

Effect of Articaine in Symptomatic Irreversible Pulpitis using Three Injection Techniques: A Clinical Study

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ABSTRACT

Introduction: Achieving profound pulpal anaesthesia can be difficult for patients diagnosed with symptomatic irreversible pulpitis due to certain factors such as altered resting potentials and reduced thresholds of excitability. Clinicians might try various strategies to address this problem such as changing the anaesthetic agent, for example using articaine instead of lidocaine injection, and by using a supplemental anesthetic injection delivery techniques. The aim of present study was to determine the anaesthetic efficacy of articaine in mandibular molars with symptomatic irreversible pulpitis with 3 injection methods: an inferior alveolar nerve block (IANB), an IANB with an intraligamentary injection, and an IANB with buccal infiltration before initiating the endodontic treatment.

Material and methods: 60 patients with diagnosis of symptomatic irreversible pulpitis in mandibular molars were selected and randomly assigned into 3 groups according to the injection method used: Group 1, a conventional IANB injection; Group 2, an IANB injection, and after 15 minutes, buccal infiltration was administered; and Group 3, an IANB injection, and an intraligamentary injection was administered. The anaesthetic solution used was articaine 4% with 1:100,000 epinephrine. Success was recorded as no or mild pain on the basis of the visual analog scale after cavity preparation or initial instrumentation and the data were sent for statistical analysis.

Results: The success rate for IANBs with an intraligamentary injection was more, than for IANBs with a buccal injection and for IANBs alone.

Conclusions: It can be concluded that the success rate of IANBs increased with intraligamentary injections and buccal infiltrations with articaine that were administered before initiating endodontic treatment.

Keywords: Articaine, Symptomatic Irreversible Pulpitis, Injection Techniques

class of sodium channels is resistant to the action of local anesthetics. A correctly administered inferior alveolar nerve block does not always result in successful pulpal anaesthesia in irreversible pulpitis. According to Rogers et al. the success rate of IANB in irreversible pulpitis decreases to 24% approximately.²

The inability to achieve pulpal anaesthesia has been shown to increase patient fear and anxiety, extend appointment duration and generate doubt in operator.³ Therefore, dentists might try various strategies to overcome this problem such as changing anaesthetic agent and by using a supplemental anaesthetic injection techniques like buccal infiltration, intraligamentary (PDL) injections, intraosseous, intrapulpal injections. Lidocaine is considered a gold standard in dentistry but articaine has become a good alternative for treatment of teeth with irreversible pulpitis because of thiophene ring in articaine that facilitates the infiltration of solution through epineurium of nerve membrane and bone.⁴ Moreover, the onset of anaesthesia is faster in articaine and duration of anaesthesia is longer as compared to lidocaine. A recent study concluded that 4% articaine was 3.8 times more effective as an infiltration rather than inferior alveolar nerve block.⁵ According to study by Hasse et al. injection of articaine in buccal vestibule of mandibular first molar increases the success rate after failure of an IANB.² This technique is relatively safe, easy and comfortable as compared to conventional IANB's.⁶

So far all of the studies conducted regarding the success rate of two supplemental methods administered them

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after failure of IANB (pain sensation during endodontic treatment).⁷ Thus, the aim of present study was to determine the anaesthetic efficacy of articaine in mandibular molars with symptomatic irreversible pulpitis with 3 injection methods: an inferior alveolar nerve block (IANB), an IANB with an intraligamentary injection, and an IANB with buccal infiltration before initiating the endodontic treatment.⁸

MATERIAL AND METHODS

The present study was conducted on 60 patients diagnosed with symptomatic irreversible pulpitis in mandibular molars. Patients selected were in good health as determined by oral questioning regarding present and past health history. Patients with following inclusion criteria were selected:

1. Systemic healthy patients
2. Not sensitive to articaine
3. Patients between 18 -60 years of age
4. Non pregnant patients
5. Not taking any medication that interferes with anaesthesia
6. Patients with mandibular 1st molar exhibiting symptomatic irreversible pulpitis

Inclusion criteria regarding clinical condition of the patient were defined as follows:

1. Patients presented with a vital mandibular permanent molar with fully formed roots (confirmed by periapical radiography).
2. Patients experiencing greater than moderate pain and spontaneous and prolonged response to cold testing.
3. Tooth with no periapical radiolucency were selected.

The anaesthetic solution used for conventional IANB injection was 2% lidocaine with 1: 100,000 epinephrine whereas for supplemental injection techniques 4% articaine with 1: 100,000 epinephrine was injected. 60 patients were checked for eligibility and after obtaining written consent from the patients, the procedure was fully described to them. Then 60 patients were randomly assigned into 3 groups of 20 patients each according to the injection method used.

Group 1: Only Inferior alveolar nerve block was given with a conventional dental injector and 27 gauge needle. After determining the injection site and aspiration, 1.8 mL of solution was injected at a rate of 1 mL/min. Fifteen minutes after the injection, the teeth were isolated and endodontic procedure was started.

Group 2: IANB was given using the same technique as in group 1, with difference that after 15 minutes of block anaesthesia buccal infiltration (in middle of mesiodistal distance of the crown) was given using 0.5 ml of solution with normal syringe and 27 gauge needle. After five minutes, the teeth were isolated, and endodontic procedure was performed.

Group 3: An intraligamentary injection was performed with a special pressure injection syringe and a 27-G needle. The needle was placed between the teeth and the bone at a 30 angle relative to the longitudinal axis of the crown. Then, in

the mesial and distal portions of teeth, 0.2 mL of the solution was injected, and after 5 minutes, endodontic treatment was started.

Pain was evaluated on the basis of visual analog scale and according to the location of the patient's markup, the pain was classified as follows: 0, no pain; 1–54 mm, mild pain; 55–112 mm, moderate pain; and 114–170 mm, severe pain. Successful anesthesia was presented as painless (0) and mild pain (54 mm) according to VAS criteria.

STATISTICAL ANALYSIS

Data collected was subjected to statistical analysis. The anaesthetic success rates were analyzed using the chi-square test.

RESULTS

The success rate for IANBs with an intraligamentary injection was 70%, and for IANBs with a buccal injection, it was 60.6%. For IANBs alone, it was 27.1%. The IANB by itself had a significantly lower success rate than the first 2 groups with IANBs combined with the 2 supplemental techniques ($P < .05$). There was no significant difference between intraligamentary and buccal infiltration injections ($P > .05$).

DISCUSSION

This study aimed to compare the success rate of anaesthesia using three injection methods with 4% Articaine for mandibular first molars diagnosed with symptomatic irreversible pulpitis. The results of the study suggested that there is a significant increase in the success of an IANB when it is combined with a buccal or intraligamentary injection. Several studies found that 4% articaine was significantly better than 2% lidocaine for supplemental infiltration in mandibular molars with irreversible pulpitis. A recent meta-analysis by Kung et al found that, in cases of a failed IANB, supplementary infiltration with 4% articaine was 3.55 times more successful in achieving profound pulpal anaesthesia than 2% lidocaine.¹³

The lower pKa of articaine would convert greater percentage of the drug in the active base form. Articaine's greater lipid solubility improves diffusion through both nerve sheaths (such as the inferior alveolar nerve) and neural membranes of individual axons comprising a nerve trunk. Articaine's unique properties seem to allow it to diffuse more readily through bone than lidocaine because cortical plate is thin in first molar zone.¹²

In this study, we selected mandibular first molars with symptomatic irreversible pulpitis because the type of tooth influences the success of anaesthesia. Teeth with irreversible pulpitis are the most difficult one to anaesthetise due to the inflammation, which includes changes in tissue pH, expression of sodium channels resistant to local anaesthesia, increased local vascularity.⁹ The inflammation process leads to hyperalgesia and allodynia. Patients exhibit spontaneous pain, lingering pain response to cold testing. Therefore, supplemental injections were given before starting the treatment rather than waiting for the pain during access

cavity preparation or while doing pulp extirpation. Rate of injection given was also standardised in this study. In order to prevent error, injection was performed by one person and 1 cartridge of articaine was injected at the rate of 1 ml/min.² In this study pain was evaluated on the basis of Visual Analog Scale because according to various studies (Nusstein et al), 42% of patients who showed a negative response to electric pulp testing after injection had pain during work on the tooth.¹⁴ It might be that in teeth with Irreversible pulpitis the responses to electric pulp tests or cold tests are related to fast and slow silent A-delta fibers, respectively.¹² Hence, it can be hypothesized that if the tetrodotoxin resistant sodium channels mostly appear on deeper nociceptive C fibers, then neither negative nor positive responses to EPT and cold tests indicate the success of anesthesia after the administration of anesthetic agents because these C fibers might be responsible for the pain response.

An intraligamentary injection of articaine immediately after IANB had highest success rate as intraligamentary injection technique allows the solution to be placed in spongy bone adjacent to tooth. One possible complication of using articaine for an IANB is paresthesia, in the present study, none of the patients reported this complication.¹¹

CONCLUSION

IANB alone were not able to provide pain free emergency root canal treatment. Buccal infiltration and intraligamentary injection with 4% articaine is clinical alternative to IANB. Supplemental injections increased anaesthetic success rates, and therefore, a combination of techniques should be considered prior the root canal treatment of symptomatic irreversible pulpitis in mandibular molars.

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