



## Comparative Evaluation of the Efficacy of Intraligamentary and Supraperiosteal Injections in the Extraction of Maxillary Teeth: A Randomized Controlled Clinical Trial

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### ABSTRACT

**Aim:** The aim of this clinical trial was to compare the efficiency of the intraligamentary (periodontal ligament) injection with supraperiosteal injections in extraction of maxillary teeth, using pain during injection and extraction as the parameters.

**Materials and methods:** Thirty patients indicated for extraction of maxillary molars were randomly allocated into one of the following intervention groups (n = 15): intraligamentary injection and supraperiosteal injection. In both groups, anesthesia was given using a standard volume of 2% lignocaine with adrenaline 1:2,00,000 with a 27G needle. Patients indicated pain during injection and extraction and this was measured using the visual analog scale (VAS). Statistical analysis of the pain scores was done using chi-square test, Levene's test, and Mann-Whitney U test with the alpha error set at  $p = 0.05$ .

**Results:** The mean VAS score for pain during injection was higher for the intraligamentary injection group (VAS = 18.67) than for the supraperiosteal infiltration group (VAS = 16), but this was not statistically significant ( $p > 0.05$ ). The VAS score during extraction was significantly higher for the intraligamentary injection group (VAS = 34.67) than for the infiltration group (VAS = 20) ( $p < 0.05$ ).

**Conclusion:** Periodontal ligament injections may not be optimal, "stand-alone" alternatives to supraperiosteal injections in the exodontia of maxillary teeth.

**Clinical significance:** Intraligamentary or periodontal injections are useful in extractions on patients with bleeding disorders, as they eliminate the risk of encountering blood vessels during injections as in the case of nerve blocks. The efficacy of intraligamentary injections in extraction of mandibular teeth has been

widely studied. This study evaluates the efficacy of this alternate injection technique on maxillary teeth extraction and, if proved successful, can be useful in patients where supraperiosteal injections are contraindicated.

**Keywords:** Anesthesia, Infiltration, Intraligamentary, Pain, Visual analog scale.

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### INTRODUCTION

Local anesthesia can be defined as the loss of sensation in a circumscribed area of the body caused by depression of excitation in nerve endings or by inhibition of the conduction process in the peripheral nerves without inducing loss of consciousness.<sup>1</sup> Substances which induce a transient and completely reversible state of anesthesia have found varied application in dental practice. The medical and dental fields use local anesthesia as the primary treatment modality for controlling pain. The various techniques of administering a successful dose of anesthetic agent have been reported over the years. However, the injection process itself has been observed to be the painful and most feared aspect of the dental procedure. The fear of the injection is considered a major factor in avoiding dental treatment.<sup>2</sup> The following factors have been shown to determine fear at the time of injection or extraction: tissue distensibility, speed of injection, solution temperature, patient characteristics, and, most importantly, the type of technique which is employed.<sup>3</sup>

Supraperiosteal injection, commonly referred to as infiltrations, is the technique used for isolated maxillary

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tooth anesthesia. Some of the favorable characteristics of this technique include ease of administration, rapid diffusion of anesthetic agent through porous maxillary bone, and independent of collateral innervations.<sup>4</sup> The anatomic variations in the osseous component and the patient factors have resulted in variation in the pain scores and success rate of suprapariosteal injections or infiltrations. With the advent of alternative techniques of local anesthesia, the intraligamentary (periodontal ligament) injection was introduced in the 1970s to minimize the pain and provide a successful alternative to the routine infiltrations for maxillary teeth. In this method, local anesthetic (LA) solution is deposited into the coronal part of the periodontal ligament, from where it reaches the alveolar bone through the fenestrations and marrow spaces. The intraligamentary injection is a preferred primary technique for short-duration anesthesia and limited anesthesia of the soft tissues for single tooth extractions.<sup>5</sup> Though it is popular for mandibular extractions to avoid giving a nerve block, it can also be used for maxillary teeth due to its rapid onset of action, adequate duration of anesthesia, and rare systemic toxicity.<sup>6</sup>

There is variable evidence in the literature on the success and pain scores of intraligamentary injection compared with other techniques. Pain during administration of periodontal ligament injection was found to be greater than suprapariosteal injections in some studies,<sup>3</sup> whereas others reported no significant difference in the pain scores between the two groups.<sup>7</sup> The intraligamentary injection has most often been used as a substitute for inferior alveolar nerve blocks. Intraligamentary anesthesia using computer-controlled local anesthetic delivery (CCLAD) is associated with reduced pain and better anesthetic efficacy as compared with suprapariosteal injections.<sup>8</sup> Though extensive literature studies are available to validate the use of intraligamentary injection for mandibular teeth extractions, not much data are available for maxillary teeth extractions. Also this allows for comparing intraligamentary injections with suprapariosteal injections, which would not be possible when mandibular teeth are included, as they would need nerve blocks.

The aim of this randomized clinical trial was to compare the pain during injection or extraction and efficacy of periodontal ligament injection with the suprapariosteal injections for extraction of maxillary teeth.

## MATERIALS AND METHODS

This randomized study was conducted under a protocol approved by the Institutional Review Board and Ethics Committee of the University. A sample of size of 15 patients for each group, intraligamentary injection and

suprapariosteal injection, was calculated to offer results at 80% power. Written consent was obtained from the patients.

Inclusion criteria were patients between the ages of 18 and 40 years who were fit for surgery, exhibiting full understanding of the given oral instructions, with caries or fracture in relation to firm maxillary teeth that were deemed nonrestorable or when patients preferred extraction over restoration. Exclusion criteria were presence of acute dentoalveolar infection, periodontally compromised teeth, patients requiring conscious sedation, patients on antibiotic or anti-inflammatory drugs, those requiring additional injections, and those unwilling to participate in the study.

The patients were guided on how to use the VAS to evaluate pain at the time of injection and during the extraction. This scale consists of line with markings from 0 to 100, where 0 represents no pain and 100 represents maximum pain. The method of anesthesia used for a patient was blinded to the patient and chosen at random by the clinician performing the extraction.

For each technique, a standard 27G dental syringe was used which was loaded with recommended volume of 2% lignocaine with adrenaline 1:200,000. No topical anesthetic was applied at the site of injection. For the patients receiving conventional suprapariosteal injection, 1.5 mL of LA solution was administered as a buccal infiltration and 0.3 mL LA solution was given as palatal infiltration over a span of 1 minute. For patients receiving the intraligamentary injection, the needle was directed parallel to the long axis of the tooth and inserted till the depth of the gingival sulcus on the mesial and distal aspects of the root. A dose of 0.2 mL of LA was given over 30 seconds. The patients were asked to assess the degree of pain during needle insertion using the VAS while waiting for the anesthesia to take effect. The extraction was performed after the subjective and objective symptoms were evaluated. Once the entire procedure was completed, the patients were asked to rate the pain during the extraction using the same VAS.

## Statistical Analysis

Statistical analysis was done using Statistical Package for the Social Sciences software. Visual analog scale values during injection and following extraction were compared between both the groups. Chi-square test, Levene's test, and Mann-Whitney U test were done to check the statistical significance. The p-value was set at 0.05 for all the analyses.

## RESULTS

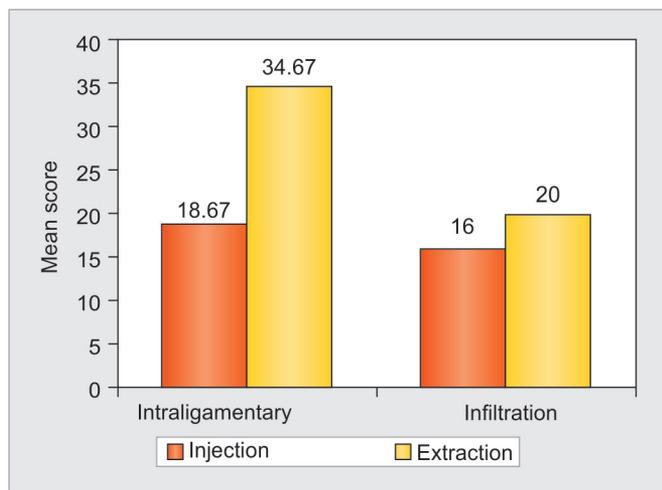
The mean VAS score at the time of injection was higher for intraligamentary injection group (VAS = 18.67) than

**Table 1:** Differences in VAS scores between two groups for injection and extraction

	Group	n	Mean		t-value	p-value
			VAS	SD		
Injection	Intraligamentary	15	18.67	5.16	1.43	0.165
	Infiltration	15	16.00	5.07		
Extraction	Intraligamentary	15	34.67	15.05	3.29	0.003
	Infiltration	15	20.00	8.45		

**Table 2:** Difference in VAS scores between two parameters for intraligamentary injection and supraperiosteal injections

	Group	n	Mean	SD	t-value	p-value
Intraligamentary	Injection	15	18.67	5.16	-4.26	0.001
	Extraction	15	34.67	15.05		
Infiltration	Injection	15	16	5.07	-1.47	0.16
	Extraction	15	20	8.45		



**Graph 1:** Mean VAS scores between two groups during injection and extraction

for the supraperiosteal injection group (VAS = 16), but was not statistically significant (p-value >0.05). The VAS score during extraction was found to be higher for the intraligamentary injection group (VAS = 34.67) than for the infiltration group (VAS = 20) and was statistically significant (p < 0.05) as shown by the results of Mann-Whitney test (P = 0.003) (Table 1).

For group I (intraligamentary injection), the VAS score during extraction (VAS = 34.67) was found to be significantly higher than the score during injection (VAS = 18.67) (p < 0.05). For group II (supraperiosteal injections), the VAS score was higher during extraction (VAS = 20) than during injection (VAS = 16), but was not statistically significant (p > 0.05) (Table 2).

Graph 1 shows the mean VAS scores between two groups during injection and extraction.

**DISCUSSION**

Pain is a process that starts with some kind of injury or disease which produces nociceptive impulses that are sent to the cerebral cortex to be interpreted. This perception of pain is influenced by a number of factors, such as past experience, attention, anxiety, and depression.<sup>9</sup> Though the main objective of administering an LA is to eliminate pain, the process of delivering these drugs using syringes is the most frightening and uncomfortable experience for most patients.<sup>10</sup> Evaluating this pain as a

number can be done using self-reported scales, such as the VAS and the verbal rating scale (VRS). The VAS pain score was used in this study due to its ease of use, minimally demanding for the patient, and higher sensitivity and validity than the VRS.<sup>11</sup> The selection of patients to be included in this study was done after a thorough examination and randomization was done for each patient. The sample size was fixed at 15 for each group. The armamentarium used for the study included standard 27G dental syringes, 2% lignocaine with adrenaline 1:200,000 concentration, and conventional instruments used for extractions.

In this study, the VAS scores were compared between intraligamentary injection and supraperiosteal injections, during injection and extraction of maxillary permanent teeth. Statistical analyses were done separately for two parameters: pain during injection and pain during extraction. The t-test values (Table 1) show that the VAS scores during injection were rather high in intraligamentary injections with a mean score of 18.67 as compared with a score of 16 for supraperiosteal injections. These values were seen to be somewhat similar between the two study groups with no statistical significance. The results of this study were similar to those reported by Al Shayyab.<sup>12</sup> This reduction in pain is mainly attributed to the abundance of free nerve endings in the porous maxillary bone. Some studies have shown a score greater than 30 during needle penetration in supraperiosteal injections.<sup>13</sup> This can be explained by the fact that supraperiosteal injections comprise of two injections, buccal and palatal. Palatal injections are reported to be the more painful than their buccal counterparts. Studies where only a single buccal infiltration was given have reported lower VAS scores with only mild pain.<sup>14</sup> Due to the resistance felt while administering an intraligamentary injection, some clinicians tend to apply more pressure which often increases the discomfort experienced by the patient.

The VAS scores were evaluated after the extraction was completed. The results showed that the VAS scores were significantly higher in the group which received an intraligamentary injection, with a mean score of 34.67. This was statistically significant (p < 0.05) when compared with the VAS score of 20 for the group which received the

supraperiosteal injection. Similar results were obtained by Al Shayyab<sup>12</sup> where the intraligamentary scores were less than 30 during extraction, but significantly higher when compared with the supraperiosteal injections values. The favorable response seen in infiltration is due to the porosity of the maxillary bone with a pronounced effect that gravity has on the faster diffusion of anesthetic solution. One of the findings noted in studies while giving intraligamentary injections is that the rate of perfusion increases from anterior to posterior teeth. This may be due to the fact that the number and size of openings in the lamina dura increase in the posterior teeth.<sup>15</sup> Patients often experience pressure in the region adjacent to the extraction site.

A comparison made between the VAS scores during injection and extraction within the two groups showed that there was a statistically significant ( $p < 0.05$ ) variation in the scores in the intraligamentary injection group, whereas the scores were comparable in the supraperiosteal injections (Table 2). This study shows that the type of injection technique used does have an influence on the pain perceived by the patient during the extraction procedure as a whole.

For many years, intraligamentary injections have been proposed as an alternative for inferior alveolar block. The advantages of this substitution are mainly that only those mandibular teeth which are indicated for extraction can be anesthetized instead of all the teeth in the quadrant. Intraligamentary injection also limits the amount of soft tissue anesthesia, sparing the lip and the tongue, thus increasing patient comfort.<sup>16</sup> They can also be safely used on patients with bleeding disorders, to eliminate the possibility of encountering a blood vessel during a supraperiosteal or nerve block injections. Some of the post-injection complications that have been reported with respect to intraligamentary injections are discomfort, swelling, discoloration of soft tissues at the injection site, prolonged ischemia of interdental papilla, sloughing, and eventually exposure of the crestal bone.<sup>17</sup> Patients often complain of postextraction sensitivity in adjacent teeth while mastication for 2 to 3 days. These complications most commonly occur due to one of the following reasons: rapid injection (may lead to extrusion of teeth due to increased apical pressure) and excessive volume of solution being injected.<sup>18</sup>

Since pain control has been given utmost importance following anesthetic administration, it should be noted that many new techniques have emerged recently to ensure this. Methods, such as electronic dental anesthesia, intraoral lidocaine patch (DentiPatch), jet injection, iontophoresis, eutectic mixture of LA, and CCLAD have become popular.<sup>19</sup> Since palatal infiltrations are most painful, it has been suggested that deposition of articaine

HCl in the buccal vestibule helps in achieving adequate anesthesia with a single buccal infiltration.<sup>20</sup>

## CONCLUSION

Though the intraligamentary injection is associated with significantly higher pain scores compared with the conventional supraperiosteal injection, it is effective in establishing pulpal and soft tissue anesthesia in the maxillary teeth. The efficacy of intraligamentary injection is lower when compared with supraperiosteal injections. However, it may be indicated as an alternative anesthetic approach in patients where conventional techniques are contraindicated.

## CLINICAL SIGNIFICANCE

Intraligamentary or periodontal injections are useful in extractions on patients with bleeding disorders, as they eliminate the risk of encountering blood vessels during injections as in case of nerve blocks. The efficacy of intraligamentary injections in extraction of mandibular teeth has been widely studied. This study evaluates the efficacy of this alternate injection technique on maxillary teeth extraction and shows that it can be useful in patients where supraperiosteal injections are contraindicated.

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