

Article

Not peer-reviewed version

Evaluation of Different Form Topical Anesthesia Agents in Dental Practice

[Kenan Cantekin](#) *

Posted Date: 29 August 2024

doi: 10.20944/preprints202408.2068.v1

Keywords: pediatric dentistry; dental anxiety; local anestehesia



Preprints.org is a free multidiscipline platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Article

Evaluation of Different Form Topical Anesthesia Agents in Dental Practice

Kenan Cantekin

Department of Pediatric Dentistry, Faculty of Dentistry, Sakarya University, Sakarya, Turkey;
k_cantekin@hotmail.com

Abstract: Purpose: The aim of this study was to compare the topical anesthetic effect of a 10% atomized lidocaine spray and an EMLA cream at different time intervals using parameters of visual analogue scale (VAS) score and heart rate (HR). Methods: The randomized split-mouth study included 30 patients (17 boys, 13 girls) aged 8.22 ± 1.8 years. Application of atomized lidocaine spray or cream was randomly used in the upper second premolar region. The parameters was measured before and at each needle insertion after 10,30,60 and 120 sec. Paired *t*-test and independent *t*-test were used for statistic analyses. Results: Compared to the first applications (10 sec), atomized lidocaine and EMLA cream applications significantly decreased scores of VAS at the applications at 30 and 120 seconds, respectively. Despite atomized lidocaine showed early effect compared to EMLA, there were no significant differences in VAS scores between the atomized lidocaine and EMLA cream at the 60 and 120 seconds measurements. Although HR significantly increased at first anesthetic administration with the atomized lidocaine spray, HR significantly decreased at 30 and 120 seconds administrations. Conclusion: Atomized 10% lidocaine-based topical anesthetics significantly reduced pain more rapidly and better than EMLA from needle pricks in the buccal mucosa. Therefore, atomized lidocaine topical anesthesia could be used as a substitute for EMLA cream before buccal anesthetic administration. On the other hand, further comprehensive studies are required to explore the effects of several doses of atomized lidocaine in various areas of the oral cavity.

Keywords: pediatric dentistry; dental anxiety; local anesthetics

Introduction

Topical anesthetics are most commonly used in dentistry for the application of a local anesthetic injection to mucosal surfaces. Patients suffer from two pains during local anesthesia in the oral mucosa. One pain is at the point of needle insertion, and the other is during the agent injection. Topical anesthetics are generally used for analgesia during needle insertion [1,2]. One of the most commonly used oral mucosal topical anesthetic agents worldwide is 2.5% lidocaine and 2.5% prilocaine (L/P) EMLA® cream (Astra USA Inc., Westborough, MA, USA) [3]. However, since conventional topical anesthetic agents have little bioadhesiveness to the oral mucosa, anesthetic gels often migrate from the application area resulting in insufficient analgesia [2]. Additionally, anesthetic gels diluted by saliva may produce an unpleasant taste and discomfort for the patient [4].

Several methods for increasing absorption of local anesthetic agents in the oral mucosa tissue have been developed and reported. Some of these methods include iontophoresis, which uses a small electric current to speed the penetration of local anesthetic agents into the gingival tissue[5,6], phonophoresis, which uses ultrasonic waves [7,8], and needle-free local anesthesia systems (Injex; Pharma AG, Berlin, Germany) [9]. However, all of these methods require specialized equipment and complex techniques, thus, they are not commonly used.

Mucosal atomization devices (MADs) have been used for the delivery of topical anesthetics to the naso- and oropharyngeal mucosa for a 15 years [10]. Previous studies have shown that MADs increase the volume and distribution of delivery compared with traditional medical sprays when used prior to oro- and nasotracheal intubations[10-13]. These properties may help to increase patient compliance and improve clinical efficacy without increasing systemic side effects. Furthermore, MADs are relatively inexpensive (\$3 per device) and very portable.

Recently, a pediatric MAD (LMA MADdy™, Teleflex Medical, New York City, USA) was developed for intra-oral applications. The LMA MADdy™ consists of a small atomizing tip at the end of a flexible applicator that is partially concealed by a colorful, child-friendly blowfish used to dispense topical medications to the nose, mouth, throat, hypopharynx, larynx, and trachea in a fine, gentle mist (Figure-1).

The aim of this study was to compare the topical anesthetic effect of a 10% atomized lidocaine spray and an EMLA cream at different time intervals using both objective parameters (vital findings in pulse oximeter) and self reported parameters (visual analogue scale).

Materials and Methods

This randomized split-mouth study was conducted according to the Declaration of Helsinki. The study protocol was approved by the Ethics Board of the Medical Faculty of Erciyes University, Kayseri, Turkey, and all patients gave their written informed consent to participate before inclusion in the study.

Healthy, cooperative children with a score of 4 according to the Frankl scale [14], and between 7 to 10 years of age were selected for the study from among the patients attending the clinic in the Department of Pediatric Dentistry, Erciyes University, Kayseri, Turkey.

Each child had at least one right and one left maxillary second primary molars with caries not requiring pulpotomy/pulpectomy treatment. A supervisor (KC) randomized and noted the application side and a single operator throughout the study performed all the procedures. The child as well as the operator was blinded of the type of product being used. Another blinded person recorded VAS scale and HR score.

Although a single experienced clinician performed all of the anesthesia and treatment procedures, the suitability of patients, randomization of the teeth, as well as monitoring the degree of pain were performed by another clinician. The study was performed in a quiet examination room. A power calculation indicated that we needed 50 teeth in each group to demonstrate the effect at a 91% power.

The topical agents were applied on the buccal mucosa at the second primary molar bilaterally without allowing the subjects to notice which substance was being applied. Atomized lidocaine was always applied to one side and EMLA cream (AstraZeneca, Södertälje, Sweden) was placed on the other side.

The sides where the substances were applied were systematically alternated. Supervisor researcher used online randomizer program for randomized application site (<https://www.randomizer.org/>). The buccal mucosa of the second maxillary premolar was carefully dried, but not rubbed, with a cotton roll prior to application of the topical anesthetic. The gel was applied on a cotton roll that was pressed slightly to the oral mucosa. Atomized lidocaine was applied with use of a single-use new pediatric MAD device. After the application of the agent, a 27-gauge needle was inserted in the buccal mucosa at the second primary molar region bilaterally 10, 30, 60, and 120 seconds during a two-minute period. The needle pricks were always given in the same order (i.e., first the right side and then the left side). A bleeding point from the first needle prick was taken as the reference point for subsequent needle pricks. The needle insertions were not allowed to reach any contact with bone.

To monitor the degree of pain, the responses were measured using both a modified visual analog scale [15] (VAS) and a portable pulse oximeter (CMS50-DLP model, Contec Medical Systems Co. Qinhuaogdao, P.R. China) (Figure-2), which measured heart rate (HR) both before needle insertion and at needle insertions. The child was instructed to mark his/her response to pain over the VAS as explained pre-operatively.

The VAS ratings and heart rates scores were compared for all of the evaluated criteria using a paired sample's *t*-test to determine if there was a statistically significant difference between atomized lidocaine spray and EMLA cream. The *t*-test was also used to determine if the differences in mean values between groups of different ages and gender were statistically significant. The significance level was set at $p < 0.05$.

Results

The mean age of the 30 patients (17 boys, 13 girls) was 8.22 ± 1.8 years. None of participants presented water or gag reflexes during the treatment period. The results of the VAS and heart rate (HR) are presented in Tables 1 and Regarding gender comparisons, there were no significant differences in VAS or HR scores ($p > 0.05$).

VAS Scores

VAS pain rating scores at different insertions of the needle in the buccal mucosa are shown in Table-Compared to the first applications (10 sec), atomized lidocaine and EMLA cream applications significantly decreased scores of VAS at the applications at 30 and 120 seconds, respectively. Despite atomized lidocaine showed early effect compared to EMLA, there were no significant differences in VAS scores between the atomized lidocaine and EMLA cream at the 60 and 120 seconds measurements.

Heart Rate

The mean heart rate was 108.83 (Mean) ± 11.86 (Standard deviation) bpm during the test period. There were significant differences in terms of heart rates between atomized lidocaine and EMLA treatments at 30, 60, and 120 seconds. The mean heart rates during the study are shown in Table

Although HR significantly increased at first anesthetic administration with the atomized lidocaine spray, HR significantly decreased at 30 and 120 seconds administrations.

Discussion

The pain occurring during the administration of a local anesthetic performed before a dental treatment may cause children to become dental phobic or become uncooperative for dental treatments [14]. Therefore, topical anesthetic agents are most commonly used before local anesthesia injections for reducing the pain from needle insertion. Although several types of topical agents have been used in dentistry, EMLA cream is one of the most frequently used topical anesthetic agents by dentists [4,16-18]. On the other hand, since EMLA is not always potent enough to prevent the pain caused by needle insertion to the oral mucosa due to salivary dilution, other topical analgesics have been tested as possible alternatives to analgesic cream [4].

Atomized lidocaine has been widely used in the medical field, especially with nasogastric tube placement and several studies have examined its efficiency as an analgesic. However, for local dental anesthesia, this is the first study to use the LMA MADdy™ atomized spray, which consistently produces a fine spray of approximately 30 microns. This in vivo study has demonstrated that the application of topical anesthesia before needle insertion using a 10% atomized lidocaine was significantly more effective than EMLA in reducing pain. However, while applications of atomized lidocaine spray for 30 seconds were enough to prevent pain from needle insertions, EMLA cream must be used for at least 120 seconds before it significantly decreases pain.

Atomized lidocaine demonstrated superior properties when compared with EMLA cream. For instance, it had a rapid onset of action, it was easily applied, and stayed in place after its application. One of the biggest disadvantages of EMLA is that it is diluted by saliva because of both its slow absorption and its cream-like nature [4]. Therefore, atomized lidocaine may be a better alternative for intraoral use.

In children, pain measurements are clearly a challenge because they are dependent on several physiological and psychological factors. Various pain measurement scales have been used to determine the level of pain in humans. Several studies have evaluated children's self-reports of pain intensity and reported that the VAS shows a good sensitivity and validity for most children over six years of age [4,19-21]. These studies also found that self-reports, when used in conjunction with observer reports of pain, can provide a valuable indication of treatment outcomes in both clinical and research contexts [4,19-21]. On the other hand, cardiovascular neural regulation is the integrated response to a continuous interaction of excitatory reflexes [22]. In physiological conditions, there is

a dynamic closed-loop interaction of these reflexes with rhythmic hemodynamic oscillations, such as those caused by respiratory and vasomotor activity. Thus, it has been proposed that arterial pressure and heart rate may provide indices of neural regulation and, in particular, of the balance between sympathetic and parasympathetic cardiovascular modulation [19,23,24]. In the present study, VAS was used to assess the subjective pain and the pulse oximeter recorded objective pain since this combination of measurements has been shown to be reliable in children [25].

With regard to children's reactions to intraoral injections, girls and boys exhibited similar levels in the present study. Concurring with our study, Ram and Peretz [26] and Allen *et al.* [27] reported no significant gender-specific differences in children's reactions to intraoral injections. In contrast, Peretz [28] reported significantly higher pain scores in girls than in boys. They obtained the data from self-reports completed by patients in the waiting room before the dental procedure. In the present study, children had good communications with the operator and it is possible that the explanation of the benefits of topical anesthesia prior to the dental procedure could have limited the pain scores.

Conclusions

Based on the results of this study, the following conclusions can be made:

Atomized 10% lidocaine-based topical anesthetics significantly reduced pain more rapidly and better than EMLA from needle pricks in the buccal mucosa. Therefore, atomized lidocaine topical anesthesia could be used as a substitute for EMLA cream before buccal anesthetic administration.

On the other hand, this is the first study that has evaluated atomized lidocaine use in dentistry. Therefore, further comprehensive studies are required to explore the effects of several doses of atomized lidocaine in various areas of the oral cavity.

References

1. Huang C, Chen Y, Kou M, Wang X, Luo W, Zhang Y, Guo Y, Huang X, Meng L, Xiao Y. Share Evaluation of a modified ultrasound-assisted technique for mid-thoracic epidural placement: a prospective observational study. *BMC Anesthesiol.* 2024 Jan 19;24(1):31.
2. Mats Bågesund , Parisa Tabrizi. Share Lidocaine 20% patch vs lidocaine 5% gel for topical anaesthesia of oral mucosa. *Int J Paediatr Dent.* 2008 Nov;18(6):452-60.
3. Subramanian P, Kaur I, Choubey K, Arya A, Shenavi LM, Waskle R. Comparative Evaluation of Two Different Topical Anesthetic Agents against Pain Associated with Intraoral Injections in Pediatric Dental Patients. *J Pharm Bioallied Sci.* 2024 Feb;16(Suppl 1):S449-S
4. Park KJ, Choi E, Jung IY, Kim ST. Pharmacologic management of trigeminal nerve injury after endodontic treatment: A retrospective analysis. *J Oral Rehabil.* 2024 Sep;51(9):1737-1747.
5. Das C A, James EP, S J, V P, K G V, Varughese A, Rajesh V, Balan P. Effect of Iontophoresis on the Effectiveness of Nano-Hydroxyapatite and Pro-argin in In-Office Treatment of Dentin Hypersensitivity: A Split-Mouth Randomized Clinical Trial. *Cureus.* 2023 Dec 23;15(12):e50990.
6. Ragit R, Fulzele P, Rathhi NV, Thosar NR, Khubchandani M, Malviya NS, Das S. Iontophoresis as an Effective Drug Delivery System in Dentistry: A Review. *Cureus.* 2022 Oct 25;14(10):e30658.
7. Guo L, Liu X, Liu Q, Xie X, Jiang X. Treatment of Melasma with Tranexamic Acid Essence Combined with Iontophoresis: A Randomized, Double-Blind, Placebo-Controlled Clinical Trial. *Drug Des Devel Ther.* 2024 Aug 20;18:3659-3666.
8. Calderipe CB, Kirschnick LB, Esteves-Pereira TC, Dos Santos ES, Vasconcelos ACU, Lopes MA, Treister NS, Santos-Silva AR. Local anesthesia nerve block for managing burning mouth syndrome: a scoping review. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2024 Jul 22:S2212-4403(24)00394-8.
9. Ocak H, Akkoyun EF, Çolpak HA, Demetoğlu U, Yücesoy T, Kılıç E, Alkan A. Is the jet injection effective for teeth extraction? *J Stomatol Oral Maxillofac Surg.* 2020 Feb;121(1):19-doi: 10.1016/j.jormas.2019.05.001.
10. Wolfe TR, Fosnocht DE, Linscott MS. Atomized lidocaine as topical anesthesia for nasogastric tube placement: A randomized, double-blind, placebo-controlled trial. *Ann Emerg Med* 2000;35:421-425.
11. Ducharme J, Matheson K. What is the best topical anesthetic for nasogastric insertion? A comparison of lidocaine gel, lidocaine spray, and atomized cocaine. *J Emerg Nurs* 2003;29:427-430.
12. Farrington M, Bruene D, Wagner M. Pain management prior to nasogastric tube placement: atomized lidocaine. *ORL Head Neck Nurs* 2015;33:8-16.
13. Kuo YW, Yen M, Fetzer S, Lee JD. Reducing the pain of nasogastric tube intubation with nebulized and atomized lidocaine: a systematic review and meta-analysis. *J Pain Symptom Manage* 2010;40:613-620.
14. AAPD. Guideline on behavior guidance for the pediatric dental patient. *Pediatr Dent* 2008;30:125-133.

15. Farrar JT, Young JP, Jr., LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain* 2001;94:149-158.
16. Abu Al-Melh M, Andersson L, Behbehani E. Reduction of pain from needle stick in the oral mucosa by topical anesthetics: a comparative study between lidocaine/prilocaine and benzocaine. *J Clin Dent* 2005;16:53-56.
17. Yamane A, Higuchi H, Tomoyasu Y, Ishii-Maruhama M, Maeda S, Miyawaki T. Effect of dexmedetomidine injected into the oral mucosa in combination with lidocaine on local anesthetic potency in humans: a crossover double-blind study. *J Oral Maxillofac Surg* 2013;73:616-621.
18. Primosch RE, Rolland-Asensi G. Comparison of topical EMLA 5% oral adhesive to benzocaine 20% on the pain experienced during palatal anesthetic infiltration in children. *Pediatr Dent* 2001;23:11-14.
19. Shields BJ, Cohen DM, Harbeck-Weber C, Powers JD, Smith GA. Pediatric pain measurement using a visual analogue scale: a comparison of two teaching methods. *Clin Pediatr (Phila)* 2003;42:227-234.
20. Shields BJ, Palermo TM, Powers JD, Grewe SD, Smith GA. Predictors of a child's ability to use a visual analogue scale. *Child Care Health Dev* 2003;29:281-290.
21. Rathnam A, Madan N. The language of pain: A short study. *Contemp Clin Dent* 2014;1:142-145.
22. Pagani M, Montano N, Porta A, Malliani A, Abboud FM, Birkett C et al. Relationship between spectral components of cardiovascular variabilities and direct measures of muscle sympathetic nerve activity in humans. *Circulation* 1997;95:1441-1448.
23. Pagani M, Lombardi F, Guzzetti S, Rimoldi O, Furlan R, Pizzinelli P et al. Power spectral analysis of heart rate and arterial pressure variabilities as a marker of sympatho-vagal interaction in man and conscious dog. *Circ Res* 1986;59:178-193.
24. Malliani A, Pagani M, Lombardi F, Cerutti S. Cardiovascular neural regulation explored in the frequency domain. *Circulation* 1991;84:482-492.
25. Breivik H, Borchgrevink PC, Allen SM, Rosseland LA, Romundstad L, Hals EK et al. Assessment of pain. *Br J Anaesth* 2008;101:17-24.
26. Ram D, Peretz B. Administering local anaesthesia to paediatric dental patients -- current status and prospects for the future. *Int J Paediatr Dent* 2002;12:80-89.
27. Allen KD, Kotil D, Larzelere RE, Hutfless S, Beiraghi S. Comparison of a computerized anesthesia device with a traditional syringe in preschool children. *Pediatr Dent* 2002;24:315-320.
28. Uysal BC, Ozkan HD, Kocaturk O. Postoperative evaluation of special needs and healthy patients with endodontic treatment under general anesthesia: a retrospective research. *BMC Oral Health*. 2024 Jul 14;24(1):794

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.