ORIGINAL RESEARCH

DIMINUTION OF PAIN FROM NEEDLE INSERTION IN PALATAL MUCOSA BY TWO TOPICAL ANAESTHETICS: A COMPARATIVE STUDY BETWEEN LIDOCAINE/PRILOCAINE (EMLA) AND BENZOCAINE

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ABSTRACT:
Aim: To compare the topical anesthetic effect of 20% Benzocaine gel with 2.5% lidocaine/ 2.5% prilocaine (EMLA) on the pain experienced during palatal needle insertion. Study design: 80 subjects in the age group of 18 - 60 years were selected for the study. The topical agents were applied on the palatal mucosa at the canine region bilaterally without allowing the subjects to notice which substance is applied. After application of the agents, a 26 gauge sterile needle was inserted till bone contact was achieved near the palate in canine region bilaterally after 10 minutes. The subjects recorded finding using visual analogue scale. Statistical Analysis: The obtained data were compared and statistically analyzed using SPSS version 10. The following descriptive analysis like Student's T-Test, ANOVA (Univariate Analysis of Variance) and Chi-Square Test were applied to determine the significant difference between the two materials. Results: Pain scores were significantly less ($p < 0.05$) with EMLA than with Benzocaine. Conclusion: Topical application of EMLA before palatal needle insertion is associated with less pain than with benzocaine gel.
Key words: Benzocaine, lidocaine/prilocaine, Visual analogue scale.

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INTRODUCTION:

Pain and the fear of pain often hinder people from seeking dental care. Even for minor treatment, which is largely elective, patients and their parents commonly express concerns regarding pain during treatment.[1] Fear of the syringes and needle insertion is very common among children and adults. [2] This may complicate the procedure of local anesthesia prior to dental treatment, both for the patient and the doctor. For this reason topical anesthesia have been in use in order to reduce pain to the patient.[3,4]

Effective administration of a local anesthetic without the need for injection would be a major advance in dental pain control. Benefits to patients and operators might include anxiety reduction and a decline in the number of needle-stick injuries.[5] EMLA is an acronym for (E)eutectic(M)mixture of (L) local (A)anesthetics belongs to amide group. It contains 2.5% lidocaine and 2.5% prilocaine in a 1: 1 ratio by weight.[6] It also contains Arlatone 289 as emulsifier and Carbapol 234 as thickener. Sodium hydroxide is added to bring pH to 9.6. Though the melting points of lidocaine and prilocaine separately are 67^0C and 37^0C respectively, in a proportion of 1:1, the mixture becomes eutectic; that is, the melting point decreases to 18^0 C so that at room temperature, the mixture exists as an oil (liquid phase) rather than as a solid. The eutectic mixture is dispersed in a water phase by means of an emulsifying agent and consists of an aqueous and an

oil phase. Therefore, the quantity of active agent per droplet is greater with approximately 80% of the active local anesthetic substance, and the release of active local anesthetics is more rapid than could be achieved with a non eutectic preparation.[7] Dermal penetration of both lidocaine and prilocaine is enhanced over that which would be seen if each component were applied separately in crystalline form as a 2.5% topical cream. When the pH is adjusted to approximately 9, the oil base has an increased proportion of agents in the lipophilic nonpolar form (as free base) thus promoting transcutaneous absorption.[8]

Benzocaine which is an ethyl ester of para-aminobenzoic acid (PABA) can be prepared from PABA and ethanol by Fischer esterification or via the reduction of ethyl para-nitrobenzoate. Benzocaine is sparingly soluble in water; it is more soluble in dilute acids and very soluble in ethanol, chloroform and ethyl ether. Benzocaine is most commonly used topical anesthetic agent applied as a gel. [9] Various clinical procedures in dentistry carried out on adult and paediatric patients require the use of palatal injections for obtaining local anesthesia. These palatal injections can be painful owing to the thick keratinized palatal mucosa, especially for paediatric patients whose cooperation is an essential for treatment. None of the study used the above two agents in comparison of pain in the palatal region in various age groups excluding paediatric patients. Hence, the aim of the present study was to compare and evaluate the efficacy of topical anesthetic effect of 20% Benzocaine with 5% Lidocaine/Prilocaine cream (EMLA) on the reduction of pain from needle prick in the palate

MATERIALS AND METHODS

The study protocol was approved by the ethical committee of the Institute.

Subjects: The source of the study were the patients who visited the out-patient unit of the Dept of Oral and Maxillofacial Surgery, for the purpose of undergoing minor oral surgical procedures, all of which were to be performed under local anesthesia. All 80 subjects were above 18 years of age and below 60 years of age and were all systemically healthy patients with no history of any medical conditions. A written informed consent was obtained from all the subjects.

Excluding Criteria:

1) Patients allergic to local anesthesia.
2) Patients with impacted canine.
3) Patients with palatal anomalies like cleft palate, palatal cyst and tumor in the palatal region.
4) Patient with history of trauma.
5) Patient who had undergone Orthognathic surgery.
6) Patient who have undergone surgery in the nasopalatine region.
7) Patient who have undergone septo-rhinoplasty.
8) Patient on antimalarials, sulphonamides and antiarrhythmic drugs.

Experimental design

Subjects were seated in an upright position in the dental chair with the head supported by the headrest. This upright position prevents the possibility of the topical agent running posteriorly to the soft palate and pharynx. The subjects were asked to close their eyes to prevent them from seeing the substance applied and mouth prop was used to open their mouth in a passive relaxed position to prevent any muscular tension or temporomandibular joint stress. An assistant used a suctioning device to suck the saliva and to prevent swallowing of the topical agent. Gauze pieces were used to gently rub the palatal mucosa to absorb any saliva. 0.1ml of each topical agent was applied on the palatal mucosa at the canine region bilaterally without allowing the subjects to notice which substance was applied. Benzocaine was applied on one side and EMLA cream was placed on another with cotton buds and the application side was alternated to remove any confounding factor. After application of the agents, a 26 – gauge stainless steel needle was inserted to bone contact in the palate at the canine region bilaterally at around 5mm distance from the margin of the gingiva with two separate needles after 10 minute period. The needle pricks were given in the right side then the left side and the order were alternated. The study was conducted by a single operator, who was trained to position the needle approx 5mm away from the gingival margin with bevel facing towards the bone and insertion till the needle contacts the bone.

To monitor the degree of pain, the responses were measured using Visual Analogue Scale (VAS). VAS is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot

easily be directly measured. The overall pain was assessed by the subjects using 100-mm horizontal VAS with the left end point marked “no pain” and the right end point marked “unbearable pain”, as the primary efficacy parameter. To further substantiate the above results, patients were also verbally asked which side was less painful and results were tabulated. The obtained data was compared and statistically analyzed using SPSS version 10.The following descriptive analysis like Student’s T-Test between mean pain scores , ANOVA (Univariate Analysis of Variance) for drugs and age and also drug and gender and Chi-Square Test for verbal findings were applied to determine the significant difference between the two materials.

RESULT

To monitor the degree of pain, responses were measured using visual analogue scale and the verbal scale. The analysis is done on the findings received with Visual analogue Scale. The group statistics was applied using Student T test to compare the mean pain scores of benzocaine and EMLA. The mean pain score of 37.2± 18.4 for Benzocaine and 17.1 ± 11.1for EMLA was seen. This result was suggestive of needle prick with EMLA to be much less painful then benzocaine (Table 1).

Further independent samples test was done to test the significance of the above results. On comparison of the score, the result was highly significant with p value of 0.000 ($p<0.05$). This result was suggestive of definite reduction of pain perception on the side where EMLA was applied.

Out of 80 patients the age group varied from 18-60 yrs. A comparison of the two topical anesthetic agents was done between three age groups which were categorized in 18-30yr, 31-45yr and 46-60yr age. The mean pain score of 40.8 ± 18.8 , 35.2± 18.9 , 33.9 ± 16.3 respectively in benzocaine group and 17.0 ± 11.8 , 17.1 ± 10.3 , 17.5 ± 12.5 in EMLA group in 18-30yr, 31-45yr, 46-60yr age group respectively was seen (Table 2). The results are indicative of more pain experienced by younger patients compared to older patients on the side where Benzocaine was applied but no such difference in the experience of pain based on age group was noticed on the side where EMLA was applied. ANOVA was done test to compare the mean pain score variation in the three agegroups.It was also applied to compare the anesthetic agents irrespective of the age groups. The result concluded that the efficacy of EMLA much more than Benzocaine with p value 0.00 ($p < 0.05$).

Table 1: Student T-Test, Group Statistics

	Drugs	**N**	**Mean**	Std. Deviation	Std. Error Mean
Pain scale	Benzocaine	80	37.2125	18.49303	2.06758
Pain scale	EMLA	80	17.1875	11.19007	1.25109

Table 2: Univariate Analysis of Variance - Descriptive Statistics based on age group

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
DRUGS	12869.581	1	12869.581	54.731	0.000
AGE_GP	327.116	2	163.558	0.696	0.500
DRUGS * AGE_GP	370.408	2	185.204	0.788	0.457
Error	36212.051	154	235.143		
Total	171324.000	160			
Corrected Total	52949.600	159			

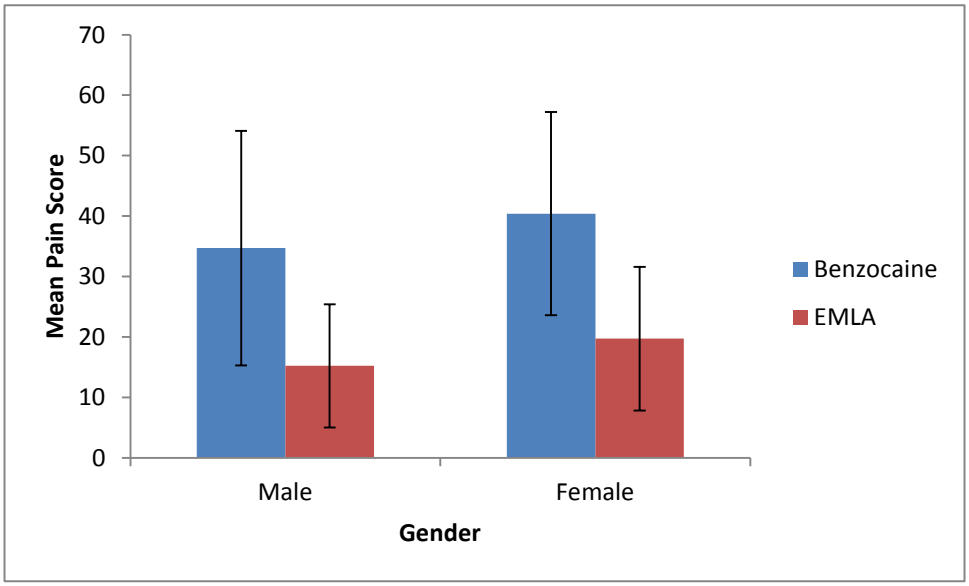
Table 3: Univariate Analysis of Variance - Descriptive Statistics based on gender and drugs

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
DRUGS	15910.406	1	15910.406	69.197	0.000
SEX	1026.057	1	1026.057	4.463	0.036
DRUGS * SEX	14.781	1	14.781	0.064	0.800
Error	35868.737	156	229.928		
Total	171324.000	160			
Corrected Total	52949.600	159			

Table 4: Table showing findings recorded verbally with percentage

Drugs	Frequency	Valid Percent
EMLA	75	93.7
No Difference	5	6.3
Total	80	100

Graph 1: Showing the gender wise variation in pain score with SD in between Benzocaine and EMLA



Out of 80 patients 45 were male patients and 35 were female patients. On the side where benzocaine was applied mean pain score of 34.7 ± 19.4 in males and 40.4 ± 16.8 in females was seen. While on the EMLA side mean pain score of 15.2 ± 10.2 in males and 19.7 ± 11.9 in females was seen. This result was indicative of females experiencing more pain compared to males on the benzocaine side but no such difference seen on EMLA side (Graph 1). Two way-ANOVA (gender and drugs) tests were also done to compare the gender wise variation on the mean painscore. On assessment the efficacy between Benzocaine and EMLA , showed EMLA to be much more effective and the result was significant with p value 0.00 (p< 0.05). But gender wise efficacies between the groups were stastically not significant with p value 0.800 (Table 3).

The Table 4 shows that out of 80 patients, 75 verbally reported the EMLA side to be least painful, 5 patients reported with no difference in pain experienced between EMLA and Benzocaine. So 93.8% told EMLA to be least painful side compared to 6.3% who told no difference in pain experienced between Benzocaine and EMLA. To rule out any confounding factor Chi-Square test was also done and result was highly significant with p value of 0.00 (p < 0.05), suggestive of EMLA being the least painful side to be statistically significant..

DISCUSSION:

The present study included 80 subjects out of which 45 were males and 35 females. Firstly, the mean pain scores of Benzocaine and EMLA were calculated and further analysis was done using various statistical analyses to recognize the significance of the values. The mean pain score difference of 20.0, between two agents was suggesting that the needle prick with EMLA was much less painful compared to Benzocaine (Table-1). The scores between the two scales were subjected to student T test, it showed very high significance with p value being 0.000 (p < 0.05). ANOVA analysis was also done to evaluate the efficacy between the two; it also showed result to be significant with p value 0.000. To substantiate the result, this test was done and result was in confluence with the other previously applied test. The outcome of all these tests divulges a definite difference in pain perception for palatal needle prick in between Benzocaine and EMLA. Two way-ANOVA (gender and drugs) tests were also done to compare the gender wise variation on the mean pain score. On assessment the efficacy between Benzocaine and EMLA , showed EMLA to be much more effective and the result was significant with p value 0.00 (p< 0.05). ANOVA test was applied between the two anesthetic agents and three age groups. On assessment EMLA was found to be much more effective but no differences among age groups.

Additional findings taken verbally showed that 75 patients reported the EMLA side to be least painful, while 5 patients reported with no difference in pain experienced between two sides. To validate the results, Chi square test was done and result was in confluence with the visual analogue scale with p value of 0.00 suggestive of EMLA being significantly less painful compared to benzocaine.

The ability of various topical anesthetics to penetrate the oral mucosa to produce anesthesia has been well documented. In dentistry, topical anesthetics have been used prior to the injection of anesthetic agents and for the suppression of gag reflex. Also, patients suffering from severe ulcerative, desquamative and traumatic lesions of the oral mucosa with associated high levels of pain and discomfort are treated through topically applied anesthetics.[10] Other uses include the drainage of pointing abscesses and removal of loose primary teeth. Such applications in dentistry have led to decrease in the level of pain experienced by the patients, thus leading to better rapport between the patient and the doctor and resulting in greater acceptance of dental procedures. [11]

EMLA is one such topical anesthetic, an eutectic mixture of Lignocaine and Prilocaine in equal proportions along with an emulsifier and a thickener was introduced for medical applications like for intravenous cannulations and harvesting of skin grafts.[12] Its use in the oral cavity was first documented by Holst A and Evers H in 1985.[3] Since then, a number of studies have been conducted to investigate its efficacy for lowering the pain of injection, removal of arch bars, excision of gingival tissues, gingival probing, scaling, root planing and other clinical procedures in paediatric dentistry.[13,14] In a recent study, it was documented that the Lidocaine/Prilocaine cream was able to eliminate or reduce pain from anesthetic needle prick in the maxillary vestibular mucosa[15] and for increasing the threshold to electric pulp testing. Still, the most common topical anesthesia used intraorally

is benzocaine.[16]So this study was conducted to clinically evaluate the efficacy of the topical anesthetic effect of 20% Benzocaine with 5% Eutectic Mixture of Local Anesthesia on the reduction of pain during palatal needle insertion.

A study conducted by Holst and Evers (1985) effects of 2 and 5 min applications of 5% lignocaine and EMLA on the labial gingiva in the mandibular canine region and the palatal mucosa opposite the upper canine on 10 healthy female volunteers. They also concluded that EMLA was significantly better than 5% lignocaine.[3] In the present study, benzocaine was used instead of lignocaine and results were in parallel to the above study.

Literature search revealed that numerous studies have been done using two components on paediatric patients. But no studies till date have compared the two components on various age groups as in the present study. So, the ANOVA analysis (age and drugs) was done and it can be concluded that EMLA is a more efficient anesthetic agent than benzocaine but the results do not vary with age group.

A study conducted by M Mansell-Gregory and B Romanowski to determine the efficacy of EMLA for the control of pain related to cryotherapy on 20 male and 20 female. Women reported significantly higher pain scores than men in the EMLA groups ($p < 0.01$). Our results were in correlation with the present study. [17] Females experienced more pain compared to males and similar results were obtained by Ana Maria Leyda and Carmen Llena. In the study the Girls expressed more needle puncture-related pain than boys. [18]Research in the literature did not reveal any study comparing Benzocaine and EMLA in males and females.

Anesthesia is often a prerequisite for carrying out any treatment likely to be associated with pain. However, the act of inducing anesthesia through conventional injection acts as a deterrent and is cited to be one of ten fears children have about dental experience.[23] Hence, EMLA though requiring a longer time of application under isolation, is still a valuable anesthetic technique in paediatric dentistry.

In the present study, the target region was the palatal mucosa which is a thick keratinized mucosa. This feature may affect the efficacy of penetration of the topical agent thus requiring more time to produce an anesthetic effect. In the present study, we used a thick layer of the topical agent so even with presence of a thick palatal tissue Lidocaine/Prilocaine combination were able to penetrate efficiently and produced a significant degree of anesthesia.

Toxicity of prilocane has been listed as one of the reasons for using EMLA with caution. Two of the metabolites of prilocaine 4-hydroxy-2-methyl aniline and ortho-toluidine are capable of oxidizing hemoglobin to methemoglobin thus EMLA has the potential risk of inducing methemoglobinemia. [19] None of the subjects participating in our study showed any signs of cyanosis symptomatic of methemoglobinemia considering the small amount of EMLA required for anesthesia.

Normally, the small amount of naturally formed methemoglobin in healthy adults and chidren is reduced by Nicotinamide Adenine Dinucleotide dehydrogenase (NADH) methemoglobin reductase. The amount of this enzyme is 40-60% of the adult values in the umbilical cord blood; level increases to those of the adults within 3 months of life. Hence the increased potential risk of methemoglobinemia has lead to the EMLA cream being contraindicated in infants less than 3 months of age. [20]

The results of our study showed the excellent anesthetic property of EMLA compared to Benzocaine when palatal needle insertion was considered with success rate of 93.70%. It can be concluded that topical anesthetic EMLA reduces pain significantly better than 20% benzocaine from needle insertion in the palatal mucosa. It promises to be a viable mode of pain control during palatal needle insertion and can substitute benzocaine before palatal anesthetic infiltration.

REFERENCES

1. Meechan J.G. Intraoral topical anaesthetics: a review.J Dent. 2000 ;28(1):3-14
2. Kleinknecht RA, Klepac RK, Alexander LD. Origins and characteristics of fears in dentistry. J Am Dent Assoc. 1973;86:842-848
3. Hoist A and Evers H. Experimental studies of new topical anesthetics on the oral mucosa. Swed Dent J. 1985; 9 : 185-191
4. Malamed SF: Handbook of local anesthesia (3rd edition). Mosby book Inc 1990 ; 46-73
5. Meechan J.G. The use of EMLA for an intraoral soft biopsy in a needle phobic: a case report. Anesth Prog 2001 ; 48 :32-34
6. Haasio J, Jokinen T , Numminen T , Rosenberg PH. Topical anesthesia of gingival mucosa by 5% eutectic mixture of lignocaine and prilocaine or by 10% lidocaine spray. BrJ Oral Maxillofac

Surg. 1990; 28 : 99-101
7. Ehrenstrom R, GME and Reiz SLA. EMLA- a eutectic mixture of local anesthetics for topical anesthesia. Acta Anesthesiol Scand. 1982; 26 : 596
8. Vitkun SA. Regulatory Affairs: EMLA cream approved. Med Sci Bulletin 1993;15 : 1-2
9. Patricia D, Ignacio P. Synthesis of Two Local Anesthetics from Toluene: An Organic Multistep Synthesis in a Project-Oriented Laboratory Course. J.Chem. Educ.2012; 89: 147–149.
10. Wewers ME and Lowe N.K. A critical review of visual analogue scale in the measurement of clinical phenomenon. Res Nurs Health. 1990; 13: 227-236.
11. Kincheloe JE , Mealiea WL , Mattison GD , Seib K. Psychophysical measurement on pain perception after administration of a topical anesthetic. Quintessence Int. 1991; 22:311-315.
12. Vickers ER, Moorthy P. A clinical evaluation of three topical anesthetic agents. Aust Dent J. 1992 ;37 : 266-270
13. Juhlin L, Evers H, Broberg F. A lidocaine-prilocaine cream for superficial skin surgery and painful lesions. Acta Dermatologica Venerologica (Stockholm) 1980 : 60 ; 544-546
14. Friskopp J, Nilsson M, Isacsson G. The anesthetic onset and duration of a new lidocaine/prilocaine gel intra-pocket anesthetic (Oraqix) for periodontal scaling/root planning. J. Clin Periodontol. 2001; 28: 453-458.
15. Svensson P, Petersen JK and Sevensson H. Efficacy of a Topical Anesthetic on pain and unpleasantness during scaling of gingival pockets. Anesth Prog 1994; 41: 35-39.
16. Pere T , Lizuka T , Rosenberg TH , Lindqvist C. Topical application of 5% eutectic mixture of lignocaine and prilocaine before removal of arch bars. Br J Oral Maxillofac Surg. 1992; 30: 153-156.
17. Malamed SF. Handbook of local anesthesia (5th edition) Mosby book Inc 2004; Pg: 20.
18. Mansell-Gregory M, Romanoswki B: "Randomised double blind trial of EMLA for the control of pain related to cryotherapy in the treatment of genital HPV lesions". Sex Transm Infect 1998 : 74 ; 274-275
19. Leydal AM, Carmen L. Comparison of the eutectic mixture of lidocaine/prilocaine versus benzocaine gel in children. Open Journal of Stomatology 2011 : 1 ; 84-91
20. Pinkham JR. Managing behavior of the cooperative preschool child. Dent Clin North Am. 1995; 39 : 771-787.

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