



Efficacy of Articaine in the Mandibular Infiltration Technique: A Systematic Review

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Authors' contributions

This work was carried out in collaboration between all authors. Authors ALARM and TFS designed the study. Authors JMMS and MMAF managed the literature searches. Authors ALARM, TFS and MLR analyzed the data. All authors drafted and approved the final version of the manuscript.

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ABSTRACT

The use of local anesthetic has become more common in dental offices. Throughout the last few years, an anesthetic base of surprising properties has been studied with the aim of evaluating the possibility of providing more comfort to patients during small mandibular procedures. Some studies show that Articaine can be used in the mandible through an infiltration technique as a possible alternative to the inferior alveolar nerve block technique, because it presents a high diffusive power in the cortical bone. The aim of this systematic review was to analyze evidence approaching the efficacy of Articaine through the mandibular infiltration terminal technique. The research survey, which follows the PRISMA protocol, was done by accessing PubMed, Scopus and BVS (Medline) databases. The keywords found in DeCS and MeSH were combined with the Boolean operator "AND." The 18 studies included in this review were limited to articles published since 1999 that

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used humans; articles that discussed the mandibular infiltration technique and that compared other anesthetic bases through this technique. Based on the analysis of evidence, Articaine was relatively effective in the mandibular infiltration technique.

Keywords: Articaine; mandible; anesthetic.

1. INTRODUCTION

The use of local anesthetics in Odontology is highly important, since several clinical procedures can provoke painful stimuli. Anesthetics have the ability of reducing or ceasing the patient's painful sensation and, as a consequence, of making the procedures more comfortable [1-4]. Lidocaine was the first anesthetic base of the amide group to be launched in the market, thus it is a target of comparison with other bases [1,4].

Articaine is a local anesthetic of the amides, which, when compared to other bases from the same class, presents an ester group in its structure, therefore it is bio-transformed both in plasma and in the liver [5-7]. Articaine is a new anesthetic in the market, which was approved in 1999 for use in Brazil [4,8,9]. Due to its high diffusion, such anesthetic can be effective in mandibular infiltration techniques.

The mandibular supra-periosteal infiltration anesthetic was commonly avoided in the clinical practice due to its questionable efficacy [10]. The mandibular bone presents a compact dense bone that would difficult the diffusion of anesthetics and consequently would result in anesthetic failures regarding the applied technique. This technique is chosen when the expected objective is to make a small area insensitive. Literature describes that Articaine can be effective regarding the infiltration technique in inferior molars due to the great diffusion power of the anesthetic [9,11,12].

Several studies approach the efficacy of 4% Articaine in the infiltration technique performed in the mandibular posterior region [9,11,13]. Since it has a great power of diffusion, the use of Articaine in the infiltration technique seems a more comfortable option to the patient, given the reduction of the anesthetized area and the fact it is a technique of simple execution by the professional.

By then, the regional block technique was the main anesthetic technique performed for the conduction of dental procedures in the clinical range in the mandibular area, because, due to

the density of this cortical bone, infiltration techniques would not be successful. Literature shows that Articaine can be a promising anesthetic for use in mandibular infiltration techniques, because it presents a higher diffusive power in mineralized tissues. Therefore, in those procedures involving a small area, the supra-periosteal infiltration of this anesthetic could be an alternative to the inferior alveolar nerve block technique.

For the research, the authors used the PICO acronym (P – patients who had mandibular procedures; I – Articaine with epinephrine; C – other anesthetic bases of the amides; O – efficacy of Articaine in the mandibular infiltration technique) to describe the components associated with the review. Thus, they structured the following guiding question: Does Articaine with epinephrine has an efficacy in the infiltration technique for procedures performed in patients in the mandibular area? The aim of study was to conduct a systematic review based on evidence that discussed the efficacy of Articaine through the mandibular infiltration terminal technique.

2. MATERIALS AND METHODS

This is a systematic review of scientific literature following the recommendations of the PRISMA protocol (PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies), in which the items 13, 14, 16, 21, 22 and 23 were excluded because this is a meta-analysis. The protocol can be accessed through the following electronic address: www.prisma-statement.org/documents/PRISMA%202009%20checklist.doc

Crossing of keywords was used in order to obtain a successful research, applying the PICO strategy, in which P: population (population or clinical situation); I: intervention; comparison; and O: outcome [14]. The descriptors were chosen based on verification in the Descriptors of Health Sciences (DeCS, acronym in Portuguese) and in the Medical Subjective Heading (MeSH).

The databases accessed for article search included: PubMed, Scopus and BVS (Medline). The keywords used in the search were

“articaine,” “mandible,” and “anesthetic” [DeCS] in the BVS (Medline) and “articaine,” “mandible” and “anesthetic” [MeSH] in PubMed and Scopus. The Boolean operator “AND” was used to make a combination between the descriptors.

The study was based on articles published since 1999 in the Portuguese and English languages. Articaine was approved in 1999 in Brazil [4], whereas the Federal and Drug Administration (FDA) provided its approval in the United States only in the next year.

The search for articles began in may 2016 and ended in august of the same year. The inclusion criteria were articles that approached the mandibular infiltration technique, that compared anesthetic bases by means of this technique, and studies performed in humans. The exclusion criteria were literature/systematic reviews, letters, preface, comments, and articles that did not approach the mandibular anesthetic infiltration technique as the main anesthetic technique used before others.

Two reviewers chose the articles simultaneously, following the inclusion criteria. Firstly, 146 articles were selected, which were submitted to a screening process (reading of titles and abstracts), and based on this process, 32 studies were chosen for complete reading. After the full reading, 18 papers were included in the qualitative synthesis for the systematic review. During the classification process, a table was developed so data could be better organized. An advisor monitored the search, and an *ad hoc* well-known examiner was invited to perform the classification of articles. The studies that fulfilled the inclusion criteria were evaluated on the methodological quality with the Effective Public Health Project (EPHP) tool [15]. The studies quality was assessed by one reviewer and checked by a second reviewer. Disagreements were resolved by discussion and, when necessary, by arbitration involving a third reviewer.

3. RESULTS

After the search performed in PubMed, Scopus and BVS (Medline) electronic databases, 146 articles were found: 52 in PubMed, 53 in Scopus, and 41 in BVS (Medline). After removing the duplicates, an amount of 65 papers was obtained. The authors, by means of the classification of studies (reading of abstracts) and respecting the inclusion criteria, chose 32

articles for a careful reading (Fig. 1). All 32 full articles were accessed for eligibility criteria. Then, they were read and 18 studies were included for a review, in which most part of them showed Articaine as a relatively effective local anesthetic in the mandibular infiltration technique, thus it could be a more comfortable option regarding anesthetic terms (Table 1). The analyses of the studies quality showed that four articles scored a global rating of “strong” based on EPHP criteria. Most of the studies were either “moderate” (twelve articles) and only two articles were scored as “weak”.

4. DISCUSSION

The inferior alveolar nerve block for small mandibular dental procedures is still discussed regularly in literature due to the discomfort and high rate of failure of this technique. In the last years, some studies have showed that the use of an anesthetic base of high diffusive power in the mandibular bone cortical, through the infiltration anesthetic technique, can be a more comfortable and effective alternative for the patient [4, 10, 16]. Several factors can be analyzed based on reviewed evidence to clarify the efficacy of Articaine.

Many authors evaluated the efficacy of Articaine in different volumes associated with vasoconstrictors in difference concentrations or compared with other anesthetic bases that were, or were not, associated with vasoconstrictors in the mandibular area [2-4,7,9,16-24].

In terms of effectiveness, several studies support that the mandibular infiltration technique using 4% articaine was superior to 2% lidocaine. Oliveira et al. [7] compared the efficacy of 4% articaine and 2% Lidocaine, both with 1:100.000 of epinephrine in a sample of 30 adults that were undergoing procedures in the inferior molars and that presented a vital pulp. The results showed that duration of pulpar anesthetic with articaine was significantly more effective than lidocaine [7]. Jaber et al. [25] described that the 4% articaine had higher results compared to 2% lidocaine. The authors highlight that articaine was more effective than lidocaine in the performed testes, especially in prolonged anesthetics. Silva et al. [4] in their double-blinded, randomized and transversal study in human beings (adult patients that needed dental treatment in at least one side of the arcade), showed that 4% articaine with 1:100.000 adrenaline is more effective in the tongue and lip

mucosa than 2% lidocaine with 1:100.000 adrenaline, through the supra-periosteal infiltration technique in the second inferior molar level. In such study, the high diffusion of Articaine was proven; therefore, its use is possible for procedures involving a small region in the mandible [4].

Evidence in this review showed that the use of 4% articaine is viable to provide a good mandibular anesthesia. Etoz et al. [10] evaluated the efficacy of the supra-periosteal technique in the posterior region of the mandible during the dental implant surgery. The results showed that infiltration of articaine in the mandible is a safe and effective technique to insert implants [10]. El-

Kholey [24] compared two volumes of Articaine (1.8 mL x 3.6 mL) with 1:100.000 adrenaline as first vestibular infiltration during removal of third inferior molars. The results highlight that the volume of 3.6 mL Articaine compared to 1.8 mL showed a statistically high difference, which can be an option to the extraction of third inferior molars with supplemental lingual anesthetics [24]. Currie et al. [26] compared the efficacy of infiltration with Articaine in several points of the mandible. There were no differences of pain regarding the anesthetized places. Anesthesia is more probable after injections in an adjacent place. Infiltration in the second molar produces anesthesia of molars and pre-molars in the same side [26].

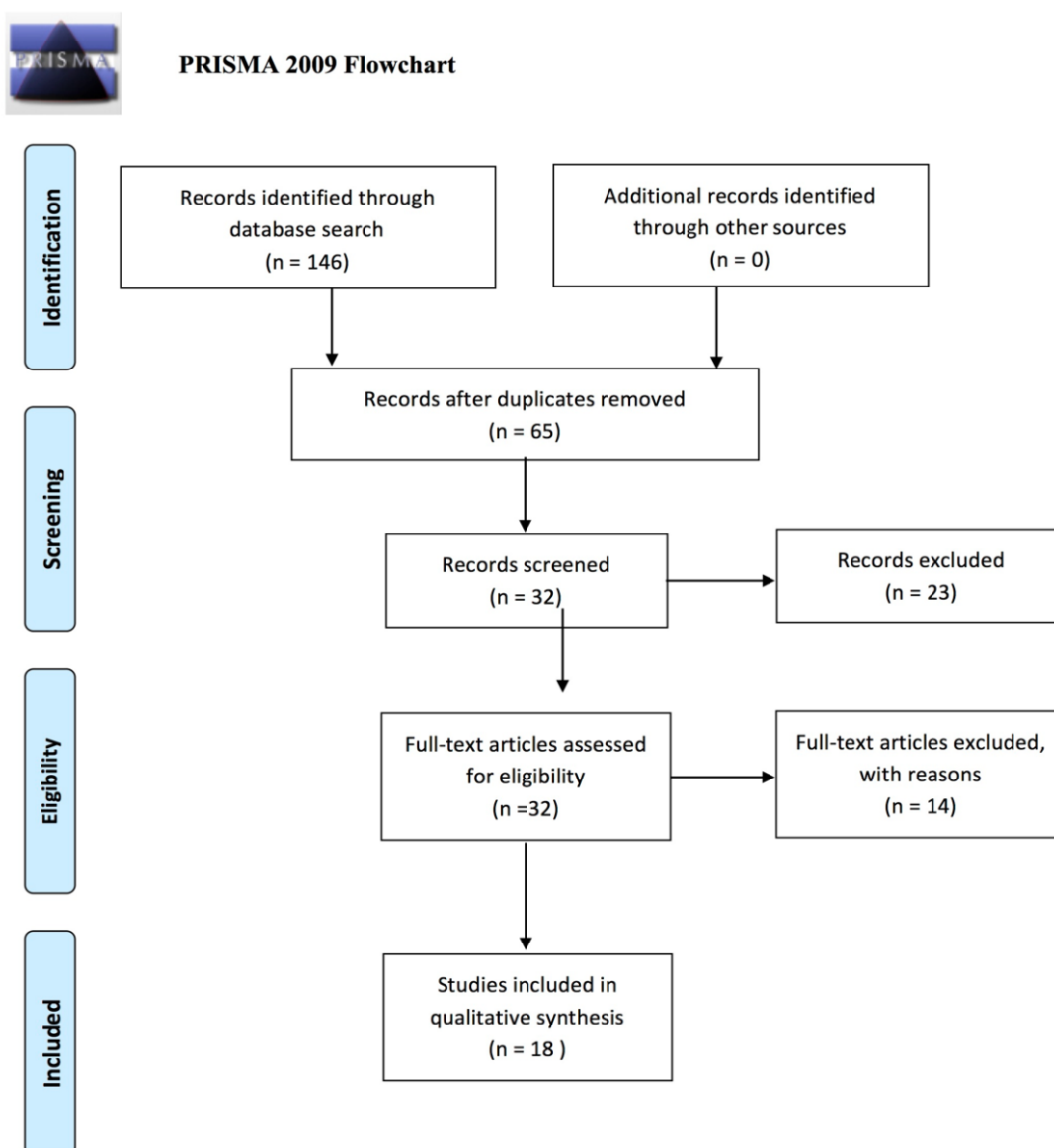


Fig. 1. PRISMA flow chart to demonstrate the methodology applied to selected articles

Table 1. Characteristics of included studies

Authors	Journal	Study design	Sample	Main findings
Flanagan [16]	Local Reg Anesth.	Retrospective study.	Nine caucasian patients in a private general dental practice in eastern Connecticut, USA were selected for these measurements.	The results are consistent with the idea that a total of 4% articaine infiltration at mandible may produce effective local anesthesia in patients with thinner cortices where the anesthetic is delivered.
Jing et al. [19]	Chin Med Sci J.	Clinical Study.	A total of 162 Chinese patients aged 18-51 years were enrolled in the present study.	The computer-controlled PDL injection system demonstrates both satisfactory anesthetic effects and safety in local soft tissues as primary anesthetic technique in endodontic access to the mandibular posterior teeth in patients with irreversible pulpitis using 0.5 mL of 4% articaine with 1:100.000 epinephrine.
Biocanin et al. [18]	Clin Oral Investig.	Single-center, single-blinded, randomized clinical study.	One hundred and eighty healthy volunteers (ASA I physical status) were enrolled in this study.	It seems that dental procedures requiring profound pulpal, bone, and soft tissue anesthesia could be effectively and safely obtained by
Currie et al. [26]	J Endod.	Single-center, randomized, double-blind, crossover trial.	All 22 volunteers who enrolled completed the trial (2 men and 20 women with a mean age of 22.1 years [range, 20–29 years]).	1.8 mL of 4% articaine hydrochloride with 1:100.000 epinephrine first mandibular molar infiltrations achieve an effect via a combination of modified mental and incisive nerve block and local infiltration.
El-Kholey [24]	J Oral Maxillofac Surg.	Prospective, randomized, single-blinded clinical study.	Thirty patients requiring extraction of their impacted mandibular third molars under local anesthesia were enrolled in the study.	The results of the present study may be enough evidence to support the view that primary mandibular first molar infiltration of 3.6 mL of 4% articaine with 1:100.000 may be a good option for lower third molar surgery with supplemental lingual anesthesia.
Etoz et al. [10]	Med Oral Patol Oral Cir Bucal	Clinical study	Fifty-two dental implants were inserted at the posterior mandible (posterior to the mental foramen) of total 29 patients (12 males, 17 females) under mandibular suprapariosteal infiltration anesthesia.	The study informations conclude that suprapariosteal infiltration of 2 ml of articaine including 0.010 mg/ml epinephrine is a safe and effective method for posterior mandibular implant surgery.
Martin et al. [20]	J Endod.	Prospective, randomized, single-blind, crossover study.	Eighty-six adult subjects participated in this study.	When comparing different volumes of articaine 4% with epinephrine 1: 100.000, the authors noted a significant difference in the degree of pulpal anesthesia after a primary infiltration in the mandibular first molar.
Meechan et al. [13]	Int Endod J.	Prospective randomized double blind cross-over trial study.	20 volunteers participated of the trial (8 men and 12 women, ranging in age from 21-29 years with an average age of 23.6 years).	The study infered that buccal infiltration with 1.8 mL of 4% articaine with epinephrine 1:100.000 is more effective than lingual infiltration in obtaining anesthesia of the mandibular first molar and premolar teeth.
Silva et al. [4]	Pesquisa Brasileira em Odontopediatria e Clinica Integrada	A randomized, crossover, double-blinded study.	30 adults patients participated in the study [53,33% men and 46,67 women with a mean age of 23,53 years (range, 18-40 years)].	The study showed that using buccal infiltration in the mandible, articaine presents diffusibility capable of anesthetize the lingual, oral and labial, which suggests that it is possible to perform procedures located in small regions of the mandible using the infiltrative technique.

Authors	Journal	Study design	Sample	Main findings
Jaber et al. [25]	Br Dent J.	Prospective, randomised, double-blind, cross-over study.	Thirty-one volunteers completed the investigation (11 male, 20 female; mean age 24.4 yrs, SD = 4.4 yrs).	The authors analysed that 4% articaine was more effective than 2% lidocaine (both with 1:100.000 adrenaline) in anaesthetising the pulps of lower incisor teeth after buccal or buccal plus lingual infiltrations.
McEntire et al. (2010)	J Endod.	Prospective, randomized, double-blind, crossover study.	43 men and 43 women ranging in age from 18-43 years, with an average age of 26 years, participated in this study.	The findings show that there was no noteworthy difference in the degree of pulpal anesthesia between the 4% articaine formulations containing 1: 100.000 or 1: 200.000 epinephrine.
Nuzum et al. [3]	J Endod.	Crossover study.	82 adult subjects, 43 men and 39 women ranging in age from 19–56 years, with an average age of 27 years, participated in this study.	The results indicate that the labial plus lingual infiltrations obtained a higher success rate when compared to the labial infiltration. Also, the data demonstrate a statistically significant difference.
Oliveira et al. [4]	Pesquisa Brasileira em Odontopediatria e Clinica Integrada	A randomized, crossover, double-blinded study	30 adult patients who looked for ambulatory services on Odontology course.	The data show that articaine presented the shortest latency period and the longest anesthetic effect, being a safe option for procedures with medium duration located in the molar region in the mandible.
Abdulwahb et al. [17]	J Am Dent Assoc.	Randomized, double-blind, controlled clinical trial study.	Twelve female and six male participants (mean age, 24.9 years; range, 18-53 years) completed this study.	The authors found that only 4% articaine with epinephrine 1:100.000 induced statistically greater pulpal anesthesia after mandibular buccal infiltration when compared with 2% lidocaine with epinephrine.
Pabst et al. [22]	Anesth Prog.	Prospective, randomized, single-blind, crossover study	Eighty-six adult subjects, 43 men and 43 women ranging in age from 20 to 41 years, with an average age of 26 years, participated in this study.	A repeated infiltration of a cartridge of 4% articaine with 1:100.000 epinephrine given 25 minutes after an initial infiltration of the same type and dose of anesthetic significantly improved the duration of pulpal anesthesia, when compared with only an initial buccal infiltration, in the mandibular first molar.
Robertson et al. [9]	J Am Dent Assoc.	Crossover study.	Sixty adult subjects, 34 women and 26 men, aged 19 to 51 years with an average age of 27 years, participated in the study.	The authors conclude that the infiltration of 4 percent articaine with 1:100.000 epinephrine is more efficient than 2 percent lidocaine with 1:100.000 epinephrine in achieving pulpar anesthesia in mandibular posterior teeth.
Berlin et al. [23]	Oral Surg Oral Med Oral Pathol Oral Radiol	Doubleblind crossover study design	Fifty-one adult subjects, 25 men and 26 women from age 20 to 53 years with an average age of 26 years, participated.	Was verified that the efficacy of 4% articaine with 1:100.000 epinephrine was similar to the efficacy of 2% lidocaine with 1:100.000 epinephrine for intraligamentary injections.
Nusstein et al. [2]	Anesth Prog.	Prospective, randomized, double-blind study.	Fifty-one adult patients, 25 men and 26 women, from age 20 to 53 years with an average age of 26 years, participated in the study.	The authors confirmed experimentally that the intraligamentary injection of 4% articaine with 1:100,000 epinephrine was similar to 2% lidocaine with 1: 100,000 epinephrine for injection pain and postinjection pain in the mandibular first molar when administered with a computer-controlled local anesthetic delivery system.

5. CONCLUSION

Given the factors involving the analysis of Articaine efficacy (volume, area of injection, bone density, association with vasoconstrictor of different volumes and amount of uses), Articaine shows considerable success in nerve blocks through the mandibular infiltration technique. Dental procedures performed in a small mandibular region can be done with simple blocks without using a technique that would cause the insensitivity of a larger area than expected. Although it has a high diffusion in tissues for presenting a tiophene ring in its structure, some studies showed that Articaine was not better when compared to other anesthetic bases that used the same technique. Thus, more papers should be performed to evaluate its real efficacy in mandibular infiltration anesthetic techniques.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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