Comparison of Articaine and Lidocaine for Buccal Infiltration After Inferior Alveolar Nerve Block For Intraoperative Pain Control During Impacted Mandibular Third Molar Surgery

Geraldo Prisco da Silva-Junior, DDS, MSc,* Liane Maciel de Almeida Souza, DDS, MSc, PhD,* and Francisco Carlos Groppo, DDS, MSc, PhD†

*Dental School of Federal University of Sergipe, and †Piracicaba Dental School, University of Campinas

In order to compare the efficacy of lidocaine and articaine for pain control during third molar surgery, 160 patients presenting bilateral asymptomatic impacted mandibular third molars were selected. They received 1.8 mL of 2% lidocaine with epinephrine 1:100,000 during inferior alveolar nerve block. In group 1 ($n = 80$), an infiltrative injection of 0.9 mL of 2% lidocaine with epinephrine 1:100,000 was performed in buccal-distal mucosa of the third molar. Group 2 ($n = 80$) received 0.9 mL of 4% articaine with epinephrine 1:100,000 in the contralateral side. All procedures were performed at the same visit, by a single operator, in a double-blind and parallel design. The duration of each surgery and the moment when the patient expressed pain were noted. Data were analyzed by nonpaired t test and chi-square test (alpha = 5%). Duration of surgery did not differ ($p = .83$) between Groups 1 (19.8 ± 2.3 minutes) and 2 (19.7 ± 3.0 minutes). Pain was expressed more in group 1 (26.3%) than in group 2 (10%) (odds ratio = 3.2, $p = .0138$). In both groups, tooth sectioning was the most painful event ($p < .0001$). No influence of gender ($p = .85$) or age ($p = .96$) was observed in pain response. Buccal infiltration of 4% articaine with epinephrine 1:100,000 showed more efficacy than 2% lidocaine with epinephrine 1:100,000 when used in combination with inferior alveolar nerve block in controlling intraoperative pain related to impacted mandibular third molar surgery.

Key Words: Lidocaine; Articaine; Pain; Third molar

The most common local anesthetics used in dentistry are the tertiary amines, with lidocaine and articaine probably the most frequently used specific agents.[1–3]

The commonly used 2% lidocaine with 1:100,000 epinephrine (henceforth "lidocaine") onset is reported between 2 and 3 minutes, with an anesthetic duration of approximately 60 to 85 minutes for pulpal anesthesia, and 120 to 180 minutes for soft tissues.[2,4] It has low toxicity in comparison to other local anesthetics, and its safety is well recognized in the dental practice. In addition, it is still widely used around the world,[5] being considered the gold standard for comparison with other local anesthetics.[4] However, some studies have discussed the ineffectiveness of lidocaine in more invasive procedures or when a better distribution into the tissues is necessary, especially in the bone tissue.[1,2,4]

Similar to lidocaine, 4% articaine with 1:100,000 epinephrine (henceforth "articaine") is also classified as an intermediate-duration local anesthetic agent.[6] It has a thiophene ring, allowing greater lipid solubility, which facilitate the diffusion across membranes, and an ester group that allows hydrolyzation in plasma by nonspecific cholinesterases.[7]

In maxillary infiltration anesthesia, no significant differences were observed in the onset and duration of anesthesia between articaine and either lidocaine[8] or bupivacaine[9] formulations.

Some studies have reported better anesthesia parameters for articaine in comparison with lidocaine[10] or 3% mepivacaine[11] when these were infiltrated in the mandibular buccal aspect. However, a recent study

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Address correspondence to Francisco Carlos Groppo, Av Limeira 901, CEP 13414-903 Piracicaba-SP-Brazil; fcgroppo@fop.unicamp.br

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showed no significant differences between lidocaine and articaine after buccal infiltrations in mandible.[12]

A significantly faster onset of action and longer duration of anesthesia was obtained after inferior alveolar nerve block (IANB) with articaine than lidocaine in some studies.[13] However, other studies have shown no statistically significant differences in anesthetic efficacy between them after IANB for extraction of bilateral impacted mandibular third molar.[14] In addition, both local anesthetic solutions showed similar effects on patients with irreversible pulpitis after IANB.[15]

Since articaine introduction in the market, it has been compared to a number of local anesthetics. Despite reports on articaine safety in comparison with lidocaine in both adults and children,[2] a possible relationship between paresthesia and articaine has been suggested.[16] The main cause of the paresthesia is not completely understood, but it could be related to the higher concentration of local anesthetic agent. The possibility of paresthesia has led to suggestions to avoid the use of high-concentration anesthetic formulations for nerve block anesthesia when other viable alternatives exist.[17]

The aim of the present study was to compare the efficacy of lidocaine and articaine for intraoperative pain control during impacted third molar surgery.

METHODS

This study was approved by the Committee of the Ethics of Research on Human Beings of the School of Dentistry of the Federal University of Sergipe–UFS (protocol #32405914.1.0000.5546), and each patient gave written informed consent to participate in the study.

In a randomized, double-blind and parallel design, patients with asymptomatic impacted mandibular third molars indicated for extraction surgery were selected. After clinical and radiographic examinations, 160 patients presenting with bilateral mandibular molars classified as class II-B (according to Pell & Gregori classification) and in a mesioangular position (according to Winter's classification) were included.

Exclusion criteria were patients under 18 years old, any systemic diseases, use of any medication in the past 15 days before the beginning of the study, history of hypersensitivity of any substances used in the study, pregnancy or lactation, previous history of pericoronitis, and severe dental anxiety.

All patients were randomly assigned into 2 groups ($n = 80$) by using the Sealed Envelopes app (http://www.sealedenvelope.com) to randomize them. Patients of group 1 submitted to the surgical procedure under inferior alveolar nerve/lingual nerve block (IANB) with 1.8 mL of 2% lidocaine with 1:100,000 epinephrine (Alphacaine 100; DFL, Rio de Janeiro, RJ, Brazil) and 0.9 mL of the same solution injected at the buccal-distal mucosa of the third molar, which also allowed for the long buccal nerve anesthesia. In group 2, patients were submitted to IANB with the same lidocaine solution, but with 0.9 mL of 4% articaine with 1:100,000 epinephrine (Articaine 100; DFL, Rio de Janeiro, RJ, Brazil) injected at the buccal-distal mucosa of the third molar in similar manner. After 5 minutes, the surgical procedure started.

Before the surgical procedures, a single dose of 8 mg/ intra-muscular of dexamethasone (Aché Lab., Rio de Janeiro, RJ, Brazil) was administered 30 minutes before the surgical procedures. Intra- and extraoral antisepsis were performed by 0.12% chlorhexidine (Colgate Periogard, São Paulo, SP, Brazil) and 10% polyvinylpyrrolidone-iodine (Riodeine derme, Rioquímica, Rio de Janeiro, RJ, Brazil) solutions, respectively. The surgical procedure and the local anesthesia were performed by the same single operator, with the starting side for local anesthesia (same as surgical start side) also randomized. Osteotomy and tooth section were used in all patients by drills, under constant irrigation with 0.9% sodium chloride solution.

Patients were instructed to inform the surgeon of any pain episode during the surgical procedure, and a supplementary injection of 1.8 mL of 2% lidocaine with epinephrine 1:100,000 was performed (IANB) in response to pain report.

Mouthwashes with 0.12% chlorhexidine digluconate (twice a day, for 7 days) and 750 mg paracetamol (acetaminophen) tablets (4 times a day, for 3 days) were prescribed after the surgical procedures.

Comparisons between groups regarding demographic data, pain report, and moment of pain were performed by chi-square test. Surgery duration was analyzed by nonpaired Student's t test. Significance level was set at 5%. GraphPad Prism 6.0 and BioEstat 5.0 were used to analyze all data.

RESULTS

Table 1 shows distribution of gender and age of the patients. It shows more female ($p = .0328$) than males in both groups, but no significant differences ($p = .26$) were observed between groups regarding gender. The mean ($\pm$SD) age of patients in group 1 was 23.9 ($\pm$ 5.7) years, and 21.5 ($\pm$3.1) years for group 2. Age did not significantly differ ($p = .31$) between groups.

No significant differences ($p = .83$) regarding the duration of surgery (Figure) were observed between

Table 1. Distribution of Gender and Age According to Both Groups

	Group 1, n = *80,* n (%)	*Group 2,* n = *80,* n (%)	*Chi-square* p
Gender			
Female, $n = 94$	51 (63.75)	43 (53.75)	.26
Male, $n = 66$	29 (36.25)	37 (46.25)	
Age			
Between 18 and 20 y, $n = 53$	23 (28.75)	30 (37.5)	.31
Older than 21 y, $n = 107$	57 (71.25)	50 (62.5)	

groups 1 (19.8 ± 2.8 minutes) and 2 (19.7 ± 3.0 minutes).

Table 2 shows the absolute proportion of patients reporting pain during surgery and the relative proportion of the exact moment when they related it. Significantly ($p = .0138$) more pain episodes were observed in group 1-lidocaine than group 2-articaine. Pain was 3 times more probable in group 1 than in group 2 (odds ratio = 3.2, $p = .014$, 95% confidence interval = 1.3 to 7.8). In addition, tooth sectioning was the most painful surgical experience for both groups ($p < .0001$).

The influence of gender and age of the patients in pain episodes is shown on Table 3. No significant differences ($p > .05$) between either gender or age were observed in the pain episodes.

DISCUSSION

The method used to evaluate local anesthesia success in the present study was the pain complaints during any step of the surgical procedure. This methodology was previously used by other studies.[2,18,19] There are other methods, but the direct communication of pain is the most used in the real life clinical practice. However, it is not possible to exclude the influence of stress using this methodology, since third molar removal is considered one of the more fearful and painful dental procedures. Thus, it is possible that part of the complaints of pain could be induced by stress, which was not controlled in the present study. Both gender and age also could interfere with the pain perception and local anesthesia efficacy.[20] However, there is no consensus on this influence, as observed by other studies.[21] In the present study, these 2 factors did not affect the pain reports of between groups.

Many studies have shown better anesthesia performance of articaine than other amides, especially in mandibular infiltration, probably due to its tissue

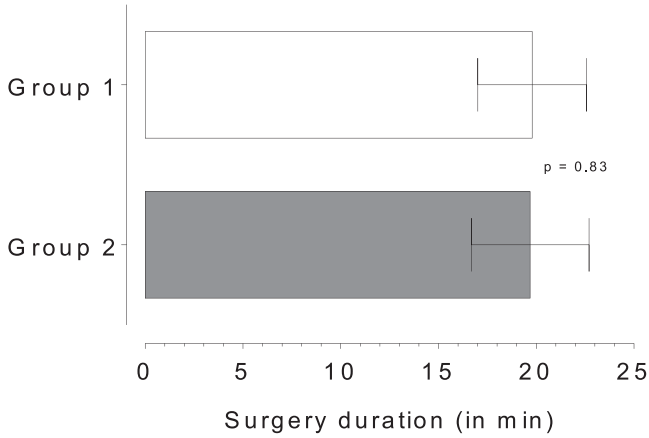

Figure. Duration of surgery (mean ± SD) of groups 1 (lidocaine/lidocaine) and 2 (lidocaine/articaine).

diffusion.[22–24] These properties may explain the results obtained in the present study.

Lidocaine is the gold standard for amide comparison due to its fast onset, potency, and anesthesia duration.[4] However, 2% lidocaine with 1:100,000 epinephrine infiltrated in mandible does not produce consistent anesthesia in many patients (usually less than 40%). It was previously demonstrated that infiltrative techniques are significantly effective for mandibular incisors but only when 4% articaine with 1:100,000 epinephrine is used.[24]

The total volume of the local anesthetic agent injected could also affect the anesthesia effectiveness. When injected at the mandibular first molar (buccal infiltration), articaine showed success rate of 56% after 1.8 mL injection and 96% for 3.6 mL volume.[25] However, the potential tissue toxicity and discomfort increases with high local anesthetic volumes injected during buccal infiltrations.[26] In the present study, the volume used was the minimum necessary to block the inferior alveolar nerve (1.8 mL) and buccal nerve (0.9 mL). However, an extra cartridge was used when the patient complained about pain, which occurred 18% of all surgeries (10% for group 2). In any case, the total amount used is within safety limits.

Anesthesia failure induces the use of increased volume of local anesthetic agents. Usually, anatomical variations in the location of the mandibular foramen or the nerve canal, which could present bifurcation or canal septa, are pointed out as the main causes for IANB failure when irreversible pulpitis is not present.[27–29] The anesthesia success rate of IANB complemented by buccal infiltration in the present study would be considered quite adequate considering the surgical procedures involved.

Despite possible failures, the IANB is generally utilized for third molar surgery.[30] Failure rate of this

Table 2. Proportion of Patients Reporting Pain During Surgery and When Experienced

	Group 1, n = *80*, n (%)	*Group 2*, n = *80*, n (%)	*Total*	*Chi-square* p
Pain at any moment				
No pain	59 (73.8)	72 (90.0)	131 (81.9)	.0138
With pain	21 (26.2)	8 (10.0)	29 (18.1)	
Moment of pain, $n = 29$				
Tooth section	15 (71.4)	7 (87.5)	22 (75.9)	<.0001
Osteotomy	2 (9.5)	1 (12.5)	3 (10.4)	
Tooth removal	4 (19.1)	—	4 (13.8)	

technique depends on the local anesthetic agent to some degree. The percentage of failure for IANB using lidocaine varies from 20%[13] to 40%[2] and for articaine varies from 9%[13] to 40%.[31] Buccal infiltrations are not often used to anesthetize mandibular molars due to the dense cortical bone, which theoretically limits diffusion of the anesthetic agent. However, 4% articaine with 1:100,000 epinephrine induced a pulpal anesthesia success rate of 64.5% when inject as a buccal infiltration in the lower first molar.[32]

In the present study, the percentage of failure for lidocaine IANB with buccal infiltration of lidocaine was 26.3%. However, with articaine for buccal infiltration, there was a significantly improved efficacy of lidocaine IANB with only 10% failure. This result is similar to previous observations, which observed that IANB supplemented with articaine for buccal infiltration was more successful than IANB alone in the mandibular teeth.[33]

The experience of the operator could also positively contribute to the anesthesia success verified in the present study. The short time needed for the surgical procedures was adequate to observe the anesthesia success, since pulpal anesthesia is around 1 hour for both amides used here.[34,35] All surgeries demanded tooth section and, thus, an adequate pulpal anesthesia, which was obtained in the present study in most of patients.

Considering that the use of articaine in the present study was an infiltrative anesthesia after IANB with lidocaine, the potential neurotoxicity was minimized, and no cases of paresthesia were observed, although only a small number of participants were involved.

In conclusion, after 2% lidocaine with 1:100,000 epinephrine IANB, the supplementary infiltration of 4% articaine with 1:100,000 epinephrine in the buccal fold is a more efficacious method to anesthetize impacted mandibular third molars for extraction surgery than 2% lidocaine with 1:100,000 epinephrine buccal infiltration at same site.

Table 3. Influence of Gender and Age in Pain Episodes

	No Pain, n = *131*, n (%)	*With Pain*, n = *29*, n (%)	*Chi-square* p
Gender			
Female, $n = 94$	76 (80.9)	18 (19.1)	.85
Male, $n = 66$	55 (83.3)	11 (16.7)	
Age			
Between 18 and 20 y, $n = 53$	44 (83)	9 (17)	.96
Older than 21 y, $n = 107$	87 (81.3)	20 (18.7)	

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