

Extraction of Maxillary Teeth without Palatal Injection: A Comparative Study between 4% Articaine Hydrochloride and Lignocaine Hydrochloride

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ABSTRACT

Introduction: Effective control of pain during dental procedures has been one of the most important pre-requisite of painless dentistry. This fact makes local anaesthesia an important part of daily routine for a dentist. In this study, it was intended to know the safety and efficacy of an amide local anaesthetic, Articaine in extraction of maxillary teeth avoiding palatal injection, as compared to that of Lignocaine wherein palatal injection is a requirement and is most commonly used in our country.

Methodology: This study was done on sixty patients who underwent extraction of bilateral maxillary teeth. The mean volume, efficacy, onset, duration of action, and post-operative complications of Articaine HCl were evaluated in comparison with Lignocaine HCl.

Results: Statistical analysis confirmed that 4% Articaine HCl has longer duration of action than Lignocaine HCl. The efficacy of 4% Articaine HCl based on VAS (visual analogue scale) was better than 2% Lignocaine HCl. No significant postanaesthetic complications were observed.

Conclusion: The study concludes that Articaine HCl can be used as an alternative to Lignocaine HCl in extraction of maxillary teeth avoiding palatal injection which is very painful for the patient.

INTRODUCTION

Fear of pain has been associated with dental treatment since ages. The discovery of anaesthesia has been a great boom to the field of dentistry and surgery in general.

In 1943, Nils Lofgren synthesized Lidocaine which was the first modern local anaesthetic agent. It is an amide derivative of diethyl amino acetic acid. Lidocaine was marketed in 1948 and is up to now the most commonly used local anaesthetic in dentistry worldwide. In 1969, Articaine was synthesized by a chemist Muschaweck and was approved in 1975 as a local anaesthetic in Germany.¹ In countries like Norway, Canada, Italy, France, and the Netherlands, Articaine is the number one choice and in Germany more than 90% of local anaesthesia used by dentists is Articaine.²

The immunogenic potential of Articaine is very low. Allergic reactions that have been reported with Articaine are comparable with that of Lidocaine. Therefore, patients allergic to Articaine would likely be allergic to Lidocaine also. One of the reasons why Articaine instantly became so popular in many countries was due to its excellent efficacy. Dentists claimed that they seldom missed with blocks and the buccal infiltration in maxillary arch often was enough before an extraction of tooth because of bone penetration property of Articaine.^{2,3}

Because of the tight binding of the palatal mucosa to its underlying periosteum and its abundant nervous supply, palatal injection can be very painful, which is caused by the displacement of the mucoperiosteum rather than the needle piercing the mucosa.⁴ Many studies have been done to compare various properties of Articaine and Lignocaine.^{2,5-12} There are only few studies which compared the need of palatal injection of Articaine and Lignocaine during extraction of maxillary teeth.^{13,14}

Therefore, this study was conducted to know the efficacy of a new amide local anaesthetic, Articaine in the extraction of maxillary teeth avoiding palatal injection, as compared to that of Lignocaine where in palatal injection is a requirement which is most commonly used in our country. Other parameters which include volume of drug, time of onset, duration of action, efficacy and intra or post administration complications of Articaine hydrochloride (HCl) and Lignocaine HCl were also compared in our study.

METHODS

This study was a randomized controlled trial. Patients visiting the Department of Oral and Maxillofacial Surgery from June 2010 to December 2010 needing bilateral extraction of maxillary teeth were randomly selected for the study. Both male and female patients of age group 16 to 70 years and American Society of Anaesthesiologists (ASA) grade I were included in the study. Medically compromised, hypertensive, diabetic, and pregnant patients were excluded from the study. Total of sixty patients who fulfilled the criterion were selected for the study.

In local infiltration technique, small nerve endings in the submucosa of the area of the dental treatment were flooded with local anaesthetic solution, preventing them from becoming stimulated and creating an impulse. Volume of 0.6-1 ml of 4% Articaine HCl with 1:100000 Adrenaline was injected in buccal vestibule with respect to the tooth to be extracted on one side. Objective symptoms were checked using shepherd probe before extraction procedure. Palatal anaesthesia was achieved without palatal infiltration.

1-2 ml of 2 % Lignocaine HCl with 1:100000 Adrenaline was injected on the other side (control side) for anaesthetizing maxillary teeth to be extracted. Similarly, objective symptoms were checked. Palatal anaesthesia was not achieved. Hence, an additional palatal infiltration was given to anaesthetize palatal mucosa before carrying out extraction procedure. After attaining adequate anaesthesia, extraction procedure was carried out under aseptic condition.

Amount of anaesthetic solution used (volume in ml) in each case and any additional injections required were recorded. Time of onset of anaesthesia was calculated by recording the time of injection and time of patient's first

report of numbness of the upper lip. Objective signs were checked using shepherd probe. Time of onset of anaesthesia was calculated from time of injection till the time of soft tissue anaesthesia achieved. Duration of anaesthesia was calculated by recording the time of onset of anaesthesia and patient reporting the loss of numbness. Efficacy of anaesthesia was determined on gross scale immediately after the procedure using the Visual Analog Scale (VAS) ranging from 0 to 10 where 0 refers to no pain and 10 represents worst pain imaginable. Patients were explained about the Visual Analog Proforma preoperatively and informed to report the numbness of lip as soon as they feel. Any post anaesthetic complications, local or systemic, were observed. The values were compared and statistically analyzed using Z-test and Chi-square test.

RESULTS

Among 60 patients, 37 were males and 23 females. 32 patients were less than or equal to 30 years in age, 28 were above 30 years. Necessary amount of local anaesthetic solution was injected to achieve adequate anaesthesia. The mean volume of Articaine administration was 0.85 ± 0.086 ml and mean volume of Lignocaine was 1.38 ± 0.22 ml. The volume used was less in Articaine group, which was statistically highly significant ($p < 0.001$) (Figure 1).

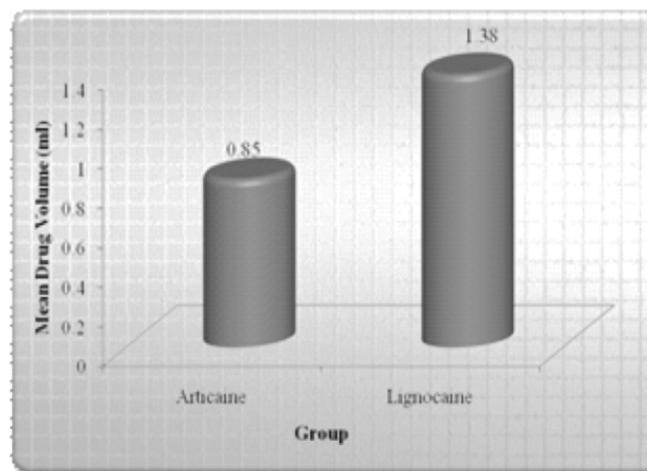


Figure 1: Mean drug volume.

The study showed the mean onset time of anaesthesia in Articaine group was 1.02 ± 0.13 minutes and 1.85 ± 0.36 minutes in Lignocaine group ($p < 0.001$).

A mean duration of anaesthesia of 139.50 ± 34.89 minutes was seen with Articaine group and 116.00 ± 50.04 minutes with the Lignocaine group. Distribution according to duration of anaesthesia (minutes) is shown in table 1. The

difference was statistically significant ($p < 0.01$) giving an inference that Articaine has longer duration of anaesthesia compared to that of control group.

Table 1: Distribution according to duration of anaesthesia (minutes)

Duration (in minutes)	Articaine		Lignocaine	
	No.	%	No.	%
60-89	1	1.67	23	38.33
90-119	12	20.00	6	10.00
120+	47	78.33	31	51.67
Total	60	100.00	60	100.00

Table 2: Distribution according to pain score on buccal side

Pain score on buccal side	Articaine		Lignocaine	
	No.	%	No.	%
0	60	100.00	56	93.33
1	0	0.00	3	5.00
2	0	0.00	1	1.67
Total	60	100.00	60	100.00

Table 3: Distribution according to pain score on palatal side

Pain score on palatal side	Articaine		Lignocaine	
	No.	%	No.	%
0	36	60.0	1	1.67
1	24	40.00	2	3.33
6	0	0.00	11	18.33
10	0	0.00	46	76.67
Total	60	100.00	60	100.00

This study included visual analogue scale evaluation for efficacy analysis. We found no significant difference in pain score on buccal side of Articaine and Lignocaine group (0.00 ± 0.00 , 0.08 ± 0.33 ; $p > 0.05$) (Table 2) but highly significant difference in pain score on palatal side was observed in Articaine and Lignocaine group (0.40 ± 0.49 , 8.83 ± 2.32 ; $p < 0.001$). The distribution according to pain score on buccal side values are depicted in table 3. No complications were observed either in Articaine group or in Lignocaine group.

DISCUSSION

Pain control during any operative or surgical procedure is one of the most important factors for successful treatment. There are various methods used to control pain among which use of local anaesthetic agent is the commonly employed technique in dental practice. It is essential for a local anaesthetic agent to have rapid onset of action, sufficient duration of action, easy metabolization, and injections have to be less painful.

Articaine is not exactly a new drug. It is identified as Articaine in German literature. Articaine is unique among available amide local anaesthetics because it is based on a thiophene structure rather than the typical benzene group. Articaine unlike other amide local anaesthetics undergo biotransformation in both liver and plasma thus clears more quickly from the body. Articaine has a reputation of providing a good local anaesthetic effect. The available literature suggests that Articaine is equally effective when statistically compared to other local anaesthetics.⁵

It is very essential to standardize the procedure whenever we are comparing the efficacy of two anaesthetic drugs. In our study, we have compared the efficacy of 4% Articaine HCl with 2% Lignocaine HCl both with vasoconstrictors during the extraction of maxillary teeth bilaterally. Volume of 0.6-1 ml of 4% Articaine HCl was deposited buccally on one side and 1-2 ml of 2% Lignocaine HCl on the other side was deposited. The parameters i.e. volume of drug used, time of onset of anaesthesia, duration of anaesthesia, and pain ratings were studied. It was observed that on the side where Lignocaine was injected, an additional palatal infiltration was required in order to perform painless extraction whereas palatal infiltration was not required on the side where Articaine was injected.

Articaine is an amide derivative and contains “thiophene ring” in its molecular structure instead of usual benzene ring, making it more lipophilic which is responsible for its diffusion properties within tissues and bones resulting in faster onset of action compared with Lignocaine.¹³ This is the reason we could achieve anaesthesia on palatal side only with infiltration of 4% Articaine HCl on buccal side.

In our study, we found that less amount of Articaine was required to achieve profound anaesthesia when compared to Lignocaine. When Articaine is injected, concentration of active drug at the site of injection is nearly twice that is obtained when Lignocaine is used, hence half the volume of Articaine was sufficient to achieve similar anaesthesia

as shown in the study done by Oertel R et al.¹⁴

Onset and duration periods must be considered when comparing two or more local anaesthetics. An ideal agent should have a rapid onset and should last long enough to allow the completion of the procedure. Articaine with adrenaline has been shown to be comparable with other local anaesthetic with respect to anaesthetic efficacy.¹⁵ Malamed SF et al³ assessed Articaine by the minimum dosage technique with regard to time of onset, degree of anaesthesia, efficiency, duration of soft tissue anaesthesia, and compared with other local anaesthetic solutions. It was found that Articaine without vasoconstrictor was inadequate. Only when Articaine is used with vasoconstrictor, it has a quick and prolonged action as it produces high concentration of active anaesthetic molecules locally.⁴

Malamed et al² conducted a study and found that Articaine 4% provided clinically effective pain relief during most dental procedures and had a time of onset and duration of anaesthesia appropriate for clinical use and comparable to other local anaesthetics. Berlin et al¹⁶ has found mean onset time of pulpal anaesthesia for first molar was shorter than Lignocaine solution when administered with computer controlled delivery system and he also concluded that efficacy of 4% Articaine HCl with 1:100000 adrenaline was similar to the efficacy of 2% Lignocaine with 1:100000 adrenaline for intraligamentary injections. Costa et al¹⁷ also found shorter onset and longer duration of pulpal anaesthesia with Articaine for maxillary infiltration when compared with Lignocaine.

As Articaine has similar efficacy to Lignocaine, its main advantage over Lignocaine is its better safety profile, shorter time of onset, longer duration of action, and great diffusing properties.^{2,5} The present study included both subjective and objective recordings of soft tissue anaesthesia, statistically significant variation between the two agents was observed as to the onset and mean duration of anaesthesia. The results of the study statistically confirm that 4% Articaine with 1:100000 epinephrine has shorter onset and longer duration of anaesthesia when compared to 2% Lignocaine with 1:100000 epinephrine.

It is well documented that palatal injection is a painful experience to the patients. Even though surface anaesthesia does allow for atraumatic needle penetration, palatal injection is still painful because of the density of

palatal tissues and their firm adherence to the underlying bone.⁴ Other techniques like EMLA and TENS were also used to reduce pain of palatal injection. Because of the expense, time required, complexity, and discomfort, these techniques are rarely used.¹⁹ In our study, when Articaine is used, palatal injection was not required for the extraction of maxillary premolars. Other similar studies done by Uckan S et al⁴, Srinivasan et al⁹, Jose et al¹⁸, and Oliveira et al¹⁹ have shown that palatal injection was not required with Articaine for extraction of maxillary teeth.

Our study showed no significant difference in pain score in Articaine palatal-buccal group while significant difference in pain score in Lignocaine palatal-buccal group, and an additional palatal infiltration was required for Lignocaine group to perform painless extraction of maxillary premolars. Pain measurement is difficult to establish, because its perception and intensity are multifactorial, encompassing sensorial and affective factors. Although VAS may show deficiencies regarding understanding and perception, it provides a validated and meaningful measure of anaesthetic efficiency, being used for this purpose by many authors.^{3,5,19}

There are various factors which affect both the depth and duration of a drug's anaesthetic action, either prolonging or decreasing it. These factors include individual response to drug, accuracy in deposition of local anaesthetic, status of tissue at the site of drug deposition, anatomical variation, and volume of anaesthetic agent used. Deposition of the local anaesthetic close to the nerve provides greater depth and duration of anaesthesia compared with local anaesthetic deposited at a greater distance from the nerve to be blocked.

Many studies have compared the anaesthetic efficacy (time of onset, duration of action, and diffusing property) of Articaine and other anaesthetic solutions.^{2,5,15,16,17} Visual analogue scores during and after procedure indicated that Articaine is an effective local anaesthetic. There were no serious adverse events following injection of Articaine.

CONCLUSION

Efficacy of 4% Articaine HCl is comparable to Lignocaine HCl. Amount of local anaesthetic solution required is less for Articaine HCl than Lignocaine HCl. The efficacy of 4% Articaine HCl based on VAS is better than 2% Lignocaine HCl indicating that Articaine provides adequate analgesia for the procedure to be

performed. Articaine HCl can be used as an alternative to Lignocaine HCl in extraction of maxillary teeth avoiding palatal injection which is painful. Clinical advantages like fast time of onset, longer time of duration, and greater diffusing property over Lignocaine HCl could be proved. Numerous factors of variability exist, therefore further controlled clinical trials are essential to bring valuable contribution to research area.

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