

## Anesthetic efficacy of 4% articaine and 2% lignocaine during the surgical removal of impacted third molar in both maxilla and mandible: A comparative study

Miss. Sumedha N Kale<sup>1</sup>, \*Mr. Pratik P Khaladkar<sup>2</sup>, Dr. Hansraj D Patil<sup>3</sup>

Department of oral surgery, School of dental sciences, KVV, Karad, Maharashtra, India

Correspondence author: Pratik P Khaladkar

### ABSTRACT

#### Background

Local anesthesia is a crucial and safe practice in dental extractions, ensuring patient comfort throughout the procedure. The randomized controlled study was conducted to evaluate the effectiveness of 4% articaine and 2% lignocaine during the surgical removal of impacted third molars in both the maxilla and mandible.

#### Objective

The intent of the study is to evaluate the anesthetic solutions, 4% Articaine and 2% Lignocaine using the Visual analogue scale (VAS SCALE).

#### Study design

This randomized controlled study was conducted in the Oral Surgery department from August 1, 2024, to November 1, 2024 involving 100 patients of both genders, aged between 20 years to 40 years, for the surgical removal of impacted molars.

#### Materials and methods

The study included 100 patients of both genders, who visited the respective department for tooth extraction. Participants were distributed into two groups of 50 patients each. 2% lignocaine was used for group A participants and 4% articaine for group B participants.

#### Results

The results demonstrated that 4% Articaine outperformed lignocaine in dental extraction. Articaine offered fast anesthesia and long-lasting anesthesia, making it the preferred option for the surgical extraction of impacted 3<sup>rd</sup> molars.

### Introduction

Impaction refers to a condition in which a tooth, typically a molar, is unable to fully emerge and align properly in the mouth because of various physical obstacles. An impacted molar refers to a tooth that is blocked from normal eruption by surrounding tissues, bone, or other teeth [Harris]<sup>1</sup>. The extraction of wisdom tooth is a crucial procedure that requires the use of appropriate anesthetic techniques to ensure patient comfort and effective outcome. The two primary anesthetic solutions commonly used in the surgical extraction of impacted 3<sup>rd</sup> molars are 4% Articaine and 2% lignocaine. This study assesses the anesthetic effectiveness of 4% Articaine and 2% lignocaine in the surgical extraction of wisdom tooth in both the maxilla and mandible. Articaine, a more recent anesthetic, is renowned for its early onset and deeper anesthesia, while lignocaine continues to be one of the most frequently used local anesthetics, thanks to its proven effectiveness and long-standing reliability.

Lidocaine, commonly referred to as lignocaine, is an amide-type local anesthetic widely used in dentistry and medicine. It is renowned for its rapid onset and moderate duration of action, making it an ideal choice for many clinical procedures, including dental extractions, restorative work, and minor oral surgeries<sup>2</sup>. It works by blocking sodium channels, inhibiting the transmission of nerve impulses, which results in temporary numbness in the targeted area [Bingham & Norris]<sup>3</sup>. The key advantage of lidocaine is its versatility, as it can be used both for infiltration anesthesia and nerve blocks. The common side effect includes local reactions such as swelling or redness at injecting area. In rare cases, systemic toxicity can occur, particularly if used in excessive amounts. Lidocaine is typically administered as a 2% solution, though concentrations can vary.

Articaine is a local anesthetic frequently used in dental procedures because of its strong efficacy and fast onset of action. It is a member of the amide class of anesthetics and has a chemical structure similar to lidocaine but with a thioester group instead of an ester group. This structural difference enables articaine to be metabolized more rapidly in the body, resulting in a quicker recovery time for patients (Haas, 2002)<sup>4</sup>.

One of the key distinguishing features of articaine is its ability to diffuse through tissues more effectively, leading to a better clinical outcome, especially in difficult-to-anesthetize areas (Malamed, 2013). Articaine is also considered to have a lower risk of systemic toxicity compared to other local anesthetics (Stojanovic et al., 2017)<sup>5</sup>. It is available in several formulations, including 4% concentration with epinephrine, which is mostly used in dentistry.

### Objectives

The objectives of an study are to evaluate the comparative analysis of anesthetic solutions of 4% Articaine, 0.5 % Bupivacaine and 2% Lignoacaine using the Visual analogue scale ( VAS SCALE ).

### Materials and methods

#### Study design-

This current study was performed in the oral surgery department of School of Dental Sciences, KVV, Karad, from 6/8/2024 to 05/08/24.

The study comprises of 100 patients of both sexes who come to oral surgery department for the surgical extraction of embedded 3<sup>rd</sup> molars in the age between of 20-40 years.

#### Sample size

The factor of interest of participating as sample among the population was considered as 50%. That is, P=50%

$$\text{Sample size} = Z^2 Pq / L^2$$

$$\text{Where, } Z = \text{normal standard varies at } 95\% \\ = 1.96$$

$$P = \text{population proportion has factors of interest} \\ \text{participating in this}$$

$$q = 100 - p$$

$$L = \text{margin of error at } 90\% \\ = 10\%$$

Therefore,

$$\text{Sample size} = (1.96)^2 \times (50)^2 \times (50) / (10)^2 \\ = 100$$

Two groups were made each of 50 participants: Group A and Group B

Group A participants received 2% lignocaine and group B participants received 4% articaine.

### Criteria

Onset and time of anesthesia, pain during the procedure, injection and after the procedure is done.

**Inclusion criteria –**

- All healthy participants
- Age range between 20 - 40 years
- All tooth that are indicated for surgical extraction

**Exclusion criteria**

- Pregnant women
- People with an allergy of local anesthetic solutions
- Medically compromised
- Painful tooth
- Uncooperative patients

**Ethical approval for the study**

The research has been approved by the Institutional Ethics Committee to proceed (Protocol Number 099/2024-2025) titled, " Anesthetic efficacy of 4% articaine and 2% lignocaine during the surgical removal of impacted 3<sup>rd</sup> molar in both maxilla and mandible: A comparative study" by Krishna Vishwa Vidyapeeth, Karad.

**Materials and methods**

Participants were randomly divided into two groups through a lottery system, with double-blinding procedures implemented. 2% lignocaine was given to group A patients and 4% articaine was given to group B patients. Each group consisted of 50 patients.

The allocation of participants to the respective groups (A and B) was performed by the investigator, who assigned a unique identification number to each participant

All patients were administered 1.5 mL of the local anesthetic solution to ensure a complete nerve block. The procedure followed standard aseptic surgical techniques for both the extractions and the anesthesia administration.

The anesthetic effects were evaluated by measuring pain while injecting, the onset of local anesthesia and its duration, and any pain experienced during the procedure. After the tooth extractions, patients were provided with a five-day course of analgesics and antibiotics for post-operative care.

**Evaluation**

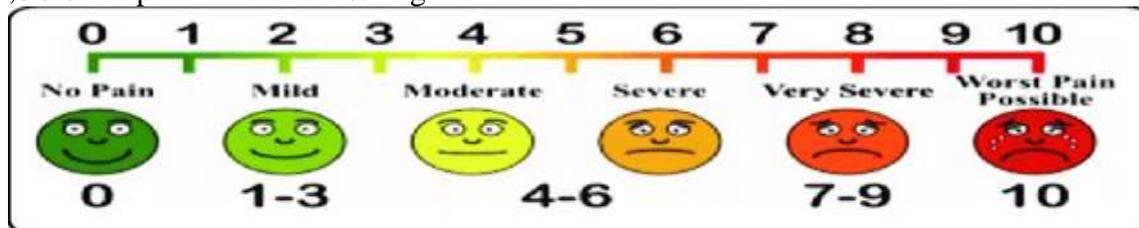
This study included total 100 interventions out of which 50 participants were administered 2% lignocaine and 50 participants were administered 4% articaine both with epinephrine 1:00,000. Mean, Mode, Medians of various quantitative variables were calculated to study the central tendency of the parameters, while standard deviations of the parameters were calculated for study.

**Table no -1** Assessment for and Lignocaine and 4% Articaine

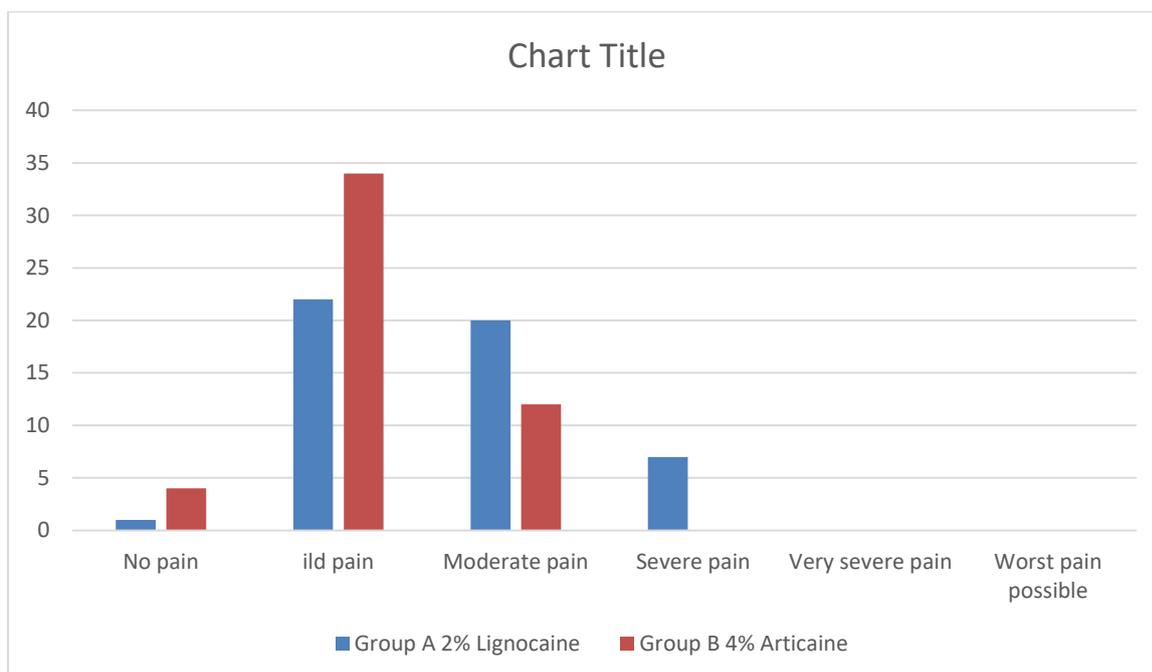
Parameter	Group A 2% Lignocaine		Group B 4% Articaine	
	Mean	SD	Mean	SD
Starting of action (seconds)	89.7	12.4	52.8	5.2
Time for soft tissue anaesthesia (minutes)	211.9	27.9	216.8	27.6

Duration of After analgesic effect ( minutes)	206.8	5.8	196.4	10.4
---	-------	-----	-------	------

**Table no -2** Assessment of pain points using VAS ( Visual Analogue Scale ) for 4% Articaine ,0.5 % Bupivacaine and 2 % Lignocaine



Method measurement of used of scale	Number of Patients	
	Group A 2% Lignocaine	Group B 4% Articaine
No	1 patients	4 patients
Mild	22 patients	34 patients
Moderate	20 patients	12 patients
Severe	7 patients	-
Very severe	-	-
Worst Pain Possible	-	-



## Discussion

The effectiveness of a local anesthetic is generally assessed by its ability to deliver effective pain relief, the speed of its onset, and the duration of its action. Lignocaine, also known as lidocaine, is an amide-based anesthetic widely utilized for its relatively brief duration of effect (Smith & Johnson, 2019)<sup>6</sup>. The World Health Organization (WHO) includes lignocaine on its list of essential medicines due to its broad clinical applications (WHO, 2021)<sup>7</sup>. The mechanism of action of lignocaine involves the inhibition of nerve impulse transmission by blocking sodium channels (Brown et al., 2020)<sup>8</sup>. Articaine, another local anesthetic with a similar mode of action, also binds to voltage-gated sodium channels, thereby preventing the influx of sodium ions and resulting in a reversible loss of sensation (Miller & Davis, 2018)<sup>9</sup>.

Our study evaluated the effectiveness of 2% lignocaine and 4% Articaine in routine tooth extractions, focusing on factors such as pain during injection, as well as the beginning and length of anesthesia, procedural pain, and postoperative discomfort. We found that Articaine (group B) had a quicker onset and a moderate length of anesthesia compared to lignocaine (group A). The quicker onset and moderate duration of Articaine can be attributed to its improved ability to penetrate nerve membranes, due to a higher concentration of active molecules in the tissues. Furthermore, Articaine is rapidly hydrolyzed in plasma, resulting in faster metabolism and elimination, which reduces pain after tooth removal.

The study highlights significant difference in its anesthetic efficacy and patient outcomes. Articaine, with its higher concentration and amide-ester hybrid structure, provides faster onset and better tissue penetration than lignocaine, making it ideal for procedures requiring rapid and deep anesthesia (Kumar & Patel, 2019)<sup>10</sup>. In contrast, 2% lignocaine, although effective, tends to have a slower onset and may require larger volumes for complete anesthesia, which can increase the challenges of adverse reactions (Lee & Choi, 2021)<sup>11</sup>. Research indicates that Articaine is linked to a lower failure rate in impacted 3<sup>rd</sup> molar extractions, likely because of its greater potency and more efficient nerve blockade. Furthermore, Articaine offers better pain control than lignocaine, reducing the need for additional analgesics. Thus, Articaine is often preferred for surgical extractions.

## Conclusion

In conclusion, the study shows that 4% Articaine provides superior anesthetic efficacy compared to 2% lignocaine for the surgical removal of wisdom tooth. Articaine's faster onset, deeper penetration, and reduced failure rates make it the preferred choice for this procedure. Lignocaine, while effective, shows slightly longer onset and lower potency.

## Reference

1. Harris, D. M., & Allman, R. (2006). *Oral and Maxillofacial Surgery: A Comprehensive Approach* (2nd ed.). Elsevier.
2. Malamed, S. F. (2013). *Handbook of Local Anesthesia* (6th ed.). Elsevier.
3. Bingham, A. D., & Norris, J. L. (2015). Local anesthetics: Clinical applications and adverse effects. *Journal of Clinical Anesthesia*, 30(3), 311-320.
4. Haas, D. A. (2002). Articaine: A review of its clinical use in dentistry. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, 94(5), 648-661.
5. Stojanovic, J., et al. (2017). Comparison of Articaine and lidocaine in dentistry: A clinical review. *International Journal of Dentistry*, 2017, 1-6.
6. Smith, J., & Johnson, T. (2019). Local anesthetic agents: Their pharmacokinetics and applications in clinical practice. *Anesthesiology Review*, 56(7), 1234-1245.
7. World Health Organization (WHO). (2021). Essential medicines list.

8. Brown, C., Williams, R., & Adams, P. (2020). Pharmacology of local anesthetics: A comprehensive review. *Journal of Clinical Anesthesia*, 45(3), 45-58.
9. Miller, S., & Davis, E. (2018). Comparative analysis of dental anesthetics: Lignocaine versus Articaine. *International Journal of Dental Anesthesia*, 12(2), 103-110.
10. Kumar, R., & Patel, S. (2019). Comparative efficacy of local anesthetics in dental procedures. *Journal of Oral Surgery*, 36(5), 457-462.
11. Lee, H., & Choi, J. (2021). Anesthetic effectiveness of Articaine and lidocaine in dental extractions. *Clinical Dentistry*, 42(2), 105-111.