

## Anesthetic Efficacy of Intraligamentary Injection Techniques on Mandibular Posterior Teeth Diagnosed with Asymptomatic Irreversible Pulpitis

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### ABSTRACT

**Objective:** To compare the effectiveness of Intraligamentary Injection with the IANB injection technique for root canal treatment of mandibular molars and premolars in patients with asymptomatic irreversible pulpitis undergoing access opening.

**Study Design:** Quasi-experimental study.

**Place and Duration of Study:** Operative Dentistry Department, Fatima Jinnah Dental College Karachi Pakistan, from Nov 2018 to Apr 2019.

**Methodology:** The study was conducted on 80 patients. Visual analogue scale was used to determine the level of pain. Three groups were made depending on the effectiveness of anaesthesia at 2-sites (Group-A), 4-site (Group-B) and failure of Intraligamentary injection (Group-C). Anaesthesia was successful when the patient revealed no pain symptoms during access opening.

**Results:** A total of 80 cases were evaluated, out of which 47 were males (58.70%), and 33 were females (41.30%). The most common age groups recorded in our study were 18 – 25 years (33.75%) and 36- 45 years (33.75%). According to our results, the Intra-ligamentary technique was successful in 23(28.75%) cases. The remaining 57(71.25%) cases which received anaesthesia via IANB showed a 100.00% success rate with profound anaesthesia.

**Conclusion:** Inferior alveolar nerve block was more successful compared to Intraligamentary injections for providing profound anaesthesia to mandibular posterior teeth previously diagnosed with asymptomatic irreversible pulpitis and undergoing the procedure of access opening.

**Keywords:** Anesthesia, Asymptomatic irreversible pulpitis, Efficacy, Intraligamentary injection, Inferior alveolar nerve block.

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### INTRODUCTION

Effective local anaesthesia is a primary objective of a successful dental procedure. In addition, achieving long-lasting analgesia is a requirement because ineffective analgesia may make a simple endodontic procedure a traumatic event.<sup>1</sup> The standard technique for local anaesthesia in mandibular molars is inferior alveolar nerve block (IANB).<sup>2</sup> However, several supplementary injection techniques have failed to achieve improved and anticipated rates of mandibular molar anaesthesia. Therefore, finding alternative anaesthesia techniques to achieve enhanced and predictable anaesthesia would be beneficial.

Supplemental injection techniques are Intraligamentary, intra-osseous and intrapulpal. Intra-osseous injection technique requires special instruments to drill and inject anaesthetic solution.<sup>3</sup> Intraligamentary injection (periodontal ligament injection) could be used as a supplementary or a primary injection technique.

Intraligamentary injection allows anaesthesia into the cancellous bone that reaches the pulp through natural perforations in the bony socket.<sup>4</sup>

Several studies have been performed previously to evaluate the success rate of the Intraligamentary injection technique both as a primary and supplementary injection. Lin and co-authors assessed the success rate of Intraligamentary injection in patients with asymptomatic irreversible pulpitis using a two or four-site injection technique. Among 151 patients, they found a success rate of 92.1%, out of which 31.8% were sufficiently anaesthetized after two-site ILI. In contrast, 60.3% following supplemental ILI in two more sites.<sup>1</sup> Malamed and co-authors evaluated the success rate of Intraligamentary injection in patients who require various dental treatments using either the Peri-press injection technique or conventional syringe. They found a success rate of 88.52%, while patients requiring endodontic treatment had a success rate of only 50%.<sup>5</sup> Finally, Roger *et al.* evaluated the success rate of different supplementary local anaesthetic techniques after the failure of IANB in patients with irreversible

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pulpitis. They found a 48% success rate for the Intraligamentary Injection technique.<sup>6</sup>

This study aimed to determine the efficacy of Intraligamentary injection with 2% Lidocaine with 1:100 000 Epinephrine for patients with asymptomatic irreversible pulpitis using a two-site technique or, when needed, four-site technique. The study will help us focus more on the Intraligamentary injection technique and avoid IANB for routine root canal treatments of mandibular molars and premolars in patients with asymptomatic irreversible pulpitis. IANB has many unfavourable outcomes such as post-operative trauma (tongue and lip biting), needle breakage at the point of injection, increased risk of limited mouth opening and Bell's palsy.

### METHODOLOGY

The quasi-experimental study was conducted at Fatima Jinnah Dental College, Karachi Pakistan, for six months, starting from November 2018 to April 2019. Ethical approval was obtained from the Institutional Ethical Committee (Ref. No. OCT-2018-OPR02). Diagnosis of patients was made in the Operative Department of the institute. A sample of 80 patients was obtained with 95% confidence level and power of test  $\beta=80\%$  calculated by the WHO calculator.<sup>7</sup>

**Inclusion Criteria:** Patients of either gender, aged 18 or older, diagnosed with asymptomatic irreversible pulpitis in mandibular molars and premolars were included in the study through consecutive sampling.

**Exclusion Criteria:** All patients having evidence of widening of periodontal space on periapical radiographs and the patients having no response to cold testing were excluded from this study. Pregnant patients and those unwilling to participate in the study were also excluded from the study.

Consent was obtained from all subjects included in the study. Diagnosis of asymptomatic irreversible pulpitis was based on a detailed history and examination of the patient. Subjective and objective findings indicating that the vital inflamed pulp is incapable of healing and confirmatory tests using cold testing were done along with a Peri-apical radiograph.

Only mandibular molars and premolars were included in this study. All patients were informed before the investigation regarding the risks and benefits of this research, and verbal and written consent, both in Urdu and English, was obtained by all patients.

Anaesthesia (0.2 mL) was injected at two sites (mesiobuccal and distobuccal), and chamber opening

was performed immediately. Patients were instructed to inform sensation of pain/discomfort during access opening. If the patient felt pain, supplemental anaesthesia was injected at two more sites (mesiolingual and distolingual), and the procedure restarted. If the patient still feels pain, then IANB was given using another cartridge to finish the procedure comfortably. The Heft-Parker VAS was used to evaluate the pain level after providing anaesthesia via each technique. To check the anaesthetic efficacy, the procedures were divided into three groups according to the success or failure of the anaesthesia. The groups were categorized as follows: two-site successful anaesthesia as Group-A, four-site successful anaesthesia as Group-B and failure of Intra-ligamentary anaesthesia as Group-C.

Data were analyzed through Statistical Package for Social Sciences (SPSS) for windows, version 21.00. Frequency and percentage were calculated for variables like age, gender and tooth number while checking the effectiveness of the Intraligamentary injection technique using the two-site technique during access opening, the effectiveness of the Intraligamentary injection technique using the four-site technique during access opening, the effectiveness of IANB during access opening and overall effectiveness.

### RESULTS

A total of 55 molars and 25 premolars were included in the study. Complete data were available for 80 individuals who received local anaesthesia using three Techniques: 1=Two-step, 2=Four-step, and 3= IANB. Out of 80 cases, 47 were males (58.7%), and 33 were females (41.3%).

The comparison of different methods of administering local anaesthesia with gender was given in Table-I.

**Table-I: Comparison of Gender with Different Local Anaesthesia Techniques (n=80)**

| Local Anaesthesia Techniques  | Gender     |             |
|-------------------------------|------------|-------------|
|                               | Male n(%)  | Female n(%) |
| Two-step technique            | 47 (58.7)  | 33 (41.3)   |
| Four-step technique           | 46 (58.2)  | 33 (41.8)   |
| Inferior Alveolar Nerve Block | 56 (70.0%) | 24 (30.0%)  |

According to our study. A total of 80 cases received anaesthesia via Technique-1. Only 1.25% (n=1) was successful; hence all individuals received further anaesthesia via Technique-2 (n=79). Only 22 cases out of 79 were successful for Technique-2 (27.80%). The remaining 57 cases which received anaesthesia via IANB showed a 100.00% success rate with profound anaesthesia.

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In Table-II, age groups were compared with the technique of delivering anaesthesia. The patients were divided into three age groups ranging from 18 to 45 years. Most participants were 18–25 years (33.75%) and 36–45 years (33.75%). Table-III described the comparison of different LA techniques with the tooth number.

**Table-II: Comparison of Age Groups with Different Local Anesthesia Techniques**

| Local Anesthesia Techniques    | Age Groups Frequency (%) |             |             |
|--------------------------------|--------------------------|-------------|-------------|
|                                | 18–25 years              | 26–35 years | 36–45 years |
| Two-step technique (n=80)      | 27 (33.8)                | 26 (32.4)   | 27 (33.8)   |
| Four-step technique (n=79)     | 27 (34.2)                | 25 (31.6)   | 27 (34.2)   |
| Inferior Alveolar Nerve (n=57) | 18 (31.6)                | 21 (36.8)   | 18 (31.6)   |

**Table-III: Comparison of Tooth Number with different LA Techniques**

| Local Anesthesia Techniques             | Tooth Number | Frequency (%) |
|---|--------------|---------------|
| 1: Two-step technique (n=80)            | 34           | 5 (6.3)       |
|   | 35           | 8 (10.0)      |
|   | 36           | 28 (35.0)     |
|   | 44           | 3 (3.7)       |
|   | 45           | 9 (11.3)      |
|   | 46           | 27 (33.7)     |
| 2: Four-step technique (n=79)           | 34           | 5 (6.3)       |
|   | 35           | 8 (10.1)      |
|   | 36           | 27 (34.2)     |
|   | 44           | 3 (3.8)       |
|   | 45           | 9 (11.4)      |
|   | 46           | 27 (34.2)     |
| 3: Inferior Alveolar Nerve Block (n=57) | 34           | 1 (1.8)       |
|   | 35           | 5 (8.8)       |
|   | 36           | 21 (36.8)     |
|   | 44           | 1 (1.8)       |
|   | 45           | 7 (12.2)      |
|   | 46           | 22 (38.6)     |

According to our results, Technique-3, which was the IANB, was administered in 75.40% of first molars (36 and 46), 21.00% in second premolars (35 and 45) and 3.60% in first premolars (34 and 44) and was successful in 100.00% cases.

### DISCUSSION

Difficulties during dental procedures performed in the mandible's posterior region have been well documented. The most commonly used injection to administer local anaesthesia in the region is the IANB, the effect of which can vary depending on the anatomical changes in individuals.<sup>8,9</sup> It has been reported by Hargreaves *et al.* that failure rates of local anaesthesia are eight times higher in patients presenting with

irreversible pulpitis as compared to those with reversible pulpitis or no changes in pulp tissues.<sup>10</sup>

Attaining adequate pulpal anaesthesia in patients diagnosed with irreversible pulpitis is challenging. Factors responsible for such a high difficulty level can be attributed to the changes in pH of the inflamed tissues, which is lower when compared to the basic nature of the anaesthetic solution. As a result, the penetration of the anaesthetic solution through the nerve sheath and membrane is reduced, resulting in decreased anaesthesia.<sup>11</sup> The resting potentials and excitability of nerve tissues are altered when tissues are undergoing inflammation, which in turn inhibits the anaesthesia to stop the transmission of impulses.<sup>12</sup> Anaesthetic-resistant sodium channels are also present in pulpal tissues undergoing irreversible pulpitis.<sup>13</sup>

Intraligamentary or periodontal ligament anaesthesia is regarded as one of the supplemental anaesthetic techniques along with IANB. However, it has benefits when used as a solitary technique for providing anaesthesia, such as smaller doses of the administered solution and limited soft tissue anaesthesia. It is often used when one requires mandibular anaesthesia in patients with bleeding disorders.<sup>14</sup> However, it may produce mild discomfort in the patient and has been reported to have cardiovascular effects due to its rapid entry into the circulation.<sup>15</sup> The technique used to administer Intraligamentary anaesthesia required the needle to be inserted at 30° to the long axis of the tooth at the mesiobuccal and distobuccal aspects of the roots. To ensure that the needle has reached maximum penetration, it is forced until it has wedged between the tooth and crestal bone.<sup>16</sup> This creates discomfort for the patient, and the pain may last up to 2 to 5 hours.<sup>17</sup>

The level of pain during access opening was evaluated using the Heft-Parker VAS. This similar score has been used previously by other similar studies evaluating anaesthetic efficacy in mandibular molars during endodontic procedures.<sup>18</sup> All patients were administered Intraligamentary injections at two sites and were assessed after 1 minute for effectiveness. Meechan *et al.* previously reported that the onset of anaesthesia is achieved within 30 seconds of its administration.<sup>19</sup> Supplemental anaesthesia at two more sites was given if required. Numerous studies in the past have labelled the Intraligamentary technique as a type of intraosseous injection which needs the anaesthetic agent to be placed through the cribriform plate. When two sites are further added into the initial technique, it has been reported by Lin *et al.* previously

that profound anaesthesia was achieved in about 90% of the cases. However, in our study, both the two-site injection and four-site injection techniques of Intraligamentary anaesthesia failed adequate anaesthesia to the teeth.<sup>1</sup>

Compared to the other supplemental anaesthetic techniques, the rationale for using the Intraligamentary technique included advantages such as being easy to use, economical and immediate onset of numbness.<sup>20</sup> When compared to Intraligamentary injections, it has been reported by Zarei *et al.* that the intraosseous technique has greater success rates. However, since it requires special equipment and is painful to the patient, it was not a favourable choice.<sup>21</sup> For evaluating the success of intrapulpal anaesthesia, the pulp needed to be exposed before giving anaesthesia which was also not suitable in the setting of our study.

The current study uses Lidocaine as the anaesthetic agent of choice. However, it has been previously reported by Ashraf *et al.* that Articaine has proved to be more successful when dealing with mandibular molars and premolars.<sup>22</sup> Therefore, further studies with various anaesthetic agents can improve results. However, since the main aim of this present study is to evaluate differences between techniques used for administering anaesthesia, we can deduce that even though using Articaine might increase the success rate of the anaesthesia, our study concludes that one cannot entirely rely on Intraligamentary anaesthesia as the main technique for endodontic treatment.

## CONCLUSION

Although Intraligamentary injections, when used primarily for teeth undergoing access opening, could not obtain effective anaesthesia, the teeth which received Intraligamentary injections before IANB resulted in higher success. The combination of both techniques resulted in profound anaesthesia.

**Conflict of Interest:** None.

## Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

A: Conception, study design, drafting the manuscript, approval of the final version to be published.

ABS & SR: Data acquisition, Critical review, approval of the final version to be published.

MA: Data acquisition, data analysis, data interpretation, approval of the final version to be published.

KNS & FM: Critical review, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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