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Onset and duration of 2% lidocaine as inferior alveolar nerve block versus buccal/lingual infiltration of 4% articaine in mandibular second molars: Clinical trial study

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Original Article

Abstract

BACKGROUND AND AIM: The effectiveness of buccal or lingual (B/L) infiltration of 4% articaine as supplemental injection for pulp anesthesia of mandibular teeth was confirmed in previous studies. However, this study was aimed to compare the effectiveness of 2% lidocaine as inferior alveolar nerve block (IANB) versus B/L infiltration of 4% articaine for pulp anesthesia, as primary injection in mandibular second molars.

METHODS: Thirty adult volunteers ranging from 18 to 40 years old with no systemic disease or medicine intake were included in this split-mouth, double-blind, randomized clinical trial study. Each mandibular side of included subjects was allocated randomly to control group (IANB using 2% lidocaine and 1/80000 epinephrine using direct technique) and B/L infiltration group using 4% articaine (Septanest; Septodont, Saint-Maur-des-Fosses, France). After obtaining base line sensitivity, electric pulp testing (EPT) was done at 5, 8, 11, 15, 20, 25, 30, 45, 60, 75, and 90 minutes post injections. The data were analyzed using chi-square test.

RESULTS: The success rate of anesthesia for IANB group was 83.3% (25 of 30 subjects) and 30% (9 of 30 subjects) for B/L infiltration group, and the difference between the groups was statistically significant ($P = 0.0005$). The mean onset time of pulp anesthesia for IANB group was 22.6 ± 30.9 minutes and 65.5 ± 38.0 for B/L infiltration group, and the difference between the groups was statistically significant ($P = 0.0001$). The mean duration time of pulp anesthesia for IANB group was 53.0 ± 27.4 minutes and 10.6 ± 17.2 for B/L infiltration group, and the difference between the groups was statistically significant ($P = 0.0001$).

CONCLUSION: The results indicated that IANB using 2% lidocaine was more successful than B/L infiltration of 4% articaine in onset and duration of pulp anesthesia of mandibular second molars as primary injections.

KEYWORDS: Articaine; Lidocaine; Local Anesthesia; Molar; Inferior Alveolar Nerve; Volunteers

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Predictable anesthesia has an essential role in successful endodontic treatment, and failing to reach this point causes patient miss management. A range of local anesthetic drugs and techniques have been used which lidocaine is the most popular of them, and after a long time articaine was introduced in the United States of America.¹ The inferior

alveolar nerve block (IANB) is the technique of choice for pulpal anesthesia of mandibular teeth. However, the technique is not always successful, and failure rates of 7% to 75% have been reported.²⁻⁴ Therefore, alternatives to this technique were studied in several studies, such as intra ligament, intra osseous, mylohyoid, and infiltration injections.⁵⁻⁸

Articaine is an amide local anesthesia

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including a thiophene ring, benzene ring, and ester linkage.¹ High lipophilic properties of this solution has made it suitable for infiltration techniques in maxillary and mandibular teeth.⁹⁻¹¹

Several studies have shown the effectiveness of buccal or lingual (B/L) infiltration of 4% articaine as supplemental injection for pulp anesthesia of mandibular teeth.^{9,11} Some studies showed anesthetic effect of B infiltration (BI) of 4% articaine as primary injection on mandibular first molar;^{4,12} however, no one showed its effectiveness as primary injection compared to IANB for pulp anesthesia of second molar.

This study was aimed to compare the effectiveness of 2% lidocaine with 1/80000 epinephrine as IANB versus B/L infiltration of 4% articaine with 1/100000 epinephrine in mandibular second molar pulp anesthesia.

40 years old with no contributing systemic disease or medicine intake, with at least one intact second mandibular molar were included in this split-mouth, double-blind, randomized clinical trial study in Endodontic Department, Dental Branch, Islamic Azad University, Tehran, Iran, from 2015 to 2016 (Figure 1). Exclusion criteria were volunteers younger than 18 or older than 40 years old, allergies to local anesthetics or intolerance of vasoconstrictors, pregnancy, and inability to give informed consent. Sample size was determined based on the results of an initial pilot study on five patients at $\alpha = 0.05$ and a study power of 80%. The Ethics Committee of Islamic Azad University of Tehran approved the study (IR.IAU.DENTAL.REC.1395.19), and informed consent was signed by each volunteer. The proposal of this study was reviewed, confirmed, and recorded in Iranian Registry of Clinical Trials (IRCT) (code No: IRCT2017021523620N7).

Methods

Thirty adult volunteers ranging from 18 to

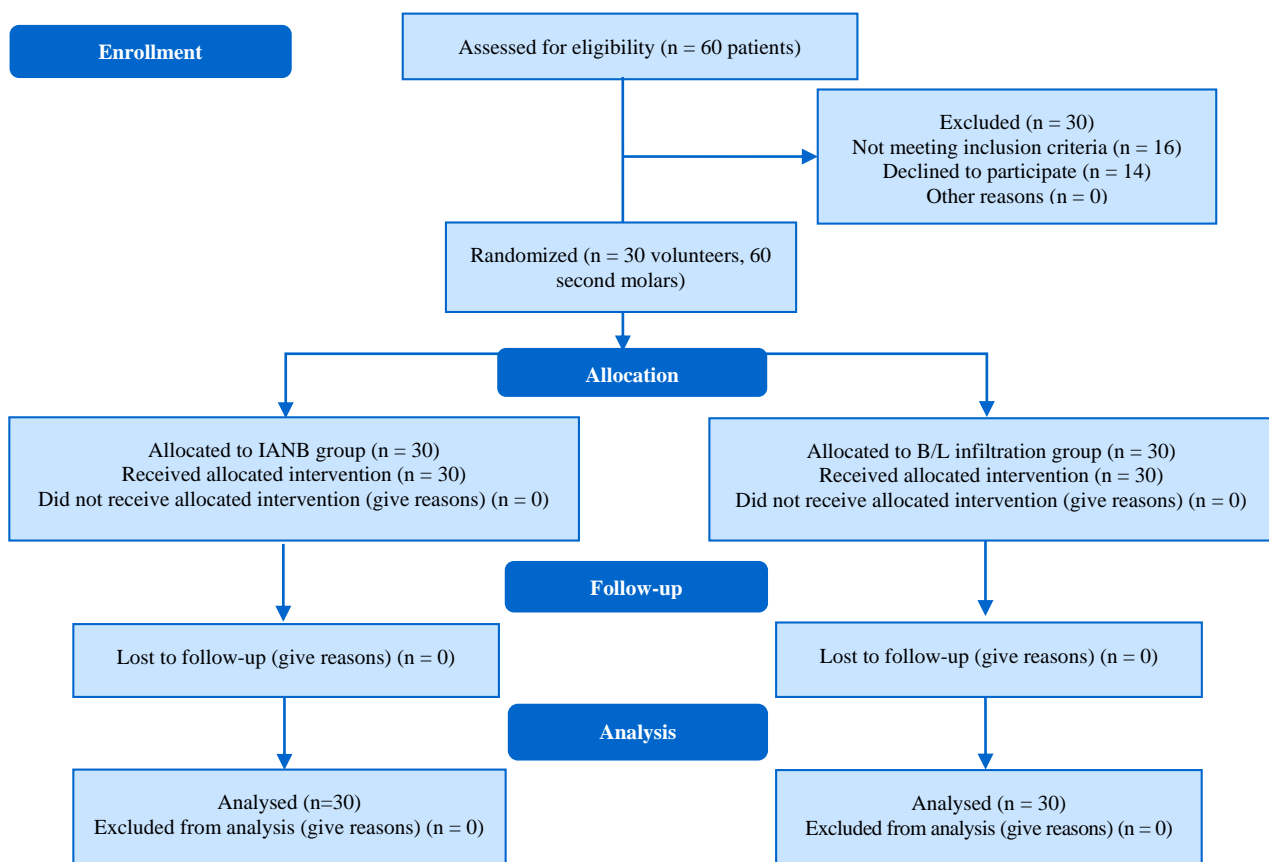


Figure 1. Consort flow diagram
IANB: Inferior alveolar nerve block; B/L: Buccal/lingual

Each mandibular side of included subjects was randomly (coin flipping method by the patients) allocated to control group (IANB using 2% lidocaine and 1/80000 epinephrine 1.8 ml using direct technique) and the group of B/L infiltration of 4% articaine (Septanest, Septodont, Saint-Maur-des-Fosses, France) using half the solution (0.9 ml) at B and the other half (0.9 ml) at L vestibule just close to the target tooth (second molar). The injections were done in separate sessions by one-week intervals. All the injections were done after negative aspiration at rate of 1 ml/min by one blinded skilled operator; the injections for each volunteer were done by one-week interval.

One of the intact maxillary canines was considered as the control for the pulp tester set up. Base line sensitivity of subjected teeth was determined using electric pulp tester (EPT) (Gentle-Pulse vitality tester; Parkell Inc., Farmingdale, N.Y.) before any injection by blinded trained personnel.

Toothpaste was used as contact media on coronal third of B surface of the crown, and the EPT tip was placed over that. The power was increased incrementally from 1 to 10, until the patient became aware of the electric stimuli. During the EPT test of the teeth, a well-sealed rubber dam was placed over the target tooth (mandibular second molar) to avoid false positive responses due to close contact with neighboring teeth. The pulp testing repeated at 5, 8, 11, 15, 20, 25, 30, 45, 60, 75, and 90 minutes' post injections.⁴

Success in obtaining the pulp anesthesia was considered as at least two subsequent negative responses to EPT in maximum degree. When the pulp anesthesia in subjects was not achieved, the onset was considered

as the maximum follow up time (90 minutes) and the duration as 0.

Comparisons between IANB and B/L infiltration groups for anesthetic success, and onset and duration of pulpal anesthesia were analyzed using chi-square test by SPSS software (version 17, SPSS Inc., Chicago, IL, USA).

Results

All the thirty volunteers (60 subjects which 30 received IANB on one side and 30 received B/L infiltration on the other side) subjected for comparison of success, onset, and duration of pulp anesthesia of mandibular second molars (60% male and 40% female, with mean age of 26.8 ± 1.4).

The success rate of anesthesia for IANB group was 83.3% (25 of 30 subjects) and 30% (9 of 30 subjects) for B/L infiltration group, and the difference between the groups was statistically significant ($P = 0.0005$) (Table 1).

The mean onset time of pulp anesthesia for IANB group was 22.6 ± 30.9 minutes and 65.5 ± 38.0 minutes for B/L infiltration group, and the difference between the groups was statistically significant ($P = 0.0001$) (Figure 2).

The mean duration time of pulp anesthesia for IANB group was 53.0 ± 27.4 minutes and 10.6 ± 17.2 for B/L infiltration group, and the difference between the groups was statistically significant ($P = 0.0001$) (Figure 2).

Discussion

The result of this clinical trial study showed that IANB is advantageous over B/L infiltration of articaine as primary injection in success rate, onset, and duration of pulp anesthesia of mandibular second molars.

Table 1. The success, onset, and duration of pulp anesthesia of mandibular second molar in inferior alveolar nerve block (IANB) and buccal/lingual (B/L) infiltration groups

Groups	Indexes	Success [n (%)]	Failure [n (%)]	Onset (minute) (mean \pm SD)	Duration (minute) (mean \pm SD)
IANB group (n = 30)		25 (83.3)	5 (16.7)	22.6 ± 30.9	53.0 ± 27.4
B/L infiltration group (n = 30)		9 (30.0)	21 (70.0)	65.5 ± 38.0	10.6 ± 17.2
P		0.0005	0.0005	0.0001	0.0001

SD: Standard deviation; IANB: Inferior alveolar nerve block; B/L: Buccal/lingual

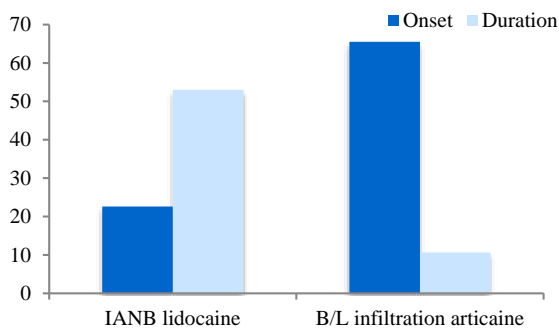


Figure 2. Comparing onset and duration of pulp anesthesia of second mandibular molar in inferior alveolar nerve block (IANB) and buccal/lingual (B/L) infiltration groups

Although some studies did not show any significant difference between articaine and lidocaine solutions in obtaining pulp anesthesia of mandibular molars,^{13,14} recent studies found that articaine was remarkably better than lidocaine in pulpal anesthesia of mandibular molars after B/L infiltration.^{11,15,16} For that reason, we analyzed pulpal anesthesia using articaine B/L infiltration for mandibular second molar teeth.

The suspected mechanism of articaine is its better bone-penetration efficacy. Articaine contains a thiophene and benzene ring, which makes the solution to penetrate better through natural barriers.¹⁷ This phenomenon makes the solution suitable for infiltration injections, especially for mandibular molars with thick cortical in both B/L sides.

In a clinical trial study by Jung et al. on mandibular first molar anesthesia after IANB or BI of 4% articaine, they concluded that BI group had faster and more predictable pulp anesthesia at 5 and 8 minutes post injection, and the total success rate was close to IANB group.⁴ The result was totally against our study, and this difference can be explained by the fact that in our study we analyzed pulp anesthesia of second mandibular molars instead of first mandibular molar, which has thicker B cortical bone. Moreover, we used half the articaine solution at B and half at L vestibule, same as Corbett et al.¹² and Foster et al.,⁹ which had used the same technique for obtaining pulp anesthesia of mandibular molars.

In the previous studies, the B/L infiltration of articaine for local anesthesia of mandibular molars was studied as primary or supplementary anesthesia.^{10-12,15,18,19} Most of the studies found B/L infiltration of 4% articaine as an effective technique for pulp anesthesia of mandibular first molars as primary local anesthesia, but the effect was more manifest for B instead of L or B/L injections.¹² However, we found B/L infiltration of articaine as an ineffective technique for pulp anesthesia of mandibular second molars. The success rate of pulp anesthesia of mandibular second molar for this technique was only 30%, which was close to Aggarwal et al. study; however, they had irreversible pulpitis cases, and their pain assessment was during access cavity preparation and root canal instrumentation instead of normal pulp cases and EPT sensibility test in this study.²⁰ The higher success rate of IANB using 2% lidocaine in this study compared to other studies can be explained by using normal healthy dental pulps instead of teeth with irreversible pulpitis subjected to other studies.^{19,21}

One of the main concerns, when using articaine as local anesthesia especially in mandibular nerve block, is the paresthesia as an important side effect.²² In a comprehensive review study on articaine as local anesthesia by Kakroudi et al., it was concluded that the solution appears safe and the adverse effects are very rare.²³ One of the main limitations of this study was non-inflamed and normal pulp of subjects for maximum unification, while most of the anesthetic failures suspected in inflamed pulp conditions.

Conclusion

It seems that IANB using 2% lidocaine was more effective than B/L infiltration of 4% articaine in success, onset, and duration of pulp anesthesia of mandibular second molars as primary injections.

Conflict of Interests

Authors have no conflict of interest.

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