Efficacy of mental-incisive nerve block in root canal treatment of mandibular first molars with asymptomatic irreversible pulpitis: a randomized controlled trial

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The aim of this study was to evaluate the effect of mental-incisive nerve block (MINB) along with finger pressure following inferior alveolar nerve block (IANB) on anesthetic success in mandibular first molars with asymptomatic irreversible pulpitis. In this randomized controlled trial, 70 patients were randomly divided into 2 groups (n = 35). Each patient in the control group received only a standard IANB injection of 1.8 mL of 2% lidocaine with 1:100,000 epinephrine. The injection was administered within 1 minute, using a standard aspirating dental cartridge fitted with a 27-gauge dental needle. In the intervention group, 15 minutes after injection of the standard IANB as described for the control group, each patient received a standard MINB injection of 1 mL of 2% lidocaine containing 1:100,000 epinephrine, administered by an operator not involved in assessing the outcomes. After the MINB injection, the patient applied firm finger pressure to the soft tissue of the mental foramen region for 1 minute using the hand on the side opposite to the injection. Objective assessment of tooth anesthesia was carried out with electric pulp tests (EPTs). In addition, the patients rated their pain during the initial steps of endodontic treatment based on a visual analog scale (VAS). The Mann-Whitney *U* and Wilcoxon tests were used for the analysis of data. Of the 35 patients in each group, 20.0% (7 patients) in the control group and 71.4% (25 patients) in the intervention group had no response to EPTs 15 minutes after injections; this difference was statistically significant ($P < 0.05$). The VAS pain scores were significantly higher in the control group than in the intervention group ($P = 0.001$). The administration of MINB with pressure following IANB significantly improved the success of anesthesia in mandibular first molars with asymptomatic irreversible pulpitis.

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One of the main goals of root canal treatment, especially in the initial stages, is pain control, making both the dentist and patient confident and comfortable during the dental procedure.[1] The difficulties associated with blocking the inferior alveolar nerve and collateral innervations make the mandibular teeth more susceptible to failed anesthesia than the maxillary teeth.[2,3] Studies also have shown that it is more difficult to achieve anesthesia in mandibular molars with irreversible pulpitis than in teeth with normal and necrotic pulps.[4,5] A number of alternative or supplementary techniques have been suggested to overcome the failure of conventional inferior alveolar nerve block (IANB) injections, including intraligamentary anesthesia, intraosseous anesthesia, and mental-incisive nerve block (MINB).[6-9]

The success rate of MINB as a supplement or alternative to IANB for posterior teeth rarely has been assessed. When MINB is applied, the premolar teeth have been shown to exhibit the highest rate of pulpal anesthesia.[6,10,11] MINB might be less effective in lateral incisors and first molars.[11,12] However, the combination of IANB and MINB might significantly improve the success of anesthesia in these teeth.[6]

MINB is a simple technique and does not require special equipment, unlike the intraosseous and intraligamentary methods.[12,13] In addition, MINB causes less pain and discomfort than other supplementary techniques for anesthesia.[14]

There is disagreement about the effect of MINB as a supplement or even an alternative to IANB in providing anesthesia for mandibular molars.[9] The present randomized controlled trial was undertaken to evaluate the effect of applying MINB and pressure, following IANB, on the success of anesthesia in mandibular first molars with asymptomatic irreversible pulpitis. In the present study, pressure on surrounding soft tissues after an MINB injection was not evaluated as a separate variable, since it has been suggested that massage or pressure facilitates the movement of local anesthetic agents to structures surrounding the mental foramen and improves the efficacy of anesthesia.[12,15]

Materials and methods

The protocol of this study was approved by the Research and Ethics Committee of Tabriz University of Medical Sciences, Tabriz, Iran (IRCT2016090329671N1), and written informed consent was obtained from every subject. Power analysis and sample size (PASS) software for Windows (NCSS Statistical Software) was used to calculate that a sample size of 35 for each group would provide 80% power (α = 0.05) to detect a difference of 2.5 units between 2 groups in response to the pulp tester (before and after).[12]

A total of 70 patients participated in this randomized controlled trial. The participants had to meet the following inclusion criteria: healthy adults, aged 18-60 years, with a mandibular first molar that had asymptomatic irreversible pulpitis, normal periapical radiographic appearance, and no sensitivity to percussion or previous pain. The clinical diagnosis of irreversible pulpitis was confirmed by a positive response to an electric pulp test (EPT; PT-20, Parkell) and an exaggerated response to a cold test (Roeko Endo-Frost, Coltène/Whaledent), defined as moderate-to-severe pain that lingered for more than 10 seconds after the cotton pellet had been removed. This positive diagnostic EPT score was recorded and used as the before-injection data. The exclusion criteria consisted of the following conditions: pregnancy, systemic disease, allergy to local anesthetic agents or latex, dental pain before or at the time of study, oral or facial paresthesia, serious periodontal disease, unrestorable teeth, teeth with crowns, use of sedatives, use of analgesics or anxiety medications 12 hours before treatment, and use of any other drugs that could have affected pain perception and the response to vitality tests.

All the clinical procedures were carried out in the Department of Endodontics, Dental School, Tabriz University of Medical Sciences. Patients who agreed to participate in this study were randomly assigned to 1 of 2 groups (n = 35) using an online random number generator (first generator, www.randomization.com). The trial was double blind because the participants and the person analyzing and assessing the study data were blinded to the type of injections used in the study groups.

Each patient in the control group received only a standard IANB injection of 1.8 mL of 2% lidocaine with 1:100,000 epinephrine (Darupakhsh Pharmaceutical). The injection was administered within 1 minute, using a standard aspirating dental cartridge fitted with a 27-gauge dental needle. In the intervention group, 15 minutes after the injection of the standard IANB as described for the control group, each patient received a standard MINB injection of 1 mL of 2% lidocaine containing 1:100,000 epinephrine, administered by an operator not involved in assessing the outcomes. After the MINB injection, the patient used the hand on the side opposite to the injection to apply firm finger pressure to the soft tissue of the mental foramen region for 1 minute.[12]

All of the injections were carried out by a third-year postgraduate student (AAA). The position of the mental foramen was determined before injections by reviewing panoramic radiographs that were obtained for other dental evaluations before patients were referred to the endodontics clinic for root canal treatment.

The same postgraduate student performed the objective assessment of mandibular first molar anesthesia by EPT and recorded the patient's responses. Each participant was requested to note the moment at which the stimulus was first detected, and the score was recorded from the analog scale (0-8, in which scores of 8 or more are considered no response). Anesthetic success was defined as 2 consecutive readings of 8 within 15 minutes. Electric pulp testing was carried out every 4 minutes until 15 minutes after injection. In the intervention group, EPT was carried out after administration of MINB. The final EPT reading was used in data assessment. The tooth was isolated and an access cavity was prepared. The patient was requested to inform the operator of the existence of pain during access cavity preparation, pulp chamber entrance, and introduction of the first file into the root canal and rate the pain on visual analog scale (VAS) forms. The mean pain rate of these 3 timepoints was considered for analysis. The following criteria were outlined for the patients to rate their pain: 0, no pain; 1–3, mild pain; 4–6, moderate pain; 7–9, severe pain.[12,16]

Statistical analyses were performed using SPSS software (version 17, IBM). Mann-Whitney *U* and Wilcoxon tests were used for the analysis of data. Intragroup differences were analyzed using paired *t* tests. The Kolmogorov-Smirnov test was used for the evaluation of normal distribution of the data. Statistical significance was set at $P < 0.05$.

Results

A total of 70 patients, 32 men and 38 women, participated in this study. The mean (SD) ages, which ranged from 18 to 59 years, were 31.40 (11.3) and 28.32 (7.8) years in groups 1 and 2, respectively. The mean ages of the 2 groups were not significantly different ($P = 0.23$). A Kolmogorov-Smirnov test showed that the ages were normally distributed between the 2 groups.

The results of Kolmogorov-Smirnov tests showed nonnormal distribution of the data related to EPT scores and pain values ($P < 0.05$); therefore, the Mann-Whitney *U* test was used for statistical analysis of these variables. The mean (SD) EPT scores in the control group were 4.89 (2.11) and 3.01 (3.33) before and after injection, respectively (Chart 1). The mean (SD) scores in the intervention group were 4.03 (1.40) before injection and 1.23 (2.61) after injection. There was no statistically significant difference in the mean EPT scores of the 2 groups before the injections of the anesthetic agents ($P = 0.06$). However, the mean EPT score in the intervention group after IANB and MINB was significantly lower than that in the control group after IANB ($P = 0.01$). Of the 35 patients in each group, 20.0% (7 patients) in the control group and 71.4% (25 patients) in the intervention group had no response to the EPT 15 minutes after injections, and this difference was statistically significant ($P < 0.05$). In addition, only the intervention group showed a statistically significant difference between EPT scores obtained before and after injection ($P < 0.001$).

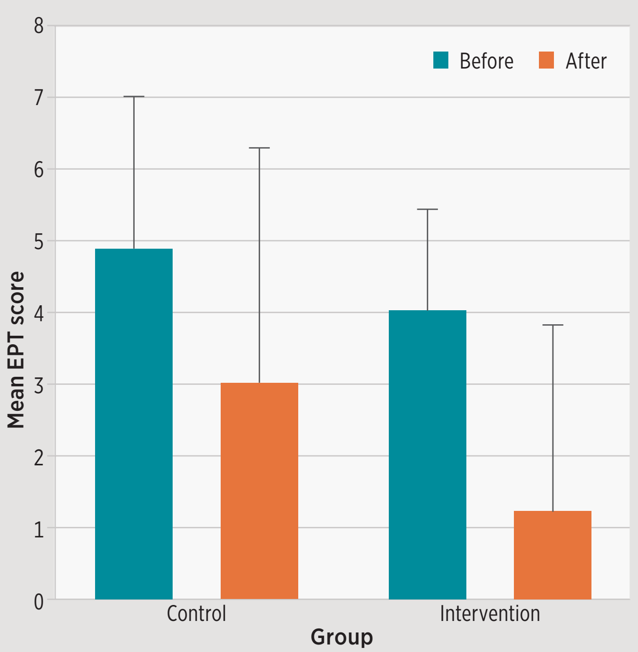
The mean (SD) VAS score for pain in the control group, 4.43 (2.86), was significantly greater than that in the intervention group, 2.03 (2.81) ($P = 0.001$) (Chart 2).

Discussion

This randomized controlled trial was designed to evaluate the effect of MINB and manual pressure, following IANB, on the success of anesthesia in mandibular first molars with asymptomatic irreversible pulpitis. MINB is a supplementary technique to IANB and can provide improved anesthesia for mandibular lateral incisors, premolars, and first molars, although with different success rates depending on the tooth.[6,10,11]

In the MINB technique, the anesthetic solution is deposited close to or in the mental foramen, which diffuses the anesthetic solution into the mandibular canal.[17] In the present study,

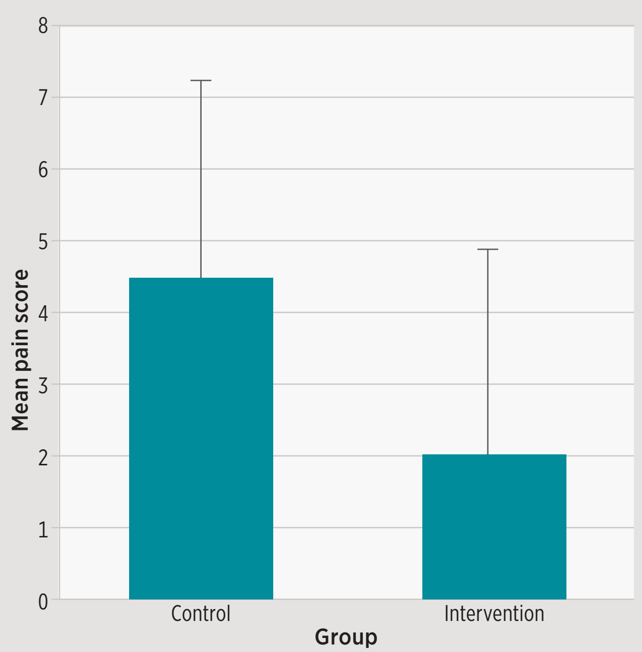
Chart 1. Mean electric pulp test (EPT) scores before and after anesthetic injections (n = 35 per group).



Groups: control, standard inferior alveolar nerve block injection (1.8 mL of 2% lidocaine containing 1:100,000 epinephrine); intervention, standard inferior alveolar nerve block injection followed by standard mental-incisive nerve block injection (1 mL of 2% lidocaine containing 1:100,000 epinephrine).

EPT scores based on an analog scale: 0, initial reading on the pulp tester; 8 or higher, considered no response. Error bars represent the standard deviation.

Chart 2. Mean pain scores during endodontic therapy (n = 35 per group).



Groups: control, standard inferior alveolar nerve block injection (1.8 mL of 2% lidocaine containing 1:100,000 epinephrine); intervention, standard inferior alveolar nerve block injection followed by standard mental-incisive nerve block injection (1 mL of 2% lidocaine containing 1:100,000 epinephrine).

Pain scores based on a 10-point visual analog scale: 0, no pain; 1-3, mild pain; 4-6, moderate pain; 7-9, severe pain. Error bars represent the standard deviation.

panoramic radiographs were used to determine the positions of the mental foramina before the injections, although Joyce & Donnelly stated that the needle does not have to be placed within the mental foramen to achieve successful anesthesia.[10] The effect of MINB as an alternative to IANB in obtaining successful anesthesia for mandibular molars is controversial. In addition, the effect of pressure on surrounding soft tissues after injection of MINB has not been evaluated. Based on anecdotal reports, the application of pressure and massage might help local anesthetic agents disperse to structures surrounding the mental foramen, including innervations of the first molar, improving the efficacy of anesthesia.[12,15]

In the present study, EPT was used for assessing the anesthetic success rate before and after injections because it is a well-established, objective tool for assessing pulp sensation in studies on local anesthetic agents.[6,10,18-24]

Whitworth et al concluded that the injection speed does not affect anesthetic success rates.[11] However, the MINB injections were administered within 1 minute in the present study. Several authors have suggested the use of 1.0-1.5 mL of local anesthetic agent for MINB.[25,26] Also, the injected volume has been shown to influence the rate of successful anesthesia as well as the duration of anesthesia.[27,28] Therefore, in this study, the volume of MINB injection was selected to be 1 mL.

According to the results of the present study, there was no statistically significant difference between the 2 groups before the injections; however, after injections, the intervention group, which received MINB injection and pressure application, showed significantly lower EPT scores as well as a greater percentage of patients with no response to EPT than the control group. In contrast, Jaber et al reported no statistically significant difference in the incidence of pulpal anesthesia between MINBs administered with active (injection site) and control (tooth surface) massage, based on the number of episodes of no response to maximal EPT stimulation.[12] This contrast could be attributed to the different methods used in the 2 studies.

Deposition of an anesthetic agent close to the mental foramen might facilitate retrograde dispersal of the solution to the mandibular canal and toward the first molar.[29,30] In addition, Whitworth et al concluded that anesthetic solution that enters the mental foramen can spread proximally to block the inferior alveolar nerve in the molar region.[11] Applying pressure to the soft tissue of the injection region might improve the retrograde movement of local anesthetic solution. In addition, Currie et al suggested that buccal infiltration in the first molar area is, in fact, a modified MINB.[30]

In the present study, a combination of MINB and IANB injections was used in the intervention group. According to Nist et al and Aggarwal et al, the combination of these injections enhances anesthesia for the lateral incisors and first molars.[6,26] In addition, the addition of IANB overcomes a common limitation of MINB, the short duration of anesthesia.[6]

Moreover, the results of the present study showed that applying MINB injection and pressure following IANB significantly reduced the pain during endodontic access preparations in comparison to using IANB injections alone. These results coordinated with the results of EPT and demonstrated the efficacy of using MINB injections with pressure.

One of the limitations of this study was a lack of standardization of the amount of pressure applied by the patients. However, Kaufman et al demonstrated that IANB resulted in significantly more pain and discomfort during injection than MINB.[14] Moreover, in the present study, the patients did not complain about the pain and discomfort of the MINB injections. However, some patients in the control group complained about pain or discomfort associated with the IANB injections.

The present study was the first to evaluate the effect of MINB with pressure following IANB on anesthetic success in mandibular first molars. Further studies should be carried out on a wider scale and in patients who have teeth with symptomatic irreversible pulpitis and necrosis. The anesthetic success rates should also be compared with different methods of anesthesia in other teeth, including lateral incisors and premolars.

Conclusion

Based on the results of this randomized controlled trial, administration of MINB and finger pressure following IANB significantly improved the anesthetic success rate in mandibular first molars with asymptomatic irreversible pulpitis.

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