Dental Research Journal

Original Article

Effect of pre-cooling injection site on pain perception in pediatric dentistry: "A randomized clinical trial"

Faezeh Ghaderi[1], Shahin Banakar[1], Shima Rostami[2]

[1]Department of Pediatric Dentistry, [2]Dental Student of Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran

Received: July 2012
Accepted: January 2013

Address for correspondence:
Dr. Faezeh Ghaderi,
Department of Pediatric Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran.
E-mail: Faezeghaderi@yahoo.com

ABSTRACT

Background: Injection of local anesthesia is one of the most important reasons for development of avoidance behavior in children. Efforts have been performed to decrease pain perception of injection. The present research evaluated the effect of cooling the injection site on pain perception before infiltration of local anesthetics.

Materials and Methods: A prospective single-blind crossover clinical trial was used to investigate pain perception in 50 healthy pediatric patients who needed bilateral buccal infiltration of local anesthetics for dental treatment. They received a topical anesthetic agent (Benzocaine) on one side (control) for 1 min and topical anesthetic agent plus one minute of ice pack on the other side (trial) prior to the injection. A dentist blind to the study assessed the patients' reaction during injection. Wilcoxon and Mann-Whitney U tests were used for statistical analysis. Statistical significance was defined at $P < 0.05$.

Results: The means of sound, eye, and motor scales (SEM) were 4.06 ± 1.32 and 5.44 ± 1.79 for the study and control groups, respectively. The means of visual analogue scales (VAS) for the study and control groups were 42.20 ± 12.70 and 58.40 ± 16.83, respectively; with statistically significant differences between the two groups ($P < 0.05$).

Conclusion: Cooling the injection site before infiltration of local anesthetics in the buccal mucosa for 1 min, reduced pain perceived by pediatric patients.

Key Words: Cooling, local injection, pain perception

INTRODUCTION

Injection of local anesthetics is one of the most feared or anxiety-inducing stimuli in dental operatory.[1] The fear of pain attributed to injection of anesthetic agents is cited as an obstacle to providing appropriate dental care.[2,3] Successful treatment of pediatric patients, in terms of allaying their anxiety and their discomfort during restorative and surgical procedures, is facilitated by profound local anesthesia.[4]

Access this article online

Website: http//:drj.mui.ac.ir

There are several methods to reduce pain during injection of local anesthetics, such as the application of topical anesthetics (e.g., Benzocaine),[5] warming the local anesthetic agents,[6] buffering the local anesthetics,[7-9] adjusting the rate of the infiltration[8] by reducing the speed of injection, counter-irritation,[9] and distraction technique.[10]

Furthermore, vibrating the surrounding tissue while administering the injection, applying pressure to the injection site, and use of a mechanical delivery system have been tried to minimize the pain experienced during administration of dental anesthetic agents.[11,12]

Another recommended method to relieve the pain of injection is cooling of the injection site. This technique has been used in sprains, burns, fractures, bruises, insect bites, and sports injuries.[13,14] In several studies, ice has been used to relieve pain from a

local anesthetic injection, control postoperative pain, and prevent edema.[15-18] Ethyl chloride was used for pre-injection anesthesia as well as for pain control in minor surgical procedures, minor sports injuries, and myofacial pain in other studies.[13,19,20]

There are a few reports in medical studies using preoperative cooling to modify pain perception associated with infiltration of local anesthetics.[15-18] Only one of these studies was a randomized trial,[15] which focused on pain perception prior to ophthalmic eyelid surgery. In 2003, Chan *et al*., investigated the effect of cooling the skin prior to laser treatments.[16] Leff *et al*., reported that cooling of the injection site for a nerve block 5 min prior to the administration of a local anesthetic agent in patients undergoing inguinal hernia repair.[17]

There are a few dental studies in this field.[21-23] Harbert performed the first study in this issue in 1989. He found cooling of palatal area before injection relieved pain perception.[21] Kosaraju *et al*., compared 5-s application of a refrigerant (1,1,1,3,3-pentafluoropropane/1,1,1,2-tetrafluoroethane) and a 2-min application of a topical anesthetic gel (20% Benzocaine gel) in the posterior palatal area before injection of a local anesthetic solution with a 30-gauge needle in 16 adult participants.[22] They reported that the application of a refrigerant as a pre-injection anesthetic was more effective compared to the use of a topical anesthetic gel in reducing the pain experienced by participants who received a posterior palatal injection.[22]

In 2009, Aminabadi *et al*., used a cooling technique on the mucosa of injection site of local anesthetics in pediatric patients aged 5-6 years of age. They applied Benzocaine, without mentioning the concentration, for 1 min followed by a 2-min application of ice before injection of local anesthetics. Sound, eye, and motor (SEM) was used to evaluate pain perception of children during injection. The differences were statistically significant.[23]

Therefore, the aim of the present study was to compare the effect of topical cooling of injection sites in the left and right maxillary buccal mucosa on pain perception in the same pediatric subjects.

MATERIALS AND METHODS

The present study was a randomized single-blind (observer) crossover clinical trial. The subjects consisted of 50 healthy children (ASA I) aged 8-10 years (girls and boys), attending the Department of Pediatric Dentistry, Shiraz University of Medical Sciences, in southwestern Iran. Random number table have been used for block randomization. The number was chosen by tracing a line starting from random number till reaching to a block which was chosen as designated number. They all required dental extractions of maxillary primary canine on both sides under local anesthesia.

All the patients were cooperative (Frankl's rating scales III and IV). They had no aversive experience about medical or dental treatment. Subjects with allergies, systemic diseases, intellectual disability, psychiatric disorders, and dental abscesses or fistulas in the procedure site were excluded.

After explaining the study procedure, a written informed consent was obtained from all the parents before the trial. The Committee of Research and Ethics approved all the aspects and steps of this research protocol.

Using a visual analogue scale (VAS) [Figure 1], the subjects were instructed how to point to the position on the line between faces to indicate how much pain they might feel. In this system the total scores range from 0 to 100 based on measuring the distance in millimeters from the left end bar to mark made by the child on the 10 cm line anchored by happy to sad faces, with a higher score indicating more severe pain.

The anesthetic injection procedure was carried out by an attending pediatric dentist.

A dentist who was unaware of pre-cooling injection site, asked patients to rate their pain after injection on VAS diagram. The dentist also objectively recorded

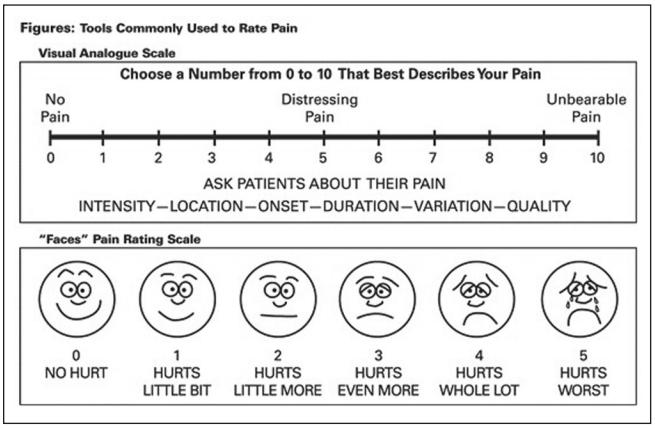

Figure 1: Visual analogue scale (VAS) for assessment of children's pain perception

SEM during injections [Table 1]. Total scores for SEM range from 0 to 9 based on 0-3 score for each parameter.

Administration of local anesthetics

In this crossover trial, each subject randomly received both pre-injection techniques: Topical anesthetic gel (20% Benzocaine gel) plus ice on one side (trial side) and only topical anesthetic gel on the other (control side). The participants were randomly assigned to receive the topical anesthetic gel plus ice one side, and later, only anesthetic gel on the other side at the same appointment. Others received only anesthetic gel first, then anesthetic gel and ice on the other side at the same session.

On the control side, the buccal mucosa of maxillary canine area was dried by a cotton roll for 30 s and then a topical Benzocaine gel 20% (Benzocaine, Beutlich, USA) was applied for 1 min. The procedure was followed by infiltration injection of three-fourth of a 2% lidocaine cartridge with 1:100,000 epinephrine (Darou pakhsh, Iran) using a short 27-gauge needle (TERUMO, Japan).

On the trial side, the buccal mucosa of maxillary canine area was prepared with the same topical anesthetic gel followed by ice for 1 min prior to the infiltration injection. In order to prepare ice, a number of lidocaine cartridges were emptied and filled with water and placed in a freezer [Figure 2]. Discomfort produced by ice on the soft tissue depends on the length of time of ice contact, and pain threshold of the patient. Suggested time is 2-5 min.[23] Five minutes can be tolerated well by adult patients, but in pediatric patients it may lead to lack of cooperation.[23] Therefore, in this study ice was applied on the buccal mucosa just for 1 min.

Statistical analysis

Data was analyzed using Statistical Packages for Social Sciences (SPSS) ver. 17. Wilcoxon and Mann-Whitney U Tests were applied for comparison of means. Statistical significance was defined at $P < 0.05$.

RESULTS

The research comprised 50 patients (28 girls and 24 boys) with a mean age of 8.94 ± 0.76 years (range: 8-10 years).

Analysis of SEM

The means of SEM values for the study and control groups were significantly different in totals(SEM) as well as sound, eye and motor parameters individually($P = 0.000$) [Table 2].

Analysis of VAS

The means of VAS values for the study and control groups were 42.20 ± 12.70 (range: 0-100) and 58.40 ± 16.83 (range: 0-100), respectively with statistically significant lower VAS scores in the study group ($P < 0.05$).

DISCUSSION

The aim of the present clinical trial was to appraise pain perception by pediatric patients during cooling of the injection site prior to injection of local anesthetics for dental extraction. The effects of application of topical anesthetic agents with and without ice were compared.

The results showed that cooling of the injection site for 1 min after 1-min application of topical

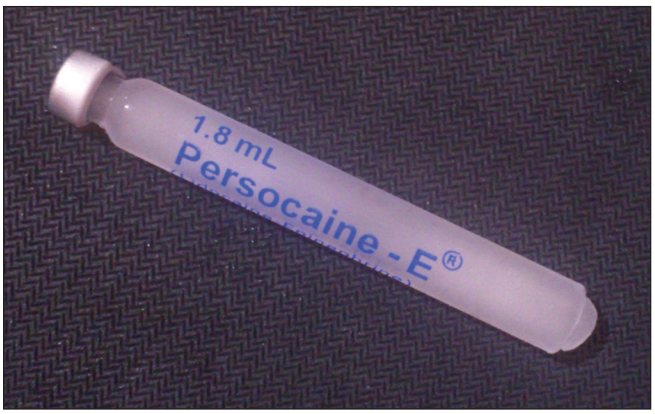

Figure 2: Refrigerated cartridges which were filled with water

Table 1: SEM scale for assessment of children behavior

Parameter	Comfort	Mild discomfort	Moderate discomfort	Severe discomfort
Sound	No sound	Nonspecific sound (probable pain)	Verbal complaint, louder sound	Verbal complaint, shouting, crying
Eye	No sign	Dilated eyes without tears (anxiety sign)	Tears, sudden eye movements	Crying, tears covering the face
Motor	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

SEM: Sound, eye, motor

Table 2: SEM (sound, eye, motor) scores among the study and control groups

parameter	Cooling injection site and anesthetic gel (study)	Anesthetic gel (control)	*P*-value
N	50	50	
sound; mean±SD, [range]	1.46±0.68 [1-3]	1.86±0.80 [1-3]	*P*=0.000
eye; mean±SD, [range]	1.36±0.52 [1-3]	1.80±0.70 [0-3]	*P*=0.000
movement; mean±SD, [range]	1.24±0.62 [0-3]	1.78±0.71 [0-3]	*P*=0.000
total; mean±SD, [range]	4.06±1.32 [2-8]	5.44±1.79 [2-9]	*P*=0.000

anesthetics (benzocaine) significantly alleviates pain during administration of local anesthetics for dental procedures. The results of the present study correspond with the study carried out on cooling the skin prior to surgery of inguinal hernias.[17] Chan *et al*., used a laser system with a cooling device to treat 37 patients with nevus of Ota removal.[16] They reported that cooling the site of injection resulted in less pain perception by their patients. However, the difference was not statistically significant and they did not specify the objective criteria used to evaluate pain. Also, we should consider that the pain induced by laser therapy may differ from that of local anesthesia.

The findings of Leff *et al.*'s study[17] is consistent with the results of the present study. Furthermore, Kuwahara and Skinner[18] and Goel *et al.*,[15] in different studies, reported reduction in pain perception by application of ice on injection site.

The results of the present study support the results reported by Harbert, who applied ice to reduce pain perception associated with palatal injections. However, his study was not a randomized control trial and he did not support his results with objective pain scoring systems.[21]

The results of the present study are in accordance with the findings obtained by the study of Kosaraju *et al*., but, their evaluation were not elaborated on an objective scale.[22] That is difficult to evaluate a feeling such as pain perception precisely just using the subjective scale (VAS) for assessment.

Aminabadi *et al*., reported the efficacy of 2-min application of ice prior to infra-alveolar nerve block injection in decreasing perception of pain.[23] The finding would have been more reliable if each single subject has been considered to be as a case and control simultaneously.

A number of theories have been put forward to explain the mechanism of effect of injuries and induction of analgesia at a local level, which include decreasing tissue metabolic rate and vasoconstriction leading to a decrease in the inflow of inflammatory mediators and a decrease in edema. This might explain the successful application of topical cooling to reduce bruising, bleeding, and edema in sports injuries[13,19] and after orthopedic surgeries.[24,25] Local cooling is also believed to slow or eliminate pain signal transmission[26] and to retard neuromuscular transmission.[27] In addition, cooling muscle tissue reduces its tone via a reduction in the activity of muscular spindles.[27] Topical cold application stimulates myelinated A fibers, activating inhibitory pain pathways, which in turn raises pain threshold. Cold has also been demonstrated to work at the spinal level to inhibit stretch reflex and reduce muscle spasm.[25] The results of the present study support the idea that topical cooling amplifies pain threshold to stimuli such as needle stick during local anesthetic injection and helps patient management during dental procedures.

The design of the present study could not support a double-blind study as well as interactions of anesthetic gel and cold as two mechanisms for reducing injection pain.

CONCLUSION

Cooling of the injection site before local anesthetics is an easy, reliable, and effective technique with no additional cost and can be beneficial to apply to all pediatric patients with fear and anxiety during dental procedures in which injection of local anesthetics is necessary.

ACKNOWLEDGEMENTS

Authors would like to acknowledge Research Deputy of Shiraz Dental School. The manuscript was prepared from an undergraduate dissertation (Dr. Shima Rostami: 90-5662) for a doctoral degree in dentistry.

REFERENCES

1. Bedi R, Sutcliffe P, Donnan PT, McConnachie J. The prevalence of dental anxiety in a group of 13- and 14-year old Scottish children. Int J Paediatr Dent 1992;2:17-24.

2. Milgrom P, Coldwell SE, Getz T, Weinstein P, Ramsay DS. Four dimensions of fear of dental injections. J Am Dent Assoc 1997;128:756-66.
3. McDonald RE, Avery DR, Dean JA. McDonald and Avery's Dentistry for the Child and Adolescent. 9th ed. Maryland Heights: Mosby/Elsevier; 2011. p. 241-4.
4. In: Pinkham JR, Casamassimo PS, Fields HW, Mctigue DJ, Nowak A, editors. Pediatric Dentistry: Infancy Through Adolescence. 4th ed. St. Louis: Elsevier Saunders; 2005. p. 106.
5. O'Brien L, Taddio A, Lyszkiewicz DA, Koren G. A critical review of the topical local anesthetic amethocaine (Ametop) for pediatric pain. Paediatr Drugs 2005;7:41-54.
6. Colaric KB, Overton DT, Moore K. Pain reduction in lidocaine administration through buffering and warming. Am J Emerg Med 1998;16:353-6.
7. Bartfield JM, Crisafulli KM, Raccio-Robak N, Salluzzo RF. The effects of warming and buffering on pain of infiltration of lidocaine. Acad Emerg Med 1995;2:254-8.
8. Courtney DJ, Agrawal S, Revington PJ. Local anaesthesia: To warm or alter the pH? A survey of current practice. J R Coll Surg Edinb 1999;44:167-71.
9. Younis I, Bhutiani RP. Taking the 'ouch' out-effect of buffering commercial xylocaine on infiltration and procedure pain-a prospective, randomized, double-blind, controlled trial. Ann R Coll Surg Engl 2004;86:213-7.
10. Touyz LZ, Lamontagne P, Smith BE. Pain and anxiety reduction using a manual stimulation distraction device when administering local analgesia oro-dental injections: A multi-center clinical investigation. J Clin Dent 2004;15:88-92.
11. Friedman MJ, Hochman MN. The AMSA injection: A new concept for local anesthesia of maxillary teeth using a computer-controlled injection system. Quintessence Int 1998;29:297-303.
12. Hutchins HS Jr, Young FA, Lackland DT, Fishburne CP. The effectiveness of topical anesthesia and vibration in alleviating the pain of oral injections. Anesth Prog 1997;44:87-9.
13. Meeusen R, Lievens P. The use of cryotherapy in sports injuries. Sports Med 1986;3:398-414.
14. Brandner B, Munro B, Bromby LM, Hetreed M. Evaluation of the contribution to postoperative analgesia by local cooling of the wound. Anaesthesia 1996;51:1021-5.
15. Goel S, Chang B, Bhan K, El-Hindy N, Kolli S. "Cryoanalgesic preparation" before local anesthetic injection for lid surgery. Orbit 2006;25:107-10.
16. Chan HH, Lam LK, Wong DS, Wei WI. Role of skin cooling in improving patient tolerability of Q-switched Alexandrite (QS Alex) laser in nevus of Ota treatment. Lasers Surg Med 2003;32:148-51.
17. Leff DR, Nortley M, Dang V, Bhutiani RP. The effect of local cooling on pain perception during infiltration of local anesthetic agents, a prospective randomized controlled trial. Anesthesia 2007;62:677-82.
18. Kuwahara RT, Skinner RB. Emla versus ice as a topical anesthetic. Dermatol Surg 2001;27:495-6.
19. Russell SC, Doyle E. A risk-benefit assessment of topical percutaneous local anesthetics in children. Drug Saf 1997;16:279-87.
20. Waibel KH, Katial RK. Effect of topical vapocoolant spray on skin test wheal, flare, and pain responses. Ann Allergy Asthma Immunol 2005;95:149-53.
21. Harbert H. Topical ice: A precursor to palatal injections. J Endod 1989;15:27-8.
22. Kosaraju A, Vandewalle KS. A comparison of a refrigerant and a topical anesthetic gel as pre injection anesthetics: A clinical evaluation. J Am Dent Assoc 2009;140:68-72; quiz 112-3.
23. Aminabadi NA, Farahani RM. The effect of pre-cooling the injection site on pediatric pain perception during the administration of local anesthesia. J Contemp Dent Pract 2009;10:43-50.
24. Daniel DM, Stone ML, Arendt DL. The effect of cold therapy on pain, swelling, and range of motion after anterior cruciate ligament reconstructive surgery. Arthroscopy 1994;10:530-3.
25. Abramson DI, Chu LS, Tuck S, Lee SW, Richardson G, Levin M. Effect of tissue temperatures and blood flow on motor nerve conduction velocity. JAMA 1966;198:1082-8.
26. Halar EM, DeLisa JA, Brozovich FV. Nerve conduction velocity: Relationship of skin, subcutaneous and intramuscular temperatures. Arch Phys Med Rehabil 1980;61:199-203.
27. Ottoson D. The effects of temperature on the isolated muscle spindle. J Physio 1965;180:636-48.

How to cite this article: Ghaderi F, Banakar S, Rostami S. Effect of pre-cooling injection site on pain perception in pediatric dentistry: "A randomized clinical trial". Dent Res J 2013;10:790-4.

Source of Support: Nil, **Conflict of Interest:** None declared.