



## RESEARCH ARTICLE

# Comparison of Pain Perception for Nasopalatine Nerve Block using Conventional and Computerized Local Anesthesia Delivery Systems in Adults: A Randomized Split-mouth Clinical Study

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## ABSTRACT

**Introduction:** Profound local anesthesia (LA) is necessary in order to reduce patient discomfort during oral surgical procedures. However, injection technique itself may be a potentially painful procedure. A comfortable and consistent LA can increase the level of trust between the patient and the operator, since even a thought of intraoral injection causes a considerable amount of anxiety in many patients. To reduce this anxiety, a computer-controlled local anesthesia delivery (CCLAD) system is commercially available as a possible means of minimizing the sensation of pain (especially for palatal injections).

**Aim:** The aim of the present study was to compare the pain perception, when injections were administered using the CCLAD system or a conventional technique in patients requiring oral surgical procedures in the maxillary anterior region.

**Materials and methods:** This randomized split-mouth study included 15 patients (7 females and 8 males). Conventional syringe or computerized single tooth anesthesia (STA) system with a 30-gauge needle was used to give nasopalatine nerve block by the same operator, over a minimum gap of 7 days. Immediately after injection, patient's pain perception was assessed using numeric rating scale (NRS). Overall difference in pain perception and effect of change in sequence of type of anesthesia were determined using unpaired t-test.

**Results:** Results of the study showed statistically significant difference between the pain scores of STA system and conventional injection technique; however, the change in sequence of anesthesia technique did not show any effect on the effectiveness of STA system.

**Conclusion:** The STA system significantly reduces the pain perception after administration of nasopalatine nerve block in adults.

**Clinical significance:** Use of STA system for administration of nasopalatine nerve block in adults provides better patient acceptance and pain control over conventional cartridge syringe.

**Keywords:** Conventional technique, Local anesthesia, Nasopalatine nerve block, Pain perception, Single tooth anesthesia system.

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## INTRODUCTION

Dental anxiety and fear are the two feelings present in every patient's mind during dental procedures.<sup>1</sup> The main cause of this anxiety and fear is the thought of painful dental injections. Pain experienced by the patient during injection can be twofold. First, tissue damage occurs during the actual perforation of the mucosa by the needle, and second, pressure is built up by the infiltration of the injection fluid.<sup>2</sup>

Local anesthesia (LA) is one of the most frequently performed procedures in daily dental practice. It is a prerequisite to ensure painless treatment and is, therefore, important for the success of various dental procedures. When LA is administered properly, it has many advantages like patient comfort, cooperation, and increased operator performance. The amount of anesthetic solution injected for a particular procedure is also a key factor. It is always advisable to administer the optimum amount of anesthetic for which the technique of administration is one of the governing factors. A supraperiosteal injection in the mucobuccal fold is the most commonly utilized route of administration to achieve LA of maxillary teeth. This injection is referred to as an infiltration or field block and was first described by William Halsted in the late 1800s.<sup>3</sup> Anesthetic solution diffuses from the injection site, penetrating through the soft tissues, periosteum, and porous maxillary bone, and results in anesthesia of the radicular

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nerve fibers of the teeth in proximity to the injection site.<sup>4</sup> To avoid patient discomfort, computer-controlled local anesthesia delivery (CCLAD) systems have been recommended, which can be used as an alternative.

The aim of the present study was to compare severity of pain for the nasopalatine nerve block technique using a conventional syringe and single tooth anesthesia (STA) system in the maxilla.

## MATERIALS AND METHODS

A total of 15 patients with the age range of 20 to 60 years were selected from the outpatient Departments of Oral surgery and Periodontology, out of which 7 were females and 8 were males. All systemically healthy patients indicated for surgical procedures (such as flap surgery, extraction) in the anterior maxillary region and patients without prior experience of injections were included in the study. Pregnant and lactating females, patients allergic to LA, patients having systemic conditions contraindicating the use of LA, and patients taking analgesics (aspirin, etc.) were excluded from the study. Informed consent was obtained from each patient who participated in the study. The ethical committee approval was obtained from the ethical committee of Mahatma Gandhi Vidyamandir's Karmaveer Bhausaheb Hiray Dental College and Hospital Nashik, Maharashtra, India.

At baseline examination, the patients were given information about the use of numeric rating scale (NRS)<sup>4</sup> to record the level of pain they felt during treatment procedures. All the injections were given by one operator using a 30-gauge needle for both the injection techniques. The subjects received the injections during two separate appointments spaced at least 1 week apart, and the order of anesthesia techniques was randomly selected by the flip of a coin in a crossover design. The nasopalatine nerve block was given to the patients requiring surgical procedure in the maxillary anterior region. For this, the operator obtained the NRS for each patient immediately after the injection was administered.

In six subjects, the first injection was given using a conventional cartridge syringe, and in nine subjects, the STA system was used first. Nasopalatine nerve block using a conventional cartridge syringe was performed for a period of 30 seconds into the soft tissue just lateral to the incisive papilla at the midline, 10 mm (palatally) to the maxillary central incisors, and the amount of LA administered was 0.3 mL. Injection with the STA was performed using normal mode, i.e., 0.3 mL/second with a 5-second aspiration cycle, which was activated by tapping the foot pedal. Positive aspiration was not noted at any sites injected using conventional or STA system. Surgical sites were anesthetized utilizing 1.8 mL cartridge of 2% lidocaine hydrochloride with 1:200,000 adrenaline.

## SINGLE TOOTH ANESTHESIA SYSTEM

Single tooth anesthesia system was introduced by Milestone Scientific in 2007 (Figs 1 and 2). The STA system incorporates dynamic pressure sensing (DPS) technology that provides a constant monitoring of the exit pressure of the LA solution in real time during all phases of the drug's administration and also to identify the ideal needle placement for periodontal ligament (PDL) injections. The DPS system alerts the user if leakage of LA occurs that can be caused by improper needle placement, insufficient hand pressure on the syringe, or internal leaking from the cartridge/syringe. Pressure of the LA is strictly regulated by the STA system; therefore, greater volume of LA can be administered with increased comfort and less tissue damage. The technique of needle insertion is similar to that used for conventional technique as mentioned previously. The rate of injection: (i) STA mode: Single, slow rate of injection, i.e., 0.005 mL/second; (ii) normal mode: 0.03 mL/second emulates the WAND<sup>®</sup>; and (iii) turbo mode: Faster rate of injection of 0.06 mL/second.

Descriptive statistics of pain during injection was analyzed and presented in terms of mean with standard deviation. Unpaired t-test was used to compare pain



Fig. 1: The STA system

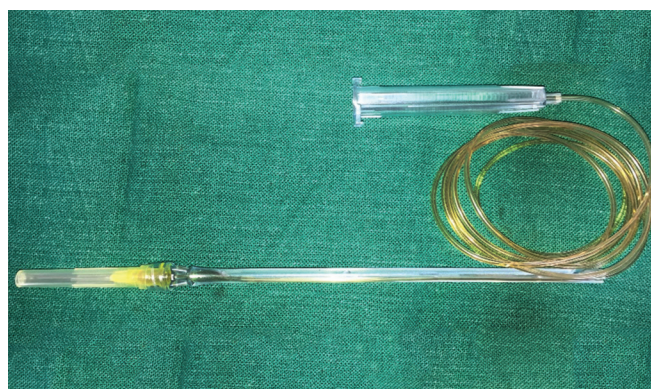


Fig. 2: Handpiece of the STA system with needle and tubing

**Table 1:** Mean NRS scores in conventional and the STA group

Injection technique	Total patients	Mean $\pm$ SD (NRS scores)	p-value	Mean difference	SD difference
STA system	15	2.06 $\pm$ 0.594	0.0045	2.67	0.741
Conventional	15	4.73 $\pm$ 1.335			

SD: Standard deviation

**Table 2:** Mean NRS scores when STA was given first and conventional given first

Sequence of anesthesia	Mean NRS scores	p-value
STA system used first	1.88	0.1628 NS
STA system used second	2.33	
Conventional used first	5.33	0.1624 NS
Conventional used second	4.33	

NS: Nonsignificant

scores (NRS) during injection using conventional syringe and STA system.

## RESULTS

Totally, 15 patients participated in the study, of which 7 were females and 8 were male patients with a mean age of 41.50 years. The mean values of NRS scores were obtained for both the groups (Table 1), and it was found that the mean score for the conventional group (4.73  $\pm$  1.335) was more than the mean for the STA group (2.06  $\pm$  0.594). Thus, patient acceptance was significantly higher for nasopalatine nerve block with the STA system than the conventional syringe. The average difference between the conventional and STA groups was found to be 2.67. Nasopalatine nerve block with STA system produced a statistically significant lower level of pain ( $p = 0.0045$ ) in comparison with the conventional group. However, both the techniques achieved adequate anesthesia as displayed by the patients' response, assessed by NRS, during treatment. Within the sample population, conventional cartridge syringe was used first in six subjects and, in nine subjects, STA system was used first (Table 2). There was no difference in the NRS scores when either of the two techniques was used first or second ( $p > 0.05$ ).

## DISCUSSION

Obtaining profound LA is of utmost importance for any oral surgical procedure. As stated by Hochman et al<sup>5</sup> in 1997, the pain perception during administration of LA is primarily due to tissue puncture, fluid pressure, and flow rate of LA solution. Palatal injections are rated to be the most painful injections as the palatal mucosa is tightly bound to the periosteum of the underlying bone. The STA system has added advantages of excellent tactile sensation due to the lightweight plastic handle, the ability to rotate the needle as it is introduced into tissues, producing a coring penetration that minimizes needle deflection and

a controlled flow rate of LA solution. Decreasing the total amount of anesthetic and vasoconstrictor necessary for maxillary anesthesia, shortening the total anesthesia time, and diminishing patient – operator anxiety are other advantages of the STA system.<sup>6</sup> To our knowledge, there is one similar study reported in the literature in which a computer-controlled injection system was used.<sup>7</sup> In the present study, we have used the normal mode of the STA system, which is similar to that of WAND. The first study reported in the literature on the use of the WAND in children was carried out in 1999 by Asarch et al<sup>8</sup> to compare the efficacy of computerized LA with the traditional syringe. They showed no significant difference between the two methods. However, the study failed to target injection sites and control the existing differences in the duration of the two injection methods as specifically recommended by the manufacturer.

Saloum et al<sup>9</sup> in 2000 studied 240 subjects in which they compared WAND *vs* traditional anesthesia technique and concluded that WAND was significantly less painful. Loomer and Perry<sup>10</sup> in 2004 studied the use of a computer-controlled technique in which anterior middle superior alveolar (AMSA) nerve block was compared with greater palatine and nasopalatine anesthesia techniques. The results revealed lower visual analogue scale scores for AMSA compared with the other two techniques. In yet another study carried out by Yenisey<sup>11</sup> in 2009, the AMSA technique with the use of WAND system was compared with the infiltration technique, and the results using visual rating scale (VRS) scores showed less pain with the WAND system for anesthetic delivery. Lee et al<sup>12</sup> reported that AMSA is more successful with WAND Plus<sup>®</sup> in comparison with a conventional syringe.

In order to check for the novelty effect of the STA system, few patients were given STA first and, in others, conventional technique was used first. However, there was no statistically significant difference when the sequence of the injection techniques was changed. Pain perception during the injection was similar for a particular technique whether it was given first or second. In the present study, a 30-gauge needle used was used for both conventional technique and STA system in order to prevent bias.

The present study showed significantly lesser pain scores of the STA system group than the conventional group even in the absence of topical anesthetic gel. There was no statistically significant difference in the pain

perception when either of the two techniques was used first. The results thus confirm the theory that control of the flow rate and fluid pressure with the STA system can lessen the pain perception during nasopalatine nerve block, which is nearly difficult to achieve when using a conventional cartridge syringe.

However, there are a few disadvantages like the cost of the system, time required to learn the technique, and extra space needed to store the device. Considering all this, future studies should be carried out on a larger sample size and, if possible, compare different commercially available brands to see if they all are equally effective or any particular brand is more effective than others.

## CONCLUSION

The results of the study revealed that STA system can be used as an alternative to conventional injection technique for administration of LA in the maxillary arch. There was a statistically significant difference between the pain scores of STA system and conventional injection technique. The STA system not only lowers the pain of injection, but also eliminates the visual stimulus of dental anxiety that occurs due to dental syringes. The noncompliance of the treatment on the maxillary arch is usually due to the fear associated with multiple anesthesia. Hence, introducing STA system can help improve patient compliance as well as ease for the clinician operations.

## CLINICAL SIGNIFICANCE

Use of the STA system for administration of nasopalatine nerve block in adults provides better patient acceptance and pain control over conventional cartridge syringe.

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