Original Article

Influence of needle gauge on pain perception and use of obturators in achieving profound pulpal anesthesia – A double-blinded *in vivo* study

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Abstract

Introduction: Achieving profound pupal anesthesia and pain management is key in endodontic practice. However, inferior alveolar nerve block (IANB) does not always result in successful pulpal anesthesia, during symptomatic irreversible pulpitis and has a high failure rate between 35% and 45%. Intrapulpal (IP) injection has been found to have increased efficiency and pain. The study aims to find the pain perception of 26G and 31G and the use of obturators in improving the efficacy of IP anesthesia.

Materials and Methods: Eighty patients with symptomatic irreversible pulpitis after the failure of IANB were recruited and divided into four groups to receive IP with Group I A: 26G with obturators, Group I B: 26G without obturators, Group IIA: 31G with obturators, and Group IIB: 31G without obturators. The pain was measured using the visual analog scale and the effectivity of anesthetic injection by the duration of action.

Results: A 31G needle produced the least pain perception compared to the 26G needle during IP injection. A 31G with an obturator was the most efficient, acting in less than a minute and 26G without an obturator showed the least.

Conclusion: Within the limitation of this trial, it can be concluded that lesser gauge needles reduce pain perception during IP, and obturators achieve adequate back pressure.

Keywords: Back pressure; hot teeth; inferior alveolar nerve block failure; intrapulpal anesthesia; needle gauge; obturators in endodontics

INTRODUCTION

Achieving profound anesthesia of pulp is a keystone in endodontic practice.[1] To achieve local anesthesia for mandibular teeth, an inferior alveolar nerve block (IANB) with 2% lidocaine with 1:80,000 epinephrine is commonly employed in injection.[2] However, it does not always result in successful pulpal anesthesia, especially during emergency cases of symptomatic irreversible pulpitis,[3] and is associated with high failure rates ranging between 44% and 81%.[4] Various reasons such as accessory innervation, anxiety, fear, anesthetic solution concentration, volume, operator technique, abnormal physiological response in the presence of inflammation as well as anatomical variation have been given as the main explanation for anesthetic failure.[5] Thus, it becomes challenging to manage endodontic emergencies associated with symptomatic irreversible pulpitis in mandibular molar teeth.[6]

Complete pulpal anesthesia is critical during endodontic treatment.[7] The clinical goal is for patients to have a pain-free endodontic experience. Despite clinical signs

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indicating complete local anesthesia, patients may still experience pain.[8]

This clinical challenge often requires the use of supplemental injections. Supplemental anesthetic field block techniques such as intraosseous, intrapulpal (IP), intraligamentary, and interseptal, have been reported to improve the efficacy of anesthesia when primary IANB fails.[9]

IP anesthesia has been found to have increased efficiency, and immediate onset but is painful. IP anesthesia relies on the deposition of solution directly into the pulp chamber under pressure.

Modifications in the needle designs, such as gauge bore diameter, bevels, and sharpness contributing to pain perception, have been made to reduce pain. In the medical literature, thinner gauge needles induce minimal pain and whether the same will be perceived by IP injection needs to be tested.

The effectiveness of IP is believed to be directly related to the ability to prevent backflow of solution and increase back pressure.[10] Strong back pressure is a major factor in producing pulpal anesthesia.[11] In that aid, the obturators are used during IP. These are suggested to create a seal between the injection needle and irregular contours of small openings into pulp space, preventing the backflow of the anesthetic agent, which is a common reason for IP failure,[12] at the same time, they are proven to increase the efficiency of IP anesthesia. The present study focuses on using obturators to check whether greater IP pressure can be generated using a novel injection needle-mounted needle obturator versus a standard conventional needle for IP.

Hence, this study aimed at finding pain perception by two different needle gauges, i.e., 26G and 31G, and using obturators to improve IP anesthesia's efficacy.

MATERIALS AND METHODS

The study was conducted after registering in the Clinical Trials Registry of India with registration number CTRI/2021/07/034868.

Adult male and female patients (n = 80) within the age group of 18–50 years with overall sound systemic conditions requiring endodontic therapy for mandibular molars obliging to participate in the study were selected after obtaining informed consent. Patients complaining of continuous pain/sharp shooting pain indicative of symptomatic acute irreversible pulpitis in the association of mandibular molars with vital pulp as determined by a positive response to cold test (Neoendo Neosnow dental cold spray) and electric pulp testing (Waldent electric pulp tester) were selected.

Inclusion criteria

1. Systemically healthy patients (Category: ASA 1) aged between 18 and 50 years with mandibular molar teeth diagnosed with symptomatic irreversible pulpitis
2. Teeth with moderate, sharp, spontaneous pain, preoperatively with a visual analog scale (VAS) score: >5 shall be considered
3. The teeth that respond positively to the electric pulp test as well as those exhibiting a lingering, exaggerated response of more than 10 s to the cold test (Neoendo Neosnow dental cold spray) were included.

Exclusion criteria

1. Teeth with crown/root fractures, acute or chronic apical abscess, compromised periodontium, and open apex were excluded
2. Hypertensive patients on medications, differently abled patients, pregnant, and lactating women
3. Patients having a history of allergies to local anesthetic solutions, long-term medications that influenced pain threshold, analgesics, steroids, and/or antibiotics in the past 24 h
4. Teeth which will be observed to be nonvital on access cavity preparation.

Methodology

After obtaining informed consent and checking for allergies, 80 patients diagnosed with symptomatic irreversible pulpitis where the failure of IANB, i.e., patients having no adequate subjective symptoms or patients experiencing pain during access or initial instrumentation after 15 min were enrolled for the study and were divided into two groups by simple random technique of sampling. These patients were broadly divided into four groups depending on the gauge of the needle used to receive the supplemental injection, i.e., IP.

- Group I: (n = 40) 26G needle
- Group II: (n = 40) 31G needle.

Further, these groups were subdivided depending on the use of obturators as

- Group I: (A): (n = 20) 26G needle with obturators
- Group I: (B): (n = 20) 26G needle without obturators
- Group II: (A): (n = 20) 31G needle with obturators
- Group II: (B): (n = 20) 31G needle without obturators.

Access cavity preparation was done using endo access bur # 02 and an opening into the pulp was made to allow the snug fit of the needle. If a large opening was present in the pulp chamber, then the needle will be advanced into the canal until it snugly fits into the canal. IP anesthesia was administered by wedging the needle into the exposed

pulp and 0.2 ml of 2% lidocaine with 1:80,000 epinephrine was administered under pressure to all the groups as said before accordingly.

Pain during the IP injection was assessed immediately after the supplemental injection was given by a blinded assessor using VAS scoring. The effectivity of the anesthetic injection was measured by the duration of action and success of anesthesia. To avoid bias, neither the patient nor the assessor was aware of the gauge and utility of the obturator. Thus, this was a double-blinded study.

To assess the effectivity of anesthetic injection, the duration was measured when IP had acted and the patient allowed continuing access or initial instrumentation at 0.5, 1, 1.5, and 2 min. More than 2 min was considered as failure.

Statistical analysis

Shapiro–Wilk test was used to check which variables were following the normal distribution. The Statistical Package for the Social Sciences (SPSS) for Windows version 22.0 released in 2013. Armonk, NY, USA: IBM Corp., was used to perform statistical analyses.

The descriptive analysis includes the expression of study parameters in mean and SD in each study group. Inferential Statistics one-way analysis of variance followed by *post hoc* Analysis was performed to compare the unpaired *t*-test used. The level of statistical significance was set at a $P < 0.05$.

RESULTS AND DISCUSSION

The term "hot" tooth generally introduces a pulp that has been diagnosed with irreversible pulpitis, with spontaneous, moderate-to-severe pain. Hot tooth is usually associated with IANB failures. In such cases, supplemental injections such as intraosseous, intraligamentary, and IP should be considered.[13]

Profound pulpal anesthesia in endodontics is a doorway to successful root canal treatment, among which IP injection proved to be painful yet most effective, which is why it was chosen for the trial. Hargreaves *et al*. recommend using IP injection as a last resort; according to him, it should only be used "when all else fails."[7]

The success of IP anesthesia is due to the cumulative effect of low compliance of pulpal tissue and increased interstitial back pressure causing direct tissue injury or compression of nerves, which triggers type A nerve fibers which causes the initial sharp intense pain. Further, depositing the anesthetic solution expands the tissue, and both type A and type C nerve fibers are stimulated, leading to pain perception.

The pain perception during IP injection was assessed using the VAS scale, as it is highly reliable and super easy to use compared to other scales. VAS Scale is a unidimensional measure of pain intensity. It is self-explanatory and not much training is required, and it takes <1 min to complete. It is a line of 10 cm in length, (score 1–3 is considered mild pain, 4 and 5 moderate pain, 6 and 7 severe pain, and 8 and 9 very severe pain).[14]

In this double-blinded study, among 80 patients with symptomatic irreversible pulpitis, the mean age was 33.6 ± 12.8 years, and the female:male ratio was 46:34.

In this trial, although there was no significant difference, the 31G needle produced the least pain perception with a mean of 2.5 VAS score compared to that of the 26G needle with a mean of 2.9 VAS score [Table 1] during IP injection. The outer diameter of 31G is the same as that of the inner diameter of 26G (0.26 mm) and overall, it is approximately 1.5 times more than a 31G needle, thus, 26G needles during needle insertion, contact a greater area of pulp and might trigger more type A nerve fibers and causes more pain.[15]

The 31G insulin needles are triple beveled and treated with special micro-bonded lubrication for comfortable injection, helping reduce pain perception.[16] A 31G needles allow the wedging of needle even in access with smaller pulpal exposure due to their small barrel and plunger diameter.[17]

The success of IP anesthesia depends on the back pressure created. Many authors such as VanGheluwe, and R Walton, suggest that the anesthetic effect of the IP technique is mainly due to the back-pressure of the solution, independent of the type of solution injected.[18]

To achieve adequate pressure during IP injection and make it more efficient, an obturator was used in this trial and it was found that 31G with an obturator was the most efficient one, acting in less than a minute with a mean duration of 0.875 s. Whereas 26G with the obturator took a mean duration of 1.2 min. There was no statistically significant difference seen in 31G without the obturator, having a mean duration of 1.1 min and 26G without an

Table 1: Comparison of mean Visual Analog Scale scores when 26G and 31G needles were used with or without using obturators

	n	Mean±SD	SEM	*T*	*P*
31G					
Without obturator	20	2.5000±1.10024	0.24602	0.825	0.414
With obturator	20	2.2000±1.19649	0.26754		
26G					
Without obturator	20	2.9000±2.07491	0.46396	0.332	0.742
With obturator	20	2.7000±1.71985	0.38457		

SD: Standard deviation, SEM: Standard error of the mean

obturator showed the least efficiency with a mean duration of 1.8 min among all the groups.

The obturator is a cone-shaped, compressible rubber, allowing for sealing different access sizes and shapes. It is proven to increase the interstitial back pressure by wedging and creating a tight seal around the orifice preventing the backflow of the anesthesia. It has been proven that the use of an obturator increases the backpressure six times during IP injection.[19] In cases with tissue located deep within a very narrow or curved canal where the pulp tissue located deep within the canal smaller gauge needles like 31G come into use.[16]

To increase the success of nerve block, in the case of hot tooth, the use of long-acting anesthetic solutions either alone or in combination with LA can be considered. Further premedication with NSAIDs before the procedure, and supplemental injection techniques such as intraosseous, periodontal, intraligamentary, interseptal, and retromolar injection techniques can be used.[20] Computer-assisted anesthetic devices, including Wand, Quick Sleeper, and Sleeper One could potentially replace the use of the conventional daunting anesthesia syringe in the coming days and have proven to increase the efficiency of IANB.[21-24]

CONCLUSION

Under the limitations of the study, it can be concluded that in cases of IANB failure in symptomatic irreversible pulpitis supplemental injection techniques like IP anesthesia are helpful. Since it is painful, 31G with an obturator was the most efficient one, acting in less than a minute. The success of IP anesthesia depends upon backpressure and obturators have proven to not only provide adequate backpressure but also to increase the efficacy by their quick action.

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Conflicts of interest
There are no conflicts of interest.

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