



# Comparative Evaluation of the Effectiveness of Intraligamentary and nerve block Injections during tooth preparation: A Randomized Controlled Trial

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## KEYWORDS

Tooth preparation, intraligamentary, nerve block, pain, anesthesia

## ABSTRACT:

**Introduction-** Patients decline dental treatments due to the pain being unbearable. Local anesthesia(LAs) act by blocking the sensory conduction of harmful stimuli from reaching the central system of pain during dental treatment, it is also useful in managing fear induced anxiety states. Intraligamentary anesthesia has been widely utilized in dental practice within recent years.

**Materials and methods-** Patients with a chief concern of fixed replacement of missing teeth participated in the study. The study was performed on patients who were undergoing fixed partial denture treatment which included 112 males and 88 females participants with ages ranging between 18 and 40 years old and who were systemically healthy. Patients in Group A were injected LA anesthetized using intraligamentary infiltration, whereas patients in Group B were injected with LA anesthesia using nerve block and VAS score was evaluated.

**Results-** In maxillary arch, Pain during the procedure in the maxillary arch was lesser ( $p < 0.05$ ) in case of intraligamentary ( $1.62 \pm 0.76$ ) than the posterior superior alveolar nerve block ( $1.87 \pm 0.80$ ). In the mandibular arch, pain during the procedure ( $p < 0.05$ ) for intraligamentary ( $1.62 \pm 0.763$ ) and posterior superior alveolar nerve block ( $1.87 \pm 0.800$ ).

**Conclusion-** Intraligamentary injections are useful on patients with bleeding disorders, as they eliminate the risk of encountering blood vessels during injections as in case of nerve blocks. Intraligamentary LA helps in reducing the toxicity of LA in the patients.

## INTRODUCTION :

The success rate of a dental procedure is heavily dependent upon effective pain management. Some patients decline dental treatments due to the pain being unbearable. Introduction of painlessly administered anesthesia not only helps with the management of pain during dental treatment, it is also useful in managing fear induced anxiety states. The methods of negating pain include interrupting the pathways that carry the data of the stimulation from the periphery of the body to the central nervous system, by interfering the central system, or by removing the stimulation that causes pain. Local anesthesia(LAs) act by blocking the sensory conduction

of harmful stimuli from reaching the central system.[1] Hence, LA is the most typically utilized technique of achieving pain management in dentistry. Tooth preparation is also one of the procedures where introduction of local anesthetics help in relieving sensitivity and associated pain [2]. There are various strategies for the administration of LA, for e.g, infiltration, nerve block. One such technique is known intraligamentary anesthesia which was introduced within the early 20th century. Intraligamentary anesthesia has been widely utilized in dental practice within recent years [3]. This method was found to be efficient for crown and cavity preparations, vital pulpectomies, root canal



treatments and dental extractions, i.e, for all procedures usually performed with local infiltration and/or nerve blocks [4]. The avoidance of any undesirable side effects usually associated with a nerve block is the main advantage of this technique.

Administering LA in the oral cavity comes with its share of problems. Incorrectly administered nerve blocks can cause damage to the nerve and hematoma if the needle is injected into an artery. One can expect a minimal degree of damage to the periodontal tissues which may occur when practicing the intraligamentary method of injection. This damage may be caused by a direct trauma to the intraligamentary tissue or cemental surface scratches made by the tip of the needle. The clinical efficacy of the intraligamentary anesthesia has been proven and described in the literature. Tsirlis et al. conducted comparative studies of conductivity and intraligamentary anesthesia in tooth preparation of mandibular molars [5]. They found no statistically vital differences within the complications of the inflammation kind. The method most commonly being used in recent times is non trephenating intraosseous injections where a normal dental syringe is placed blindly on the gingival fissure. ILT is usually done by the deposition of minimum 0.2 ml of local anesthetic solution for each root of the tooth. The use of a numbing cream or a spray to reduce the discomfort caused by the injection of the anesthetic solution.

The pain experienced by many patients during restorative procedures involving tooth preparation is referred to as hyperesthesia, usually, the most commonly used management technique is administration of local anesthesia usually in the form of inferior alveolar nerve block (IANB) and subperiosteal infiltration. Since these techniques are prone to certain complications, intraligamentary anesthetic technique may be a viable alternative under such conditions [6]. However, the effectiveness of this technique needs to be explored in controlling hyperesthesia during tooth preparation. Hence, the aim of the study was to evaluate the effectiveness of intraligamentary anesthesia during tooth preparation where the null hypothesis stated that there is no significant difference between the intraligamentary infiltration and nerve block.

## Material And Methods:

### Sample size calculation

A clinical study was carried out in the Department of Prosthodontics in a university hospital setting. The present study is an institution based study carried out within a time frame of (2021-2022). The sample size estimation was done by using G power software and the sample consisted of 200 patients (112 males and 88 females). All the selected patients were informed about the study and voluntary informed written consent was obtained from them.

### Method of sampling

Patients with a chief concern of fixed replacement of missing teeth participated in the study. The study was performed on patients who were undergoing fixed partial denture treatment which included 112 males and 88 females participants with ages ranging between 18 and 40 years old and who were systemically healthy. Simple random sampling method was followed [figure 1].

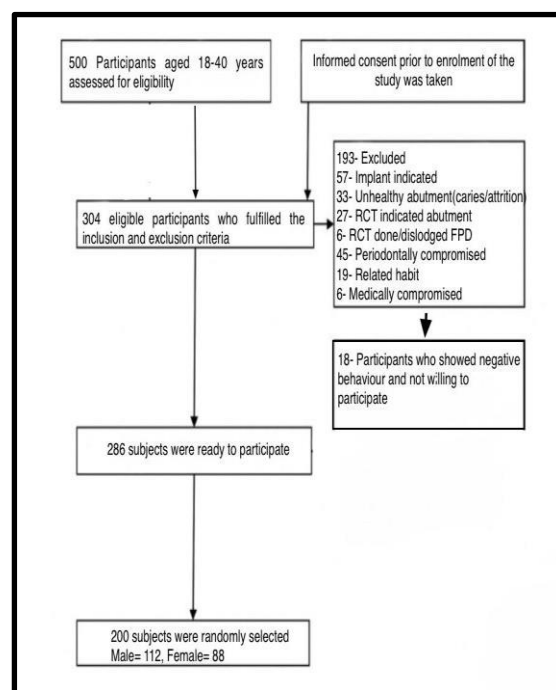


Figure 1: Flow diagram showing patient selection for study

### Study design

Randomized control Trial (RCT)



#### Ethical Approval:

The ethical approval was obtained from the institutional ethics committee. Number: IHEC/SDC/UG-1863/22/PROSTHO/630

#### Selection criteria

The study population included patients who reported to Saveetha Dental College

- Inclusion criteria- patients age ranging between 18 and 40 years old and who were systemically healthy and single first molar missing either maxillary or mandibular arch those who wanted fixed replacement of missing teeth with tooth supported fixed partial denture with healthy vital abutment, presence of proper crown root ratio were considered under the inclusion criteria
- Exclusion criteria- patients with any allergy, systemic diseases, tobacco or alcohol habits and periodontal diseases, multiple edentulous area, severe attrited abutment, recession and attachment loss, history of trauma, non vital or Root canal treated abutment, tilted abutment, patient need for implant were excluded

#### Intervention :

##### Procedure

The patients were randomly divided using chits equally into two groups, Groups A and B, respectively. Patients in Group A were injected LA anesthetized using intraligamentary infiltration, whereas patients in Group B were injected with LA anesthesia using nerve block (maxilla- posterior superior alveolar nerve block, mandible- inferior alveolar nerve block). Both of the anesthetic techniques were administered before tooth preparation using a 2 ml insulin syringe (30 gauge needle) containing 2% lignocaine hydrochloride (HCl) with adrenaline 1:80000 which is given at buccal (mesiobuccal), lingual, mesial, and distal aspects of the tooth for intraligamentary technique. The pain was evaluated using the visual analog scale (VAS) based on pain assessment which was given to the participants to be filled after the tooth preparation. The VAS score was prepared in English with easily identifiable analogs. The VAS ranged 0–10, where 0 indicates “no pain,” while 10 indicates “severe excruciating pain.” All the responses were recorded and analyzed statistically.

#### Data Collection

A total sample of 500 patients over a period of one year, with partial edentulism was taken out of which only 200 patients met the inclusion criteria. Data was reviewed by an external reviewer.

#### Statistical Analysis

Data were recorded in Microsoft Excel 2016 (Microsoft office 10) and later exported to SPSS (Statistical Package for Social Science for Windows Versions, 20.0), SPSS Inc, (Chicago IU, USA)) and subjected to statistical analysis. The Chi-square test and independent t test was employed with a level of significance set at  $p < 0.05$ .

#### Result:

In maxillary arch, there is no significant difference ( $p > 0.05$ ) between posterior superior alveolar nerve block and intraligamentary injection for pain during injection and its duration. Pain during the procedure in the maxillary arch was lesser ( $p < 0.05$ ) in case of intraligamentary ( $1.62 \pm 0.76$ ) than the posterior superior alveolar nerve block ( $1.87 \pm 0.80$ ) [table 1]. In mandibular arch, the only significant difference was found for the same i.e., pain during procedure ( $p < 0.05$ ) for intraligamentary ( $1.62 \pm 0.763$ ) and posterior superior alveolar nerve block ( $1.87 \pm 0.800$ ) [table 2]. Association between type of LA with pain during procedure and pain during injection was shown in figure 2 and 3.

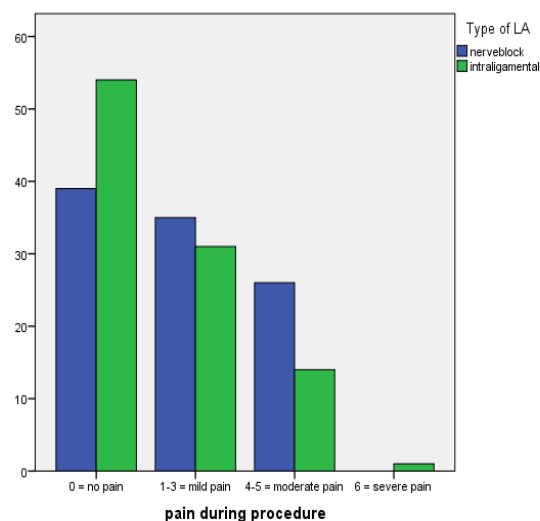


Figure 2: association between the type of LA and pain during procedure

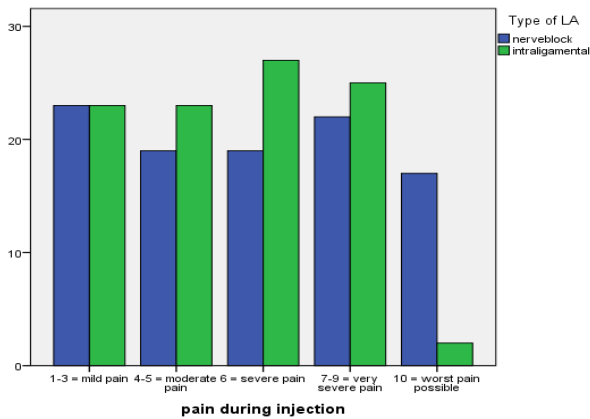


Figure 3: association between the type of LA and pain during injection

	Type of LA	N	Mean ± SD	SE	95% CI	t - value	P - value
PAIN DURING INJECTION (MAXILLA)	Nerve Block	100	3.67 ± 1.24	0.124	0.264	0.4	0.413
	Intraligamentary	100	3.60 ± 1.15	0.115	0.264	0.4	
DURATION OF ANAESTHESIA (MAXILLA)	Nerve Block	100	2.07 ± 1.312	0.186	0.397	0.161	0.872
	Intraligamentary	100	2.10 ± 1.322	0.186	0.397	0.337	
PAIN DURING PROCEDURE (MAXILLA)	Nerve Block	100	1.87 ± 0.80	0.11	0.032	0.468	2.263
	Intraligamentary	100	1.62 ± 0.76	0.11	0.032	0.468	0.025*

Table 1: comparison between nerve block and intraligamentary anesthesia technique in relation to pain

during injection, duration and pain during procedure in maxilla.

	Type of LA	N	Mean ± SD	SE	95% CI	t - value	P - value
PAIN DURING INJECTION (MANDIBLE)	Nerve Block	100	3.91 ± 1.422	0.142	0.51	0.671	0.092
	Intraligamentary	100	3.60 ± 1.155	0.115	0.51	0.671	
DURATION OF ANAESTHESIA (MANDIBLE)	Nerve Block	100	2.07 ± 1.312	0.131	0.397	0.337	0.161
	Intraligamentary	100	2.10 ± 1.322	0.132	0.397	0.337	
PAIN DURING PROCEDURE (MANDIBLE)	Nerve Block	100	1.87 ± 0.800	0.8	0.32	0.468	0.025*
	Intraligamentary	100	1.62 ± 0.763	0.76	0.32	0.468	

Table 2: comparison between nerve block and intraligamentary anesthesia technique in relation to pain during injection, duration and pain during procedure in mandible.

**Discussion :**

Dental pain management is important for oral surgical procedures and the fear is strong in some patients that makes them not report for treatment [23] and hence it is important to administer LA with minimal pain. Local anesthetics trigger a regional loss of pain around the site of administration (as in cases of infiltration anesthesia) or on the trail of a nerve (as in case of nerve block anesthesia). Its accessibility as a topical cream and as an injectable solution (local anesthesia) makes it a viable tool in dentistry [24]. It acts by inducing an analgesic impact by interacting with neural cell membranes which troubles metal binding. The resulting closure of voltage-



gated sodium channels prevents action potentials from occurring and accounts for roughly 90th of local activity of the amide-based anesthetic solutions [25]. To overcome the decrease in efficaciousness of the anesthesia caused by amides, vasoconstrictors such as endocrine are typically added to make amends for the dilatation, reduce the flow of blood at the injection site, and enhance the duration of the anesthetic effect. Studies done by Tung and Eichmiller and Jing et al., depicted that articaine and 1:100,000 epinephrine is very effective, with 92.1% anesthetic success within the jaw, first, and second molar teeth of patients with irreversible pulpitis [26] but a study associated intraligamentary injection was more successful when compared to nerve block which is in accordance with our study [27]. In the intraligamentary LA, the anesthetic solution diffuses apically through the marrow spaces into the intraseptal bone [28]. Malamed SF in 1982 conducted a study to compare the intraligamentary anesthesia as an alternative to inferior alveolar nerve block technique in root canal treatment, crown preparations, periodontal procedures and extractions [29] and thus, concluded that the periodontal injection gave a positive result in achieving adequate anesthesia and could be used as an alternative to inferior alveolar nerve block technique. Malamed SF stated that further research was required in this field as the sample size included for dental extractions in this study was low.

#### Pain on Administration of Local Anaesthesia:

Our results were positive with the study in terms of use of intraligamentary LA where Prama R et al., reported that pain during needle penetration was less in intraligamentary as compared to inferior alveolar nerve block [11] [30,31]. Hence, there appeared to be less discomfort during intraligamentary technique [32,33].

#### Duration of Onset of Local Anaesthesia:

In the present study the onset of anesthesia for all the patients was between 15 and 20 seconds. Malamed SF in 1980, in his study stated that the duration of onset of anesthesia was less than 30 seconds [5].

A study done by Jain et al shows that both intraligamentary and subperiosteal infiltrations were equally effective in controlling pain during tooth preparation whereas a study done by Eichmiller et al

found the effectiveness of anesthesia provided by intraligamentary infiltration to be about 92.1% and both the study is in accordance with present study and this this could be due to the difference between the amount of LA used and the tooth on which the test was done [34]. The current study is among the few studies to use the VAS scale as a method of pain measurement for tooth preparation after administration of local anesthesia. Although this method has been criticized for being too vague, it serves its purpose well to help communicate better in the current study population[35].

The intraligamentary technique anesthetizes only the single tooth and the extent of anesthetized soft tissue is limited and therefore complications like lip or tongue bite can be avoided. Other possible complications associated with nerve block are pain and burning on injection, injury to the medial pterygoid muscle causing trismus, paresthesia to the lip and tongue due to injury to the inferior alveolar or lingual nerve, soft tissue injury and very rarely facial nerve paralysis [36] [30]. The only complication noted in our study was transient blanching of tissues after administration of LA. Administration of LA agents produces pain and anxiety that may cause subsequent unfavorable behavior [37]. Over the years alternative injection techniques have been introduced for reducing the pain on administration of LA. One such technique is the intraligamentary technique [38]. In the present study, the intraligamentary was used on 200 patients and was successful in 100 patients. The advantages of this technique included minimal pain on administration of LA, rapid onset of anesthesia and minimal pain during the procedure [39]. Dower JS Jr and Barniv ZM in their review of literature on periodontal ligament injection have concluded that it produces effective anesthesia and lessens the adverse reaction of other techniques [40]. It was also successfully used in patients undergoing extraction of mandibular posterior teeth with exaggerated gag reflex and patients suffering from trismus due to oral submucous fibrosis. All the inherent complications of nerve block were avoided by this technique in our study. The only disadvantage of the intraligamentary observed in the present study was that the duration of anesthesia was limited to 24 minutes.

There are few limitations with intraligamentary anesthesia i.e, technique sensitivity and multiple



puncture sites. However, there are several advantages such as minimal tissue trauma, profound anesthesia, no risk of hematoma or trismus and minimal anesthetic recovery discomfort, and hence, this technique can be used to control 8. Intraligamentary is also very effective in cases where, one will treat bilateral teeth within the same appointment while not having to administer two nerve blocks which is uncomfortable for patients and intraligamentary LA is very helpful in endodontic procedures as it anesthetizes the ligament, the pulp, and therefore, the gingiva around the tooth.

#### Conclusion :

Though the intraligamentary injection is associated with significantly higher pain scores compared with the conventional nerve block injection, it is effective in establishing pulpal and soft tissue anesthesia. The efficacy of intraligamentary injection is lower when compared with nerve block injections. However, it may be indicated as an alternative anesthetic approach in patients where conventional techniques are contraindicated. Intraligamentary injections are useful on patients with bleeding disorders, as they eliminate the risk of encountering blood vessels during injections as in case of nerve blocks. Intraligamentary LA helps in reducing the toxicity of LA in the patients.

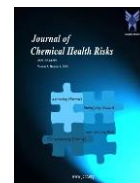
**Acknowledgments:** None

**Conflict of interest:** None

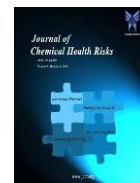
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