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Cooling Comfort: Enhancing Pediatric Pain Management with Pre-Cooling Techniques - A Case Study Review

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Abstract:
background: One of the primary causes of children's avoidance behaviour development is local anaesthetic injections. There has been an attempt to lessen the feeling of injection pain. Before local anaesthetics were injected, the impact of chilling the injection site on pain perception was assessed in this study.
Methods and Material: In order to treat dental patients who need bilateral buccal injection of local anaesthetics, 50 healthy paediatric patients participated in a prospective single-blind crossover clinical experiment to examine their experience of pain. Before the injection, they were given a topical anaesthetic (Benzocaine) for one minute on the control side and a topical anaesthetic with an ice pack for one minute on the experimental side. An unbiased dentist evaluated each patient's response to the injection. For statistical analysis, the Mann-Whitney U test and the Wilcoxon test were employed. $P < 0.05$ was used to determine statistical significance.
Results: For the study and control groups, the means of the sound, eye, and motor scales (SEM) were 4.06 ± 1.32 and 5.44 ± 1.79, respectively. The study and control groups' respective averages on the visual analogue scale (VAS) were 42.20 ± 12.70 and 58.40 ± 16.83, respectively. These differences were statistically significant ($P < 0.05$).
Conclusion: Paediatric patients reported less discomfort when the injection site was cooled prior to a one-minute infiltration of local anaesthetics into the buccal mucosa.

Keywords: Cooling, local injection, pain perception, Pediatric management

INTRODUCTION:

Injection of local anesthesia is the one of the most crucial procedures in dental operatory which helps to provide a proper dental treatment. Even Nevertheless, anxiety and dread related to receiving injections of local anaesthetic continue to be a barrier to pain treatment in paediatric dentistry. There are several methods to reduce the pain during injection of local anesthesia like topical anesthetic gel or spray, altering the rate of the infiltration, warming the local anesthesia, minimizing the speed of injection and distraction technique. Also, use of mechanical delivery system and application of pressure while injecting. To still embrace a smooth dental procedure, another recommended method to reduce the injection pain is "Tissue cooling"at the injection site.

Paediatric patients often face unique challenges when it comes to medical procedures and interventions. Maintaining their comfort and well-being is paramount, and this includes managing their body temperature during various medical treatments. In recent years, the implementation of pre-cooling techniques has gained significant attention in paediatric medicine, offering a promising avenue to improve patient outcomes. This article delves into the fascinating realm of pre-cooling techniques and their potential effects on paediatric patients, exploring the science behind them, their practical applications, and the impact they can have on the overall experience and recovery of young patients. One of the most feared dental procedures by patients is the administration of local anaesthesia [1]. Pain perception during local anaesthesia administration in children is reduced by a variety of methods, including the use of topical anaesthetics [2,3], syringe camouflage [3,4], distraction with audio-visual glasses [5,6], modification of the local anaesthetic solution [6,7], and counter-stimulation. Counter-stimulatory methods such as vibration, pressure application, and pre-cooling [8] are examples of counter-stimulatory measures used to lessen pain perception during local anaesthesia delivery.

Tissue cooling techniques fall into two categories: contact cooling and non-contact cooling. Pre-cooling, parallel cooling, and post-cooling are the nomenclatures used in relation to the timing of laser irradiation. To be more exact, the fundamental idea is to safeguard the skin's outermost layers against thermal harm. Cold air convection, contact cooling, or cryogen spray (dynamic) cooling can all be used to accomplish it [9,10,11,12,13,14]. Both active (copper, sapphire tips) and passive (ice, cold gels) approaches can be used to cool contacts. When tissue is cooled through touch, heat is transferred from the skin to the cooling material or device that is placed directly on the skin [15]. Heat is transmitted from the skin's surface to a cold cooling agent through heating in passive contact cooling. This removes heat from the skin's surface. However, with active contact cooling, thermoelectric components or flowing liquid cooling agents actively remove the heat that has been transferred to the device. Through convection or evaporation, heat is actively removed from tissues during non-contact cooling. Cryogen spray or cool air can be used to achieve non-contact cooling.

CONTACT COOLING: Using chilled aqueous gels, ice, or sapphire metal or glass plates built within the handpiece.

Due to the straightforward procedure of applying an ice cube to the skin for several minutes (pre-cooling & parallel cooling), ice cube cooling is a user-friendly technique. The least efficient way is to apply aqueous gels. It entails applying a sterile, single-use hydrocolloid gel pad (non-adherent wound dressings) to the treatment region after it has been pre-cooled in a regular refrigerator. The gel pad has been chilled to 8 °C. Following application, skin temperature drops sharply from 32 degrees Celsius to 23.5 degrees Celsius in just five seconds, but then quickly rises to 26.5 degrees Celsius after ten seconds and 27 degrees Celsius after sixty, which is insufficient for laser treatment [16]

Ice application (Ice was made by filling the finger part of gloves with water which was then looped and freezed); and Technique [17][18].

NON-CONTACT SKIN COOLING:

Cryogen spray-The first spray cooling technology was liquid nitrogen applied 20 cm away from the skin. The evaporation of the droplets on the surface cools the skin. Unsupervised use, however, can result in cryonecrosis, and excessive use can suffocate the perioral and nasal regions.

Dynamic cooling device (DCD), a more recent cooling system that uses pulsed cryogen spray as its cooling agent and is either an add-on device or integrated into the laser, is used to selectively cool the epidermis. The DCD spray and delay parameters can be changed by the user using the built-in software. Just prior to the laser pulse, the cryogen is injected onto the skin, chilling it.[25]

The application of ice is thought to have anaesthetic effects that assist reduce discomfort in the treatment region. Additionally, studies have revealed that it slows down cellular metabolism, nerve conduction velocity, edema, and local blood flow [19]. To determine the impact of pre-cooling the injection site, several studies in the dental area have been undertaken. In the first trial, conducted in 1989, Harbert et al. found that freezing the palatal region before injecting L.A. reduced pain perception [20].

Additional research by Ghaderi et al. and Aminabadi et al. found that pre-cooling the injection site before local anaesthetic was administered considerably decreased the discomfort that paediatric patients reported [20,22]. In research by Kosaraju et al., either a topical anaesthetic gel for two minutes or a refrigerant for five seconds in the maxillary posterior palate region before injecting a local anaesthetic solution was compared. They claimed that the use of a topical anaesthetic gel was less efficient at reducing pain than the use of a cooling agent, such as refrigerant, as a pre-injection anaesthetic [23].

Aminah M., et al.'s study assessed the effectiveness of various desensitising approaches in lowering injection pain in paediatric patients, including topical anaesthetic gel administration, pre-cooling the region, vibration, and buffering the anaesthetic agent. They came to the conclusion that, of all the procedures mentioned above, pre-cooling the injection site greatly decreased the experience of pain in young children [21].

METHODS AND MATERIALS:

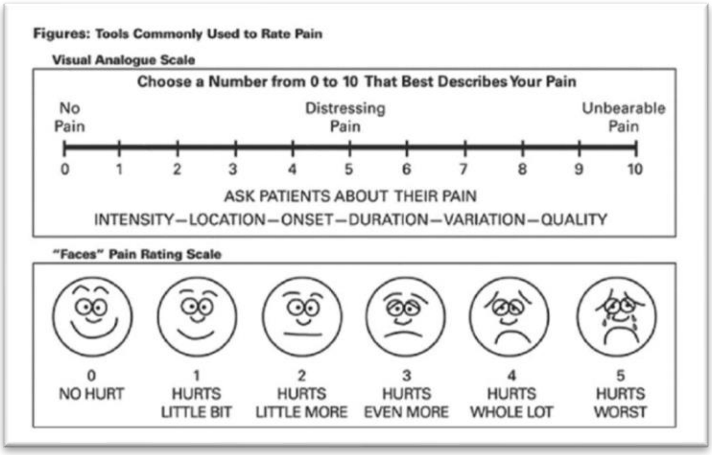
A randomized single-blind (observer) crossover clinical trial was conducted for this study. 50 healthy youngsters (ASA I) in the 8–10 age range (boys and girls) who were enrolled in the pediatric dentistry department at Shiraz University of Medical Sciences in southwest Iran served as the subjects. Block randomization has been implemented using a random number table. The number was selected by drawing a line from a random number to a block that was selected as the designated number. On both sides, they all needed their maxillary primary canines extracted by a dentist under local anesthetic.

Every patient met the third and fourth Frankl's rating scales and was cooperative. They had no negative experiences with dental or medical care. During the process, subjects with allergies, systemic ailments, mental health issues, intellectual disabilities, and oral abscesses or fistulas were excluded.

This work was a crossover clinical trial that was randomized, single-blind, and observer-controlled. The. Before the trial, written informed consent was obtained from each parent after the study method was explained. This research protocol's phases and all its components were approved by the Committee on Research and Ethics.

The subjects were instructed on how to use a visual analogue scale (VAS) to indicate where on the line between faces they might feel the most pain [Figure 1]. More points indicate more intense pain. According to this method, the final scores, which can vary from 0 to 100, are determined by measuring the millimeters between the left end bar and the mark the child placed on a 10 cm line that is marked with happy to sad faces.

FIGURE1:



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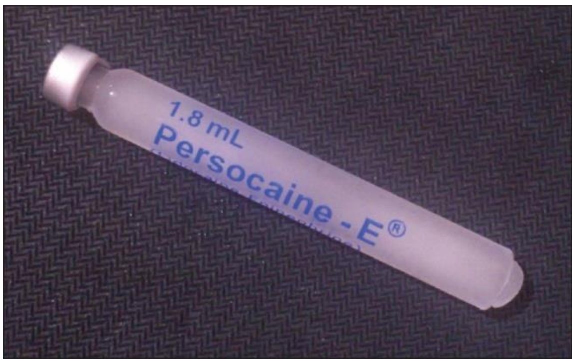
Local anesthetic administration

Each participant in this crossover trial was randomly assigned to receive one side (the trial side) of topical anesthetic gel (20% Benzocaine gel) plus ice, and the other side (the control side) receiving simply topical anesthetic gel. At the same appointment, the participants were randomized to receive topical anesthetic gel plus cold on one side and, subsequently, anesthetic gel simply on the other. In a single session, some individuals were administered anesthetic gel alone, followed by anesthetic gel plus cold on the other side.

On the control side, a topical Benzocaine gel (20%; Beutlich, USA) was administered for one minute after the buccal mucosa of the maxillary canine area had been dried with a cotton roll for thirty seconds. The process was carried out by with a small 27-gauge needle (TERUMO, Japan), infiltration injection of one-fourth of a 2% lidocaine cartridge with 1:100,000 epinephrine (Darou pakhsh, Iran). On the experimental side, the same topical anesthetic gel was applied to the buccal mucosa of the maxillary canine area, and then ice was applied for one minute before the infiltration injection. Several lidocaine cartridges were emptied, filled with water, and then put in a freezer to make ice [Figure 2]. The amount of time that ice is in touch with soft tissue before causing discomfort varies depending on the patient's pain threshold. It should take two to five minutes.23] Adult patients can withstand five minutes rather well, but pediatric patients may become uncooperative as a result.23]

As a result, ice was applied to the buccal mucosa for only one minute in this investigation.

FIGURE2:



DISSICUSION:

The current clinical trial's objective was to evaluate pediatric patients' perceptions of pain during cooling of the injection site prior to local anesthetic injection for dental extraction. Topical anesthetic drugs were applied both with and without ice, and their effects were compared.

The findings demonstrated that administering topical anesthetics (benzocaine) for one minute followed by cooling the injection site for one minute considerably reduced pain during the delivery of local anesthetics for dental procedures. The findings of the current study are consistent with a study on cooling the skin before inguinal hernia surgery.[30] Chan et al. treated 37 patients with nevus of Ota excision using a laser system with a cooling device.[29] They claimed that by chilling the injection site, their patients had less pain. The difference was not statistically significant, and they did not state the precise standards by which pain was measured. We should also consider the possibility that laser therapy may cause different pain than local anesthetic.

The findings of the study by Leff et al. [30] are in agreement with those of the current investigation. Additionally, Kuwahara and Skinner [31] and Goel et al. [28] showed reduction in pain perception by application of ice to the injection site in separate investigations.

The findings of the current study confirm those of Harbert, who used ice for reducing palatal injection-related pain perception. However, he did not use an objective pain grading system to evaluate his findings, and his study was not a randomized control trial.[34]

The findings of the current study are consistent with those of Kosaraju et al.'s study, but they did not elaborate on an objective scale for their evaluation.[23] It is challenging to analyze an emotion like pain perception precisely using the subjective scale (VAS).

Amin Abadi et al. found that applying ice for two minutes before receiving an infra-alveolar nerve block injection significantly reduced the sense of pain.[21] If each individual had been treated as both a case and a control at the same time, the results would have been more trustworthy.

According to a number of ideas, decreasing tissue metabolic rate and vasoconstriction, which in turn leads to a decrease in the influx of inflammatory mediators and a reduction in edema, are two mechanisms by which injuries have an effect and analgesia is induced locally. This could account for the effective use of topical cooling to lessen bruising, bleeding, and edema following orthopedic surgery and sports injuries[26,32].[21,35] Additionally, local cooling is thought to reduce or stop the transmission of pain signals and neuromuscular signals[36].[37] Cooling muscle tissue also lessens its tone by reducing the activity of the muscular spindles.[38] Topical cold treatment activates inhibitory pain pathways by stimulating myelinated A fibers, which in turn raises the pain threshold. There has also been evidence of cold to decrease the stretch reflex and lessen muscle spasm at the spinal level.[38] The current study's findings are consistent with the notion that topical cooling increases a person's pain tolerance to stimuli like a needle stick during the administration of a local anesthetic and aids in patient management during dental operations.

Double-blind research and the interactions between anesthetic gel and cold as two strategies for lessening injection pain were not supported by the methodology of the current investigation.

CONCLUSION:

All young patients who experience dread and anxiety during dental treatments requiring injection of local anesthetics may benefit from using the simple, dependable, and cost-free strategy of cooling the injection site prior to local anesthetics.

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