

# Comparative Study of 10% Lidocaine Hydrochloride Solution with Lidocaine Procaine Emulsion Prior to Local Anesthetic Injection

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## ABSTRACT

Comparative Study of 10% Lidocaine Hydrochloride Solution with Lidocaine Procaine Emulsion Prior to Local Anesthetic Injection Few studies have been conducted with the aim of evaluation and comparison of the effects of local anesthesia on patients. Furthermore, most of these studies address the general effects of anesthetics. Therefore, due to the role that anesthesia plays for patients and lack of information in this regard, the present study aimed to investigate and compare the efficacy of local EMLA and 10% lidocaine hydrochloride solution in mucosa prior to anesthesia injection. Moreover, the Spearman's rank correlation coefficient revealed an insignificant correlation between the age and the anesthetic effect of the four solutions. Local anesthetics are commonly used in dentistry to prevent the stimulation of pain during dental procedures. Given that the usage of local anesthetic agents prior to injections can be effective in reducing pain and anxiety of the patient, no significant difference was observed in the use and efficiency of 4 anesthetic solutions in the present study.

**Keywords:** Lidocaine Hydrochloride; Lidocaine Procaine; Anesthetic Injection; anesthetic

## INTRODUCTION

Dental procedures are associated with pain for most of the patients. Often, the usage of local and profound anesthesia can help the dentist concentrate more on the surgical procedure since they make the patient calm. According to previous studies, the pain caused by local anesthesia injection causes the most discomfort in patients. Moreover, many patients postpone their dental appointments due to their fear of its painfulness. Controlling pain and discomfort in patients has different solutions, which are divided into pharmacological and psychological approaches. Since the pain caused by the injection of the anesthetic solutions make the patients anxious, many dentists use local anesthesia to reduce their inconvenience. The application of local anesthetics plays a crucial role in reducing the fear and anxiety of patients. Moreover, various studies have indicated that the usage of one effective local anesthetic agent can have more significant results, compared to multiple anesthetic injections [1].

Various local anesthetics, such as lidocaine, prilocaine, benzocaine, and lidocaine prilocaine emulsion (EMLA) are used for local anesthesia. It is very common to use the 10% lidocaine

hydrochloride solution as a local analgesic to relieve toothache or reduce the pain of the injections. However, despite its popularity, it is not very effective in reducing pain. Therefore, given the prevalence of toothache, there is a need for an effective and long-lasting local anesthetic. There are various anesthetics available today that provide quick and long-lasting anesthesia which have rarely been reported to cause neurological and systemic deficits. According to some studies, EMLA is more effective in this regard in comparison to lidocaine gel. Moreover, different concentrations of lidocaine prilocaine have been tested on humans in previous studies and caused no complications. Few studies have been conducted with the aim of evaluation and comparison of the effects of local anesthesia on patients. Furthermore, most of these studies address the general effects of anesthetics. Therefore, due to the role that anesthesia plays for patients and lack of information in this regard, the present study aimed to investigate and compare the efficacy of local EMLA and 10% lidocaine hydrochloride solution in mucosa prior to anesthesia injection [2].

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**MATERIALS AND METHOD**

This randomized (with random number table), double-blind, and clinical trial compared the efficacy of four different anesthetic solutions. The selected solution included a 10% lidocaine hydrochloride solution and three different formulations of EMLA with concentrations of 5%, 7.5%, and 10 % (2.5 to 5 wt%), which were made using a non-ionic emulsifier. The used mixture of lidocaine and prilocaine bases in this study was a eutectic physical mixture which had a melting point of less than 20° C. Therefore, by physically mixing the two materials and grinding them, a clear viscous liquid is obtained [3].

This liquid is converted to thermodynamically and kinetically stable emulsions by non-ionic emulsifiers (Tween 80 and Span 20). Different concentrations of these emulsions were prepared in water and used as formulations with the desired concentrations. Lidocaine and prilocaine are two compounds that have low water solubility; therefore, a eutectic mixture with non-ionic emulsifiers was used in order to increase their water solubility. This mixture was used in the preparation of an oil-in-water emulsion with concentrations of 5%, 7.5%, and 10% wt %. These three substances and the lidocaine solution were placed in containers which were numbered from 1 to 4 so that the dentist was unaware of the anesthetic agents.

**Sample selection**

For the purposes of the study, 15 subjects were randomly selected from the patients who had referred to the dental clinic due to moderate chronic periodontitis. The inclusion criteria consisted of 1) the need for flap surgery of maxilla on both sides, 2) not afflicted with systemic diseases that prevent surgery, 3) no usage of neuropathic pain medications or NSAIDs, 4) not allergic to anesthesia, and 5) possession of the desired teeth. The ethical considerations were respected by explaining the purpose of the study for the participants and obtaining their informed consent. Thereafter, on one side of the maxilla, the vestibular mucosa in the first premolars and second molar teeth were dried by dental air-water spray. Afterward, one of the four solutions was applied to the area by a swab and infiltration was performed 3 min later. Subsequently, the pain was measured by visual analog scale (VAS) and in the next session, the same procedure was carried out on the other side of the mouth, on the vestibular mucosa of the identical teeth, using the other two solutions.

**RESULTS**

The results showed that the 7.5% EMLA solution was the most effective on mucosal anesthesia. However, the four solutions had no significant difference in this regard (Table 1).

Friedman test	Median ±IQR*	Mean±SD**	Mouthwash
X2=4.65	1.00±1.00	1.20±1.37	5% EMLA***
P=0.199	1.00±1.00	0.80±1.01	7.5%EMLA
	0.00±1.00	0.87±1.46	10%EMLA

1.00±2.00	1.40±1.59	lidocaine
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**Table 1:** Comparison of the anesthetic effect of the four studied solutions.

Moreover, the Spearman's rank correlation coefficient revealed an insignificant correlation between the age and the anesthetic effect of the four solutions (Table 2).

		5% EMLA	7.5% EMLA	10% EMLA	Lidocaine
Age	Spearman's correlation coefficient	0.110	0.419	0.170	0.165
	P value	0.697	0.120	0.544	0.558

**Table 2:** Correlation of age with the anesthetic effect of the studied solutions (n=15).

The results of this study revealed that lidocaine and 10%EMLA were the most and least effective anesthetic solutions for male participants, respectively. Similarly, lidocaine and 7.5% EMLA were the most and least effective anesthetic solutions for female participants, respectively. In order to determine whether there was a significant correlation between the gender of the participants and the efficacy of the anesthetic agents, the normality of the data regarding the different solutions for both genders was examined. Based on the results of the Shapiro-Wilk test, the distribution of the data was not normal, and despite using different conversions, it remained the same. Therefore, the Friedman test was used and the results indicated that there was no significant difference in the anesthetic effects of the four solutions regarding the gender of the participants (p=0.270 and p=0.439 for male and female, respectively) (Table 3).

Gender	Solution	Mean ± SD	Median ± IQR	Friedman test
Male	5% EMLA	0.50 ± 0.55	0.50 ± 1.00	X2=3.92
	7.5% EMLA	0.83 ± 1.17	0.50 ± 2.00	P=0.270
	10% EMLA	0.17 ± 0.41	0.00 ± 0.00	
	lidocaine	1.00 ± 1.09	1.00 ± 2.00	
Female	5% EMLA	1.67 ± 1.58	1.00 ± 3.00	X2=2.71
	7.5% EMLA	0.78 ± 0.97	1.00 ± 1.00	P=0.439
	10% EMLA	1.33 ± 1.73	1.00 ± 3.00	
	lidocaine	1.67 ± 1.87	2.00 ± 3.00	

**Table 3:** Comparison of the anesthetic effects of the four studied solutions on different genders.

Moreover, in order to investigate the relationship between the age and the efficacy of the solutions the participants were divided by gender. The Spearman's rank correlation coefficient indicated that there was an insignificant association between the age and the efficacy of the solutions in female subjects. However, regarding the male subjects, the Spearman's rank correlation coefficient revealed that the efficacy of 5% EMLA and lidocaine had a negative and insignificant relationship with the age while the efficiency of 5% EMLA% and 10% EMLA had a positive and insignificant relationship with the age. (Table 4).

Gender		5% EMLA	7.5% EMLA	10% EMLA	Lidocaine
Female	Spearman's correlation coefficient	0.483	0.548	0.358	0.346
	P value	0.188	0.127	0.343	0.362
	number	9	9	9	9
Male	Spearman's correlation coefficient	-0.293	0.309	0.393	-0.278
	P value	0.573	0.552	0.441	0.594
	Number	6	6	6	6

**Table 4:** Correlation of age with the efficacy of anesthetic solutions in different genders.

**DISCUSSION**

Local anesthetics are commonly used in dentistry to prevent the stimulation of pain during dental procedures. Since the pain caused by the injection of local anesthetics is an inconvenience for the patients, most dentists are encouraged to use painless methods of injection or apply local anesthetics beforehand. Moreover, the concern about the pain of injections usually causes them to avoid visiting the dentists and seeking treatment. Furthermore, many patients postpone their dentist appointments for the fear of such pain. Previous studies have indicated that using such methods before the injection is very effective in reducing pain and anxiety in patients [4].

Various local anesthetic agents are available for such uses, namely lidocaine, prilocaine, benzocaine, and EMLA (2.5% lidocaine and 2.5% prilocaine). EMLA is an emulsion containing the oily phase of the mixture of eutectic lidocaine and prilocaine at a 1:1 ratio. The present clinical trial aimed to investigate the efficacy of 3 different formulations of lidocaine prilocaine at concentrations of 5%, 7.5%, and 10% (2.5 to 5 wt %), which were prepared using non-ionic emulsifiers and 10% lidocaine hydrochloride. Therefore, in order to measure the

depth of their local anesthesia, they were used prior to infiltration anesthesia injection. These agents had been previously tested on humans and caused no side effects.

Painless anesthesia injection before and during any dental practice is one of the most important factors in this profession. For many years, various local anesthetics have been used to reduce the pain of injection. Therefore, this study was conducted with the purpose of evaluating the anesthetic effects of 4 local anesthetics (i.e., 10% lidocaine hydrochloride, 2.5%, 5%, and 7.5% concentrations of EMLA) prior to infiltration injection. The practice of measuring the quantity of pain is extremely difficult, if not impossible. Huskisson has stated that "pain is a psychological and indexical experience and the observer can never directly measure it". The VAS and its variables have proven useful in children over 6 or 7 years of age as well as adults and provide valid and logical data. Therefore, it was used for the comparison between the four groups of participants in this study.

According to the results of a study conducted by Mishara prilocaine gel was more effective than other local anesthetics based on VAS, since lidocaine and benzocaine were absorbed more slowly, compared to other local anesthetic agents. The pain scores in previous studies indicate that the performance of all local anesthetics increases until a maximum of 30 min after the removal. Moreover, it is possible for the anesthetic effect of lidocaine to last 10-15 min longer for some patients. Based on the results of recent studies, the duration of the efficacy of 2.5% EMLA is 3 min, which increases with the passage of time if it remains within the mouth. Furthermore, the amount of viscosity is also a contributing factor to the effect of local anesthetics. According to the findings of another study, no difference was observed between the efficiency of EMLA gels and that of other local anesthetics. However, the findings of the two above mentioned studies indicated that the anesthetic effect of lidocaine hydrochloride was insignificant and short. Overall, observations have shown that lidocaine hydrochloride practically is not very effective. However, according to the results of VAS and pulse oximetry, 5% lidocaine reduces pain, compared to placebo. In another study performed by Abu Al-Melh [5], it was found that the anesthetic effect of these four solutions did not have a significant difference.

The results of previous studies are various regarding the efficacy of local anesthetics in the reduction of pain in adults. According to the literature review, few studies have investigated the efficacy of the usage of local anesthetics prior to intravenous injections in children. Therefore, the relationship between age and the efficiency of the anesthetic agents has remained unexplored. The findings of a study that aimed to investigate the efficacy of local anesthetics in children revealed that the results of the usage of local anesthetics and their placebo did not differ in children. Furthermore, the results of the present study showed that there is an insignificant correlation between the age and the efficiency of the four selected anesthetic solutions. In general, with the exception of lidocaine and 5% EMLA solutions that had a negative relationship with age in male participants, there was an insignificant association with the effect of the anesthetic agents with the age of all other subjects. It should be noted that none of these solutions had a significant relationship with age.

Various epidemiological studies have indicated an increase in the prevalence of pain in females. Results of clinical and laboratory studies have also shown gender-based differences in pain threshold and sensations that could be due to the nociceptors and gonadal hormones. Moreover, the effect of gender hormones on analgesic neurochemical mediators has been controversial. Previous research has indicated that females have lower pain thresholds, are less tolerant of harmful stimuli and pain compared to males. Findings of a study performed by Gursoy et al. on the gender-based differences regarding the perception of pain, indicated that males felt less pain, compared to females in both EMLA and placebo groups. Few researchers have investigated the relationship between gender and local anesthesia [6, 7].

## CONCLUSION

Given that the usage of local anesthetic agents prior to injections can be effective in reducing pain and anxiety of the patient, no significant difference was observed in the use and efficiency of 4 anesthetic solutions in the present study. Moreover, there was an insignificant relationship between the age and efficiency of the studied solutions. However, due to the insufficient sample size and limitations of the present study, it is suggested for future clinical trials to investigate the effect of different local anesthetic agents and their relationship with age and gender.

## REFERENCES

1. Fincher CL, Thornhill R, Murray DR, Schaller M. Pathogen prevalence predicts human cross-cultural variability in individualism/collectivism. *Proceedings of the Royal Society B: Biological Sciences*. 2008; 275(1640): 1279-1285.
2. Murray DR, Schaller M. Threat(s) and conformity deconstructed: Perceived threat of infectious disease and its implications for conformist attitudes and behavior. *European Journal of Social Psychology*. 2012; 42(2): 180-188.
3. Spielmann N, Laroche M, Borges A. How service seasons the experience: Measuring hospitality services capes. *International Journal of Hospitality Management*. 2012; 31(2): 360-368.
4. Dunham B. The Role for Signaling Theory and Receiver Psychology in Marketing. In: Saad G. (eds) *Evolutionary Psychology in the Business Sciences*. Springer, Berlin, Heidelberg. 2011; 225-256.
5. Terrizzi Jr JA, Shook NJ, McDaniel MA. The behavioral immune system and social conservatism: A meta-analysis. *Evolution and Human Behavior*. 2013; 34(2): 99-108.
6. Kapoor PS, Jayasimha KR, Sath A. Brand-related, consumer to consumer, communication via social media. *IIM Kozhikode Society & Management Review*. 2013; 2(1): 43-59.
7. Torres EN, Adler H, Behnke C. Stars, diamonds, and other shiny things: The use of expert and consumer feedback in the hotel industry. *Journal of Hospitality and Tourism Management*. 2014; 21: 34-43.