
Efficacy Of Articaine And Lidocaine For Local Anesthesia In Tooth Extraction: A Systematic Review

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Abstract

Pain is one of the main obstacles in tooth extraction procedures; therefore, effective local anesthesia is required to improve patient comfort during the procedure. Lidocaine is the most commonly used local anesthetic in dentistry, while articaine has increasingly been used because it is claimed to have better tissue diffusion ability and a longer duration of action. This systematic review aimed to determine the effectiveness of articaine compared with lidocaine as a local anesthetic in tooth extraction procedures. The method used was the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) with article searches conducted through the ScienceDirect, PubMed, and Scopus databases using the keywords "Lidocaine AND Articaine AND Tooth Extraction." The inclusion criteria included randomized controlled trial (RCT) articles, articles published in English between 2015 and 2025, and studies discussing the use of lidocaine and articaine in tooth extraction procedures. From the search results, 797 articles were identified, and after the selection process, 6 articles met the inclusion criteria. The review results showed that articaine has several advantages over lidocaine, including no need for additional injection volume, faster onset of action, longer anesthetic duration, and lower intraoperative and postoperative pain complaints. Based on these findings, it can be concluded that articaine is a more effective local anesthetic than lidocaine for tooth extraction procedures.

Keywords: Articaine, Lidocaine, Local Anesthesia, Tooth Extraction, Literature Review.

INTRODUCTION

Pain is an unpleasant sensation caused by tissue injury, which is transmitted through sensory nerves to the central nervous system and interpreted as pain. In tooth extraction procedures, pain becomes an obstacle to dental treatment; therefore, strategies are required to manage it. One commonly used pain control method is the inhibition of pain impulse transmission from the peripheral nervous system to the central nervous system through local anesthesia procedures (Kamadjaja, 2019).

The success of local anesthesia in tooth extraction procedures is an important factor in supporting patient comfort and treatment success. An ideal local anesthetic should have a rapid onset of action, sufficient anesthetic duration, low toxicity, and the ability to provide optimal pain control during the procedure. Failure of local anesthesia may increase patient anxiety, discomfort during the procedure, and difficulties in dental treatment procedures (Martin *et al.*, 2021).

In determining the type of anesthesia to be used, local anesthesia should be the first choice because it provides relatively mild physiological disturbances and is therefore recommended for patients with high systemic risk. In addition, local anesthesia has relatively low morbidity, practical application, and low cost (Kamadjaja, 2019).

Various local anesthetic agents are used in dentistry, and lidocaine is the most popular among them (Rayati *et al.*, 2021). Lidocaine is widely used because it fulfills the ideal requirements of an anesthetic agent, including rapid onset, long duration of action, and low risk of hypersensitivity reactions (Ni Putu Alit Listya Dewi, Desak Nyoman Ari Susanti, 2020). However, several studies have shown that lidocaine has limitations, especially in posterior mandibular tooth extraction procedures that require deeper anesthetic penetration into bone tissue. This condition causes some patients to still require additional injections to achieve adequate anesthesia (Bartlett and Mansoor, 2016).

Articaine, first introduced in 1976, is the second most commonly used anesthetic by dentists. Articaine is the only amide anesthetic containing an ester group. Its clinical benefits include a longer duration of anesthesia and increased diffusion through bone tissue. Articaine is claimed to diffuse

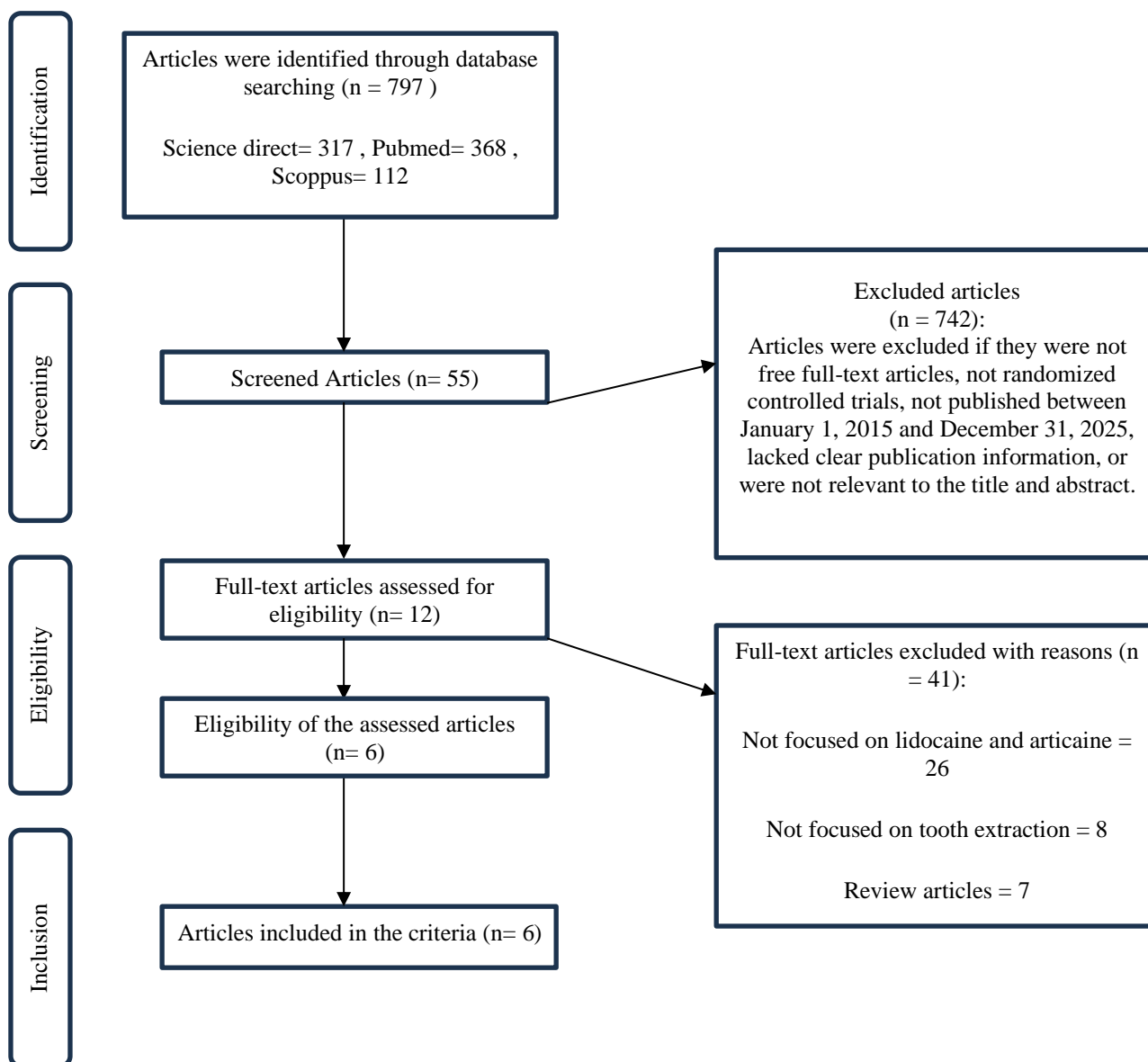
more extensively through hard and soft tissues compared with other local anesthetics (Rayati *et al.*, 2021). Furthermore, articaine has the ability to produce faster and longer-lasting anesthesia, making it capable of improving the success of local anesthesia in various dental procedures (Luo *et al.*, 2022).

The addition of vasoconstrictors to local anesthetics can improve the duration and quality of anesthesia (Karm *et al.*, 2017). Vasoconstrictors in local anesthesia can increase blood perfusion, reduce the absorption of local anesthetic agents into the cardiovascular system, reduce bleeding at the injection site, and increase local anesthetic concentration around the nerves. Increased anesthetic concentration around the nerves enhances the duration of local anesthetic action (Saputra *et al.*, 2023).

The most common vasoconstrictor is epinephrine, which is available in formulations of 1:50,000, 1:100,000, and 1:200,000 (Lasemi *et al.*, 2015). Epinephrine provides many benefits and can be used safely in most dental patients. However, its benefits may sometimes be accompanied by the risk of serious medical complications, especially in patients with cardiovascular disorders or other systemic conditions (Borman Sumaji, Herjanto Kurnia, 2025). Inappropriate use of vasoconstrictors may worsen the patient's condition. Therefore, clinicians must have sufficient knowledge regarding the various vasoconstrictors commonly used in dental practice to ensure effective use and avoid negative effects (Saputra *et al.*, 2023). This systematic review aimed to determine the effectiveness of lidocaine and articaine as local anesthetics for tooth extraction procedures.

RESEARCH METHODS

This systematic review used the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) method to collect and select research articles by accessing three electronic databases: ScienceDirect, PubMed, and Scopus. The article search was conducted using the keywords "Lidocaine AND Articaine AND Tooth Extraction." The abstracts of identified articles were carefully reviewed to meet the inclusion criteria for this systematic review: studies focusing on lidocaine and articaine as local anesthetics for tooth extraction; articles published between January 1, 2015, and December 31, 2025; articles written in English; and articles using a randomized controlled trial method.



RESULTS AND DISCUSSION

In the initial search, 797 articles were identified from the three databases (ScienceDirect, PubMed, and Scopus). Articles with similar content were removed from the list. The remaining articles were then screened based on title, abstract, and full text, resulting in 6 complete articles relevant to this study and included in the systematic review. A summary of the articles that served as the sources for this study is presented in Table 1.

Table 1. Summary of International Articles Results

No.	Author	Year	Study Design	Title	Methods	Result
1.	Mittal <i>et al</i>	2018	A randomized crossover clinical trial	Comparative stud of the efficacy of 4% articaine vs 2% lidocaine in surgical removal of bilaterally	The study was conducted on 20 patients aged 18–30 years with bilateral impacted	The volume of lidocaine required was slightly higher (3.815 mL) compared to articaine (3.725

				impacted mandibular third molars	mandibular third molars. During the first wisdom tooth extraction visit, patients were randomly assigned to receive either 4% articaine or 2% lidocaine (both combined with epinephrine 1:200,000). At the subsequent postoperative visit, the alternative local anesthetic agent was administered. Each patient received a total of 3.6 mL of anesthetic solution; 1.8 mL of the solution was used to achieve the local anesthetic effect	mL). The mean duration of anesthetic effect with articaine (141.2 ± 36.15 minutes) was significantly longer, and articaine provided a longer postoperative analgesic period. No significant differences were found in perioperative and postoperative pain scores.
2.	Rathi <i>et al</i>	2019	A randomized controlled trial	Anesthetic efficacy of buccal infiltration articaine versus lidocaine for extraction of primary molar teeth	The trial was conducted on 100 children aged 7–12 years who were indicated for primary molar extraction. A randomized single buccal infiltration technique was performed, in which Group A received 1.7 mL of 4% articaine with epinephrine 1:100,000, while Group B received 1.8	Lingual anesthesia was achieved with a single buccal infiltration in all children in the articaine group, and no additional injections were required. All participants in the lidocaine group reported a lack of subjective numbness and required additional palatal or lingual injections.

					mL of 2% lidocaine with epinephrine 1:80,000.	
3.	Rayati <i>et al</i>	2021	A double-blind, randomised, clinical trial	Comparison of the efficacy of 4% articaine with epinephrine 1:100,000 and 2% lidocaine with epinephrine 1:100,000 buccal infiltration for single maxillary molar extraction: a double-blind, randomised, clinical trial	The study was conducted on 139 patients aged 20–60 years who required extraction of one maxillary molar tooth. Cartridges containing 4% articaine with epinephrine 1:100,000 and 2% lidocaine with epinephrine 1:100,000 were masked with tape, and buccal infiltration was administered randomly to the patients. A total of 64 patients received 2% lidocaine local anesthesia, while 75 patients received 4% articaine.	-A total of 58 patients in the lidocaine group and 27 patients in the articaine group experienced pain during tooth extraction, with success rates of 9.38% for lidocaine and 64% for articaine.
4.	Adigun <i>et al</i>	2022	A randomized double blind crossover study	Comparison of the anaesthetic effects of 4% articaine hydrochloride and 2% lidocaine hydrochloride for maxillary molar extraction: A randomized	The study was conducted on adult patients aged 18–40 years who required bilateral maxillary molar extractions. A minimum sample of 14	Articaine had a shorter onset time (2.60 minutes) compared to lidocaine (2.85 minutes). The duration of action of articaine was 31.45 minutes, compared to 30.46 minutes for lidocaine. The

				double blind crossover study	extractions was included in each study group, receiving either 1.7 mL of 2% lidocaine with epinephrine 1:100,000 or 1.7 mL of 4% articaine with epinephrine 1:100,000.	extraction durations for articaine and lidocaine were 3.97 minutes and 3.44 minutes, respectively. No statistically significant differences were found in any of the measured parameters.
5.	Al-Mahalawy <i>et al</i>	2023	Randomized-controlled clinical study	Articaine versus Lidocaine in only buccal infiltration anesthesia for the extraction of mandibular anterior teeth. A prospective split-mouth randomized-controlled clinical study	The trial was conducted on 31 female and 21 male patients, in which one mandibular anterior tooth was randomly extracted using a single labial infiltration technique with either 4% articaine or 2% lidocaine. After 14 days, the other mandibular anterior tooth was extracted using the alternative anesthetic agent.	The effectiveness of a single labial infiltration injection for mandibular anterior tooth extraction was demonstrated by the fact that none of the patients in either the study group or the control group required re-administration of local anesthesia. Its safety was also confirmed, as no patients in either group reported postoperative anesthetic complications. The mean VAS score recorded for pain control during extraction was 1.16 ± 0.93 in the articaine group and 1.71 ± 0.90 in the lidocaine group.
6.	Huang <i>et al</i>	2025	A single-blinded, randomized clinical trial	Efficacy and safety of infiltration anesthesia with 4 % Articaine and block anesthesia with	The clinical trial involved 30 adults with bilateral mandibular third molars. Patients were	Based on the amount of anesthetic used, the articaine group required an average of 1.5 ± 0.4 cartridges, whereas

				2 % Lidocaine in the mandibular third molar extraction	randomly assigned to receive 4% articaine through infiltration anesthesia on one side and 2% lidocaine through nerve block anesthesia on the contralateral side.	the lidocaine group required 2.2 ± 0.5 cartridges, showing a statistically significant difference. Regarding pain control effectiveness, the articaine group had a pain score of 2.4 ± 1.9 , while the lidocaine group had a score of 2.4 ± 1.4 , with no significant difference observed. The duration of the procedure was 16.7 ± 10.9 minutes for the articaine group and 17.7 ± 10.2 minutes for the lidocaine group, with no significant difference between them.
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From the six articles reviewed in this systematic review, it was found that local anesthesia using articaine has advantages over lidocaine in tooth extraction procedures and minor oral surgery procedures, including:

- a) Articaine does not require additional injection volume, whereas some patients receiving lidocaine still complained of insufficient numbness.
- b) The duration of the anesthetic effect of articaine is longer than that of lidocaine.
- c) Articaine has a faster onset of action compared with lidocaine.
- d) Pain complaints during tooth extraction using articaine are lower than those using lidocaine.
- e) Postoperative pain using articaine is lower than with lidocaine, although the difference is not always statistically significant.

Articaine is known to have better tissue diffusion ability than lidocaine because of its thiophene ring structure, which increases lipid solubility. This characteristic allows more effective penetration into bone tissue and nerves, enabling successful anesthesia without requiring additional injection volume. Several studies reported that patients receiving lidocaine still required additional injections due to inadequate anesthesia, whereas articaine provided more optimal anesthetic effects at the same volume (Zhang *et al.*, 2019).

In addition, articaine has a faster onset of action compared with lidocaine. Studies have shown that the onset time of articaine is shorter, allowing patients to achieve anesthetic conditions more quickly before the procedure. This is related to the high diffusion capacity and pKa of articaine, which is close to physiological pH, resulting in more drug molecules existing in the base form and penetrating nerve membranes more easily (Gong *et al.*, 2026).

The duration of action of articaine is also reported to be longer than that of lidocaine. A longer anesthetic duration provides advantages during tooth extraction procedures, especially in procedures requiring longer operation times, such as odontectomy or impacted molar extraction. Meta-analysis studies have shown that articaine has a longer anesthetic duration in both infiltration and nerve block techniques compared with lidocaine (Zhang *et al.*, 2019).

From the patient comfort perspective, the use of articaine is also associated with reduced pain complaints during extraction procedures. More effective anesthesia causes patients to experience lower intraoperative pain compared with lidocaine use. Furthermore, several studies showed that postoperative pain in the articaine group tended to be milder, although in some studies the difference was not statistically significant (Gong *et al.*, 2026).

In addition to anesthetic effectiveness, the safety of articaine use is also an important consideration in dental practice. Research conducted by Yamamoto *et al.* demonstrated that the use of articaine in routine dental procedures has a good safety profile and does not show an increased risk of significant complications compared with lidocaine when used according to proper indications and dosage (Yamamoto *et al.*, 2025).

Overall, the results of this literature review indicate that articaine is a local anesthetic agent with better effectiveness than lidocaine in several clinical aspects, especially onset of action, anesthetic duration, anesthetic effectiveness, and reduction of patient pain during tooth extraction procedures.

CONCLUSION

Based on the results of this literature review of six randomized controlled trial articles, it can be concluded that articaine has better effectiveness than lidocaine as a local anesthetic in tooth extraction procedures. Articaine demonstrates a faster onset of action, longer anesthetic duration, lower need for additional anesthetic volume, and lower intraoperative and postoperative pain levels compared with lidocaine. Therefore, articaine can be considered an effective local anesthetic option to improve the success of tooth extraction procedures and patient comfort during treatment. Further studies with larger sample sizes and more homogeneous research methods are still needed to strengthen evidence regarding the effectiveness and safety of articaine compared with lidocaine in various dental procedures. The selection of local anesthetic agents should still consider the patient's systemic condition, treatment indications, and the safety of vasoconstrictors contained in the anesthetic agents.

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