



Comparison of Local Ice Packs with Local Anaesthetics for Decreasing the Pain of Injection during a Dental Procedure

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Authors' contributions

This work was carried out in collaboration between both authors. Author NH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author DP managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: To evaluate the efficacy of different possible and non-pharmacological techniques in eliminating the discomfort of local anaesthesia injection during dental procedures.

Introduction: Dental anxiety and fear of needles are one of the most common problems seen by dental practitioners; several methods are currently used to lower the discomfort of local anaesthesia injection during dental procedures. The desensitization of injection sites is one of the recommended strategies. Among chemical anaesthetic topical agents that are effective but might have allergic side effects, using some non-pharmacological and safe techniques might be useful.

Materials and Methods: Randomly chosen patients receiving LA underwent pre-injection intervention that included heat, cold and pressure. This was compared with a control of no pre-injection intervention. Pain score in ice and LA spray pre-injection intervention. It clearly shows that the pain levels in the LA spray technique are higher than those in the Ice technique.

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Results: Comparing the pain score of ice as a pre-injection intervention between males and females it was found that males have lower pain scores than females.

Conclusion: This study shows a significant advantage of the non-pharmacological method over the pharmacological method. Hence further research could help standardize ice application pre-injection for a more nontoxic and natural method of reducing pain during an LA injection. It can also prove beneficial when LA does not work due to an acidic environment.

Keywords: Dental procedures; local anaesthesia; pain; non-pharmacological technique.

1. INTRODUCTION

Dentistry involves the injection of local anaesthesia on a daily basis to combat the pain and discomfort which often causes anxiety and fear among patients. Research suggests that three stable factors are known to cause fear during dental treatment [1]. They are anxiety, dental stimuli, and psychological reasons, of these three, dental stimuli from injections is the major cause of fear. The exact reason for fear of needles (also known as trypanophobia) is not known. Research suggests that needle phobia may be caused by other underlying causes from past experiences. These could be personal experiences or experiences of their family and friends. Some reasons include traumatic or painful experiences or perceptions of pain felt by family or friends. Though the last few decades have seen a drastic improvement in pain management from non-anesthetized tooth-pulling to the modern-day painless procedure, needle sticks still induce fear and anxiety amongst people [2].

Research suggests that the primary reason people delay dental visits is due to the fear of needles therefore reduction in injection site pain could potentially result in improved oral health [3]. This irrational fear can lead to canceling dental and medical check-ups or appointments, not taking treatment due to fear and worsening of the present condition until the condition is extremely complicated and treatment becomes difficult and painful [4]. Therefore as a dentist treating every patient with minimal pain is the first priority. Eliminating discomfort and pain during dental procedures can greatly ease patients undergoing dental treatment and helps in oral health promotion [1].

One method of providing painless procedures is by using aesthetics. Since dentists most often work only within the oral cavity a local anaesthetic does the job. Local aesthetics in dentistry is not a recent advancement it was known and used for the past 100 years. The use

of local aesthetics and the development of nerve block injection techniques started a new era of patient comfort, permitting more extensive and invasive dental procedures without compromising patient comfort.

1.1 Lidocaine

Lidocaine is considered the gold standard of local anaesthetic agents. It was introduced in the year 1948, lidocaine quickly became the most popular local anaesthetic in dentistry owing to its apt duration of action and effectiveness. However, lidocaine also has some disadvantages which restrict its use in the management of pain. For example, it shows poor performance during an infection. Imbalance in pH, or acidity level, of the body, can lead to its diminished effect. Local anaesthetic agents require a very narrow pH range to be effective. Other disadvantages include adverse symptoms that often occur when using a dose large enough to cause, without any discrete warnings: tremors, dizziness, blurred vision, nervousness, nausea, cardiovascular collapse, and cardiac arrest may also occur in some cases. Paralysis of the injected area is also seen commonly.

Due to the disadvantages of the current anaesthetic technique used, an alternative technique with optimum qualities is required [5].

With a rich case bank established over 3 decades we have been able to publish extensively in our domain [6,7,8,9,10,11,12,13,14,15,16]. Based on this inspiration we aim to assess non-pharmacological techniques to eliminate pain and discomfort during the administration of local anaesthesia.

2. MATERIALS AND METHODS

This study was conducted in a private dental institute. For this study, a split-mouth technique was used to prevent any bias that may occur while recording pain scores. The sample size of

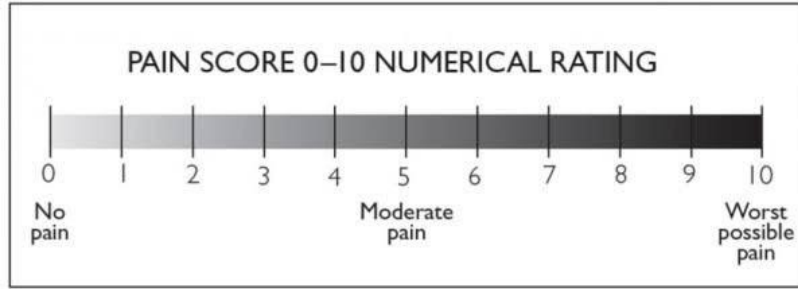


Fig. 1. Showing the numerical pain intensity scale used to assess pain levels caused by LA injection

this study was 9 volunteers which were statistically defined from similar studies. Before beginning the study thorough planning of the methodology was done and patient approval was obtained. Patients demographics, medical history and treatment history were recorded from patient records. A strict inclusion and exclusion criteria was followed to prevent any unwanted affliction to the patient.

Inclusion criteria included patients with a treatment plan of two extractions on different quadrants, the exclusion criteria included patients having an abscess concerning the tooth to be extracted or suffering from any systemic diseases. Patients from 5 - 10 years were excluded due to high anxiety levels in this age group, all participants in this study were selected with typical anxiety level, in order to ensure prevention of bias due to anxiety, further more participants of this study included only those with prior experience of undergoing a dental extraction.

The pre-injection intervention for the study included ice packs covered with gauze, which is applied on site for a minute and a topical anaesthetic (control), for this study an LA spray 10% was used. In both cases procedure is started after waiting for 15-20 seconds after application of ice/ spray. To assess the pain a numerical pain rating chart (Fig. 1) was chosen due to its ease of calculation and better patient response due to its ease of understanding and comprehension [17]. To correlate the two techniques and its pain scores in the same patient, the patients received the pre-injection intervention with ice for one tooth and LA sprays for the other tooth. Patients were then asked to rate pain based on a numerical rating pain score. The scores were obtained and statistically analyzed.

3. RESULTS AND DISCUSSION

The results showed an average pain score of 2.11 in ice pre-injection intervention when compared to 4.11 with the use of LA spray advised scaling shown in table 1. The participants ranged from 20-60 years old with 5 male and 4 female participants, all of the participants had to undergo dental extraction due to decayed teeth.

Chart 1 depicts the pain score in ice and LA spray pre-injection intervention. It is observed that the pain levels in the LA spray technique are higher than that in ice technique.

Comparing the pain score of ice as a pre-injection intervention between males and females it was found that males have lower pain scores than females.

According to research done in Iran, prevalence of dental anxiety amongst the study populations was found to be as high as 60% [18]. The study also suggests an inverse relationship between anxiety and the frequency of dental visits. This means that the more regular the dental check-up, the more accustomed and relaxed the person gets to the dental environment and eventually a reduced anxiety level. Dental anxiety has an irrational origin. Experts believe there seems to be no exact reason for the fear and anxiety [19]. The most popular theory is that the fear was stimulated by or linked to an unpleasant experience, most often when young. Most people with dental anxiety can link one or more unpleasant dental experiences. Hence dental anxiety stems from this irrational cognitive behaviour. To reduce anxiety and fear amongst the patients, it is necessary to build a good rapport with the patient (11) and keep the patient calm, this can be done using non-verbal

Table 1. Showing the pain scores (using a pain scale) for ice and LA spray respectively

Patient	ICE as a pre-injection intervention	LA spray as a pre-injection intervention
	2	6
	3	3
	1	2
	3	5
	3	4
	2	5
	2	5
	1	4
	2	3
Mean score	2.11	4.11

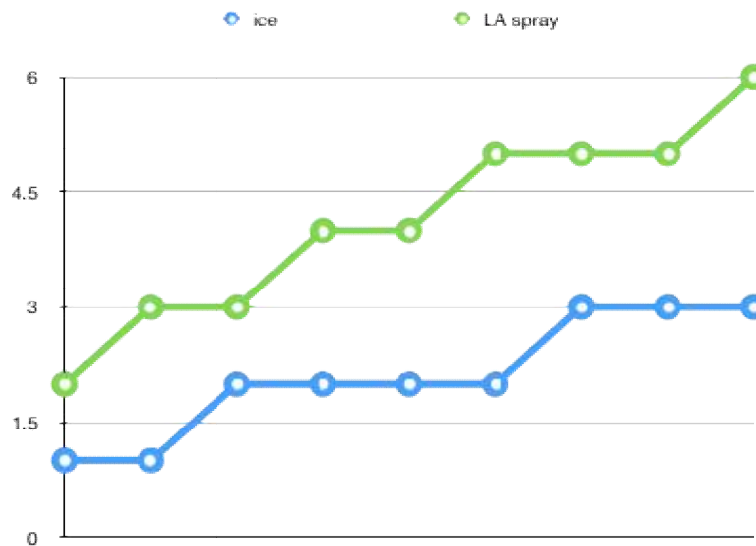


Chart 1. Comparing the ice pre-intervention (blue line) against LA spray (green line). It is seen that the pain levels in LA spray are much higher than those in ice

Table 2. Comparing pain score when using ice advised scaling a pre-injection intervention. The table shows males have better pain scales when compared to females

	Male scores	Female scores
	3	2
	1	3
	2	2
	1	2
	3	
Mean score	2	2.3

methods (gestures), verbal methods or with the help of drugs like anxiolytics. Another way is to use anaesthetics during treatment to ease the pain.

Dental anxiety is caused by various reasons such as fear of needles or sharp objects, sounds

made by the rotary instruments, and the tense atmosphere as a whole. Also, a patient becomes restless and irritable if made to wait a long time before the treatment. Hence a calming environment and short waiting time can help ease the patient. Needle-stick phobia is the major cause of dental anxiety [20]. The fear of

the needle may have caused patients to undergo painful procedures and irrational fears. In most procedures, the local anaesthetic spray is used which helps reduce the pain of the prick. But LA spray might not work in all cases and hence this study aims at comparing a non-pharmacological intervention against topical anaesthetics in terms of discomfort and pain during an LA injection. This study aims at assessing the pain scores between ice(pre-injection intervention) and topical LA spray [21]. The mean pain score for ice was found to be 2.13 and that for LA spray was 4.25. The pain levels in ice intervention are found to be almost half of that experienced by the LA spray. This shows a significant reduction in pain against the control.

A similar study was done in 2009 comparing refrigerant and topical anaesthetic. The use of refrigerant on the patients gave a mean VAS score of 17.7 ± 15.3 mm, and the group receiving the topical anaesthetic gel had a VAS score of 26.2 ± 18.0 mm. The use of the refrigerant significantly reduced the pain experienced during the administration of local anaesthetic injections. This study shows similar findings to the present study. The study suggests a difference in pain perception amongst men and women owing to differences in cognitive thinking and perception, therefore the study also compared pain scores amongst male and female patients it was found that males have a pain score of 2, and females have a pain score of 2.3. This shows that the males in the study population have a higher pain threshold and are better able to tolerate pain than women in the same setting.

Local anaesthetics produce anesthetics by inhibiting excitation of nerve endings or by blocking conduction in peripheral nerves. This is achieved by anaesthetics reversibly binding to and inactivating sodium channels. Sodium influx through these channels is necessary for the depolarization of nerve cell membranes and subsequent propagation of impulses along the course of the nerve. When a nerve loses depolarization and capacity to propagate an impulse, the individual loses sensation in that area supplied by the nerve. The order of affinity of local anaesthetics for different sodium channel states is open is better than inactivated, which is better than resting. Hence, the open state of the sodium channel is the primary target of local anaesthetic molecules. Ice helps anesthetize the area of interest by decreasing neural transmission. This is called the gate control theory. According to this theory, cold

temperatures decrease the neural transmission of the thin non-myelinated neuraxons that transfer stimuli from the periphery and reduce the pain [22]. Local cooling causes vasoconstriction of vessels thus reducing the tissue metabolism, and inflow of inflammatory mediators during penetration of the needle.

Distribution of local anaesthetic following absorption into the bloodstream occurs in 3 phases. Initially, uptake occurs through highly vascular tissues. Subsequently, the local anaesthetic appears in less vascularised tissues such as muscle and fat. Finally, the drug is metabolized.

Metabolism of local anaesthetics depends on the chemical structure. Adverse reactions may occur following the administration of local anaesthetics and usually result from the administration of too much drug. Adverse reactions may also occur following the injection of very vascular sites or from an accidental direct intravascular injection of the drug. Deaths following local anaesthetic administration are always a result of overdose.

Tissue toxicity can be achieved by all local anaesthetics if "high" concentrations are used. Adverse reactions occur primarily in the CNS (neurotoxicity) and cardiovascular system (myotoxicity) because these tissues are also composed of excitable membranes, the target of local anaesthetic action. The patient may experience generalized CNS depression leading to hypoxia, acidosis, and respiratory arrest. Local anaesthetics decrease the rate of depolarization of cardiac tissue, which is the rationale behind the use of lidocaine in the treatment of ventricular arrhythmias. At higher concentrations, the amplitude of the cardiac action potential is decreased, and the velocity of conduction is reduced. At toxic doses, the negative inotropic effects of local anaesthetics may lead to bradycardia, ventricular fibrillation, or asystole. Other cardiovascular effects include hypotension, which occurs via the direct vasodilating effects of local anaesthetics on peripheral arteriolar smooth muscle. A rare, life-threatening complication the local anaesthetic systemic toxicity (LAST).

Since the LA is being used in the oral cavity its use depends highly on patients' ability to tolerate smell and taste. As discussed above LA can have side effects if used in large doses [3]. Hence a safer and more natural approach is to use ice which is frozen water and therefore safe to use.

The use of ice as a topical anaesthetic seems promising, it has no side effects, no taste, no smell, and is readily accepted by the patients [22].

The only major drawback is the storage of ice in a dental clinic. Refrigerators are to be used to store ice. Care must be taken to have the ice separated for easy access when in need also the refrigerator should be close enough to ensure the ice is below 0 degrees Celsius. Currently, the use of a refrigerator in a dental clinic is not required hence for ice to be used as a topical local anaesthetic requires a willingness to accept and adapt to change.

4. CONCLUSION

LA spray is currently used as a topical anaesthetic to reduce discomfort before a mildly invasive procedure such as scaling or before the insertion of the syringe needle as in an LA injection. Though not a compulsory step before anaesthetic injections it does help reduce the pain induced, it also helps the dentist manage the patient better and hence its popularity.

But LA might not always work to its optimum levels, for example, it does not function as well in an acidic environment, moreover, its taste and method of application may add to the discomfort. Hence the search for a natural non-pharmacological method to ease LA injection intramucosal. (In case of LA not functioning due to an acidic environment, greater LA dose and non-pharmacological methods like pressure should be used). This study shows a significant advantage of the non-pharmacological method over the pharmacological method. Hence further research could help standardize ice application pre-injection for a more non-toxic and natural method of reducing pain during an LA injection. It can also prove beneficial when LA does not work due to an acidic environment.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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