoption in dental practice as a preferred option for mandibular anesthesia.

21. T. Paul Levy conducted a split-mouth study with 26 patients to compare the Gow-Gates mandibular block for third molar removal. Highlighting the limitations of the inferior alveolar block, Levy advocates for the true mandibular subcondylar block introduced by Dr. George Gow-Gates in 1973. The study reviewed the technique's anatomy, physiology, and application. Results supported Gow-Gates' assertion that this block provides superior mandibular anesthesia compared to the conventional method. The Gow-Gates technique was well-tolerated by patients when administered in the operator-seated, patient-supine position, with long buccal anesthesia achieved in 77% of cases. Levy's experience indicated that 3.0 ml of the injection provided excellent surgical anesthesia, while 1.8 ml was less effective. The study suggests further research into optimal injection volumes for this technique.

22. In the article by Vladen Lazarevic, the author discusses an intraoral approach to maxillary nerve anesthesia using a curved needle, which offers advantages over the traditional extraoral method. The extraoral approach is noted for its complexity, requirement of long non-standard needles, and significant pain. In

contrast, the intraoral technique is less traumatic and easier to perform. The method involves using a standard 10 cc syringe with a 22G 40mm long intramuscular needle, which is curved at a 90-degree angle. After the cheek is widened with a blunt hook, the needle is placed behind and above the maxillary tuber, aiming through the pterygomaxillary fissure. Following aspiration, 4 ml of lidocaine with adrenaline is injected. The procedure was conducted in 65 patients, achieving satisfactory anesthesia in the maxillary nerve region, though additional infiltrative anesthesia was needed for the incisor area. The study concludes that this intraoral method is a reliable, simple, and patient-friendly alternative to the extraoral approach, offering greater precision and comfort without the need for specialized equipment.

23. Chang Kim et al. explore various anesthesia methods for mandibular third molar extraction, a common dental procedure. The conventional inferior alveolar nerve block (IANB) is widely used but has a relatively low success rate and carries risks such as aspiration and nerve injury. Given these limitations, alternative anesthesia techniques are being explored. Articaine, a local anesthetic, has shown efficacy in several studies and is increasingly used in clinical practice. The article provides a brief review of different local anesthesia methods, anesthetic agents, and the role of computer-controlled local anesthetic delivery (CCLAD) systems. CCLAD systems are highlighted for their ability to control the speed of drug injection, which helps reduce pain during the procedure. This review emphasizes the importance of exploring alternative anesthesia approaches to improve patient outcomes in mandibular third molar extractions.

24. Steve Goldberg's study(JOE —Volume 34, Number 11, November 2008) aimed to compare the efficacy of three mandibular anesthesia techniques—the

conventional inferior alveolar nerve block (IANB), Gow-Gates, and Vazirani-Akinosi—in achieving pulpal anesthesia in vital, asymptomatic teeth. A randomized, prospective crossover design was used, with 40 subjects receiving each technique at separate appointments. The anesthetics used were 3.6 mL of 2% lidocaine with 1:100,000 epinephrine. Pulpal anesthesia was tested using an electric pulp tester over a 60-minute period. Successful anesthesia was defined as two consecutive readings of 80 on the electric pulp tester within 15 minutes, sustained for the duration of the test. The success rates for each technique were: IANB 25%-62%, Gow-Gates 16%-44%, and Vazirani-Akinosi 13%-50%. Although no significant difference in success was found ($P > 0.05$), the study noted that both the Gow-Gates and Vazirani-Akinosi techniques had slower onset times compared to the IANB. The study concluded that while the IANB had a faster onset, the success of anesthesia for vital, asymptomatic teeth was similar among all three techniques, with IANB being slightly more effective in terms of onset speed.

25. In their study, Donald N. Franz and colleagues (J. Physiol. (1974), 236, pp. 193-210) investigated the differential sensitivity of saphenous nerve fibers in cats to block by procaine hydrochloride. The researchers recorded action potentials from small nerve filaments to assess the effects of the anesthetic. Their findings revealed that small myelinated axons were blocked more quickly than large myelinated axons, though this difference could not be attributed to variations in anesthetic concentration. The onset of block in non-myelinated axons was found to be slower or comparable to that of small myelinated axons, depending on the concentration of the anesthetic. Absolute differential blocking of non-myelinated and small myelinated axons was achieved by limiting the length of axons exposed to procaine to 2 mm.

Additionally, the study noted that the differential blocking rates among myelinated axons were influenced by the length of axons exposed to blocking concentrations of procaine. This was due to the irregular distribution of procaine within the exposed nerve fibers, which affected the speed and extent of block.

26. John T. Farrar et al.(J.T. Farrar et al. / Pain 94 (2001) 149–158) conducted a study to establish clinically significant thresholds for changes in pain intensity, measured on the 11-point Pain Intensity Numerical Rating Scale (PI-NRS), widely used in chronic pain studies. The study addressed a key gap in interpreting minor changes in pain intensity, such as 1- or 2-point reductions, which may be difficult to quantify in clinical practice. The researchers analyzed data from 2,724 participants across 10 placebo-controlled trials of pregabalin, covering various chronic pain conditions such as diabetic neuropathy, fibromyalgia, and osteoarthritis. By comparing changes in the PI-NRS with global assessments of patient improvement, captured through the Patient Global Impression of Change (PGIC), they identified a consistent relationship between a reduction of approximately two points, or a 30% decrease, in the PI-NRS and clinically meaningful improvement as reported by patients. This relationship was observed across different studies, disease types, and patient demographics. The study concluded that a reduction of 2 points on the PI-NRS corresponds to a clinically important difference in pain, providing a standardized benchmark for defining meaningful improvement in clinical trials. These findings have the potential to enhance the comparability, validity, and clinical relevance of chronic pain studies, offering clearer guidelines for assessing treatment efficacy in future research.

27. Fabien Espitalier et al. conducted a study (/ Journal of Cranio-Maxillo-Facial Surgery 39 (2011) 164e168) to evaluate the effect of mandibular nerve blocks (MNB) on intraoperative bleeding during sagittal split osteotomy of the mandibular ramus (SSOMR). MNB is commonly used for analgesia, and the researchers observed that it might also reduce bleeding and improve visibility of the inferior alveolar nerve (IAN) during surgery. The study randomized patients undergoing bilateral SSOMR under general anesthesia into two groups: the Block group, which received bilateral MNB with ropivacaine, and the Control group, which underwent sham MNBs. The results showed that the Block group experienced significantly less intraoperative bleeding (median score of 20 versus 55, p=0.0002) and had a drier surgical field (29% versus 5%, p=0.01). Additionally, the Block group had a shorter mean osteotomy time (15 minutes versus 17.5 minutes, p=0.009) and lower intraoperative opioid consumption (770 mcg versus 2310 mcg, p=0.0001). Pain scores in the recovery room were also lower for the Block group (0 versus 3, p=0.12). The study concluded that MNB reduces intraoperative bleeding, enhances surgical visibility, and may lead to a more efficient procedure with less opioid consumption, while also offering potential benefits for post-operative recovery.
28. Robert H. Dworkin et al. in their study (PAIN 146 (2009) 238–244)address the critical distinction between interpreting the clinical importance of individual patient improvements and group differences in randomized clinical trials of chronic pain treatments. The article emphasizes that while the importance of patient-level improvements can be assessed by considering what patients perceive as meaningful, the interpretation of group differences requires a more nuanced approach. This involves evaluating responder analyses, treatment effect sizes, safety profiles, secondary efficacy outcomes, treatment onset

speed, durability of benefits, and other relevant factors, such as cost and the limitations of existing treatments.Dworkin outlines the multifaceted nature of determining the clinical importance of group differences, which goes beyond statistical significance to include real-world applicability and patient-centered outcomes. The clinical relevance of treatment differences between groups must be assessed with input from various stakeholders, including clinicians, patients, researchers, and societal representatives. This comprehensive evaluation ensures that the clinical significance is meaningful and aligned with the primary therapeutic goals. By distinguishing between individual and group-level assessments, the article highlights a more holistic approach to understanding the effectiveness of chronic pain treatments in clinical trials.

29. P. Donkor et al. conducted a randomized, double-blind study comparing the efficacy of the closed-mouth and conventional mandibular block injection techniques in 200 patients undergoing tooth extractions. The study found that the conventional technique achieved a higher success rate in inferior alveolar nerve anaesthesia, with a 97% success rate compared to 79% for the closed-mouth technique. In terms of speed, 87% of patients in the conventional group experienced lip numbness within 5 minutes, whereas only 55% in the closed-mouth group did. Additionally, the conventional technique had a higher rate of positive aspirations (22%) compared to the closed-mouth technique (2%). The closed-mouth technique provided long buccal nerve anaesthesia in 71% of cases. Both techniques had similar pain responses, as well as similar effects on blood pressure and pulse rate. However, the closed-mouth technique resulted in a greater variety of unexpected symptoms compared to the conventional technique. The study concluded that while the conventional technique is more effective and faster in achieving inferior alveolar nerve anaesthesia, it carries a

higher risk of positive aspirations. The closed-mouth technique, though less effective, showed a lower incidence of complications.

30. Rudolph Jong's study(JAMA238:1383-1385, 1977)explores the mechanism by which local anesthetics block nerve impulse propagation through the occlusion of transmembrane sodium channels, thereby preventing depolarization. The process begins when the uncharged lipid-soluble anesthetic base penetrates the nerve membrane. Once inside, the positively charged cation of the anesthetic binds to the anionic components within the sodium channel's internal axoplasmic mouth. While the base primarily serves as a carrier, it also contributes to the blockade by causing the membrane to swell, thereby pinching the sodium channels.In solution, local anesthetic salt crystals dissociate into a cation and a base, with the ratio of cation to base being dependent on the drug's pKa and the tissue's pH. The concentration ratio of these components is crucial for optimal neural blockade. If the base concentration is too low, insufficient anesthetic molecules will penetrate to the neural target. Conversely, if the cation concentration is too low, fewer sodium channels will be blocked. This study emphasizes the importance of the balance between the anesthetic base and cation to achieve effective nerve blockade and underscores the role of pH in determining the efficiency of the anesthetic.

31. In their study, Russell D. Coleman et al. analyze the high success rate of mandibular anesthesia without complications when a nerve-blocking drug is injected at the lateral aspect of the mandibular neck. Anatomical dissections support the effectiveness of this injection site, particularly in the pterygomandibular space. The study challenges the traditional view that the anesthetic must be deposited in close proximity to the inferior alveolar, lingual, and buccal nerves for effective mandibular anesthesia. Instead, the results

suggest that successful anesthesia can be achieved through the lateral mandibular neck injection site, which does not require direct targeting of these specific nerves. This finding could offer a more accessible and efficient approach for achieving reliable mandibular anesthesia.

32. Henry P. Cohen et al. (Journal of Endodontics, Vol. 19, No. 7, July 1993) evaluated the efficacy of 2% lidocaine with epinephrine and 3% mepivacaine without a vasoconstrictor for pulpal anesthesia in mandibular molars with pulpitis. 61 patients received inferior alveolar nerve blocks (IANB), with 27 receiving lidocaine and 34 mepivacaine. Pulpal anesthesia was assessed using dichlorodifluoromethane (DDM), and non-responsive patients received supplemental periodontal ligament injections with lidocaine. Results showed both anesthetics were equally effective, but 23 of 61 patients with lip anesthesia required additional injections to achieve pulpal anesthesia. The study concluded that lip anesthesia is an unreliable indicator of pulpal anesthesia, whereas DDM provides a more accurate assessment.

33. H. Breivik et al. (British Journal of Anaesthesia 101 (1): 17–24 (2008))emphasized the importance of valid and reliable pain assessment in clinical trials and pain management. Due to the subjective nature of pain, objective measurement is unattainable. Acute pain can be effectively evaluated at rest and during movement using one-dimensional tools such as numeric rating scales and visual analog scales, which are more sensitive to changes than verbal categorical scales. Chronic pain assessment requires multidimensional tools, incorporating physical, emotional, and social impacts, along with disease-specific functional scales and quality-of-life instruments. The Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials provides guidelines for chronic pain evaluation. Cancer pain assessment is complex due

to additional symptoms like fatigue and depression, significantly affecting quality of life. Notably, chronic pain patients report a similar quality of life impairment to terminal cancer patients. Effective pain assessment must consider cognitive impairments and utilize validated tools for specific patient groups.

34. J. O. Akinosi in his article (British Journal of Oral Surgery 15 (1977-78) 83-87)introduced a novel technique for blocking the oral branches of the mandibular nerve with a single mucosal penetration at a relatively painless site. This approach facilitates a more rapid onset of anesthesia and proves particularly useful in cases of trismus or ankylosis. Additionally, the method minimizes common complications associated with traditional techniques.

MATERIALS AND METHODOLOGY

The study conducted in the Department of Oral and Maxillofacial Surgery, KAHER's KLE VK Institute of Dental Sciences, Belagavi with due permission availed from the institutional ethical committee. The procedure explained to all the patients and an informed consent were signed by them.

INCLUSION CRITERIA:

- Patients with a complain of pain in mandibular teeth and is indicated for extraction.
- Both male and female patients.
- Patients between 18 to 65 years
- ASA I & II
- Patients willing to give informed consent.

EXCLUSION CRITERIA:

- Patient diagnosed with periapical abcess, dentoalveolar abcess of mandibular teeth.
- Mentally challenged patients or patients with Learning disability.
- Patients with history of allergy to Local Anesthetic solution, foods, drugs,
- Alcoholics or drug abusers.
- Patients on antidepressants, anti-anginal and anti-anxiety drugs.
- Patients who had taken painkillers in the past 24 hours.
- Patients who are afraid of undergoing oral surgical treatment.
- Patient not willing to participate in study.

SAMPLE SIZE ESTIMATION:

$$n = \frac{\left(Z_{1-\alpha/2} + Z_{1-\beta}\right)^2 x\left(SD_1^2 + SD_2^2\right)}{\left(\overline{X_1} - \overline{X_2}\right)^2}$$

Zα= 1.96 at 5% alpha-error

Zβ= 1.64 at 5% beta-errorSD1 = 1.19 ; SD2 = 1.81

X_1 =2.4 ; X_2 =3.8

n = 31

So, the estimated minimum sample size is 31 per group, which makes the minimum sample size is 93 in total

METHODOLOGY:

SELECTION OF SUBJECTS

Patients selected from among those who have reported for extraction of infected mandibular teeth to Department of Oral and Maxillofacial Surgery,KLE'S Academy of Higher Education and Research, KLE VK Institute of Dental Sciences, Belagavi-590010

METHOD OF COLLECTION OF DATA:

A total of 93 patients indicated with mandibular teeth extraction diagnosed by established clinical and radiographic parameters and who meet the inclusion criteria were divided into three groups of 31 each bycomputer generated random allocation.

Group A: Halsted technique (conventional direct) - Extraction of mandibular teeth with conventionaldirect technique for inferior alveolar nerve block**. (n=31)**

Group B: Fischer 1-2-3 technique (conventional indirect) - Extraction of mandibular teeth with conventional indirect technique for inferior alveolar nerve block**.(n=31)**

Group C: Angulated Needle Approach Technique (Study Group) - Extraction of mandibular teeth withangulated technique for inferior alveolar nerve block**.(n=31)**

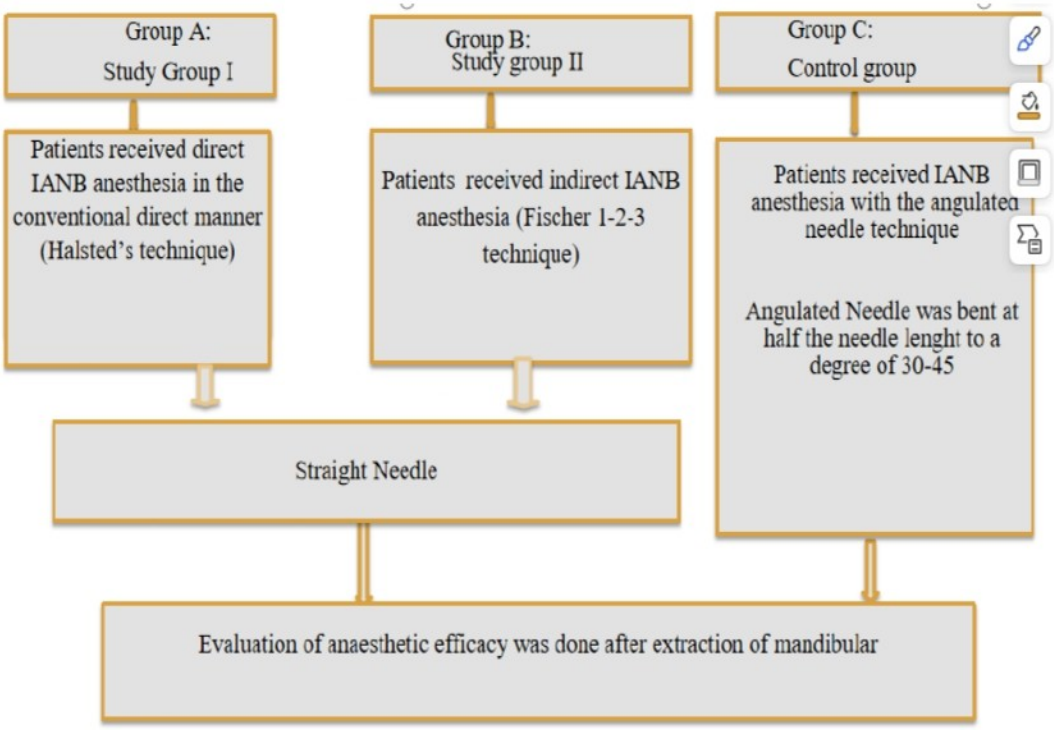
MATERIALS REQUIRED:

- Disposable sterile plastic 2.5mL syringes
- 21 gauge needles
- 2% lignocaine hydrochloride with adrenaline
- Straight Probe
- Elevators
- Tooth Extraction Forceps
- Numerical Rating Scale

DETAILS OF THE PROCEDURES TO BE CONDUCTED DURING THE RESEARCH

Method for Bending the Needle-

The needle protective cap provided with the syringe was used to angulate the needle in one steady, continuous motion, until it is angled to around 30 to 45 degrees at half its length.



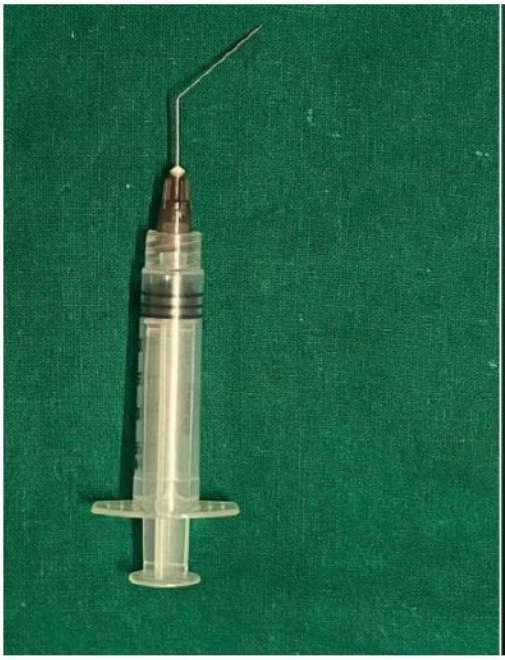


Fig 1. Angulated Needle

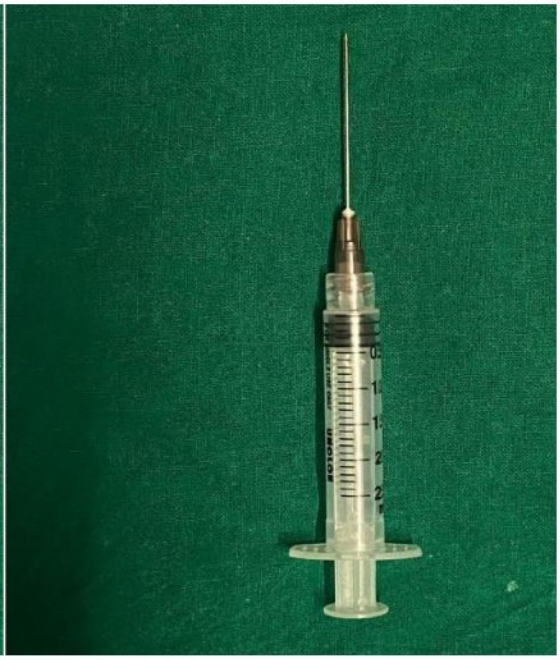


Fig 2. Straight Needle

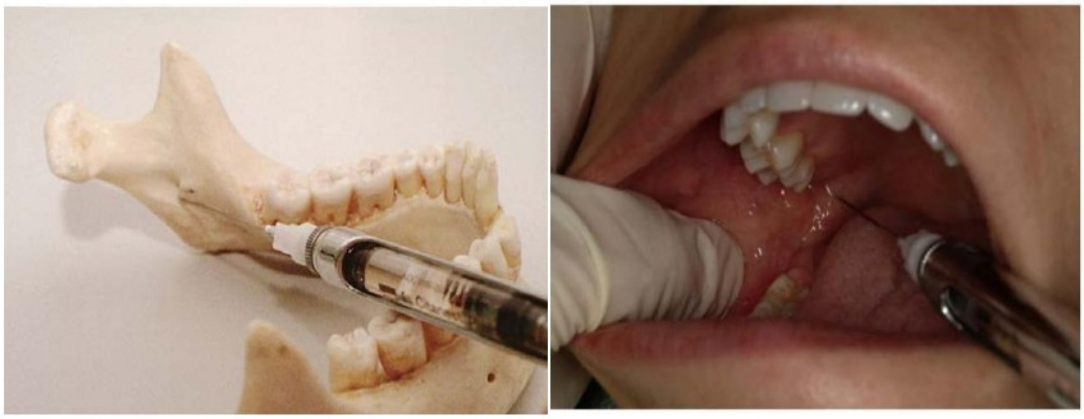


Fig 3. Conventional Technique for Inferior Alveolar Nerve Block.

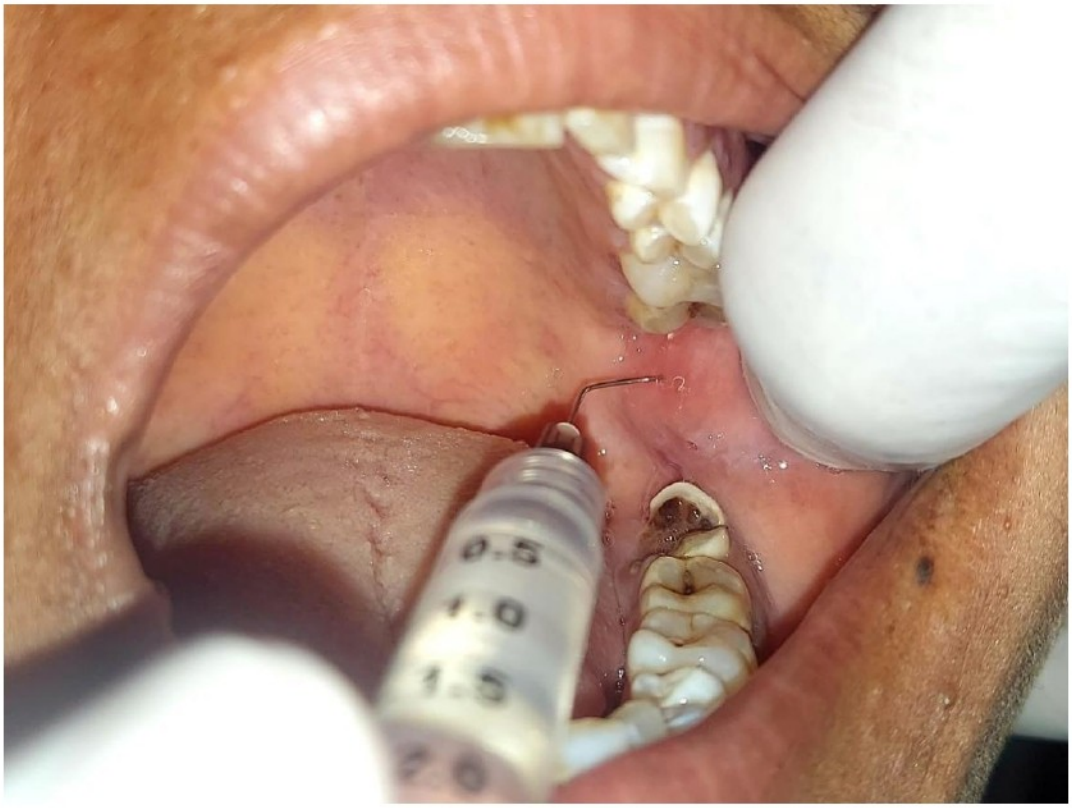


Fig 4. Angulated Direct Technique for Inferior Alveolar Nerve Block.

RESULTS

Table 1 : Comparison of three groups (1, 2, 3) with gender distribution

Groups	Male	%	Female	%	Total
Group 1	13	41.94	18	58.06	31
Group 2	14	45.16	17	54.84	31
Group 3	10	32.26	21	67.74	31
Total	37	39.78	56	60.22	93
Chi-square=1.1670, p=0.5579					

Table 1 shows a comparison of three groups (Group 1, Group 2, and Group 3) with respect to gender distribution. There are 31 participants in each group, and the total sample size is 93 participants. The distribution of males and females is different across the groups but, on the whole, the proportion of females (60.22%) is greater compared to males (39.78%). This indicates that the sample of the study is not fully gender-balanced, with higher female representation and the graphical illustration of the same is presented in the Graph 1.

Graph 1 : Comparison of three groups (1, 2, 3) with gender distribution

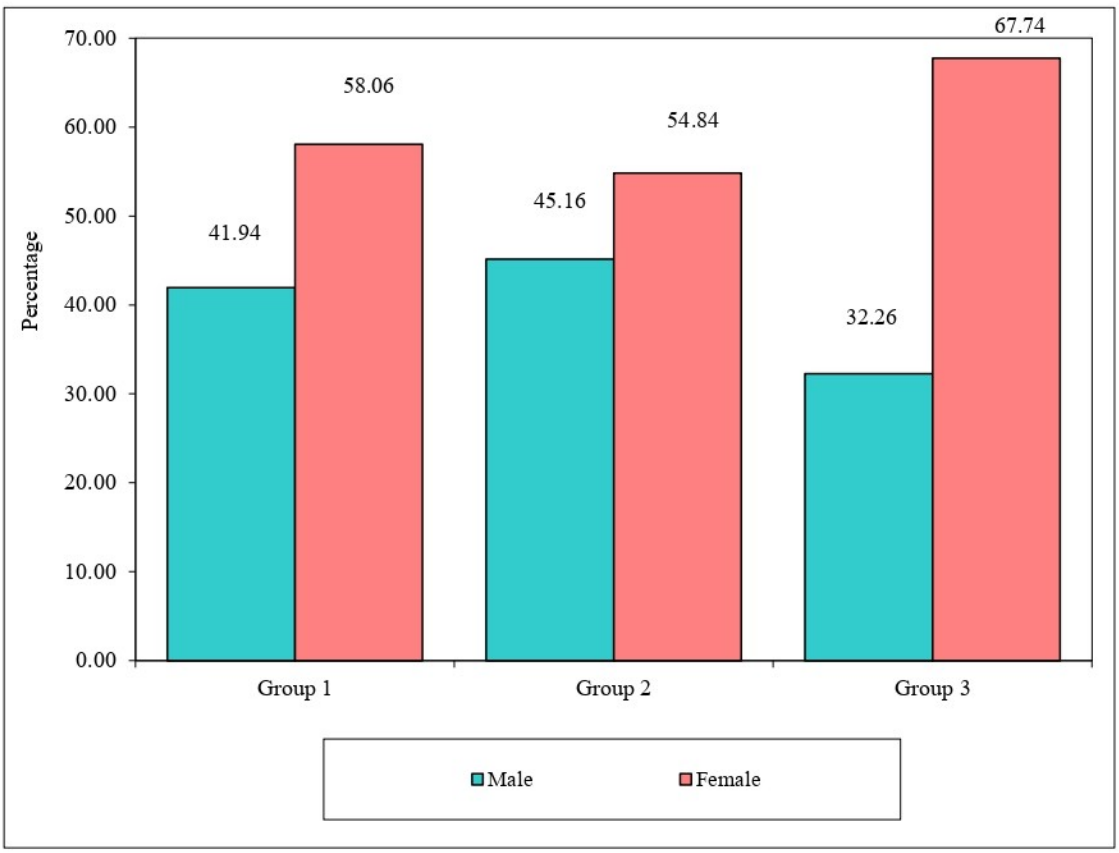


Table 2: Comparison of three groups (1, 2, 3) with Procedure type

Procedure type	Group 1	%	Group 2	%	Group 3	%	Total
Surgical Extraction	9	29.03	7	22.58	14	45.16	30
Normal Extraction	15	48.39	14	45.16	12	38.71	41
Alveoloplasty	6	19.35	7	22.58	4	12.90	17
Others	1	3.23	3	9.68	1	3.23	5
Total	31	100.00	31	100.00	31	100.00	93
Chi-square=5.3650, p=0.4979							

Table 2 shows the comparison of three groups (Group 1, Group 2, and Group 3) according to the type of procedure done. All three groups have 31 participants, giving a total sample size of 93 individuals.In Group 1, the most prevalent procedure is normal extraction (48.39%), followed by surgical extraction (29.03%), alveoloplasty (19.35%), and others (3.23%). Likewise, in Group 2, normal extraction is the most common (45.16%), followed by alveoloplasty (22.58%), surgical extraction (22.58%), and other procedures (9.68%). Group 3, however, presents a different pattern, with surgical extraction being the most common (45.16%), followed by normal extraction (38.71%), alveoloplasty (12.90%), and other procedures (3.23%). The graphical presentation has been provided in Graph 2.

Graph 2: Comparison of three groups (1, 2, 3) with Procedure type

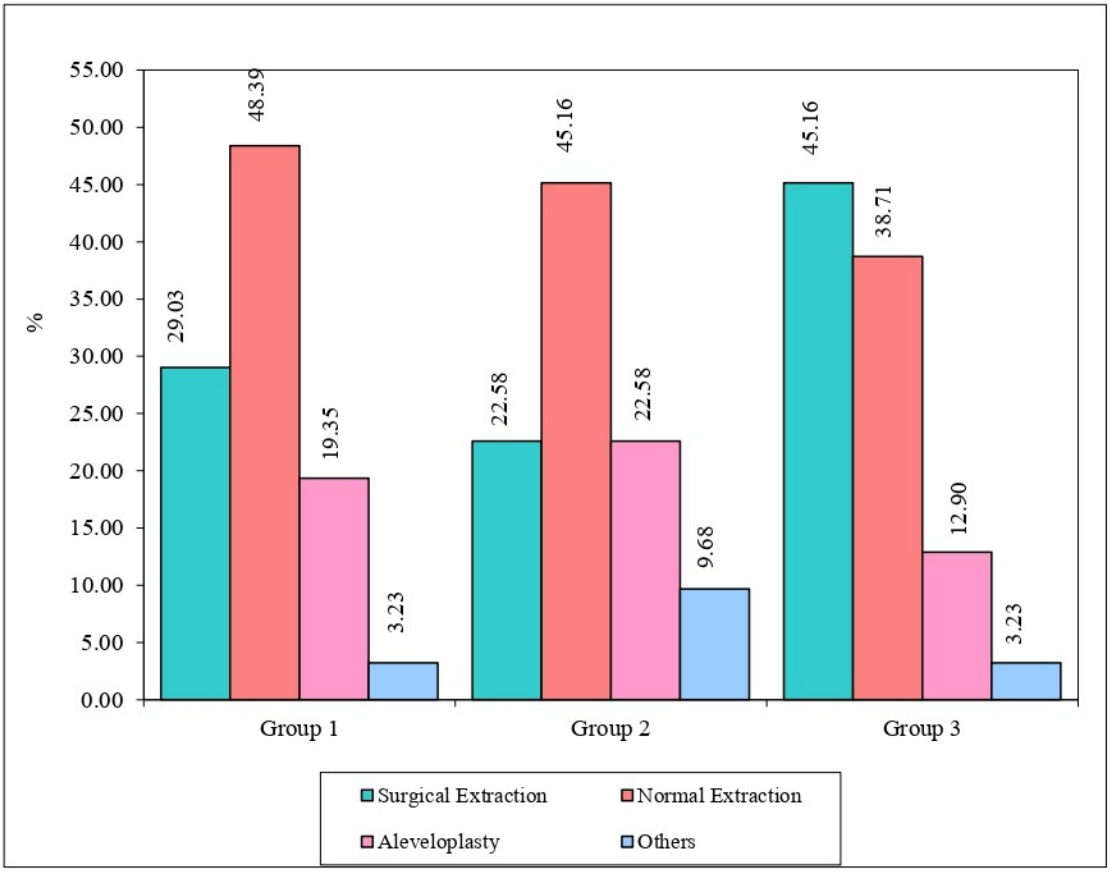
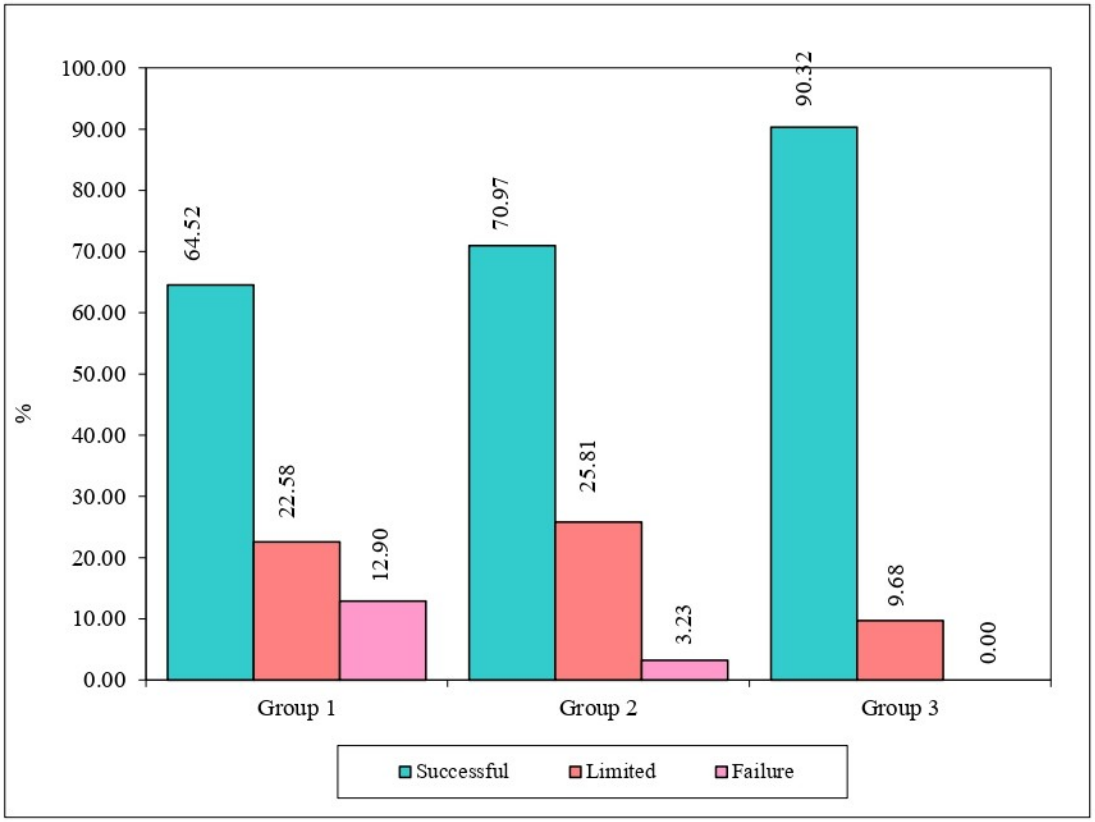


Table 3: Comparison of three groups (1, 2, 3) with Quality of anesthesia

Quality of anesthesia	Group 1	%	Group 2	%	Group 3	%	Total
Successful	20	64.52	22	70.97	28	90.32	70
Limited	7	22.58	8	25.81	3	9.68	18
Failure	4	12.90	1	3.23	0	0.00	5
Total	31	100.00	31	100.00	31	100.00	93
Chi-square=3.6765, p=0.4515							

Table 3 shows a comparison of the quality of anesthesia between three groups (Group 1, Group 2, and Group 3). The quality of anesthesia is divided into three levels: successful, limited, and failure. The number of participants is 93, and each group consists of 31 individuals. Group 1 achieved a success rate of 64.52% (20 out of 31 cases), Group 2 achieved a slightly improved success rate of 70.97% (22 out of 31 cases), and Group 3 achieved the highest success rate of 90.32% (28 out of 31 cases). This trend indicates that Group 3 received the most successful administration of anesthesia, while Groups 1 and 2 had relatively lower success rates. Graph 3 illustrates the graphical representation.

Graph 3: Comparison of three groups (1, 2, 3) with Quality of anesthesia



Graph 4: Comparison of three groups (1, 2, 3) with Post anesthetic complications

Post anesthetic Complication	Group 1	%	Group 2	%	Group 3	%	Total
No	24	77.42	28	90.32	31	100.00	83
Yes	7	22.58	3	9.68	0	0.00	10
Total	31	100.00	31	100.00	31	100.00	93
Chi-square=8.2916, p=0.0158*							

*p<0.05

Table 4 shows a comparison of post-anesthetic complications in three groups, each with 31 patients. The results show wide differences in rates of complications: Group 3 had no complications (0%), Group 2 a modest rate (9.68%), and Group 1 the highest rate (22.58%). A chi-square test identified these differences as statistically significant (χ^2 = 8.2916, p = 0.0158), indicating they are unlikely due to chance variation. This means that variables like anesthetic method or procedural differences can influence the risks of complications. Within the groups, Group 3 had the safest profile, and Group 1 had the highest risk of post-anesthetic complications. Graphical presentation of the data presented in Graph 4.

Graph 4: Comparison of three groups (1, 2, 3) with Post anesthetic complications

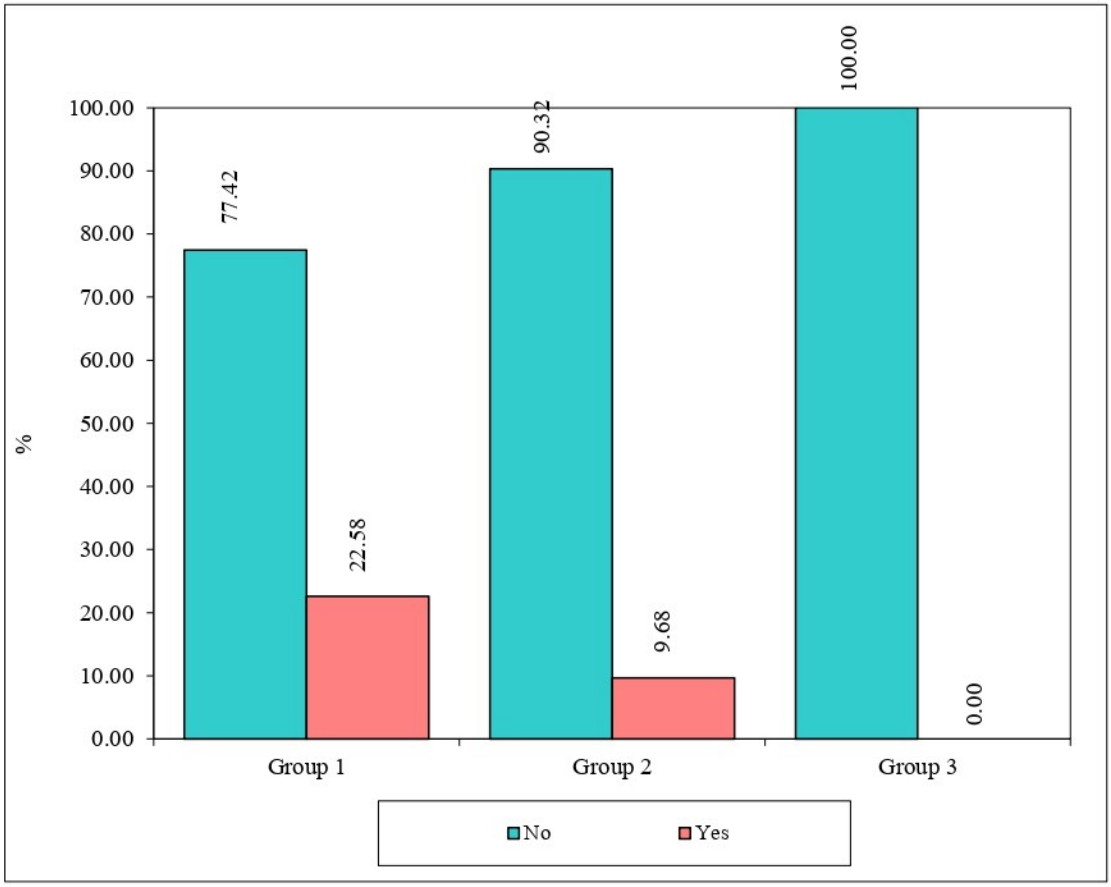


Table 5: Comparison of three groups (1, 2, 3) with Quantity of Injected Anesthesia by one way ANOVA

Groups	Means	Std.Dev.	Median	IQR
Group 1	2.03	0.30	2.00	0.40
Group 2	2.18	0.39	2.10	0.50
Group 3	1.69	0.17	1.70	0.20
F-value	22.0903			
p-value	0.0001*			
Pair wise comparisons by Tukeys multiple posthoc procedures				
Group 1 vs Group 2	p=0.1123			
Group 1 vs Group 3	p=0.0002*			
Group 2 vs Group 3	p=0.0001*			

*p<0.05

Table 5 presents an analysis of anesthesia dosage variations among three groups using one-way ANOVA. The results show highly significant differences in the amount of anesthesia administered ($F = 22.0903$, $p < 0.0001$). Group 2 received the highest average dose (2.18 ± 0.39), followed by Group 1 (2.03 ± 0.30), while Group 3 required substantially less anesthesia (1.69 ± 0.17). Post-hoc Tukey tests revealed that Group 3's dosage was significantly lower than both Group 1 ($p = 0.0002$) and Group 2 ($p < 0.0001$), while Groups 1 and 2 did not differ significantly from each other ($p = 0.1123$). The narrow standard deviations and interquartile ranges, particularly for

Group 3 (IQR = 0.20), indicate consistent dosing patterns within each group. These findings suggest that certain patient or procedural factors may substantially influence anesthetic requirements, with Group 3's markedly lower needs being especially notable. The results highlight the importance of individualized anesthesia approaches rather than standardized dosing across all cases. Graph 5 contains the graphical representation.

Graph 5: Comparison of three groups (1, 2, 3) with Quantity of Injected Anesthesia

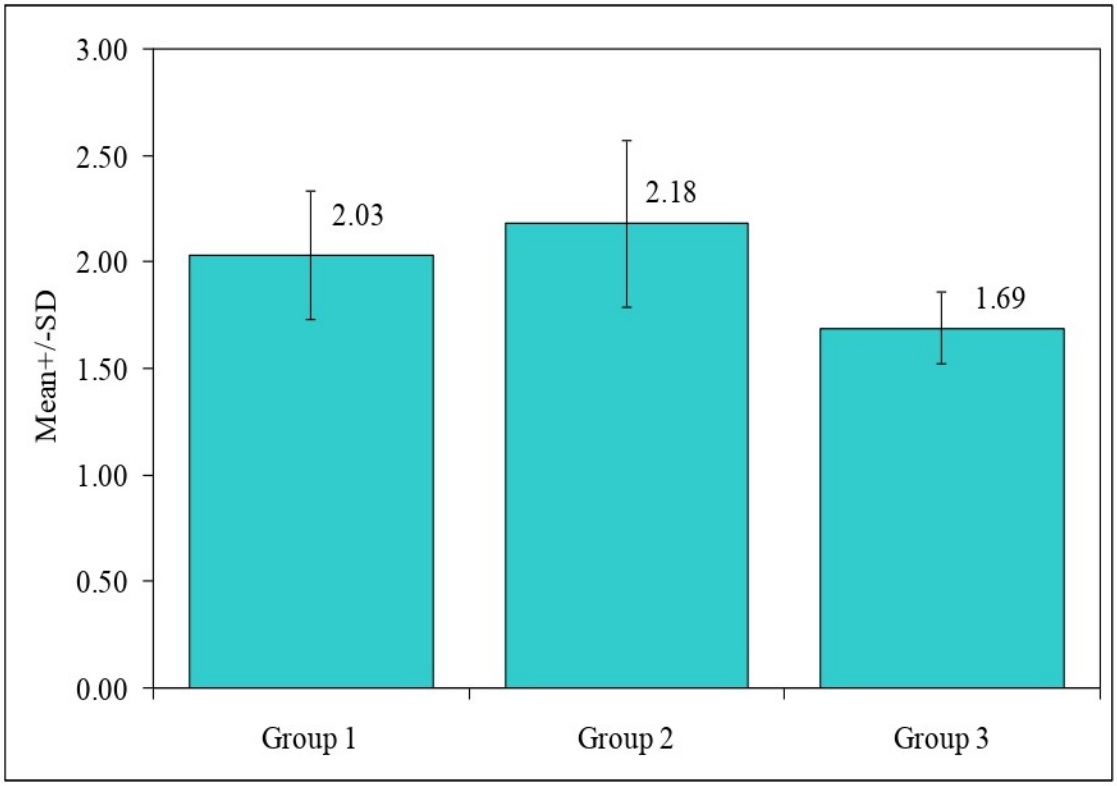


Table 6: Comparison of three groups (1, 2, 3) with pretest and intra op NRS scores by Kruskal Wallis ANOVA

Groups	Pretest				Intra op			
	Means	SD	Median	IQR	Means	SD	Median	IQR
Group 1	8.52	9.00	1.00	0.51	1.45	1.00	3.00	1.63
Group 2	7.84	8.00	0.00	0.97	2.68	3.00	3.00	1.70
Group 3	8.19	8.00	1.00	0.60	0.94	1.00	1.00	1.15
H-value	12.4241				15.2041			
p-value	0.0020*				0.0005*			
Pair wise comparisons by Mann-Whitney U test								
Group 1 vs Group 2	p=0.0025*				p=0.0104*			
Group 1 vs Group 3	p=0.0662				p=0.3209			
Group 2 vs Group 3	p=0.1977				p=0.0002*			

*p<0.05

Pretest and intraoperative pain scores were analyzed using Kruskal-Wallis ANOVA, and significant differences between the three groups were found (pretest: H=12.4241, p=0.0020; intra-op: H=15.2041, p=0.0005). While median pretest pain scores were similar between groups (Group 1:9.00, Group 2:8.00, Group 3:8.00),

intraoperative measurements indicated clear differences, with Group 3 having better pain control (median=1.00) compared to Groups 1 and 2 (both median=3.00). Mann-Whitney U post-hoc comparisons determined that Group 2 differed significantly from the other two groups (Group 1 vs Group 2: p=0.0025 pretest, p=0.0104 intra-op; Group 2 vs Group 3: p=0.0002 intra-op). Interestingly, Group 3 had persistently lower pain scores throughout surgery, indicating that its pain management strategy might be superior. These statistically significant results ($p<0.05$ for all highlighted comparisons) represent significant differences in pain perception or analgesic effect between groups, most notably emphasizing Group 3's enhanced intraoperative pain management performance. The findings suggest possible treatment variability in efficacy or patient factors warranting future clinical examination. Graph 6 displays the graphical illustration.

Graph 6: Comparison of three groups (1, 2, 3) with pretest and intra op NRS scores

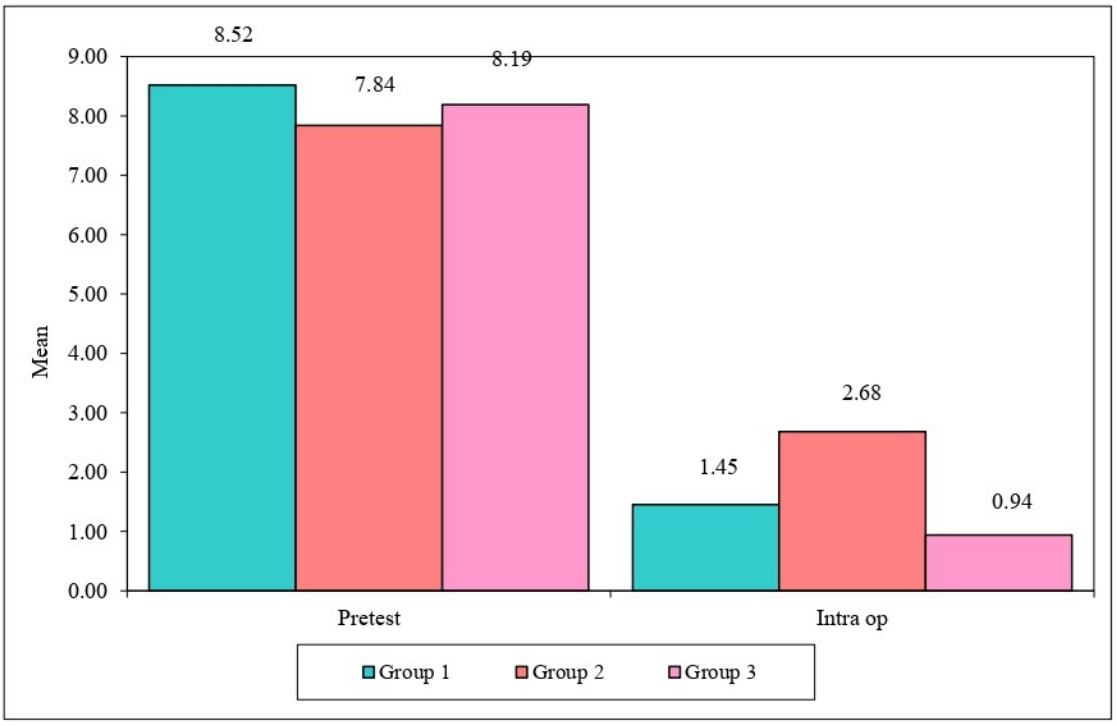


Table 7: Comparison of pretest and intra op NRS scores in three groups (1, 2, 3) by Wilcoxon matched pairs test

Group	Times	Mean	SD	Mean Diff.	% of effect	Z-value	p-value
Group 1	Pretest	8.52	0.51				
	Intra op	1.45	1.63	7.06	82.95	4.8599	0.0001*
Group 2	Pretest	7.84	0.97				
	Intra op	2.68	1.70	5.16	65.84	4.8599	0.0001*
Group 3	Pretest	8.19	0.60				
	Intra op	0.94	1.15	7.26	88.58	4.8599	0.0001*

*$p<0.05$

The Wilcoxon matched pairs test findings in Table 7 reveal the notable decreases in pain scores from pretest to intraoperative measurements in all three groups ($p=0.0001$ in each group). Group 3 exhibited the greatest improvement with an 88.58% decline in pain (mean difference=7.26), followed by Group 1 (82.95% reduction, mean difference=7.06), whereas Group 2 experienced the least but still significant reduction (65.84%, mean difference=5.16). The uniformly high Z-values (4.8599 for all groups) and very low p-values confirm these reductions in pain are statistically extremely significant. Of particular interest, although all groups started with comparable pretest pain levels (means of 7.84 to 8.52), Group 3 had the lowest intraoperative pain levels (mean=0.94) when compared with Groups 1 (1.45) and 2 (2.68). These results indicate that all interventions were successful in pain reduction, but Group 3's method seems most efficient, as it has achieved almost 90% pain

reduction. The outcomes also point out significant differences between the groups regarding the efficacy of pain management that should be investigated further into the exact protocols or elements leading to Group 3's better performance. Graph 7 illustrates the graphical representation.

Graph 7: Comparison of pretest and intra op NRS scores in three groups (1, 2, 3)

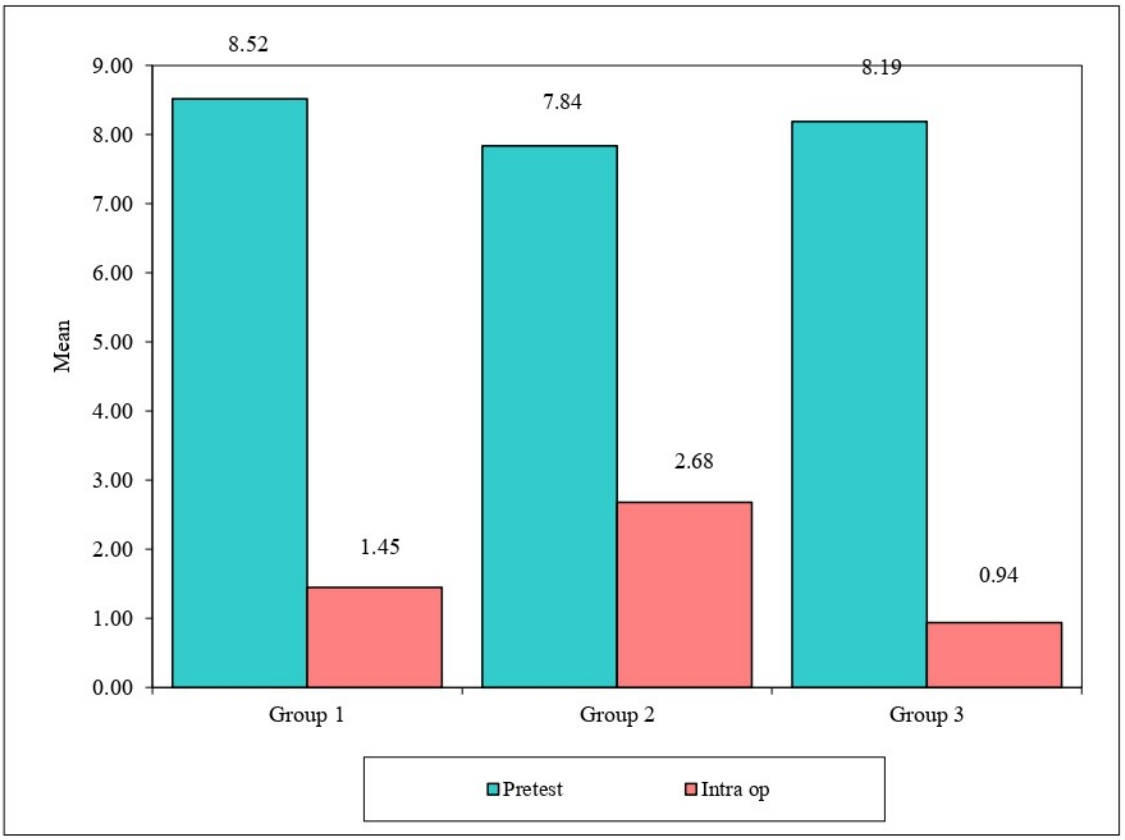


Table 8: Comparison of three groups (1, 2, 3) with onset times by one way ANOVA

Groups	Means	Std.Dev.	Median	IQR
Group 1	93.70	7.03	95.40	6.00
Group 2	129.89	25.11	126.40	34.80
Group 3	161.68	20.61	163.50	30.12
F-value	97.3616			
p-value	0.0001*			
Pair wise comparisons by Tukeys multiple posthoc procedures				
Group 1 vs Group 2	p=0.0001*			
Group 1 vs Group 3	p=0.0001*			
Group 2 vs Group 3	p=0.0001*			

*p<0.05

The analysis of onset times using one-way ANOVA shows highly significant variations between the three groups (F=97.3616, p<0.0001). Group 1 exhibited the quickest onset (93.70±7.03 seconds), demonstrating both rapid action and consistent results (IQR=6.00). Group 2 showed intermediate onset characteristics (129.89±25.11 seconds), while Group 3 had the slowest onset (161.68±20.61 seconds). Post-hoc Tukey tests revealed extremely significant differences between all possible group pairings (p<0.0001 for each comparison). The tight clustering of Group 1's data (small IQR and SD) contrasts with the wider dispersion seen in Groups 2 and 3 (IQRs of

34.80 and 30.12 respectively), indicating greater variability in these groups. These pronounced differences in pharmacological onset profiles suggest that Group 1's protocol may be particularly advantageous when fast-acting anesthesia is clinically important. The remarkable statistical significance across all comparisons ($p<0.0001$) strongly supports the conclusion that these groups represent fundamentally different anesthetic approaches with distinct kinetic properties. Graph 8 shows the graphical representation.

Graph 8: Comparison of three groups (1, 2, 3) with onset times

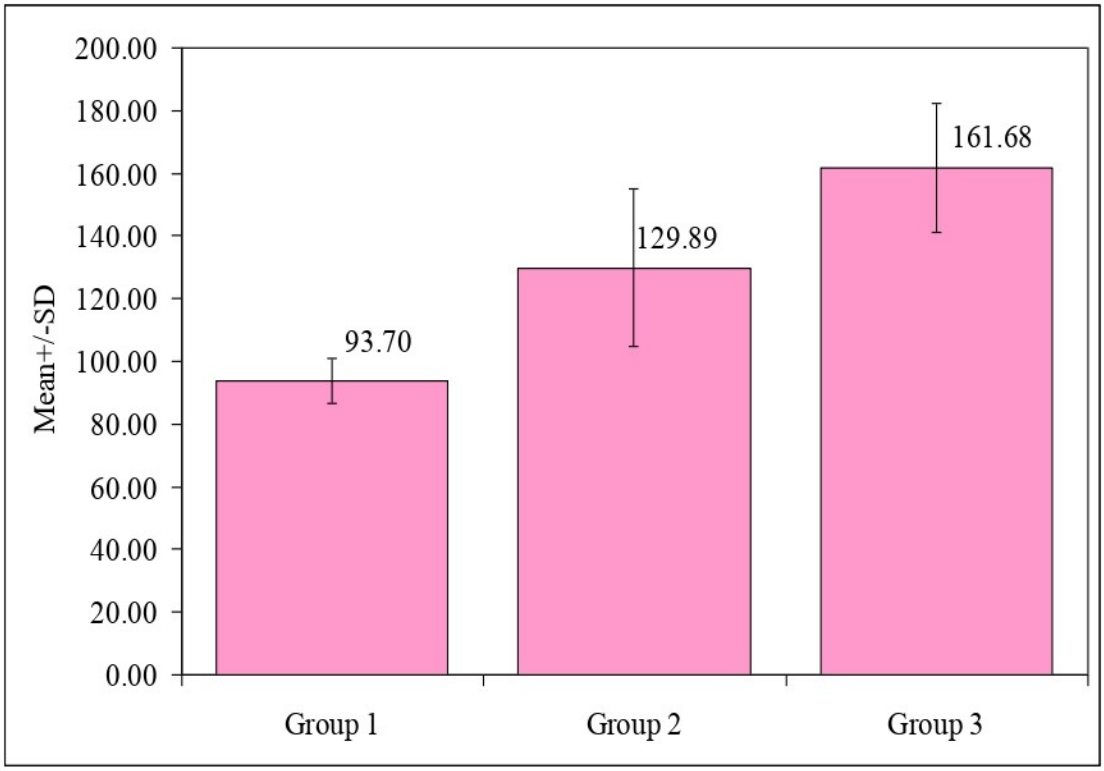


Table 9 : Comparison of three groups (1, 2, 3) with Duration of Anesthesia (mins) by one way ANOVA

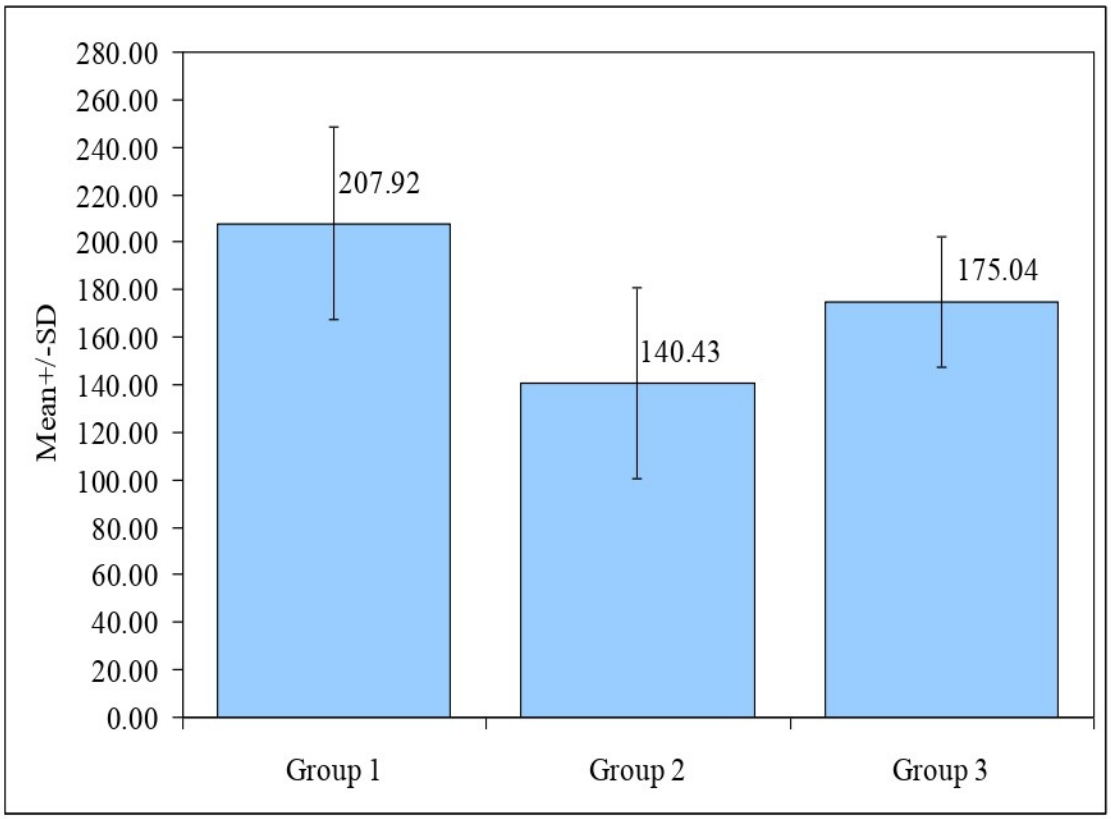
Groups	Means	Std.Dev.	Median	IQR
Group 1	207.92	40.66	198.40	48.30
Group 2	140.43	40.19	134.30	82.20
Group 3	175.04	27.56	169.80	38.90
F-value	26.3012			
p-value	0.0001*			
Pair wise comparisons by Tukeys multiple posthoc procedures				
Group 1 vs Group 2	P=0.0001*			
Group 1 vs Group 3	P=0.0020*			
Group 2 vs Group 3	P=0.0011*			

*p<0.05

The comparison of onset times with one-way ANOVA reveals extremely significant differences among the three groups (F=97.3616, p<0.0001). Group 1 had the fastest onset (93.70±7.03 seconds), reflecting both quick action and uniform results (IQR=6.00). Group 2 reflected intermediate onset values (129.89±25.11 seconds), while Group 3 reflected the slowest onset (161.68±20.61 seconds). Post-hoc Tukey tests indicated extremely significant differences among all possible pairings of groups (p<0.0001 for each). The close bunching of Group 1 data (small IQR and SD)

is in contrast to the increased dispersion in Groups 2 and 3 (IQRs of 34.80 and 30.12 respectively), reflecting increased variability in these groups. These large pharmacological onset differences would imply that Group 1's protocol could be especially beneficial when rapid-acting anesthesia is clinically relevant. The highly significant statistical difference in all comparisons ($p<0.0001$) serves strongly to support the hypothesis that these groups describe fundamentally dissimilar anesthetic methods with differing kinetic properties. Graph 9 illustrates the graphical representation.

Graph 9: Comparison of three groups (1, 2, 3) with Duration of Anesthesia (mins)



DISCUSSION

In this study, three inferior alveolar nerve block methods—Halsted conventional (Group I), Fischer's 1-2-3 (Group II), and angulated needle approach (Group III)—were compared on their effectiveness in 93 mandibular extractions patients. Outcomes confirmed the better performance of the angulated needle approach with a success rate of 90.32% in quality of anesthesia against 64.52% (Group I) and 70.97% (Group II). The new technique offered superior pain relief (88.58% reduction in NRS scores) than traditional methods, with less anesthetic volume used (1.69 mL versus 2.03-2.18 mL). The angulated needle's 30-45° curvature allowed accurate deposition in the pterygomandibular space, maximizing anesthetic spread around the nerve's extracranial segment with minimal tissue trauma. This anatomical accuracy resulted in zero complications (hematoma/nausea) in Group III, as compared to 22.58% in Group I and 9.68% in Group II. While exhibiting a marginally slower onset (161.68±20.61 seconds) owing to deposition around thicker segments of the nerve, all methods were within clinically acceptable parameters.

The success of local anesthesia methods is quantified by their capacity for providing pain-free operations.

If anesthetic effects are incomplete or inadequate during ambulatory surgery, patients undergo undue discomfort, resulting in dissatisfaction for practitioners. Sound pain control is essential to patient comfort and clinical success. Local anesthesia techniques must provide complete nerve blockade to avoid intraoperative pain. Failures may be due to anatomical differences, technical mistakes, or pharmacological reasons, leading to procedural discomfort for patients and eroding clinician confidence. The criterion for assessing any anesthetic method is its reliable

ability to abolish pain perception during the course of the surgical procedure. In dental practice more specifically, inadequate mandibular anesthesia poses considerable problems, as even mild discomfort during treatment can compromise patient cooperation and procedure quality. This underlines why anesthetic dependability is directly related to both therapeutic success and patient confidence in clinical care.

Contemporary strategies are continually fine-tuning management techniques to enhance success rates, acknowledging that predictable, complete anesthesia is crucial for quality outpatient treatment. The discipline increasingly focuses on methods that integrate anatomical accuracy with optimized delivery of medications to achieve maximum patient comfort and reduced practice disruption from anesthetic failure.

Research indicates alarmingly high rates of failure of the IANB, from 48.6% (Kaufman et al., 1984) to 77-81% (8; 21;2; 29), with noteworthy difficulties in producing consistent mandibular anesthesia with routine methods.

This study effectively performed all planned surgical procedures while systematically comparing three methods of IANB administration. Evaluation criteria involved both qualitative (Quality of Anesthesia Score) and quantitative (Numeric Rating Scale for pain) measures. Statistical analysis showed statistically significant differences in performance, with the novel angulated needle technique (Group III) having better clinical outcomes than traditional methods - namely Halsted's direct method (Group I) and Fischer's indirect technique (Group II).

The lowest QAS score (best success rate) was achieved in Group 3 with grade 1(no pain) and 2(some pain) having a success rate of 90.32% (28 out of 31 cases)

followed by Group 1 64.52% (20 out of 31 cases) with grades 1 and 2, Group 2 had a slightly better success rate of 70.97% (22 out of 31 cases) with grades 1 and 2.

A number of reasons may explain Group 3's higher success rate for quality anesthetic success (QAS) over the other groups. The altered needle angulation in this method ensures that, after mucosal penetration, the curved part of the needle takes a higher path than that of traditional methods. This higher course of passage most likely facilitates easier passage over the internal oblique ridge, close to the temporal crest of the coronoid process, thus decreasing resistance to needle insertion.

In addition, the greater elevation of the needle, combined with the syringe barrel traversing a smaller volume of soft tissue over a shorter distance, is probably more comfortable for the patient. This more direct insertion route enables the tip of the needle to be delivered to its desired destination—the superior part of the mandibular sulcus, which is above the mandibular foramen—more accurately and with less discomfort.

The enhanced success of the inferior alveolar nerve block (IANB) with a manually angulated needle indicates that this method allows for improved access to the best anatomical location for anesthetic deposition. Moreover, the raised needle tip position—like that utilized in the Vazirani-Akinosi method—seems to play a major role in increased anesthetic effectiveness by allowing more precise and consistent deposition close to the nerve trunk[48; 3; 12; 6]

In Group 3, the anesthetic solution was injected into the pterygomandibular space, a space made up of looser, more expansive areolar connective tissue. This less dense tissue structure makes it easier for better diffusion of the anesthetic, enabling it to diffuse more efficiently. The natural contraction of adjacent muscles and gravity

further enhance the passive diffusion of the solution, which is most likely to contribute to a smoother and more comfortable anesthetic experience for patients.

Conversely, the methods employed in Groups I and II placed the needle tip nearer to the mandibular foramen, where the connective tissue is much denser and the anatomical space is tighter.[6; 25]

The constricted area impedes the spread of the anesthetic and may cause increased tissue pressure upon injection. These mechanical resistances can also lead to more discomfort and pose the risk of tissue trauma[6]. Patients in both groups experienced higher rates of pain, probably because the compact tissue at the site of injection is subjected to greater stress. Recent years have seen growing adoption of angulated needle methods among dentists, with evidence supported by several clinical trials showing their effectiveness. One key breakthrough came when Dr. Tuttle (2018) introduced the TuttleNumbNow (TNN) technique that employs a novel needle guide to obtain best 90-120° angulation for precise intraosseous anesthetic deposition in mandibular surgeries. This break-through solved past problems of needle placement without loss of clinical efficiency.[47]

The scientific basis for these methods was laid prior by Lazarevic and Lazarevic-Bankovic (2009) who effectively utilized pre-curved 22-gauge needles (40 mm in length) at about 45° angles to access the pterygopalatine fossa reliably for high tuberosity anesthesia. Their study illustrated that controlled modification of the needle could greatly enhance access to difficult anatomical target locations.[26]

The positive results seen in our present study employing angulated needle techniques for inferior alveolar nerve block (IANB) anesthesia follow and build on these proven methods. The predictable success of both variations in needle angling -

guided (TNN technique) or pre-curved (Lazarevic method) - is strong evidence for the clinical benefits of these techniques. These advantages are:

1. Increased precision of anesthetic deposition
2. Easier access to challenging anatomical sites
3. Reduced patient discomfort
4. Improved procedural efficiency

Convergence of the results from different research groups implies that needle angulation is an important advance in dental anesthesia techniques, specifically mandibular nerve blocks. As clinical experience is accumulated and technique continues to improve, these techniques are destined to become more standard in dental practice.

The angulated needle technique yielded the greatest rate of success within the groups with regard to lowest pain score of 88.58% (mean difference=7.26), followed by Group 1 (82.95%, mean difference=7.06), while Group 2 had the least but meaningful reduction (65.84%, mean difference=5.16) compared with pre-test and intra-op test for NRS score.

This is likely to be because of the reduced needle insertion path to the target site, and causing less tissue damage (stretching) fewer pain sequel in the pterygomandibular space compared to the traditional Halsted[32;36;11] or Fischer method which had a poorer pain rate on the NRS. The success of inferior alveolar nerve blockade is highly reliant on the amount of anesthetic used as well as its accurate deposition along the nerve trunk. For optimal neural blockade, local anesthetic should come in contact with at least three successive internodal segments [20], necessitating exposure of 1.8-10 mm of available nerve length [38;10]. In this study,

Group III displayed better anesthetic quality (QAS) and lower pain perception (NRS) as a result of superior needle placement close to the extracranial portion of the IAN within the pterygomandibular space. This placement provided greater nerve surface contact, more extensive circumferential diffusion, and longer duration of anesthetic exposure than with other groups. The results indicate how anatomical accuracy in needle positioning can transcend the limitations of anesthetic volume alone, since proper placement guarantees sufficient internodal saturation even with routine anesthetic doses. These findings stress the need for technique improvement in regional anesthesia, indicating that specific methods may be more effective than mere augmentation of anesthetic volume in the presence of anatomical variations in nerve accessibility. The volume of injected anesthetic solution varied differently with

Group 2 was given the largest mean dose (2.18 ± 0.39), then Group 1 (2.03 ± 0.30), whereas Group 3 needed a lot less anesthesia (1.69 ± 0.17).

Post-hoc Tukey tests also demonstrated that Group 3's dosage was significantly less than Group 1 ($p = 0.0002$) and Group 2 ($p < 0.0001$), whereas Groups 1 and 2 were not significantly different from one another ($p = 0.1123$). The ideal anesthetic volume for inferior alveolar nerve blocks is still clinically significant, as studies provide different recommendations. Although anatomical research indicates that the pterygomandibular space will accommodate about 2.0 ml[9], clinical data provide greater efficacy with volumes somewhat higher than this—3.0 mL being more successful when anesthetizing third molars than 1.8 ml[27], again attributed to better coverage of the nerve. We used 2.5 mL, a midway volume that finds equilibrium between anatomical limitations and clinical efficacy in accordance with the observation that a moderate rise in anesthetic volume[30; 51] enhances the quality of blockade without incurring loss in safety. This finding supports the above principle

that we obtained sure anesthesia while taking least patient distress, thereby covering the gap between evidence and applicability. Our study revealed an interesting divergence between objective anesthesia quality (QAS) and subjective pain reports (NRS) in Fischer's group, where two patients with perfect QAS scores (rating 1) reported significant pain (NRS 6).

This apparent contradiction aligns with well-established psychophysiological principles - extreme dental anxiety can dramatically alter pain perception, causing patients to experience discomfort despite clinically effective anesthesia. Evidence shows that increased anxiety decreases pain thresholds[31] and distorts the perception of difference between real noxious stimuli and procedural pressure[39; 35]. These results highlight the fact that effective pain management involves the management of both physiological anesthesia and psychological readiness, especially in anxious patients who might find even non-painful stimuli to be painful. The findings highlight the need to integrate anxiety-reduction techniques with technical anesthetic accuracy to maximize patient experiences. Statistical analysis identified differences in onset times (OT) between groups ($p<0.0001$), with Group 1 having the shortest onset (93.70±7.03 seconds), followed by Group 2 (129.89±25.11 seconds) and Group 3 (161.68±20.61 seconds).

Clinically, all methods were effective since they attained anesthesia within the prescribed 3-minute limit for mandibular blocks [40]. The variation in onset times observed can be explained by anatomical considerations, specifically the site of deposition in relation to the inferior alveolar nerve (IAN). Group III's slower onset aligns with existing literature on techniques like Gow-Gates that deposit anesthetic in more superior positions[41], where the IAN's greater diameter (typically 2.08-2.40 mm versus 1.71-2.00 mm inferiorly) may delay anesthetic penetration. This thicker neural

morphology requires: (a) greater diffusion time for complete perineural saturation, (b) more circumferential spread to block all fascicles, and (c) longer latency for complete sodium channel blockade. These observations highlight the ways in which anatomical differences in nerve size at various injection points can have considerable effects on clinical pharmacokinetics, yet without compromising therapeutic efficacy within reasonable time frames. The intricate vascular anatomy of the infratemporal fossa renders mandibular anesthesia methods prone to vascular-related complications such as intravascular injection and hematoma.

These complications are well-documented in traditional Halstead inferior alveolar nerve blocks (IANB), with recorded incidence rates up to 22% (46; 12; 49). These complications are a result of several anatomical issues: (a) unpredictable courses of small-caliber veins and arteries, (b) variable positions of principal vessels (such as maxillary artery and inferior alveolar vessels), and (c) the necessarily blind nature of advancing a needle into the pterygomandibular space. Comparative literature shows technique-dependent variability in aspiration rates, with the Gow-Gates technique providing positive aspiration in 15–17% of instances[30; 37], whereas Halstead's technique has greater rates (22%) when data are pooled from a number of studies[12;50]. These results highlight the very significant role played by anatomical knowledge and aspiration procedures in reducing vascular complications in mandibular anesthesia procedures. Angulated needle technique, though having clinical benefits, also has comparable risk profiles because of its action within this very vascular anatomical field. Our study identified significant discrepancies in rates of complications between the groups: Group 1 exhibited a 22.58% rate of minor adverse effects (mostly hematoma and nausea), whereas Group 2 exhibited a lower rate of hematoma of 9.68%.

Of note, all the observed complications were transient and without clinically important hemodynamic changes. Complete recovery was achieved by all patients with no disruption to the scheduled anesthetic administration or surgical procedure. These findings indicate that although complication rates differ with technique, overall clinical effect is minimal when appropriate protocols are adhered to

RECOMMENDATION

- Based on the results of this randomized controlled trial, the Angulated Needle Approach demonstrated significantly higher anesthetic efficacy compared to the traditional Halsted and Fischer 1-2-3 techniques for inferior alveolar nerve block during mandibular tooth extractions. It achieved superior intraoperative pain control, required a lower volume of anesthetic solution, and showed the highest success rate in quality of anesthesia. These findings suggest that the angulated approach can enhance patient comfort and reduce anesthetic-related complications, making it a valuable alternative in clinical settings.

- Although the onset of anesthesia was slower with the angulated technique compared to Halsted's method, the trade-off is justified by the more consistent analgesia and reduced anesthetic dosage. This makes the angulated approach particularly suitable for procedures where pain control is paramount and time constraints are less critical.

- Therefore, it is recommended that this technique be incorporated into clinical practice, especially for patients undergoing complex or prolonged mandibular procedures. Additionally, dental practitioners should receive proper training in the angulated technique to ensure consistent outcomes. Further multi-center studies with larger sample sizes are also suggested to validate these results and explore modifications that may reduce onset time without compromising efficacy.

LIMITATION OF THE STUDY

- **Single-Center Design-** Conducted at a single institution (KLE VK Institute of Dental Sciences), which may limit the generalization of findings to diverse populations or clinical settings.

- **Sample Size Constraints-** Although statistically powered (n=93), a larger multi-center trial could strengthen the validity of results and better account for anatomical variations among patients.

- **Operator-Dependent Technique-** The angulated needle technique requires manual dexterity and familiarity with needle bending, which may introduce variability in execution compared to standardized conventional methods.

- **Lack of Long-Term Follow-Up-** Postoperative complications (e.g., prolonged paresthesia, delayed hematoma) were not assessed beyond the immediate procedure, potentially overlooking late-onset adverse effects.

- **Subjective Pain Reporting**-Pain scores (NRS) rely on patient self-reporting, which can be influenced by anxiety, prior pain experiences, or psychological factors, despite objective QAS measurements.

- **Exclusion of High-Risk Patients-** Patients with acute infections (abscesses), severe trismus, or systemic conditions (ASA III+) were excluded, limiting applicability to more complex clinical scenarios.

- **No Blinding of Practitioners**- Operators were not blinded to the technique used, which may introduce performance bias in administration or assessment.

- **Limited Comparison to Other Modern Techniques-** The study compared only Halsted, Fischer, and angulated needle approaches but did not evaluate newer methods (e.g., computer-controlled delivery or ultrasound-guided IANB).

- **Equipment Specificity-** The angulated needle technique's success may depend on needle gauge (21G) and bending precision, which could vary with different brands or materials.

- **Anesthetic Volume Variability-** Group 3 used less anesthetic (1.69 mL) but did not explore whether further volume reduction could maintain efficacy, leaving optimal dosing incompletely defined.

CONCLUSION

The present study conclusively proves the higher effectiveness of the angulated needle technique for inferior alveolar nerve blocks (IANB) when compared to traditional Halsted and Fischer methods. The angulated technique (Group III) had an impressive 90.32% success rate using quality anesthesia scores (QAS), far exceeding Group I (64.52%) and Group II (70.97%). Interestingly, it was the most significant pain relief (88.58% reduction in NRS scores) with a mean difference of 7.26 points compared to 82.95% (7.06 points) in Group I and 65.84% (5.16 points) in Group II. The effectiveness of the technique lies in its anatomical accuracy - the angled needle modification allows for optimal deposition within the pterygomandibular space with minimal tissue trauma, yielding both better anesthetic spread and greater patient comfort. Notably, Group III used much less anesthetic volume (1.69 mL) compared to traditional techniques (2.03-2.18 mL), indicating more effective drug delivery. The research also revealed zero complications in Group III compared to 22.58% in Group I and 9.68% in Group II, also confirming its safety profile. Such results concur with anatomical principles indicating that the angulated approach is more effective in targeting the extracranial portion of the nerve while evading vascular structures. The reduced onset time (161.68±20.61 seconds) when compared to standard methods indicates deposition at a location with greater nerve diameter, taking slightly longer to achieve full blockade but still comfortably within clinical parameters. These results solve the highly reported 30-45% failure rates associated with traditional IANB methods, providing a solution that meets anatomical specificity with pharmacological efficacy. The results indicate that needle angulation overcomes major limitations of conventional methods through optimized tissue penetration routes and anesthetic distribution patterns. Although the technique

necessitates proper needle bending and placement with specific training, its evidenced superiority in success rates, pain control, and safety as an alternative for mandibular anesthesia is a strong argument. Future studies need to address standardizing training protocols and long-term results, but the existing evidence is highly supportive of implementing the angulated needle technique as a more consistent and patient-friendly IANB procedure.

SUMMARY

This research compared the effectiveness of three inferior alveolar nerve block methods—traditional Halsted (Group I), Fischer's 1-2-3 (Group II), and angulated needle method (Group III)—in 93 patients for mandibular extractions. Results showed the superior performance of the angulated needle method, with a 90.32% success rate in anesthesia quality compared to 64.52% (Group I) and 70.97% (Group II). The novel technique achieved much greater pain reduction (88.58% reduction in NRS scores) than traditional methods, with less anesthetic volume used (1.69 mL vs 2.03-2.18 mL). The angulated needle's 30-45° curvature allowed accurate deposition in the pterygomandibular space, maximizing anesthetic spread close to the nerve's extracranial segment and avoiding tissue damage. This anatomical accuracy resulted in complete lack of complications (hematoma/nausea) in Group III, in comparison with 22.58% in Group I and 9.68% in Group II. Although appearing with a slightly lower onset (161.68±20.61 seconds) owing to deposition close to thicker segments of the nerve, all techniques fell well within clinical acceptability.

These results answer the commonly cited 30-45% failure rates of conventional IANB techniques with anatomical precision plus pharmacologic effectiveness.

The advantages of the technique—greater success rates, increased pain control, lower anesthetic needs, and better safety profile—hypothesize it will significantly enhance mandibular anesthesia outcomes. Though necessitating specialized training to adequately bend and position the needle, the angulated technique presents a practical answer to the drawbacks of conventional methods without sophisticated equipment.

The work offers strong evidence in favor of applying this method to everyday practice, especially in difficult cases or in situations where a reduction of drug volume is desired. Subsequent studies ought to aim to standardize procedures and verify findings in various clinical settings.

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ANNEXURE – I - INFORMED CONSENT FORM

CONSENT FORM

K.L.E.'s V.K. Institute of Dental Sciences

Department of Oral and Maxillofacial Surgery, Belagavi

"Assessment of anesthetic efficacy of Angulated Needle Approach, Halsted and Fischer 1-2-3 inferior alveolar nerve block technique for extraction of mandibular teeth- a Randomized Control Trial"

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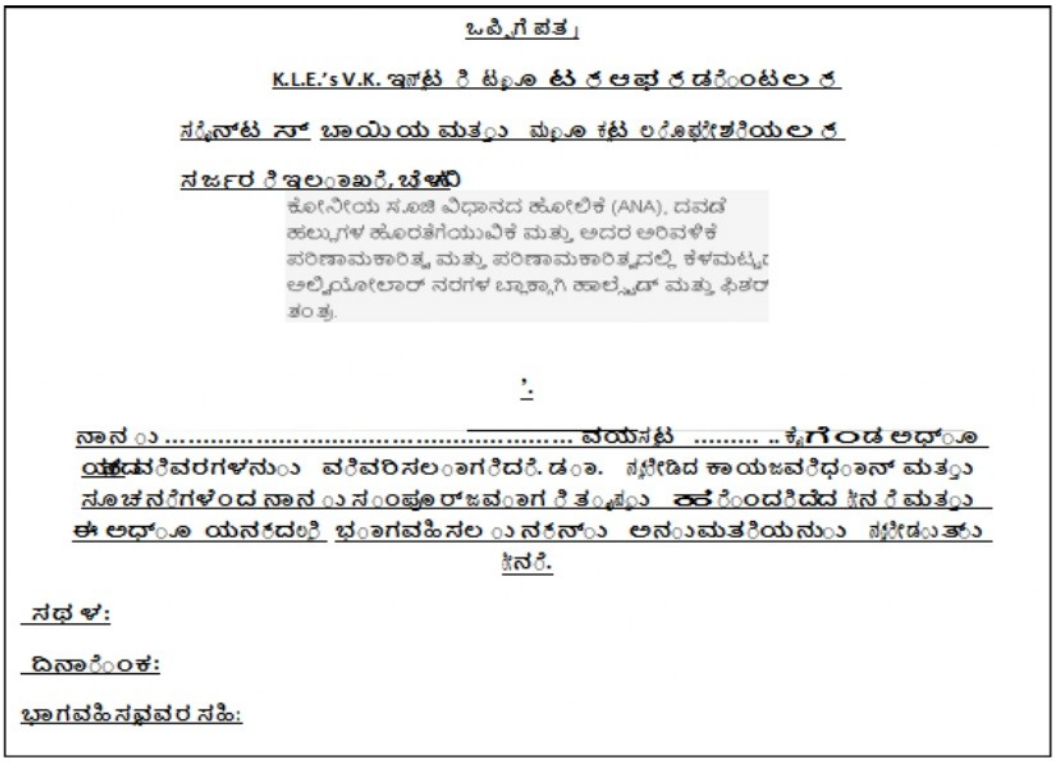
I..... age..... have been explained the details of the study undertaken. I am fully satisfied with the procedure and instructions given by Dr. _____ and hereby give my permission to participate in this study.

Place:



ಒಪ್ಪಿಗೆ ಪತ್ರ

K.L.E.'s V.K. ಇನ್ಸ್ಟಿ ಟ್ಯೂ ಟಿ ಆಫ್ ಡೆಂಟಲ್ ಸೈನ್ಸ್

ಸರ್ಜರಿ ವಿಭಾಗ, ಬೆಳಗಾವಿ

ಕೋನೀಯ ಸೂಜಿ ವಿಧಾನದ ಹೋಲಿಕೆ (ANA), ದವಡೆ ಹಲ್ಲುಗಳ ಹೊರತೆಗೆಯುವಿಕೆ ಮತ್ತು ಅದರ ಅರಿವಳಿಕೆ ಪರಿಣಾಮಕಾರಿತ್ವ ಮತ್ತು ಪರಿಣಾಮಕಾರಿತ್ವದಲ್ಲಿ ಕೆಳಮಟ್ಟದ ಅಲ್ವಿಯೋಲಾರ್ ನರಗಳ ಬ್ಲಾಕ್ಗಾಗಿ ಹಾಲ್ಸ್ಟೆಡ್ ಮತ್ತು ಫಿಶರ್ ತಂತ್ರ.

:

ನಾನು ..... ವಯಸ್ಸಿನ ..... ಕೆಳಗೆ ಅಧ್ಯಯನದ ವಿವರಗಳನ್ನು ವಿವರಿಸಲಾಗಿದೆ. ಡಾ. ನೀಡಿದ ಕಾರ್ಯವಿಧಾನ ಮತ್ತು ಸೂಚನೆಗಳಿಂದ ನಾನು ಸಂಪೂರ್ಣವಾಗಿ ತೃಪ್ತನಾಗಿದ್ದೇನೆ ಮತ್ತು ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ನನ್ನ ಅನುಮತಿಯನ್ನು ನೀಡುತ್ತೇನೆ.

ಸ್ಥಳ:

ದಿನಾಂಕ:

ಭಾಗವಹಿಸುವವರ ಸಹಿ:

संमती पत्र

के.एल.ई. च्या व्ही.के. दंत विज्ञान संस्था

त डी आवि मॉ ि ल फे वसयल शस्त्र ि या विभाग, बे लग ि ी

ॲन्युलेटेड सुई ॲप्रोच (एएनए), हॅल्स्टेड आणि फिशर तंत्राची तुलना मंडिब्युलर दात काढण्यासाठी निकृष्ट अल्व्होलर नर्व्ह ब्लॉकसाठी आणि त्याची ऍनेस्थेटिक प्रभावीता आणि परिणामकारकता

मी ..... िय.....हाती घेतलेल्या अभ्यासाचा तपशील सांगतला आहे. डॉ. _____ यांनी वदलेल्या कायपद्धती ि सूचनांसह मी पू ि य ि े समाधानी आहे आवि याद्वारे या अभ्यासामध्ये भाग घेण्याची परिनगी देत.

विका

ि ः

तारीख:

सहभागीची स्वाक्षरी:संपक्य

ि म ांक

KLE VK Institute of Dental Sciences, BELAGAVI

Department of Oral & Maxillofacial Surgery

Patient Information-

Name- Age/Sex-

CR Number-

Address –

Clinical Information-

Teeth Extracted- Type of Anaesthesia Block given- IANB

Number of attempts- Total volume of anaesthesia deposited-

After delivery of Anaesthesia

Pain before administration	
Onset time	
Duration of Surgery(in mins)	
Quantity of Anaesthesia getting injected	
Duration of conduction of anaesthesia	
Duration of Anaesthesia	

Pain experienced pain during the procedure of extraction of indicated teeth

Numerical Rating Scale(NRS)-