Research Article

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Anesthetic Efficacy of Three Different Supplementary Local Anesthetic Techniques after Failure of Inferior Alveolar Nerve Block in Patients with Irreversible Pulpitis in Mandibular Teeth: A Randomized Clinical Trial

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ABSTRACT

Background: The inferior alveolar nerve block (IANB) does not always provide satisfactory anesthesia for patients with irreversible pulpitis. Hence many a times supplementary local anesthetic techniques are required in order to achieve profound anesthesia for successful and pain free endodontic treatment.

Materials and Method: The trial included 100 patients diagnosed with irreversible pulpitis in mandibular teeth. Patients received 2.0 ml of 2% lidocaine with 1: 80,000 epinephrine as an IANB injection. Patients who did not experience pain-free treatment received randomly 1 of 3 supplementary techniques, namely repeat lidocaine IANB (rIANB), articaine buccal infiltration (ABI), lidocaine intraligamentary injection (PDL). Successful pulp anesthesia was considered to have occurred when no response was obtained to the maximum stimulation (80 reading) of the pulp tester, at which time treatment commenced. Treatment was regarded as being successfully completed when it was associated with no pain. Data were analyzed by chi-square tests.

Results: Of the 100 patients, 42 achieved successful pulpal anesthesia within 10 minutes after initial IANB injection. ABI allowed more successful (pain-free) treatment (40%) than rIANB or PDL supplementary techniques (28.6% and 31.4% respectively); but this difference was not statistically significant (p>0.005).

Conclusion: IANB injection alone does not always allow pain-free treatment for mandibular teeth with irreversible pulpitis. Supplementary buccal infiltration with 4% articaine with epinephrine are more likely to allow pain-free treatment than intraligamentary and repeat IANB injections with 2% lidocaine with epinephrine for patients experiencing irreversible pulpitis in mandibular permanent teeth.

Keywords: Buccal infiltration, Inferior alveolar nerve block, Mandibular permanent teeth, Repeat Inferior Alveolar Nerve Block, Supplementary local anesthetic techniques.

INTRODUCTION

The prerequisite for successful endodontic treatment is effective local anesthesia. Regardless of the clinician's skills, effective pain control is the pedesteal for sound endodontic treatment. The conventional inferior alveolar nerve block is the most popular and commonly employed nerve block technique for anesthetizing mandibular teeth. In certain cases, however, this nerve block fails to act,

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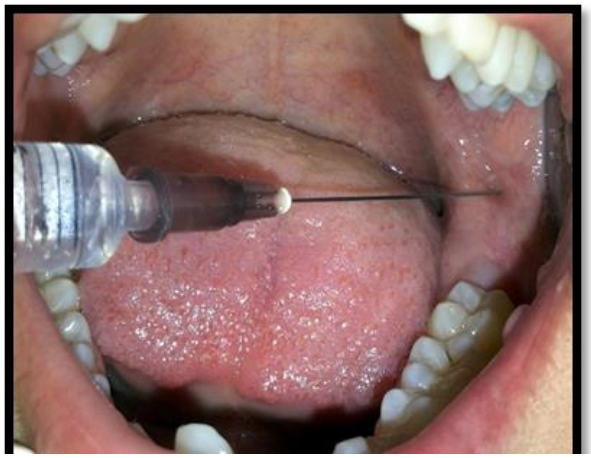

Fig 1: Inferior alveolar nerve block injection technique.

Fig 2: Intraligamentary injection technique.

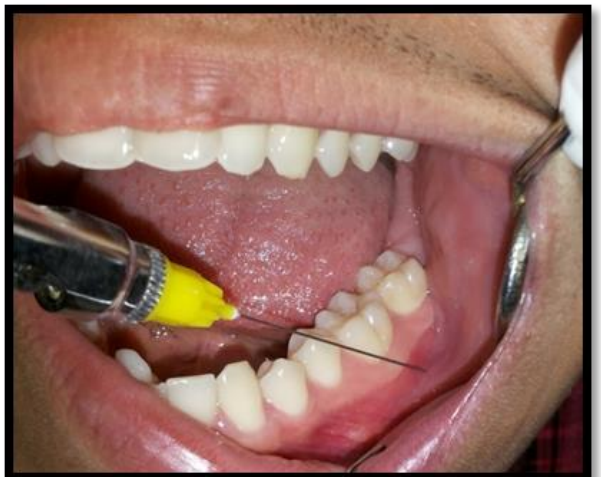

Fig 3: Articaine buccal infiltration technique.

even when performed by the most experienced clinician. Anaesthetic failure rate recorded is 13% of all injections, with the greatest number of failures reported with the inferior alveolar nerve block

Table 1: Comparison of results between supplementary articaine buccal infiltration, intraligamentary injection and repeat inferior alveolar nerve block supplementary local anesthetic techniques.

Result(Effective)	Response			
	Success	Percentage	Failure	Percentage
ABI	14	40.0%	6	26.1%
PDL	11	31.4%	9	39.1%
RIANB	10	28.6%	8	34.8%
	35	100	23	100

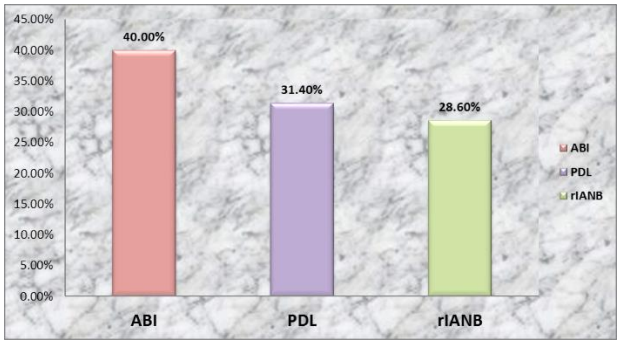

Fig 4: Success percentage of 3 supplementary techniques in 58 patients after failure of IANB (or with positive responses to pulp testing after initial IANB).

(IANB)(1). The rate of failure varies in range from 0% to 48.6% (2). Accessory innervation of jaw by mylohyoid nerve, cross innervation from the contralateral inferior alveolar nerve in anterior teeth, individual variations in the position of nerves and foramina, needle deflecting away from the bevel, choice of technique and solution, psychological factors like anxiety and fear are some of the reasons which might lead to failure of inferior alveolar nerve block in mandibular teeth (3). To overcome failure of inferior alveolar nerve block, supplementary local anesthetic techniques can be implemented to achieve painless endodontic treatment. When an initial local anaesthetic injection fails the preferable alternative is to repeat the injection; this is because it is easier to palpate bony landmarks in the second attempt as the needle can be manoeuvred in the tissues easily without

causing pain[4]. If again second injection fails then the alternative approaches should be employed namely buccal infiltration anaesthesia, intraligamentary, intrapulpal, intraosseous anesthesia or mental and incisive nerve block. Thus the present study compared the anesthetic efficacy of three supplementary local anesthetic techniques after IANB failure in patients with irreversible pulpitis of mandibular permanent teeth. Techniques selected were repeat IANB with 2% lidocaine with adrenaline, 4% articaine buccal infiltration, and intraligamentary injection of 2% lidocaine with adrenaline. The primitive end measure is provision of painless endodontic treatment. The null hypothesis was that supplementary repeat IANB with 2% lidocaine with adrenaline, buccal infiltration of 4% articaine with adrenaline, and intraligamentary injection of 2% lidocaine with adrenaline after failure of IANB are equally effective in allowing painless treatment for mandibular permanent teeth with irreversible pulpitis.

MATERIALS AND METHODS

The clinical trial included 100 healthy patients who attended dental OPD of Conservative Dentistry and Endodontics department in MIDSR Dental College and Hospital, Latur diagnosed with chronic irreversible pulpitis in mandibular teeth (premolars and molars). Inclusion criteria of the study included patients with age between 18 - 40 years. Patients presenting with asymptomatic chronic irreversible pulpitis in one tooth and an asymptomatic vital tooth on the opposite or contralateral side of the arch (which acted as control for pulp tester function) were invited to participate.

Exclusion criteria:

- Allergic to local anesthesia
- Hyperemic teeth
- H/O of cardiovascular disease
- H/O of premedication or sedation
- H/O of recent trauma
- Alcoholics , smokers
- Patients undergoing orthodontic treatment
- Patients having metallic restorations
- Radiographic finding showing pulp stones
- Patients having cardiac pacemakers

The diagnosis of irreversible pulpitis was determined by other staff of the department who were blind to this study procedure in order to rule out the bias in the selection of cases. Baseline pulpal response of the tooth with irreversible pulpitis was recorded before the initial IANB injections with an electric pulp tester (Denjoy Dental.CO.LTD). Pulp tester function and validity of the reading were assessed on a control unanesthetized tooth on the opposite or contra lateral side of the jaw once before the initial IANB. This also served in making patients familiar with the working of the pulp tester. All patients were first given an inferior alveolar nerve block by direct approach. After aspiration, 2.0 mL of 2% lidocaine HCl with 1:80,000 epinephrine (Dentox 2% A) was injected slowly at a rate of 2 ml/ min [table/figure:1] with a long needle of 27 guage. After the initial IANB, pulp testing was performed on the test tooth every 2 minutes for 10 minutes or till the point it was possible to achieve a maximum reading of 80 without sensation. Patients in whom the initial IANB achieved effective pulp anesthesia received further desired treatment. Whether the treatment was completed without any pain or not was noted down. Patients in whom the initial IANB failed to achieve painless anesthesia within 10 minutes or those who reported pain during their treatment recieved 1 of 3 supplementary local anesthetic injections. The 3 treatments were the following:

1. Repeat lidocaine IANB (rIANB) (2.0 mL of 2% lidocaine HCL with1:80,000 epinephrine) was administered in the same manner as previously described.

2)
With buccal infiltration (ABI),1.8 mL of 4% articaine HCL with epinephrine 1:100,000 (Septanest, Septodont, Kent, UK) was deposited through the muccobuccal fold adjacent to the tooth apex buccally. The solution was deposited slowly over a period of 30 seconds with a standard aspirating dental cartridge syringes (Septodont) [table/figure:2].

3) With intraligamentary injection (PDL), the pressure syringe (Medidenta) with 27 guage needle was inserted at 30 degree to the long axis of the tooth in the PDL space at the mesiobuccal aspect of

the roots [4], allowing it to penetrate deep until it was wedged between the tooth and the crestal bone with the bevel of the needle facing the root surface [5] [table/figure: 3]. 1mL of 2% lidocaine with 1:80,000 adrenaline was injected into the periodontal ligament space for each root during a period of 20 seconds [6]. The needle was allowed to remain in its position for 10 seconds after injection. All the pulp tests, local anesthetic injections and subsequent dental treatments were carried out by a single operator.

Pulp sensitivity of the anesthetized tooth was recorded after 2 minutes of each supplementary injection and again after 5 minutes if pulp anesthesia (no response at 80 pulp tester reading) was not confirmed at 2 minutes. If it was not possible to achieve 80 pulp tester reading without pain sensation after 5 minutes, the patient was not included in the study, and their treatment was completed with supplementary means according to best local practice. Treatment began when negative response to maximum reading of pulp tester was achieved. If any pain was experienced during treatment, it was considered failure, and the patient was treated according to local best measure.

Statistical analysis:

Institutional and ethical approvals were obtained,

Data were subjected to chi square analysis.

RESULTS

This study included 100 patients (67 men, and 33 women) who ranged in age between 18 and 40 years. Of the 100 mandibular teeth, 62 were molars and 38 were premolars. Out of 100 patients, 42 experienced successful pain-free treatment with the initial IANB without any need of supplementary injections. The remaining 58 patients who gave positive response to pulp testing were randomly divided into three groups to receive 1 of 3 supplementary injections. Of these 58 patients, 20 patients received intraligamentary injection (PDL), 20 patients recieved articaine buccal infiltration (ABI) and 18 patients recieved repeat inferior alveolar nerve block rIANB. From this trial it was observed that ABI produced more successful pulpal anesthesia than rIANB or PDL supplementary techniques, however the difference between ABI and PDL supplementary technique was not significant but the difference between ABI and rIANB was significant [Table/Figure 4].

DISCUSSION

Local anesthesia does not always acts effectively in routine dental practice. The success of inferior alveolar nerve blocks ranges from 46 to 100% [7,8] This study evaluated anesthetic efficacies of three different supplementary local anesthetic techniques to manage a failed inferior alveolar nerve block in teeth with irreversible pulpitis. The techniques included in the study were repeating the initial IANB or an intraligamentary injection technique of 2% lidocaine with adrenaline or a buccal infiltration of 4% articaine with adrenaline. When efficacy of local anesthesia is compared, it is prerequisite that a reproducible outcome measure be obtained. The use of electrical stimulation is considered one of the safe and precise method to check for pulpal anesthesia in vital asymptomatic teeth [9-11]. The absence of perception to the maximum stimulation of the pulp tester (80 reading) has been widely used as a criteria to detect pulpal anesthesia [7,12].

Of the 100 patients included in this study, 42 patients experienced successful anesthesia after IANB with 2% lidocaine with 1:80,000 adrenaline. The number of this study was higher than that reported by Claffey et al [13] and Simpson et al [14], similar to that of Oleson et al [15],but lower than that noted by Rood [16]. Rood in his study recorded success of 76% after IANB injection in patients who had undergone different dental procedures. This variation in success might be due to differences in diagnosis as the current study included only patients diagnosed with irreversible pulpitis. Repeat injection has been described as a first option when the initial injection was unsuccessful [19]. 28.6% success was obtained in the present study after rIANB injection, but it was the least successful method. The anesthetic efficacy of articaine buccal infiltration was better than PDL injection and rIANB.

Greater anesthetic efficacy of 4% articaine might be because of its properties like superior bone diffusion, increased lipidsolubility, presence of thiophenic ring in the chemical structure, plasma protein binding [17]. The results of a volunteer

study have shown that IANB with 2% lidocaine and adrenaline supplemented by buccal infiltration with 4% articaine with adrenaline is more successful than IANB alone [18]. The greater effect in the present study (%) might be due to the larger volume of solution utilised during the buccal infiltration. Also the results of PDL injection were better than rIANB. The route by which the anaesthetic solution reaches the periradicular tissue with a PDL injection is into and through the marrow spaces surrounding the tooth and not apically through the PDL membrane, thus making this injection as effective as intraosseous injection [19, 20, 21]. Nusstein et al [22] reported 56% of mandibular teeth with irreversible pulpitis that did not respond to IANB became anesthetized when 1.4 mL of 2% lidocaine with 1:100,000adrenaline was administered as an intraligamentary injection by using a computerized delivery system. The success percentage after intraligamentary injections reported in the current study were less than those in earlier investigations. This could be due to the differences in volume of anesthetic solution administered by the intraligamentary route and use of pressure syringe instead of computer assisted delivery system. The 1.0 mL dose was chosen in the current study because this is the amount recommended for this technique for single tooth.

CONCLUSION

IANB injection alone does not always allow pain-free treatment for mandibular teeth with irreversible pulpitis. Articaine buccal infiltration, intraligamentary injections repeat IANB can be implemented successfully as supplementary local anesthetic techniques as for patients experiencing irreversible pulpitis in mandibular permanent teeth.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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