TO COMPARE THE ANAESTHETIC EFFICACY OF TWO SUPPLEMENTAL TECHNIQUES OF LOCAL ANAESTHETIC INJECTION AFTER THE FAILURE OF THE PRIMARY INFERIOR ALVEOLAR NERVE BLOCK IN MANDIBULAR MOLARS: AN IN VIVO STUDY

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Abstract
Profound analgesia is essential for vital pulp extirpation in endodontics. The inferior alveolar nerve block (IANB), used for mandibular injection does not always result in profound anaesthesia of pulp, especially in cases of irreversible pulpitis. To manage such situations supplemental injections are being used. Thus the present study was undertaken to evaluate the efficacy of two supplemental techniques (intraligamentary and intrapulpal) of local anaesthetic injection after the failed primary inferior alveolar nerve block in mandibular molars with irreversible pulpitis.
Materials and Methods: Patients were given IANB with 1.8mL of 2% lignocaine with 1:200,000 epinephrine. Heft-Parker visual analog scale (HP VAS) was used to assess the pain. The IANB was considered successful if patients allowed endodontic access or instrumentation with no or mild pain (HP VAS score < 55 mm). While patients with'moderate-to-severe' pain (HP VAS score ≥ 55 mm) were randomly divided into 2 groups and received intraligamentary injection (group 1) and intrapulpal injection (group 2). Root canal treatment was re-initiated. Again, absence of pain or weak/mild pain on endodontic access preparation or instrumentation indicated the success.
Results: The obtained data was statistically analysed using unpaired t test. The difference between the two techniques was found to be stastically insignificant.
Conclusion: Both the techniques i.e intrapulpal and intraligamentary are equally effective in achieving adequate anaesthesia after the primary IANB fails and thus either of the technique can be used in such cases.
Key Words: Inferior alveolar nerve block, Irreversible pulpitis, Local anaesthesia, Mandibular molars.

INTRODUCTION

Achieving profound anaesthesia of pulp is a key stone in endodontic practice. Fear and anxiety associated with endodontic treatment is reduced with effective pain management.[1] To achieve local anaesthesia for mandibular teeth ,inferior alveolar nerve block (IANB) with 2% lidocaine is the commonly employed injection technique.[2] However, this IANB technique does not always result in successful pulpal anaesthesia especially in emergency cases of irreversible pulpitis and is associated with a high failure rate (Hargreaves & Keiser 2002, Aggarwal et al. 2009, Argueta-Figueroa et al. 2012).[3-7] The various clinical studies done in endodontics have reported the failure rate of IANB varying from 44% to 81 %.[3] Thus, it becomes challenging to manage endodontic emergencies associated with irreversible pulpitis in mandibular molars. This is generally managed with the help of the supplemental anaesthetic techniques like intraosseous, intra-ligamentary or intrapulpal injections, [7] as it has been reported that these supplemental techniques improve the efficacy of anaesthesia when a primary IANB injection fails (Hargreaves & Keiser 2002, Meechan 2002).[3,8] An intraosseous or intraligamentary injection can be used to deposit the local anaesthetic solution into the cancellous bone in the vicinity of tooth apex thus improving the Efficacy of anaesthesia.(Hargreaves.(Hargreaves & Keiser 2002, Meechan 2002). [3] A special equipment for drilling the cortical bone is required for an intraosseous injection thus is not a preferred technique. In intraligamentary injection local anaesthetic solution is forced through the cancellous bone so that it diffuses to the apex through the bony perforations and gets deposited into the periodontal ligament space.[9] Another commonly employed supplemental injection is the intrapulpal injection, which is administered under back pressure, and is a preferred technique in patients who experience pain or discomfort on pulp extirpation.[10] According to Birchfield and Rosenburg, efficacy of intrapulpal technique is dependent on the back-pressure with which the anaesthetic solution is injected and not the type of the solution which is injected.[11]

Materials and Methods

The study was conducted after obtaining approval from the institutional ethics committee.
Sixty patients participated in the study, out of which there were 33 men and 27 women. The patients were selected in the age group between 18 and 50 years and between 18 and 50 years and with overall sound systemic conditions. Each patient had a mandibular molar with continuous pain, but vital pulp as determined by a

positive response to thermal and electric pulp testing. Also it was confirmed that patients had not taken any painkillers prior to the initiation of endodontic treatment. Exclusion criteria included: absence of response to cold testing, swelling at the injection site , periapical pathosis, , any allergy to local anaesthetic agent, systemic condition contraindicating an endodontic procedure, pregnancy, any medications affecting anaesthetic evaluation, and inability to give informed consent. The procedure was explained to the patients and they were instructed to rate the pain on Heft-Parker visual analog scale (VAS) which was used for pain assessment. The VAS scale had 4 categories. No pain corresponding to 0 mm. Mild, faint or weak pain defined as 0 mm to 54 mm. Moderate pain defined as 54 mm to 114 mm. Severe pain describing intense or strong pain corresponding to 114 mm to 170 mm. Each patient was given a conventional IANB using 1.8mL of 2% lignocaine with 1:200,000 epinephrine for 1 minute duration using sterile 25 gauge injecting needle. 10 minutes later, the patient was questioned about the numbness on lip. Only patients having profound lip numbness after the primary IANB injection were chosen for the study. Then a conventional endodontic access preparation was started under rubber dam. In case of pain or discomfort, patients were asked to raise their hand. In patients with weak or mild pain or who allowed the continuation of the treatment, the conventional IANB was considered as successful. In patients with moderate or severe pain during access preparation or during instrumentation, the conventional IANB was considered a failure. These patients with moderate to severe pain were randomly divided into two groups. Each group comprising 30 patients (n=30). Patients in the group 1 were given intraligamentary injection as a supplementary injection to IANB and patients in the group 2 were given intrapulpal injection as a supplementary injection to IANB. Both the intrapulpal and intraligamentary injections were given with the conventional 25 gauze needle using 2% lignocaine with 1:200,000 epinephrine. For intraligamentary injections approximately 0.3 ml of local anaesthetic solution was injected at 2 sites (mesial and distal) per tooth. The amount of intrapulpal injection used as 0.6 ml. Endodontic access was reinitiated 5 minutes after the administration of second (supplemental) injection. If the patient felt pain, the treatment was discontinued and the patient was asked to rate the discomfort on the VAS using the four categories of VAS mentioned above. Supplemental injections resulting in no pain or mild pain on endodontic access opening/ instrumentation indicated success while moderate to severe pain was considered a failure. Statistical analyses were performed using the *Unpaired t* test. A P' value <.05 indicates a significant difference.

Results

In group 1(Intraligamentary) 5 patients out of 30 felt moderate to severe pain and in group 2 (Intrapulpal) 3 patients out of 30 patients felt moderate to severe pain on endodontic access or instrumentation. In Table 1, the mean for the pain experienced after IANB with intraligamentary as supplementary injection (group 1) and IANB intrapulpal as supplementary injection (group 2) are presented. Table 2 represents the anaesthetic success of the 2 groups. Data was analyzed statistically to ascertain any significant differences in the groups using the *Unpaired t* test and the P value (P =0.85) obtained indicated insignificant difference.

Group	Group 1 (INTRA-LIGAMENTARY)	Group 2 (INTRA-PULPAL)
MEAN	23.13	22.57
SD	20.66	24.77
SEM	3.77	4.52

Table1. *Mean +/- SD pain ratings* for all injections*

**Heft-Parker visual analog scale ratings*

	IANB/Intraligamentary	***IANB/Intrapulpal***
Anaesthetic success	83.33% (25/30)	90% (27/30)
P value	.85	

Table2. *Percentages and numbers of patients who achieved anaesthetic success in the 2 groups*

Discussion

IANB has been associated with high failure rates of 44%-81%, as reported by various clinical studies, in patients with irreversible pulpitis of a mandibular molar, a condition often described as "hot" tooth.[12] Difficulty in achieving profound anaesthesia of pulp in mandibular molars, can be ascribed to various reasons. This includes anatomical variations (e.g., accessory nerve supply, like mylohyoid nerve, cervical cutaneous nerve C1, C2, or auriculotemporal nerve, distinct foramen location, variable nerve course, bifid alveolar nerve or mandibular canal, density of cortical bone), [10] or altered resting potential and lowered excitability threshold due to low pH of the inflamed tissue resulting in a larger amount of the local anaesthetic being trapped in the charged acid form and, thereby, not able to cross cell membranes. This has been advocated as a major cause for the failure of local anaesthetic in conditions such as endodontic emergencies.[3] Wallace *et al.* reported that in conditions with lower excitability thresholds, the local anaesthetic agents are not sufficient to prevent impulse transmission. It has also been proposed that there is increased expression of sodium channels, known as Tetrodotoxin resistant channels (TTXr), in pulp diagnosed with irreversible pulpitis and it has been shown that these sodium channels are resistant to the action of local anaesthesia. [13] Some other factors which play a role are pathological (e.g., infection or inflammation, trismus,

previous surgery), pharmacology (e.g., chronic alcoholism, chronic narcotic drugs), and psychology (e.g. anxiety, fear, apprehension). [12]

Thus, it is imperative to find anaesthetic techniques which can improve the success rate of IANB in endodontics. Advancements in anaesthetic techniques that can be used as alternatives or adjuncts to the conventional methods include buccal infiltration (BI), intraligamentary, intraosseous , computer-controlled injections, needleless injections, and even electronic dental anaesthesia.[12] In endodontics, the intraligamentary injection is considered as both a primary injection and a supplemental injection (Hargreaves & Keiser 2002, Meechan 2002, Kanaa et al. 2012, Zarei et al. 2012, Parirokh & Abbott 2014, Shabazfar et al. 2014).[3,8,14,16] Reported success rates of intraligamentary injections have been found to be 50–90% (Kanaa et al. 2012, Zarei et al. 2012).[17,18] Zarei et al. (2012) in a clinical study assessing the effectiveness of supplemental intraligamentary injection in cases of failed IANB reported 70% success rates .[17] Fan et al. (2009) reported success rates of 83.33% with intraligamentary injection along with IANB in cases with irreversible pulpitis.[12]

Intrapulpal method of injection involves deposition of solution directly into the pulp chamber under back pressure.[10]. Around 0.2 ml of the solution is injected (Malamed1998).[19] Smith & Smith (1983) [20] in a study on dogs showed that in multirooted teeth , solution injected intrapulpally, reached the apex only in 62% of roots and 15% of adjacent roots. Therefore, they suggested injecting every root separately in multirooted teeth. Some authors also claim that efficacy is dependent upon the type of the anaesthetic solution (Gurney 1967, Malamed 1998) [21] A double-blind study has even shown obtaining intrapulpal anaesthesia by injecting saline with back pressure as effectively as with a local anaesthetic solution (VanGheluwe & Walton 1997). [22] They achieved successful anaesthesia in 33 of 35 teeth injected intrapulpally with either 2% lidocaine with 1 : 100 000 adrenaline or saline. Their study affirmed the results obtained by Birch¢eld & Rosenberg (1975) wherein anaesthetic success was achieved with saline or lidocaine with 1: 50000 adrenaline of intrapulpal injection.

Clearly, the results of our invivo study demonstrate that when a combination of IANB/PDL injection or IANB/Intrapulpal is used higher level of pulpal anaesthesia can be achieved. Thus indicating a a higher success rate as compared to conditions when IANB is used alone to mange cases of symptomatic irreversible pulpits in mandibular molars.. Also, no significant difference was found between the two groups.

Conclusion

Effective pain management strategies are essential to handle emergency endodontic conditions. They not only relieves the patient of the pain but also increases patients loyalty and treatment acceptance thus providing a clinician with an effective practice-building strategy, and also reducing personal stress levels. Therefore, practitioners must consider proper techniques of anaesthesia to manage cases with irreversible pulpitis of mandibular molar.

In the present study the anaesthetic efficacy of IANB/PDL injection was compared with the anaesthetic efficacy of IANB/Intrapulpal, and no significant difference existed. Both the supplemental techniques resulted in high anaesthetic success for achieving pulpal anaesthesia in endodontics in patients with irreversible pulpitis in mandibular molar.

To conclude it can be said that, IANB/PDL or IANB/Intrapulpal injection using 2% lidocaine with 1:200,000 epinephrine can be used to achieve higher success rate in cases with irreversible pulpitis of mandibular molar. Both the techniques can offer effective pain control strategies. Neither combination, however, provided total anaesthetic success during endodontic management of irreversible pulpitis.

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