

## Comparative Evaluation Of Application Of Cold Stimulus Versus Topical Anaesthesia To Control Pain Caused During Injection Of Local Anaesthetic Solution - A Preliminary Study

Research Article

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### Abstract

**Introduction:** Topical cooling has long been used to help heal injured tissues. Local external cooling has been used for treating sprains, burns, fractures, bruising and insect bites. There is very little information in the literature regarding the benefits of pre-cooling the injection site, to reduce the pain and discomfort caused due to injection.

**Aim:** To do a comparative study on the effectiveness of cold stimulus instead of topical anaesthetic during injection of local anaesthetic solution.

**Materials and Methods:** Patients will be subjected to LA injections after one of the following mucosal preparations - 1. no pretreatment ; 2. a 2 min application of 15% lidocaine topical anaesthetic; 3. application of cold stimulus. Patients will then give a score on the injection discomfort after each administration on a 100 mm visual analogue scale.

**Results:** With application of cold stimulus using ice sticks prior to local anaesthetic injection, 60% of the study population had mild discomfort/pain and 40% had moderate discomfort/pain.

**Conclusion:** The results of this study showed that topical application of cold stimulus prior to the injection of local anaesthetic solution, helps reducing the pain and discomfort caused by the injection.

**Keywords:** Cold Stimulus Vs Topical Anaesthetic; Cold Stimulus In Reducing Pain During La; Topical Ice To Reduce Pain.

### Introduction

Local anaesthetic injection is often considered as the most painful part of minor procedures [1, 2]. Pain from local anaesthetic injections arise both from the insertion of the needle and the infiltration of fluid. The puncture caused by injection activates the pacinian corpuscles, mechanoreceptors and the Ruffini endings. These afferent impulses are carried along the A-δ fibres to evoke a sharp, acute and pricking type of pain [3]. The infiltration of the local anaesthetic solution evokes a second type of pain, mainly from the polymodal free end nociceptors, which tends to be a more intense and prolonged pain [3, 4]. This pain, due to the infiltration of local anaesthetic solution, is produced from receptors responding to both chemical irritants and rapid distension of the tissue [1, 5].

In the literature, few methods have been explained which are suggestive of reducing pain caused during injection of local anaesthetic solution [6].

- Application of topical anaesthesia [7]
- Distraction techniques (employed for children) [8, 9]
- Counter irritation [6]
- Warming the anaesthetic agents [10]
- Adjusting the rate of infiltration by reducing the speed of the injection [11]
- Buffering the local anaesthetic agent [12]

Topical local anaesthetic application over the oral mucosa prior to injection of local anaesthetic solution is often used to control the pain caused during injection of local anaesthetic solution. In spite of its tremendous usage by the dentists it is important to note that

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topical anaesthetic may be associated with toxic sequel because of the amount of drug being absorbed through the mucosa and the relative toxicity of some topical agents [13]. Also the taste associated with topical anaesthetic pastes and gels can be uncomfortable to patients especially children.

Topical cooling has long been used to help heal injured tissues. Local external cooling has been used for treating sprains, burns, fractures, bruising and insect bites [14, 15]. In the literature, a good number of articles have explained the benefits of postoperative skin cooling to reduce wound pain and edema [15-18]. There are promising results for preoperative use of topical cooling [19]. It has been found that prolonged application of topical cold stimulates the C fibers and may block the A- $\delta$  pain signals. It also raises the supraspinal mechanisms, raising the body's overall pain threshold [20].

We have numerous highly cited publications on well designed clinical trials and lab studies [21-36]. This has provided the right platforms for us to pursue the current study. Our aim is to evaluate the effectiveness of cold stimulus to lessen pain before the injection of local anaesthetic solution. It is also compared with the Topical anaesthetic spray which has long been used long to reduce pain caused during injection.

## Materials and Methods

The study was conducted in the Conservative Dentistry and Endodontics Department of Saveetha Dental College, Chennai, India.

### Study Population

As this is a preliminary study conducted for the first time in India, the sample size consisted of 10 volunteers and were in complete physical and mental health with no oral problems and clinically healthy teeth. Decayed, infected teeth may decrease the effect of local anaesthetic solution, hence participants with clinically healthy teeth were used. Informed consent was obtained from the volunteers.

### Preparation of ice sticks

Insulin syringes were used for the preparation of ice sticks. The top part of the insulin syringes were cut off. The empty syringes were filled with water and were allowed to freeze. The ice can be applied over the mucosa by advancing the piston of the syringe. The mechanism of usage is similar to that of a normal syringe. This is shown in fig 1.

### Mucosal preparation

These 10 volunteers underwent 3 intraoral injections for infiltration anaesthesia after the following mucosal preparations at different sites on the same day.

1. No pretreatment i.e., injection of local anaesthetic directly without any mucosal preparation.
2. A 2 min application of 15% lidocaine topical anaesthetic (Nummit spray)
3. Application of cold stimulus using ice sticks at the site to be injected for 2 mins.

Patients were then injected with 1.5ml of lignocaine solution with 2% adrenaline (1:200000) at the prepared mucosal site. The technique used for administration of the local anaesthetic involved the slow, gradual injection of 1.5 ml of anaesthetic agent using a 23 gauge short needle of length 32 mm. 3 different needles were used for three different sites as reusing the same syringe for the second time blunts the needle which causes more pain and discomfort for the patient and there is a high chance for the results to get biased. Patients will then give a score on the injection discomfort after each administration on a visual analogue scale with a score from 1 to 10.

### Statistical analysis

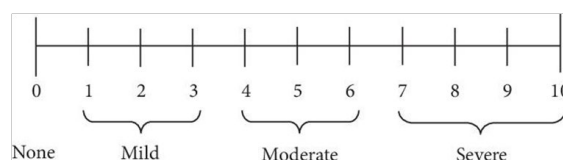
The collected data were analysed with IBM.SPSS statistics software, version 23.0. To describe the data, descriptive statistics, frequency analysis, percentage analysis were used. To find the significance in categorical data, the Chi-Square test was used. In the above statistical tool the probability value .05 is considered as a

Figure 1. Ice stick formed using insulin syringe.



Figure 2. Application of ice stick on oral mucosa.



**Figure 3. Administration of local anaesthetic solution.****Figure 4. Visual analogue scale (VAS).**

significant level. The Friedman test and Wilcoxon signed rank test were used for statistical analysis.

## Results and Discussion

The score given by the participants for pain perception was categorised into mild, moderate and severe. Score 1-3 is considered mild, 4-6 as moderate and 7-10 as severe. When the local anaesthetic solution was injected without any mucosal preparation, 40% felt moderate discomfort/pain and 60% of the participants felt severe pain. This clearly shows the difference in pain threshold experienced by the study population. With application of topical anaesthetic spray (nummit) before the administration of local anaesthetic solution, 80% of the study population felt mild discomfort/pain, and 20% felt moderate discomfort/pain. With application of cold stimulus using ice sticks prior to local anaesthetic injection, 60% of the study population had mild discomfort/pain and 40% had moderate discomfort/pain. This is shown in (Graph 1).

### Chi square test

Chi-square test was done to prove that the variables used in the parameter are independent and statistically significant. In this study the value is 0.0005 and is well below 0.01. This shows that the variables are independent and statistically significant (Table 1).

### Friedman Test

This test is done for ranking the effectiveness of the three methods of infiltration based on minimal discomfort caused by each method. In this test it has been found that Topical anaesthetic was better compared to cold stimulus.

### Wilcoxon signed rank test

This test was done to compare the 3 parameters and their ranks were used to find the z value. The difference between pain scores of topical anaesthetic and direct infiltration; and cold stimulus and direct infiltration is highly significant (0.004). The difference between pain scores of topical anaesthetic and cold stimulus is also significant (0.025). Values less than 0.05 are significant.

The mean pain scores and std. deviation of all the three param-

eters are shown in (Table 4). The mean pain scores of infiltration, infiltration after application of topical anaesthetic and infiltration after cold stimulus are 6.80, 2.30 and 2.80 respectively. (Graph2)

The aim of the study was to evaluate the effect of pre cooling of the oral mucosa of the injection site on the pain perceptions of study participants during the administration of local anaesthesia.

From the results it has been found that pain/discomfort perceived by the study population after the injection of local anaesthetic solution was different for each individual and ranged from moderate to severe type of pain with majority reporting severe pain. When the effectiveness of topical anaesthetic spray and cold stimulus to reduce pain of LA injection was compared, it is evident that topical anaesthesia acts better (with 80% of the study population reporting mild pain) compared to cold stimulus (with 60% of the study population reporting mild pain).

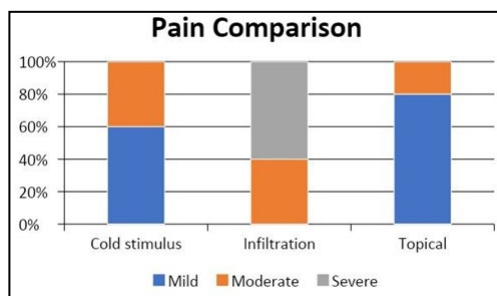
Though topical anaesthetic solution has slightly better results compared to cold stimulus, it may be often associated with toxic sequels. Also topical anaesthetic spray has a bitter taste which is uncomfortable for the patient and it may create anxiety in children. Cold stimulus does not have any bitter taste and it does not cause much discomfort to the patient. Application of cold stimulus constricts the blood vessels which help in the prolonged action of the local anaesthetic solution. Thus prior application of cold stimulus can be an effective way to reduce the pain and discomfort caused during LA administration.

These findings are in accordance with that of NaserAslAminabadiet.al., [6] where they used ice created by little fingers of gloves on children for administration of local anaesthetic as a routine clinical treatment.

These are also in accordance with studies involving skin cooling for laser therapy and inguinal hernia repair. In a study done by Chan et.al.,[19] they used a laser system with a cooling device to treat patients who had their Ota removed. The patients reported less pain on the side where cooling was employed. Leffet.al., in their study reported the cooling of injection site, 5 minutes prior to a nerve block for patients undergoing inguinal hernia repair.

In a study done by Nejla Canbulatet.al., [37] the effectiveness of vibratory and cold stimulus was compared before IV cannulation

Graph 1. Parameters and percentage of participants.



Graph 2. Comparison of pain score.

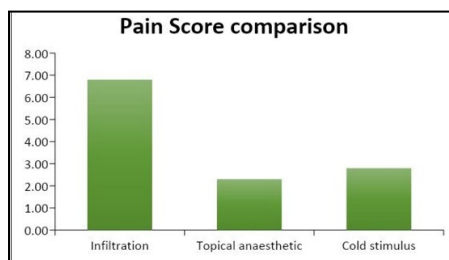


Table 1. Chi square test.

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	202.286 <sup>a</sup>	4	0.001
Likelihood Ratio	256.969	4	0.000
N of Valid Cases	300		

<sup>a</sup>. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 20.00.

Table 2. Friedman test.

Ranks	
	Mean Rank
Infiltration	3
Topical anaesthetic	1.25
Cold stimulus	1.75

Table 3. z values using Wilcoxon signed rank test.

Test Statistics		
	Z	Asymp. Sig. (2-tailed)
Topical anaesthetic - Infiltration	-2.877 <sup>b</sup>	0.004
Cold stimulus - Infiltration	-2.873 <sup>b</sup>	0.004
Cold stimulus - Topical anaesthetic	-2.236 <sup>c</sup>	0.025

Table 4. Mean pain scores.

	N	Minimum	Maximum	Mean	Std. Deviation
Infiltration	10	5	9	6.8	1.135
Topical anaesthetic	10	1	4	2.3	1.16
Cold stimulus	10	1	5	2.8	1.317

in children. It has been found that vibration and cold stimulus distracted the children and helped reduce anxiety. Also it reduced the pain and discomfort caused by IV cannulation.

## Conclusion

The results of this study showed that topical application of cold stimulus prior to the injection of local anaesthetic solution, helps reduce the pain and discomfort caused by the injection. It is not associated with any toxic sequel as topical anaesthetic agent. Hence cold stimulus can be used to help patients calm down and reduce discomfort caused due to the injection of local anaesthetic solution.

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