

Original Article

X-tip intraosseous injection system as a primary anesthesia for irreversible pulpitis of posterior mandibular teeth: A randomized clinical trail

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ABSTRACT

Background: Successful anesthesia during root canal therapy may be difficult to obtain. Intraosseous injection significantly improves anesthesia's success as a supplemental pulpal anesthesia, particularly in cases of irreversible pulpitis. The aim of this study was to compare the efficacy of X-tip intraosseous injection and inferior alveolar nerve (IAN) block in primary anesthesia for mandibular posterior teeth with irreversible pulpitis.

Materials and Methods: Forty emergency patients with an irreversible pulpitis of mandibular posterior teeth were randomly assigned to receive either intraosseous injection using the X-tip intraosseous injection system or IAN block as the primary injection method for pulpal anesthesia. Pulpal anesthesia was evaluated using an electric pulp tester and endo ice at 5-min intervals for 15 min. Anesthesia's success or failure rates were recorded and analyzed using SPSS version 12 statistical software. Success or failure rates were compared using a Fisher's exact test, and the time duration for the onset of anesthesia was compared using Mann-Whitney U test. $P < 0.05$ was considered significant.

Results: Intraosseous injection system resulted in successful anesthesia in 17 out of 20 patients (85%). Successful anesthesia was achieved with the IAN block in 14 out of 20 patients (70%). However, the difference (15%) was not statistically significant ($P = 0.2$).

Conclusion: Considering the relatively expensive armamentarium, probability of penetrator separation, temporary tachycardia, and possibility of damage to root during drilling, the authors do not suggest intraosseous injection as a suitable primary technique.

Key Words: Anesthesia, intraosseous injection, irreversible pulpitis

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INTRODUCTION

Traditional method for mandibular teeth anesthesia has been achieved via an inferior alveolar nerve (IAN) block.^[1] Complete pulpal anesthesia during root canal therapy may be difficult. Intraosseous injection has been shown to improve successful pulpal anesthesia

as a supplemental injection, particularly in cases of irreversible pulpitis. However, intraosseous injections are most useful for promoting the efficacy and duration of anesthesia by conventional methods in refractory cases.^[2] The IAN block injection is the most commonly used technique for mandibular posterior teeth anesthesia, particularly for hot teeth. Clinical studies have reported that a single IAN block injection for pulpal anesthesia is not effective in 30-80% of patients with irreversible pulpitis.^[3] This may be caused by anatomical variation, local inflammatory mediators, neuronal sprouting, patient anxiety, and operator's technique.^[4,5] Intraosseous injection has been reported to be successful as a

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supplemental technique after failure of the IAN block. In teeth exhibiting irreversible pulpitis, the success rate of intraosseous anesthesia ranges from 71% to 98%.^[6-8] Intraosseous injection involves perforation of the cortical bone around the root, and then insertion of a short specific needle into the perforated region and finally injection of the anesthetic solution directly into the cancellous bone. This system allows single-step perforation and injection of anesthetic solution through the lumen of the perforator. The medullary bone allows fast diffusion of the anesthetic solution and immediate onset of anesthesia. The advantages of this method are being quite quick, easy, and more comfortable, as well as having minimal lingering numbness.^[9] This technique may be perceived by time and be more successful than IAN block for the teeth with irreversible pulpitis. To our knowledge, few studies on teeth with irreversible pulpitis have been performed using intraosseous X-tip injection system as a primary anesthesia technique. The aim of the present study was to compare the efficacy of X-tip intraosseous injection and IAN block when used as the primary anesthesia for irreversible pulpitis.

MATERIALS AND METHODS

Treatment protocols used in this study were accepted by Dental Research Committee of Islamic Azad University of Medical Sciences, Khorasgan, Isfahan. Informed consent was obtained from all patients. The inclusion criteria were as follows: Age range 20-60 (mean 40) years, no remarkable systemic disease, e.g., cardiovascular disease, no history of taking any analgesic drugs that would alter the inflammatory response of the pulp during the past 24 h, and one mandibular posterior tooth with irreversible pulpitis. The diagnostic criterion for irreversible pulpitis was lingering thermal pain confirmed by the application of endo ice (Hygienic Corp., Akron, OH, USA) and electric pulp tester. Forty patients who referred to Endodontic Department of Islamic Azad University of Medical Sciences for endodontic treatment were randomly assigned into two groups of 20 each: Group 1 received X-tip intraosseous injection (DENTSPLY Millefer Co. Tulsa, Oklahoma, USA) and group 2 received traditional IAN block.^[1] One healthy contralateral tooth in the same jaw served as negative control and received no anesthesia, and was tested by endo ice and electric pulp tester. A single clinician performed all the procedures, including diagnosis, injection, and anesthesia evaluation. For the

first group, the X-tip intraosseous injection was done according to the manufacturer's instructions; after evaluating root proximity by radiography, perforation site was located in alveolar mucosa at the distal site of the first molars or at the mesial site of the second molars. A volume of 0.1 ml of 2% lidocaine with 1:100,000 epinephrine (Darou pakhsh, Tehran, Iran) was infiltrated through a 30-gauge needle at the perforation site before intraosseous injection. The perforator drill position was at an angle of 90° to the cortical bone, and the slow-speed hand piece was activated in a series of short bursts, using light pressure until 2-5 sec had passed. The needle was then engaged in a pen-gripping fashion and 1.8 ml of 2% lidocaine with 1:100,000 epinephrine was injected slowly during 60 sec. Before inserting the 27-gauge ultrashort X-tip needle into the guide sleeve, the needle was bent at a 60-80° angle to allow easy insertion. The perforator was pushed through the alveolar mucosa until the X-tip faced bone. The IAN block was performed by standard technique. The IAN block group received the same type and volume of anesthetic solution. Efficacy of anesthesia was determined by electric pulp tester at 5-min intervals for a period of 15 min. The contralateral tooth were also tested and served as a negative control. No response to the cold testing and the electric pulp tester for two sequential intervals was the definitive criterion for successful anesthesia.^[10] Success or failure rate of anesthesia and the time duration for the onset of anesthesia at each technique were recorded. Success or failure rates were compared using a Fisher's exact test and the time duration for the onset of anesthesia was compared using Mann-Whitney U test. $P < 0.05$ were considered significant.

RESULTS

The mean age of patients was 40 years, and gender distribution was 51% male and 49% female. The distribution of tooth type was 63% first molar and 37% second molar. All control teeth responded to the electrical and thermal test normally, and there was not any remarkable condition for these teeth.

Group 1 was successful in 17 out of 20 cases (85%). The minimum time duration for onset of anesthesia was 5 min, the maximum time was 9 min, and the average time duration was 7.4 min. Group 2 had successful anesthesia in 14 out of 20 cases (70%). The minimum time duration for onset of anesthesia was 5 min, the maximum time was 15 min, and

the average time duration was 9.5 min. Extrusion of anesthesia solution was noted in three cases of anesthesia's failure in X-tip system. The time duration for onset of anesthesia in intraosseous injection was found to be statistically more rapid than that of IAN block ($P = 0.01$). Success rate of the intraosseous injection of anesthesia was 15% more than the conventional IAN block (85% vs. 70%); however, this difference was not statistically significant ($P > 0.05$).

DISCUSSION

IAN block has been the traditional and primary method for pulpal anesthesia in mandible tooth.^[1] But according to previous studies, the success rate of this technique ranges from 19% to 65% in cases of irreversible pulpitis.^[6-7,11,12] The reasons of IAN block failure in such cases may be accessory innervations, accuracy of needle placement, anesthetic solution migration along the path of least resistance, and psychological factors.^[13] Another explanation for this issue is nerves arising from the inflamed tissue that change resting potentials and decrease excitability thresholds.^[14] Wallace *et al.* showed that local anesthetic agents are not adequate for blockage of impulse transmission, because of these lowered excitability thresholds.^[14] Another factor would be the tetrodotoxin-resistant class of sodium channels, which have been shown to be resistant to the action of local anesthetics.^[15] In addition, patients in pain are often anxious, which lowers the pain threshold. The success rate of Stabident intraosseous injection as supplemental anesthesia in patients with irreversible pulpitis has been reported to differ from 79% to 98%.^[6-7,9,11,12] Gallatin *et al.* showed that supplemental X-tip intraosseous injection of the mandibular first molar was successful 93% of the time.^[16] On the other hand, intraosseous injection has been reported to be very reliable for both normal and inflamed pulps whether as primary anesthesia or as supplemental technique.^[7] The average duration of intraosseous anesthesia for normal mandibular teeth has been reported to be 60 min,^[17,18] whereas the IAN block has longer duration of anesthesia which is more than 140 min.^[19] Intraosseous injection is contraindicated in cases such as present infection at the site of perforation, close proximity of vital structures, developing teeth, and aggressive periodontitis.^[3] IAN block may be preferred for long procedures that may cause considerable postoperative pain. In the present study, the success rate of intraosseous injection using X-tip system was 85% and the success rate of traditional IAN block

was 70%, which is in agreement with the findings of Nusstein *et al.*^[20] Furthermore, Cogins *et al.* stated that the success rate of primary intraosseous anesthesia for non-inflamed pulps was 75-93%.^[21] In the present study, X-tip system failed to obtain adequate anesthesia in three cases, which may be due to wrong selection of needle size in the perforator hole by the clinician or closure of the perforator hole with bone debris during the perforation process which leads to extrusion of the anesthetic solution. Gallatin *et al.* observed only one incidence of backflow in 41 injections, but in our investigation, backflow occurred in 3 cases out of 20 intraosseous injections.^[16] Gallatin *et al.* used a 27-gauge, 21-mm needle for solution deposition, whereas we used a 27-gauge, 8-mm needle.^[16] Using the 8-mm needle may not allow clearing of the guide sleeve and consequently the anesthetic solution may flow into the oral cavity. Furthermore, reperforation in another site was not considered in this study and would result in success and lack of backflow of anesthetic solution into the oral cavity. Gallatin *et al.* reported that guide-sleeve removal and reperforation was successful in decreasing the backflow of anesthetic solution.^[16] The side effects of intraosseous injection technique included acute periodontitis and temporary tachycardia in more than 50% of cases.^[22] Khan *et al.* showed 62% decrease in periradicular mechanical allodynia in teeth with irreversible pulpitis. It seems intraosseous injection causes more reduction in periradicular mechanical allodynia which may be due to deposition of anesthetic solution around the root apices and associated periradicular tissues.^[23] According to the average time duration for onset of anesthesia in the present study, the X-tip injection anesthesia is more rapid and more reliable than the routine IAN block technique. However, there was not a statistically significant difference. Lack of significant difference may be due to relatively small sample size. Our result was similar to those of many previous studies which reported immediate onset of X-tip injection.^[6,7,9,16] Future studies are recommended employing larger sample size to obtain valid results about the efficacy of X-tip system intraosseous injection and IAN block for primary anesthesia.

CONCLUSION

It is seen in the present study that there is no significant difference between X-tip intraosseous injection system and IAN block. Considering the pain and discomfort during anesthesia administration, relatively expensive

armamentarium, probability of penetrator separation, temporary tachycardia, and possibility of damage to root during drilling, the authors do not suggest it as a suitable primary technique for irreversible pulpitis in mandibular molars.

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