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Comparative Evaluation of Articaine and Lignocaine for Palatal Anaesthesia Following Buccal Infiltration in Maxillary Extractions.

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ABSTRACT

Background : Palatal injections administered during maxillary tooth extraction are often associated with significant discomfort and pain. Articaine, owing to its superior tissue diffusibility, may provide effective palatal anaesthesia following buccal infiltration alone and thereby reduce the need for painful palatal injections. This study compared the efficacy of Articaine and Lignocaine for palatal anaesthesia following buccal infiltration during maxillary tooth extraction.

Materials and Methods : A prospective randomized comparative clinical study was conducted among 40 patients requiring maxillary tooth extraction. Participants were randomly divided into two groups of 20 each. One group received 4% Articaine with 1:100,000 epinephrine, while another Group received 2% Lignocaine with 1:100,000 epinephrine through buccal infiltration. Parameters evaluated included onset of anaesthesia, duration of anaesthesia, pain during administration of anaesthesia, pain during extraction, postoperative pain, and need for re-anaesthesia. Pain was assessed using the Visual Analog Scale (VAS). Statistical analysis was performed using SPSS software, and $p < 0.05$ was considered statistically significant.

Results: The Articaine group demonstrated a significantly faster onset of anaesthesia (49.044 ± 7.098 seconds) compared to the Lignocaine group (93.150 ± 5.857 seconds) ($p = 0.001$). The duration of anaesthesia was significantly longer with Articaine (124.995 ± 6.972 minutes) than with Lignocaine (79.495 ± 12.102 minutes) ($p = 0.001$). Pain scores during administration, during the procedure, and after the procedure were consistently lower in the Articaine group. Re-anaesthesia was required in only 15% of patients receiving Articaine compared to 50% in the Lignocaine group ($p = 0.020$).

Conclusion: Articaine demonstrated superior anaesthetic efficacy compared to Lignocaine by providing faster onset, prolonged duration of anaesthesia, improved pain control, and reduced need for supplemental palatal injections during maxillary tooth extraction. Articaine may therefore be considered an effective alternative to Lignocaine for maxillary dental extractions.

Keywords: *Articaine; Lignocaine; Palatal anaesthesia; Maxillary tooth extraction; Intraoperative pain control; Local anaesthesia; Pain perception*

INTRODUCTION

Local anesthetic is required for painless maxillary extractions and improved patient comfort during dental treatments. Because the palatal mucosa is innervated by the larger palatine and nasopalatine nerves, extraction of maxillary teeth

traditionally requires both buccal and palatal injections. However, because the palatal mucoperiosteum is so strongly adherent, palatal injections are frequently accompanied by severe discomfort and anxiety. Two of the most prominent local anesthetics used in dentistry to achieve effective anesthesia are articaine and lignocaine, often referred to as lidocaine. Every anesthetic has distinct qualities that may influence its effectiveness, duration, and commencement of action, making them appropriate for certain clinical situations((1).

Articaine is an amide local anesthetic distinguished by its thiophene ring structure, which increases its lipophilicity over standard anesthetics. This characteristic makes it possible for improved diffusion into tissues, which may result in a quicker onset and greater efficacy when inducing anesthesia in sensitive locations like the maxillary palatal region. In addition to hepatic metabolism, its rapid metabolism by plasma esterases results in a shorter duration of action, which is advantageous for outpatient dental treatments when rapid recovery from anesthesia is required (2,3,4).

In contrast, for several decades, lignocaine has been the gold standard for local anesthetic. Because of its consistent efficacy and safety profile, it is extensively researched and utilized. Although lignocaine is also an amide anesthetic, practitioners are more familiar with it and have been utilizing it for a longer period of time. It is recommended for a variety of dental procedures because of its pharmacokinetics, which provide a predictable duration of anesthesia. However, lignocaine may take longer to induce palate anesthesia, especially in regions like the palatal mucosa that have a sufficient circulatory supply and dense connective tissue (5,6).

Several researches have examined the efficacy of Articaine and Lignocaine in the context of palatal anesthesia. Parameters including the onset time, the success rate of obtaining sufficient anesthetic, and the patient's reported pain levels both during and after the surgery are frequently the subject of these investigations. Oliveira et al. discovered that both anesthetic drugs induced equal onset and duration of anesthesia, but neither consistently achieved profound palatal diffusion enough to totally avoid palatal discomfort

Recent clinical investigations have shown that buccal infiltration with 4% articaine can give adequate palatal anesthetic for many maxillary extractions without requiring additional palatal injection. A comparative double-blind study by Staedt et al. discovered that articaine had better vestibular-to-palatal diffusion than lignocaine during maxillary tooth extraction.

(1,7).

A randomized clinical research of maxillary extractions discovered that articaine had much higher palatal anesthetic success than lidocaine in various maxillary areas. The authors came to the conclusion that articaine's improved bone penetration could reduce the need for additional palatal injections, which would improve patient comfort. The use of articaine in maxillary dental operations has been further validated by systematic studies. Research indicates that a single buccal infusion with articaine may reduce injection-related pain and anxiety while offering anaesthetic efficacy comparable to buccal and palatal injections with lignocaine (8,9).

This comparative analysis aims to evaluate the effectiveness of Articaine versus Lignocaine for palatal anesthesia following buccal infiltration during maxillary tooth extractions. By examining the clinical outcomes associated with each anesthetic, including patient comfort and procedural efficiency, this study seeks to contribute valuable insights to dental practice. Ultimately, understanding the comparative advantages of these anesthetics can enhance pain management strategies in dental surgery, leading to improved patient experiences and outcomes(10).

MATERIALS AND METHODS:

This study was conducted in the Department of Oral and Maxillofacial Surgery, Saveetha dental college. The present in vivo study was conducted to evaluate pain, onset, and duration of 4% articaine with 1:100,000 epinephrine (Septodont) and 2% lignocaine with 1:80,000 epinephrine (Xicaine) in the extraction of maxillary teeth. 40 patients in the age group of 18–45 years were selected for the study. The patients were randomly administered one of the two local anesthetics.The one group(n=20) received a single buccal infiltration of 1 ml of 4% articaine HCL with 1:100,000 epinephrine .The other group(n=20) received a single buccal infiltration of 1 ml of 2% lignocaine HCL with 1:100,000 epinephrine . The extraction was performed five minutes after the local anesthetic injection.

Inclusion criteria:

Adult patients(18-45 years)

No gender preference

No relevant medical history,

Non-surgical extraction of firm permanent Maxillary teeth(due to caries,prosthesis placement,orthodontics)

Patients classified as American Society of Anesthesiologists (ASA) physical status I or II.

Patients willing to participate and provide informed consent.

Exclusion criteria:

Highly mobile teeth (Grade 2–3)

Infection at the needle pathway

Sensitivity to lidocaine or articaine local anesthetics

Analgesics used the day before the procedure were excluded.

Periapical lesions

Pregnant or lactating women.

Patients with systemic conditions contraindicating local anaesthetic administration.

Parameters evaluated were as follows:

Onset of anaesthesia:

Time interval between administration of local anaesthetic solution and achievement of adequate anaesthesia.

Duration of anaesthesia:

Time from onset of anaesthesia until the patient reported return of normal sensation.

Pain assessment:

Pain scores were assessed using the Visual Analog Scale (VAS) during:

Administration of anaesthesia

Extraction procedure

Postoperative period

Need for palatal re-anaesthesia:

Requirement for supplemental palatal injection during extraction was recorded.

Result evaluation:

The results were developed using Statistical Package for the Social Sciences version 23.0 where mean and std.deviation was calculated. Quantitative variables were expressed as mean and standard deviation, while qualitative variables were expressed as frequency and percentage.

The Mann–Whitney U test was used to compare pain scores between the two groups. Chi-square test was used for categorical variables such as need for re-anaesthesia. A p-value < 0.05 was considered statistically significant.

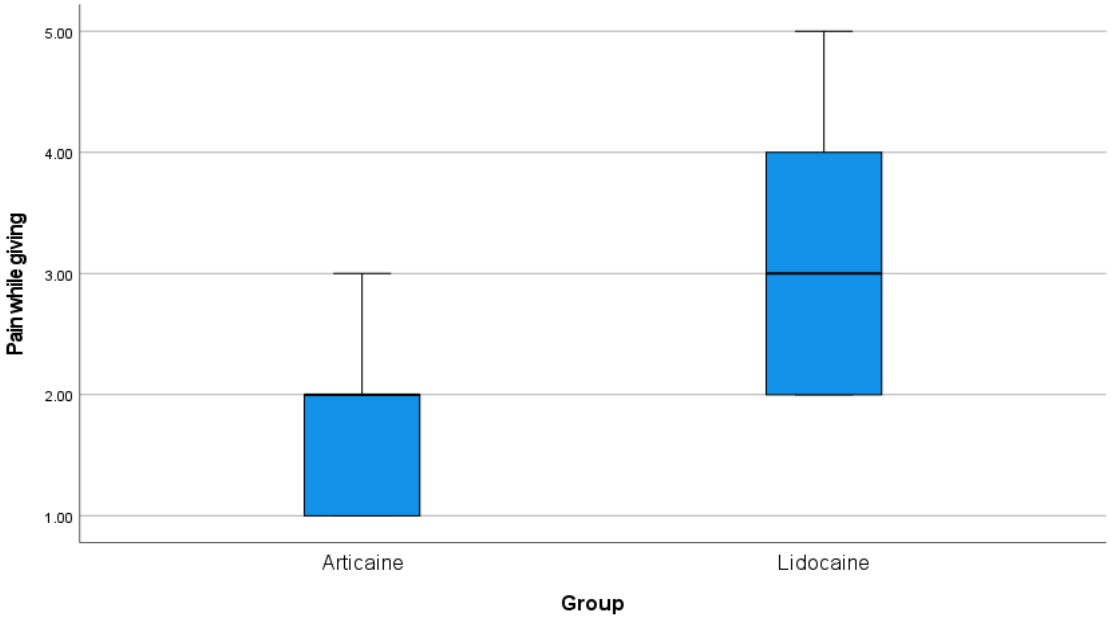
RESULTS:

Parameter	**Group**	**N**	**Mean ± deviation**	**p-value**
Onset(seconds)	Articaine	20	49.044 ±7.098	0.001
	Lignocaine	20	93.150 ± 5.857	
Duration (minutes)	Articaine	20	124.995 ± 6.972	0.001
	Lignocaine	20	79.495 ± 12.102	

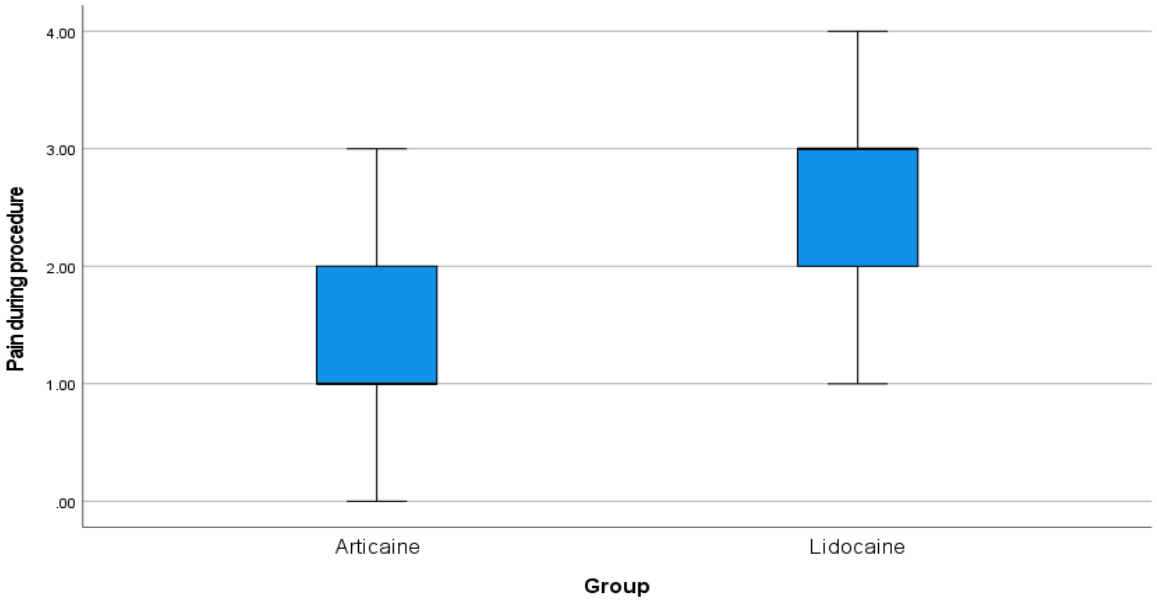
Table 1: Comparison of onset and duration of anaesthesia between the Articaine and Lignocaine groups. Values are expressed as mean ± standard deviation. Statistical significance was assessed between groups, with p < 0.05 considered statistically significant.

Parameter	Group (n=20)	Mean	Std.deviation	Median Interquartile Range	p-value
Pain while giving	Articaine	1.650	0.670	2-1	0.001
	Lignocaine	3.250	1.019	3-2	
Pain during procedure	Articaine	1.400	0.882	1-1	0.001
	Lignocaine	2.600	0.753	3-1	
Pain after procedure	Articaine	1.150	0.745	1-1	0.001
	Lignocaine	2.700	0.978	3-1	

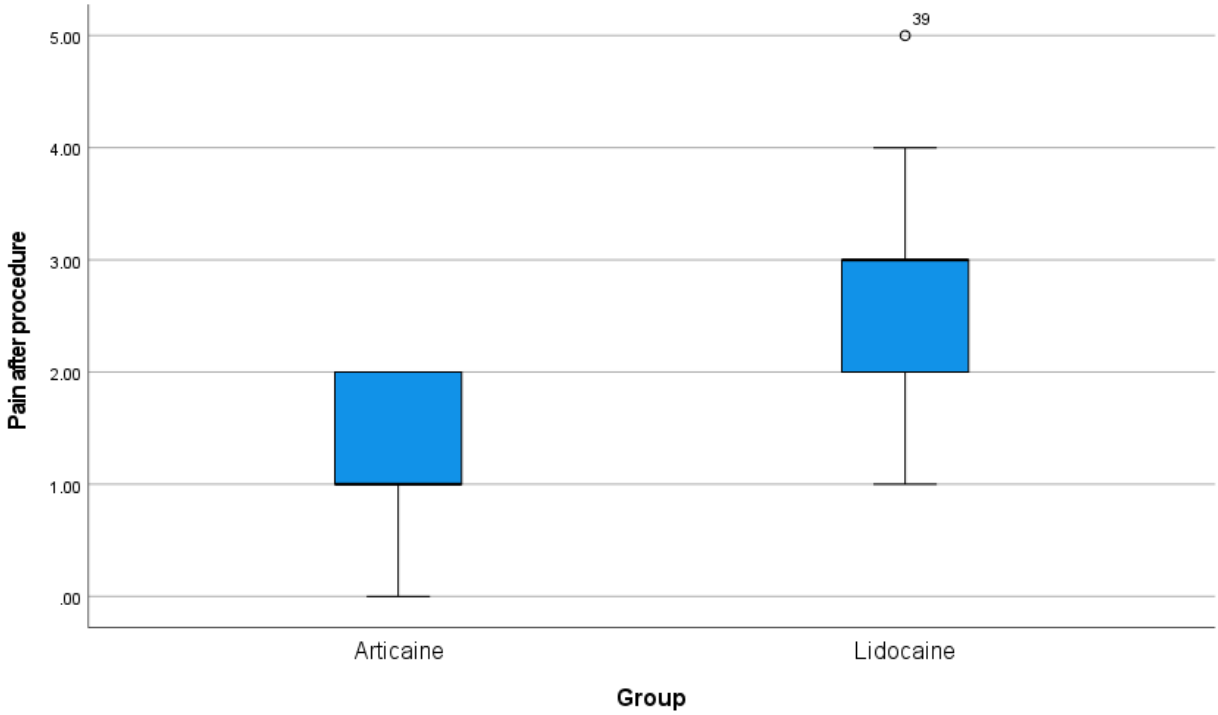
Table 2: Comparison of pain scores during administration of anaesthesia, during the procedure, and after the procedure between the Articaine and Lignocaine groups. Values are presented as mean, standard deviation, median, and interquartile range (IQR). Statistical analysis was performed using the Mann–Whitney U test. A p-value < 0.05 was considered statistically significant.



Graph 1: Comparison of pain scores during administration of anaesthesia between Articaine and Lignocaine groups using the Mann–Whitney U test. The box plot demonstrates lower pain scores in the Articaine group compared to the Lignocaine group.



Graph 2: Comparison of pain scores during the extraction procedure between Articaine and Lignocaine groups. The Articaine group exhibited lower median pain scores and reduced variability when compared with the Lignocaine group.



Graph 3: Comparison of pain scores after the procedure between Articaine and Lignocaine groups. Lower postoperative pain scores were observed in the Articaine group, whereas the Lignocaine group demonstrated greater variability and the presence of an outlier.

Table 3: Comparison of the need for palatal re-anaesthesia between the Articaine and Lignocaine groups. Values are expressed as frequency and percentage [n (%)]. Statistical analysis was performed using the Chi-square test, with $p < 0.05$ considered statistically significant.

Need for reanesthesia	Articaine n(%)	Lignocaine n(%)	Total n(%)	p-value
No	17(85.0)	10(50.0)	27(67.5)	0.020
Yes	3(15.0)	10(50.0)	13(32.5)	
Total	20(100.0)	20(100.0)	40(100.0)	

1) Onset and duration: The onset of anaesthesia (Table-1)was significantly faster in the Articaine group compared to the Lignocaine group. The mean onset time for Articaine was 49.044 ± 7.098 seconds, whereas the Lignocaine group showed a mean onset time of 93.150 ± 5.857 seconds. Statistical analysis demonstrated a highly significant difference between the two groups ($p = 0.001$). The duration of anaesthesia was also significantly longer in the Articaine group. The mean duration achieved with Articaine was 124.995 ± 6.972 minutes, while Lignocaine demonstrated a shorter duration of 79.495 ± 12.102 minutes. This difference was statistically highly significant ($p = 0.001$).

2) Comparison of Pain During Administration of Anaesthesia: The Mann–Whitney U test demonstrated that participants in the Articaine group experienced lower pain scores during administration of anaesthesia compared to the Lignocaine group. The median pain score in the Articaine group was lower mean score 1.650 ± 0.670 with interquartile range (IQR) of 2–1, whereas the Lignocaine group showed a higher mean pain score of 3.250 ± 1.019 with a median and IQR of 3–2. The difference between the groups was statistically highly significant ($p = 0.001$). This indicates that Articaine provided a more comfortable anaesthetic administration experience than Lignocaine.(Graph 1,Table 2).

3) Comparison of Pain During the Procedure: Similarly, pain experienced during the extraction procedure was lower in the Articaine group, with a mean score of 1.400 ± 0.882 and median–IQR of 1–1, compared to the Lignocaine group, which demonstrated a mean score of 2.600 ± 0.753 and median–IQR of 3–1. This difference was also statistically significant ($p = 0.001$). The box plot analysis revealed that the Articaine group had lower median pain scores and a narrower interquartile range, suggesting more consistent pain control. In contrast, the Lignocaine group showed higher median pain scores and wider dispersion of values, indicating comparatively greater intraoperative discomfort(Graph 2 and Table 2).

4) Comparison of Pain After the Procedure: Postoperative pain scores were significantly reduced in the Articaine group, with a mean value of 1.150 ± 0.745 and median–IQR of 1–1, whereas the Lignocaine group exhibited a higher mean score of 2.700 ± 0.978 and median–IQR of 3–1. Statistical analysis confirmed a highly significant difference between the groups ($p = 0.001$). The Lignocaine group demonstrated greater variation in pain scores, including the presence of an outlier with a high pain score, whereas the Articaine group maintained lower and more consistent postoperative pain values. These findings suggest that Articaine provided superior postoperative analgesic effectiveness (Graph 3,Table 2).

5) Comparison of Need for Palatal Re-anaesthesia Between the Groups: The requirement for re-anaesthesia differed significantly between the two groups. In the Articaine group, only 3 participants (15.0%) required re-anaesthesia, whereas 10 participants (50.0%) in the Lignocaine group required additional anaesthetic administration. The majority of participants in the Articaine group (85.0%) did not require re-anaesthesia compared to only 50.0% in the Lignocaine group. Statistical analysis using the Chi-square test revealed a significant difference between the groups ($p = 0.020$), indicating that Articaine was more effective in maintaining adequate anaesthesia throughout the procedure and reducing the need for supplemental injections (Table 3).

DISCUSSION:

The extraction of maxillary teeth is one of the most frequently performed dental procedures, and an adequate local anesthetic is essential for patient comfort during surgery. Lignocaine (also known as Lidocaine) has long been the preferred anesthetic agent due to its proven efficacy and safety. But in recent years, articaine—a more contemporary amide-type anesthetic—has drawn notice for its improved effectiveness, quicker onset, and longer anesthetic duration. Using data from current research and clinical trials, this discussion will evaluate articaine with lignocaine especially in the context of palatal anesthetic

followed by buccal infiltration for intraoperative pain control during maxillary tooth extraction.

Palatal Anesthesia and Buccal Infiltration

Palatal anesthesia is traditionally required for extractions in the maxillary region, particularly due to the dense innervation of the palate. Buccal infiltration, meanwhile, targets the nerves that supply the soft tissue on the cheek side of the upper teeth. In many cases, a combination of palatal anesthesia and buccal infiltration is necessary to ensure effective pain control during extraction.

Articaine vs. Lignocaine: Mechanism of Action

Articaine's molecular structure includes a thiophene ring, which enhances its lipid solubility, allowing it to penetrate bone more effectively than Lignocaine. This superior diffusion into hard and soft tissues theoretically reduces the need for multiple injections (e.g., palatal and buccal) for pain control. Lignocaine, in contrast, is less lipophilic and may not diffuse as effectively, necessitating additional anesthetic interventions, such as palatal blocks.

Pain Control: Clinical Findings

The present study demonstrated that Articaine was significantly more effective than Lignocaine for palatal anaesthesia following buccal infiltration during maxillary tooth extraction. The mean onset time of anaesthesia was significantly shorter with Articaine (49.044 ± 7.098 seconds) compared to Lignocaine (93.150 ± 5.857 seconds) ($p = 0.001$). Articaine also showed a longer duration of anaesthesia (124.995 ± 6.972 minutes) than Lignocaine (79.495 ± 12.102 minutes) ($p = 0.001$). Pain scores during administration of anaesthesia, during the procedure, and after the procedure were consistently lower in the Articaine group, with mean scores of 1.650 ± 0.670, 1.400 ± 0.882, and 1.150 ± 0.745 respectively, compared to 3.250 ± 1.019, 2.600 ± 0.753, and 2.700 ± 0.978 in the Lignocaine group ($p = 0.001$). Additionally, only 15% of patients in the Articaine group required palatal re-anaesthesia compared to 50% in the Lignocaine group ($p = 0.020$), indicating superior anaesthetic efficacy of Articaine.

According to a research by Malamed et al. (2000), when given as a buccal infiltration alone, articaine greatly improved pain control during maxillary tooth extraction, frequently obviating the need for palatal anesthetic. Claffey et al. (2004) reported similar results, showing that Articaine's diffusion into the maxillary cortical bone produced more consistent anesthetic and decreased patient discomfort throughout procedures((11,12).

In contrast, Lignocaine frequently necessitates both buccal and palatal infiltration to obtain the same level of anaesthesia. In addition to increasing patient discomfort and procedural time, the need for several injections raises the risk of consequences such as soft-tissue trauma and needle-related injuries. Furthermore, because lignocaine takes longer to start working than articaine, the treatment may be delayed, which could make the patient more uncomfortable and anxious.

Comparative Studies

Several clinical studies have explored the efficacy of Articaine versus Lignocaine for intraoperative pain control. A randomized controlled trial by Yapp et al. (2012) found that Articaine provided superior pain control with fewer injections compared to Lignocaine during extractions of maxillary molars. Specifically, patients receiving Articaine experienced a more rapid onset of anesthesia and reported lower pain scores both during and after the procedure (13).

Another study by Costa et al. (2005) focused on the efficacy of buccal infiltration alone using Articaine for maxillary tooth extraction. The results demonstrated that Articaine's increased ability to diffuse through bone allowed the anesthetic to reach the palatal nerves without the need for a separate palatal injection. This study is consistent with the findings in the dataset above, where only 30% of participants required palatal anesthesia with Articaine, compared to 80% with Lignocaine (14,15).

In contrast, it has been discovered that in order to achieve the same degree of anesthetic, lignocaine requires more frequent buccal and palatal injections. Katyal et al. (2010) observed that, while Lignocaine is still a useful anesthetic, it frequently falls short in terms of duration and overall efficacy when compared to Articaine, particularly in the setting of maxillary extractions. (16,17).

Duration of Anesthesia

The duration of anaesthesia was significantly longer in the Articaine group compared to the Lignocaine group. Patients receiving Articaine demonstrated a mean duration of anaesthesia of 124.995 ± 6.972 minutes, whereas the Lignocaine group showed a significantly shorter duration of 79.495 ± 12.102 minutes. Statistical analysis revealed a highly significant difference between the two groups ($p = 0.001$). The prolonged duration achieved with Articaine may be attributed to its superior diffusibility and higher lipid solubility, which enhance tissue penetration and anaesthetic effectiveness. These findings indicate that Articaine provides more sustained anaesthesia and improved postoperative comfort during maxillary tooth extraction procedures compared to Lignocaine.

According to a study by Brandt et al. (2011), articaine has a far longer duration of action than lignocaine, which makes it a better option for both simple extractions and more complicated surgical procedures. However, lignocaine may need to be

administered repeatedly throughout longer procedures, which raises the possibility of toxicity and patient discomfort (18,19).

Limitations of the Study

The present study had certain limitations. The sample size was relatively small, which may limit the generalizability of the findings to a larger population. Only patients undergoing maxillary tooth extraction were included; therefore, the results cannot be applied to other dental procedures or mandibular extractions. Pain assessment was based on the Visual Analog Scale, which is subjective and dependent on individual pain perception and anxiety levels. Anatomical variations among patients may also have influenced the efficacy of anaesthesia. In addition, the study evaluated only short-term outcomes and compared only two local anaesthetic agents without assessing long-term patient satisfaction or complications.

CONCLUSION:

In the context of maxillary tooth extraction, Articaine proves to be a superior anesthetic agent compared to Lignocaine. It offers faster onset, better intraoperative pain control, longer duration of action, and reduced need for additional palatal anesthesia. These advantages are corroborated by several clinical studies that highlight Articaine's superior diffusion properties and patient comfort during maxillary extractions. While Lignocaine remains a viable option, Articaine's benefits, particularly in terms of reduced injections and extended pain control, make it the preferred choice for many clinicians for maxillary teeth anesthesia.

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CONFLICT OF INTEREST:

All authors declare that there are no potential conflicts of interests..

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