

Original Research Article

The Effect of Pre-Cooling on the Pain of Local Anesthesia Injections in Children

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Abstract: Background: Fear from dental injection among children is considered the main obstacle to the dentist while delivering local anesthesia. So, this study used a pre-cooling technique at injection site and compared it to conventional methods. The study aimed to assess external cooling efficiency on the injections' pain of at the site of local anesthesia in children had dental treatment. Materials and Methods: The study subjects were 60 children with dental treatment in mandibular region. The study group were anesthetized after cold application of the injection site for 2 minutes, while the control group were administered local mandibular anesthesia after topical anesthesia application. Independent student t-test was used for means comparison. Results: The pain scores were lower in the study group with no significant difference between groups ($P < 0.5$). Conclusions: There was no significant difference between the study and control groups on the injection pain, but it was more tolerable by children and easier to apply than conventional topical anesthesia.

Keywords: Pain, local anesthesia, cooling, injection, children.

INTRODUCTION

Local anesthesia (LA) in dentistry is the cornerstone of most dental procedures. In pediatric dentistry, there is some special requests to avoid LA injection pain (Khan *et al.*, 2020). Anxiety and fear from anesthetic injection are the main cause of refusing dental treatment by children (Peng *et al.*, 2024; Ghaderi *et al.*, 2013).

There are several recommended pharmacological and nonpharmacological methods to control pain in children. Nitrous oxide sedation, benzodiazepines are some of the pharmacological methods that are frequently used. Also, there are many non-pharmacological behavior guidance methods was defined for fear and anxiety managing (Khan *et al.*, 2020; Dean *et al.*, 2019). Topical anesthetics application which has an advantage in decreasing the injection pain the LA (Khan *et al.*, 2020; Bilsin *et al.*, 2020).

Furthermore, nonpharmacological methods such as cold application and vibration at the injection area prior to LA also used to decrease pain related to dental injections (Bilsin *et al.*, 2020). Cold application method was used to reduce pain on the bodies' surfaces for a long time (Wang and Ni, 2021; Wang Y *et al.*, 2021; Al-Qarqaz *et al.*, 2012). Cold application at the injection area prior to LA is an easy, physiologically efficient and costs effective. Cold application elevates threshold and aids with child management during dental treatment involving LA injection (Amrollahi *et al.*, 2021; Gurucharan *et al.*, 2022; Bilsin *et al.*, 2020). Tissue cooling have anaesthetic properties and it was replaced to injection of LA in particular surgical procedures (Gurucharan *et al.*, 2022; Goel *et al.*, 2006).

The study aimed to assess the efficacy of pre-cooling of injection site before delivering local anesthesia and compared it to conventional topical anesthetic method.

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MATERIAL AND METHOD

Ethical Approval

This study carried out at Ibn-sina university of medical and pharmaceutical science / collage of dentistry / Baghdad - Iraq. Ethical approval no. I.S.U.7.1.23.

Subjects

The present study conducted among 60 healthy patients with age between 9-12 years (both genders) attend pediatric dentistry clinic, requiring dental treatment for mandibular teeth.

Inclusion Criteria

All of them were healthy and cooperative according to Frankl's rating scales (cooperative and definitely cooperative) (Kiranl *et al.*, 2015).

Exclusion Criteria

Children with systemic diseases, allergies, disabilities, psychological disorders, dental abscesses at the injection site and uncooperative children according to Frankl's rating scales (Negative and Definitely Negative) were excluded (Kiranl *et al.*, 2015).

Method

An explaining of the procedure and informed consent was obtained from all children's guardians. The Committee of Research and Ethics agreed all the research steps. The children of the study group (30 patients) were anesthetized after ice application at injection site for 1 minute, while those in the control group (30 patient) anesthetized using conventional topical anesthesia. The patient's reaction to injection will be assessed according to the Sound, Eye and Motor scale (SEM scale).

The SEM scale range (0-9) was recorded build on (0-3) scores for each parameter (Table 1) (Ghaderi *et al.*, 2013). For control group, the mucosa at the injected area dried by cotton for 30s and a Lidocaine hydrochloride topical spray (Astrazeneca AB, Sweden) was applied on cotton pad for 2 min. Then block injection of a (2%) lidocaine HCl cartridge with 1:80,000 epinephrine (Huons Co./ Ltd, Korea) using a short 27-gauge needle (Denject, Korea). For study group, the mucosa at the injected area dried by cotton for 30s then ice was applied for 2 min before block injection. The ice was prepared by using an empty LA cartridge, sterilized, water filled and freezes. The data analyzed by Statistical Packages for Social Sciences (SPSS) ver. 17. Independent student t-test used for means' comparison. Statistical significance was $P < 0.05$.

Table 1: Sound, eye and motor scale

Parameter	Comfort	Mild discomfort	Moderate discomfort	Severe discomfort
Sound ^a	No sound	Nonspecific sound (probable pain)	Verbal complaint, louder sound	Verbal complaint, shouting, crying
Eye ^b	No sign	Dilated eyes without tears (anxiety sign)	Tears, sudden eye movements	Crying, tears covering the face
Motor ^c	Relaxed body and hand status	Muscular contraction, contraction of hand	Sudden body and hand movements	Hand movements for defense, turning the head to the opposite side

^aSound; ^beye, ^cmotor

RESULTS

Sample distribution according to gender, age group and frankle scale. Male percentage was (40%), while female percentage was (60%). Age group (9-10) number were (27), while age group (11-12) number were (33). The percentage of definitely children cooperative was (65%) (Table 2). The study group who received ice cooling had SEM mean and standard deviation (SD) (2.10 and 1.398) respectively. While for control group who received conventional topical anesthetic had SEM mean and standard deviation (SD) (2.470 and (1.852) respectively. P value was (0.174). P value was not significant except for the motor scale which was (0.038) (Table-3).

Table 2: Sample Distribution According to Gender, Age Group and Frankle Scale

	No. ^a	% ^b
Study	30	50
control	30	50
Male	24	40

	No. ^a	% ^b
Female	36	60
9-10 y	27	45
11-12 y	33	55
Cooperative	21	35
Definitely cooperative	39	65
^a number; ^b percentage		

Table 3: Mean and standard deviation with P value of sound, eye and motor scale of study and control groups

	Study	Control	P-Value	Df ^a
SOUND (mean±SD ^b)	0.77±0.898	0.77±0.898	1	58
EYE (mean±SD)	0.73±0.521	1.00±0.587	0.110	
MOTOR (mean±SD)	0.60±0.498	0.70±0.794	0.038	
SEM ^c (mean±SD)	2.10±1.398	2.47±1.852	0.174	
^a degree of freedom; ^b standard deviation; ^c sound, eye, motor				

DISCUSSION

For long time, cooling was used to reduce pain perception. It elevates pain thresholds by decreasing nociceptor activation threshold and slowing the pain impulse conduction velocity through the nerve. The velocity decreased proportionally for each degree drop in temperature, ceasing completely in the range of 10°C to 0°C. This called “cold-induced neuropraxia”. Also, cooling cause blood vessels vasoconstriction leads to minimize oxygen utilization and tissue metabolism which in turn reduces inflammatory process (Aminabadi and Farahani, 2009; Mohiuddin *et al.*, 2015).

The present study aim was to assess pain perception by children through ice application to the injected site compared to traditional topical anesthetic application. Ice packs were used to cool the injection site. It is comfortable, safe, feasible and affordable. It's applied for 2 minutes which is the least effective and tolerable by children (Aminabadi and Farahani, 2009; Amrutha Varshini *et al.*, 2021).

Pain self report is considered challenging issue in children especially when it affected by dental anxiety and fear and their limited capacity to express their feelings. SEM scale were used to assess children's reactions which is considered an objective measure. It is depending on practitioner interpretation to child reaction (Chilakamuri, 2020; AmruthaVarshini *et al.*, 2021).

In this study, the application of cooling to injected site was nearly equally effective in pain relieving of LA injections when compared to traditional topical anesthetic application. These findings came in line with previous findings by AmruthaVarshini *et al.*, (2021). While they came in variance with other studies which reported that ice is significantly more effective than traditional topical anesthesia (Aminabadi and Farahani, 2009; Mohiuddin *et al.*, 2015; Chilakamuri, 2020; Zafar *et al.*, 2023). The study accomplished by Ghaderi, *et al.*, supported cooling increased pain threshold to needle stick during LA injection and was helpful in patient management during dental procedures (Chan *et al.*, 2003). Other study applied a refrigerant for 5 seconds before LA injection at the palatal tissue and compared it to conventional topical anesthesia, the study showed that the use of a refrigerant was more effective compared than conventional topical anesthesia (Kosaraju and Vandewalle, 2009).

Also, the results presented there is a significant difference in means of motor scale. Motor response to injection represents the withdrawal reflex which is automatic responses of the spinal cord which is important in our body's protection from harmful external stimuli. The motor reflex to needle stick happens without thinking (Fischer and Truog, 2015).

CONCLUSION

The current study concluded that external cooling administration at LA injection site had similar effect on the injection pain felt by children. Ice application was more tolerable by children and easier in application and eliminate unpleasant taste of conventional topical anesthesia.

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