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Original Article

Dentistry Section

Maxillary Posterior Teeth Removal Without Palatal Injection –Truth or Myth: A Dilemma for Oral Surgeons

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ABSTRACT

Background: Pain control is one of the most important factors for successful treatment. Each new measure to control pain has been looked as miraculous act at the initial stages. The improvements in agents and techniques for local anaesthesia are probably the most important advances in dental science to have occurred in the past years.

Aim: To evaluate 4% articaine hydrochloride against 2% lignocaine hydrochloride anaesthesia in providing adequate palatal anaesthesia in maxillary posterior regions, without the need for a palatal block.

Settings and Design: Healthy patients above 15 y of age and requiring bilateral extraction of their maxillary posterior teeth were included in this crossover study. The exclusion criteria included medical history of cardiovascular and kidney diseases, gastrointestinal bleeding or ulceration, allergic reactions to local anaesthetic, pregnancy or current lactation.

Materials and Methods: Eighty patients, requiring bilateral extraction of their teeth due to various reasons were enrolled for this study. Each patient received both lignocaine and articaine anaesthetic in equivalent dose at two different appointments. Maxillary infiltration technique was used for extraction of maxillary posterior teeth at both the appointments. A 170-mm Heft Parker visual analogue scale was used to assess the pain on the palatal mucosa after buccal infiltration of either anaesthetic agent. Blood pressure, Pulse rate and electrocardiographic monitoring were done during the procedure. Adverse effects during the study period were also monitored.

Statistical Analysis: Data was analysed by Z-test and student's t-test.

Results: Pain scores on probing palatal mucosa after buccal infiltration of the anaesthetic were more for lignocaine as compare to articaine and it was statistically significant ($p < .001$). However, for hemodynamic parameters and electrocardiographic monitoring, there was no statistically significant difference in blood pressure, pulse rate and electrocardiograph before and after the completion of extraction ($p > 0.05$).

Conclusion: Four percent articaine offers better clinical performance than 2% Lignocaine, particularly in terms of providing adequate palatal anaesthesia with only buccal infiltration.

Keywords: Articaine, Heft-Parker visual analogue scale, Lignocaine, Maxillary buccal infiltration, Palatal anaesthesia

INTRODUCTION

The management of postoperative pain and inflammation is a critical component of patient care [1,2]. The improvements in agents and techniques for local anaesthesia are probably the most important advances in dental science to have occurred in the past years. The agents currently available in dentistry have most of the characteristics of an ideal local anaesthetic. Now anaesthetics can be administered with minimal irritation and little concern for stimulating allergic reactions [3].

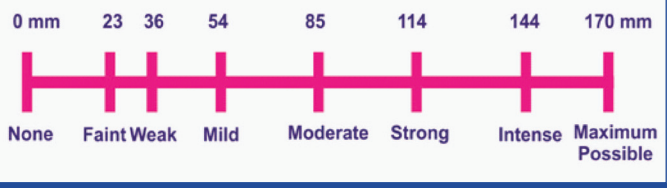
The palatal injection is well recognized as the most painful of all injections in the oral cavity because of the tight binding of the palatal mucosa to its underlying periosteum and its abundant nervous supply [4]. Although a number of adjunctive techniques have been described to reduce the discomfort of palatal injection, they have not gained universal acceptance [5]. It has been claimed that articaine is able to diffuse through soft and hard tissues more reliably than other local anaesthetics and that maxillary buccal infiltration of articaine provides palatal soft tissue anaesthesia [6]. Few previous studies have successfully evaluated articaine local anaesthetic in tooth removal only with buccal anaesthesia, without complementary palatal injection [7-9], while one study had contradictory outcomes [10]. A recent study stated that even the ideal infiltration of lignocaine with a prolonged latency period of eight minutes could bypass the need of palatal injection [11].

In a given clinical scenario, with many local anaesthetics agent currently available it is often difficult for the clinicians to decide which anaesthetic agent would be most efficacious. Against all the above backdrops, this study was planned to evaluate the equivalent doses of which local anaesthetic; lignocaine and articaine provides adequate palatal anaesthesia in maxillary posterior teeth without buccal infiltration, in all the patients needing bilateral extractions due to various reasons.

MATERIALS AND METHODS

Ethical clearance for the study was obtained from Institutional Ethical Committee. Participation in the study was voluntary and informed written consent was obtained from every participant. This study was conducted by joint collaboration of Department of Pharmacology and the Department of Dentistry of JLN Medical College, Ajmer, India for a period of five months from November 2012 to March 2013. Eligibility criteria included both male and female patients above 15 y of age with the absence of systemic illness and absence of any active pathology at the injection site. All the patients who required bilateral extraction of the maxillary posterior teeth due to various reasons were selected. Exclusion criteria included medical history of cardiovascular and kidney diseases, gastrointestinal bleeding or ulceration, allergic reactions to local anaesthetic, pregnancy or current lactation. The extraction procedure for a single patient was performed in two separate visits by the same surgeon. The local anaesthesia technique used was maxillary infiltration anaesthesia.

During the first visit, 1.8 ml (36 mg) of 2% lignocaine with 1:100,000 epinephrine was infiltrated in the right, maxillary buccal vestibule of the indicated tooth. After five minutes, the palatal mucosa was assessed for pain by probing it with shepherd's probe. Simultaneously each patient rated their pain and discomfort on a 170-mm Heft-Parker visual analogue scale (VAS) [Table/Fig-1]. If VAS score of more



[Table/Fig-1]: Heft-Parker visual analogue scale for pain

Variable		
Number of participants		
Enrolled	80	
Completed all visits	80	
Age		
Mean(years+SD)	38.725 + 12.67	
Range	18-67	
Sex(Number)		
M	37	
F	43	
Tooth extracted	Under 2% Lignocaine (Number)	Under 4% Articaine (Number)
a) 1st premolar	16	16
b) 2nd premolar	13	13
c) 1st molar	26	24
d) 2nd molar	13	15
e) 3rd molar	12	12

[Table/Fig-2]: Subjects' demographic characteristics at the screening appointment

Variable	2% Lignocaine Mean + SD	4% Articaine Mean + SD	p-value	Result
VAS* Score (palatal mucosa)	128.96 ± 19.19	32.96 ± 21.06	< .001	HS†

[Table/Fig-3]: Pain scores on probing palatal mucosa without buccal infiltration
** VAS = Visual analogue scale, † HS = Highly significant*

than 54 mm was obtained, a palatal block was administered to the patient. The second visit was scheduled after 5-7 d during which the same patient received 0.9 ml (36 mg) of articaine with 100,000 epinephrine in the left maxillary buccal vestibule of the indicated tooth. Same method for evaluation of palatal pain was followed and pain scores were assigned using VAS as in first appointment. Blood pressure, Pulse rate and electrocardiographic monitoring were done before the administration of local anaesthetic, after five min and after one hour. Adverse effects were monitored throughout the study period.

STATISTICAL ANALYSIS

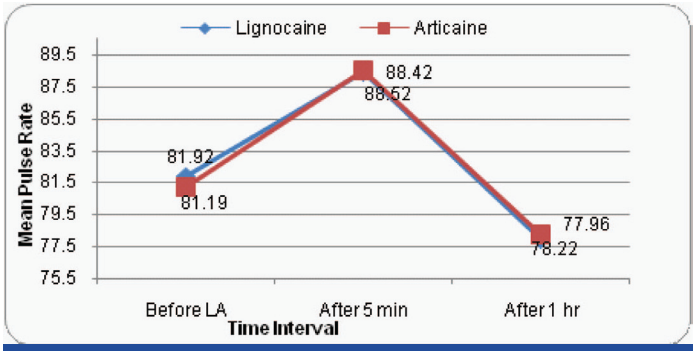
Data was analysed using computer software, Microsoft Excel. Data was recorded either in n (%) or mean ± standard deviation (SD) and Z-test and student's t-test was applied to assess the statistical significance. Values of p<.001 were considered as statistically significant.

RESULTS

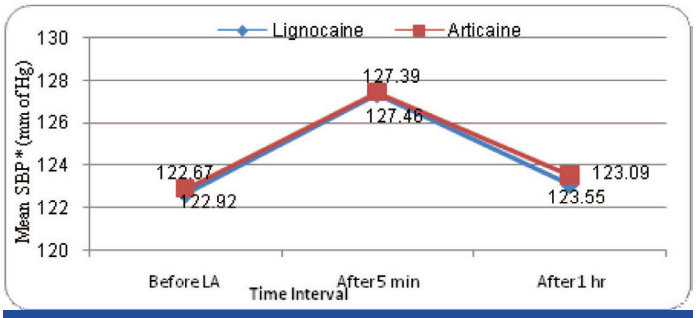
Total 80 patients with age 38.72 + 12.67 years (mean + standard deviation) needing bilateral extraction of upper maxillary posterior teeth were included in the study. During the study period 58 upper premolars and 102 upper molars were extracted [Table/Fig-2]. The pain scores on probing the palatal mucosa after buccal infiltration of the anaesthetic were more for lignocaine and it was statistically significant (p>.001) [Table/Fig-1,3]. Under articaine anaesthesia only five (n= 80) patients required palatal block [Table/Fig-4]. With respect to the hemodynamic parameters and electrocardiographic

Tooth Extracted under articaine anaesthesia	Success rate n (%) (without palatal injection)
a) 1st premolar	16 (100 %)
b) 2nd premolar	13 (100%)
c) 1st molar	20 (83.33%)
d) 2nd molar	14 (93.33%)
e) 3rd molar	12 (100%)

[Table/Fig-4]: Success rate under articaine anaesthesia



[Table/Fig-5]: Mean values of pulse rate



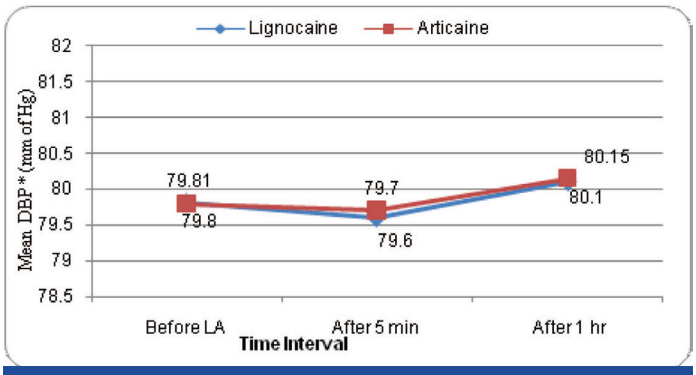
[Table/Fig-6]: Mean values of systolic blood pressure. ** SBP = Systolic blood pressure*

monitoring, there was no statistically significant difference in blood pressure, pulse rate and electrocardiograph before and after the completion of extraction (p > 0.05) [Table/Fig-5-7].

DISCUSSION

For procedures involving manipulation of palatal soft or hard tissues, routine use of palatal anaesthesia is emphasized [12]. Pain control during any operative or surgical procedure is one of the most important factors for reducing the fear and anxiety associated with that dental procedure [13]. Each new measure to control pain has been looked as miraculous act at the initial stages. Local anaesthetics form the backbone of pain control techniques in dentistry and there has been substantial research interest in finding safer and more effective local anaesthetics [14]. Palatal mucosa is more resistant to the effects of topical anaesthetics than other intraoral sites investigated [15].

Articaine is one of the most recent local anaesthetics made available to the dentists worldwide and is unique among amide local anaesthetics in that it contains a thiophene group, which increases its liposolubility. The property of diffusibility through soft and hard tissues makes articaine superior to all other local anaesthetics when used for alleviation of the pain. Epinephrine is included in the clinical formulation both to retard absorption of articaine and to prolong the duration of anaesthesia [16,17]. Articaine is increasingly being used in day care surgeries because of faster onset, shorter elimination time, rapid recovery from sensory and motor blockade and minimal effects on cardiovascular parameters [18]. Articaine also possesses antibacterial effects and can inhibit the growth of *Pseudomonas aeruginosa, Proteus mirabilis, Staphylococcus aureus, Escherichia coli* and many other bacteria [19] and hence, it is extremely useful for certain situations such as: tracheal suctioning and broncho-



[Table/Fig-7]: Success rate under articaine anaesthesia,
** DBP = Diastolic blood pressure*

alveolar lavage, infiltration during local anaesthesia, in nerve blocks and in tumescent anaesthesia for liposuction [20,21].

Although, articaine is assumed to be a safe local anaesthetic, a few contraindications to its use in clinical practice includes the patients allergic to amide- type local anaesthetics, patients allergic to metabisulfites (a preservative present in the formula to extend the half life of epinephrine) [22].

Palatal anaesthesia

Palatal injection is the most painful of all injections in the oral cavity because of the tight binding of the palatal mucosa to its underlying periosteum and its abundant nervous supply [9]. Maxillary tooth removal without palatal anaesthesia has been a topic of much research. A few studies have subjectively evaluated articaine for tooth removal only with buccal anaesthesia without complementary palatal anaesthesia. The results of these studies showed that the routine use of palatal injection for the removal of permanent maxillary teeth may not be required [7-9] while one study had contradictory outcomes [10]. One recent study states that even the ideal infiltration of lidocaine HCl with a prolonged latency period of 8 min could bypass the need of palatal injection [11].

The results of the our study and other studies which demonstrated favourable results for articaine to anaesthetize palatal mucosa, by buccal infiltration only exhibit differences in the sample size, tooth type variances, anaesthetic doses, concentration of vasoconstrictor. Somuri AV et al., employed 1.7 ml of articaine and 2 ml of lignocaine (1.75ml buccally and 0.25 ml palatally) for 30 healthy patients requiring bilateral extraction of maxillary permanent premolars as per their orthodontic treatment plan [23]. While Fan S et al., [7] employed 1.7 ml of articaine volumes as test dose for 71 patients needing bilateral extractions and on control side similar protocol with an addition of palatal injection was applied.

Considering that a given volume of 4% articaine contains twice as much active drug as equivalent volume of 2% lignocaine, the higher concentration of the drug could be a reason for adequate diffusional palatal anaesthesia in the previous studies [7,23]. However, in our study equivalent doses (36 mg) of both the anaesthetics with the same epinephrine concentration (1: 100,000) were compared utilizing crossover study design. Patients needing bilateral extraction of their maxillary posterior teeth due to various reasons were meticulously selected, thereby eliminating the pain perception response resulting from individual differences.

Because of highly varied results in anaesthesia of maxillary teeth, our results are consistent with some previous research, but contradictory to others. The success rate according to reasons for tooth extraction as revealed by our study is orthodontic treatment (100%) = periodontitis (100%) > apical lesions (87.5%) > profound caries (84%) is comparable to the previous study of Uckan S et al., [9]. The present symptoms and reason for extraction of maxillary teeth may play an important role in evaluating the treatment outcomes of research directed at evaluating the efficacy of local anaesthetic solutions. Teeth with irreversible pulpitis are eight times more likely to experience failure of anaesthesia than normal teeth that are not experiencing irreversible pulpitis [24,25] and similar results are mirrored in our study as the teeth with profound caries had least success rate (84%) of anaesthesia in our study also.

In our study, the pain scores on probing palatal mucosa after buccal infiltration of the anaesthetic were more for lignocaine and it was statistically significant ($p < .001$). Under articaine anaesthesia only five patients (6.25%, n= 80) required palatal block whereas an additional palatal block was required in all patients (n= 80) receiving lignocaine; to perform painless extraction of maxillary posterior teeth. Most of the patients in our study verbally described the procedure "totally painless" or reported "a mild pain" when articaine was used as an anaesthetic. This technique was found to be equally effective in all the posterior regions (premolars and molars region) of the maxillary alveolus, irrespective of the buccopalatal alveolar ridge thickness (as evident from the pain scores).

Pain measurement is difficult to establish, because its perception and intensity are multifactorial, encompassing sensorial and affective factors. Although Visual Analogue Scale may show deficiencies regarding understanding and perception, it provides a validated and meaningful measure of anaesthetic efficiency [26].

Hemodynamic parameters

With respect to the hemodynamic parameters and electrocardiographic monitoring, in the present study no statistically significant differences in blood pressure, pulse rate and electrocardiograph before and after the completion of extraction ($p > 0.05$) were noted. The mean rise in the pulse rate after 5 min with both lignocaine and articaine was 7 beats/min and the pulse rate gradually decreased to the basal value after 30 min. These results were congruent to previous studies of Moore et al., [27] and Vasconcellos et al., [28]. An increase in pulse rate immediately after injection was likely an expression of endogenous catecholamine because of the injection pain [29]. In contrast Nusstein et al., [30] did not report a significant increase in the pulse rate with intra-ligamentary injection using the computer–controlled local anaesthetic system with both anaesthetic solutions.

In the present study, the systolic blood pressure increased slightly after 5 min of each of the drug administration and returned to baseline values within an hour of the injection. However the diastolic blood pressure decreased slightly after 5 min of each of the drug administration and returned to baseline values within an hour of the injection and the mean change of the systolic and diastolic blood pressure after one hour from the baseline value was not significant statistically ($p > 0.05$). Similar findings were reflected in the previous studies of several authors including Malamed et al., [14], Brkovic et al., [31], Colombini et al., [32], Martinez et al., [33], Vasconcellos et al., [28]. However finding of Moore et al., [27] were contradictory where only A100 treatment group (receiving 4% articaine with 1:100,000 epinephrine) showed a statistically significant decrease in systolic blood pressure (2.6 mm Hg, $p = 0.0153$) at the completion of the testing session.

Adverse Effects

Review of the literature suggests that articaine has potential to cause methemeglobinemia, neuropathies, paraesthesia, hypersensitivity, and allergy [34-37]. Malamed et al., [16] reported overall incidence of adverse events in the combined studies was 22% for Articaine and 20% Lidocaine of which paraesthesia was 0.9%, hypoesthesia 0.7%, headache 0.55%, infection 0.45%, rash and pain 0.3%.

But in our study we did not come across any adverse effects with both the local anaesthetic. However, a female patient who was undergoing extraction under articaine anaesthesia complained of restlessness, nausea, palpitation and sweating. Mild tachycardia with pulse rate of 106 beats/minute without any arrhythmic changes was noted. Immediately, the procedure was terminated as the patient was having alarming signs of syncope attack. The procedure was

restarted after her recovery. The syncope (vasovagal) attack can occur in routine dental practice and it is attributable to a number of causes. The choice of local anaesthetic used for extraction is not a governing factor for vasovagal syncope.

Although dentist's interest has tremendously increased in articaine over the last few years a recent survey in India indicates that very less percentage of the dentists are currently using articaine [38]. It may be attributed to their lack of knowledge or lack of perceived advantages. However, through continued professional development courses, scientific literature and continuing dental education programmes the current knowledge of the dentist about this local anaesthetic can be upgraded.

The present study was conducted as a cross over design and as such, only a small patient pool was utilized. This may lead to significant operator or patient bias. Moreover pain measurement itself is difficult to establish as both pain perception and intensity are influenced by many factors and also greatly vary among individuals. So, further randomized and single or double blinded clinical trials enrolling more sample population should be undertaken in future to mitigate these problems.

CONCLUSION

Four percent Articaine offers better clinical performance than 2% Lidocaine, particularly in terms of providing adequate palatal anaesthesia with only buccal infiltration. However, further studies involving larger group of population and medically compromised patients are needed to popularize this relatively new drug to be used as a routine anaesthetic agent in dentistry for maxillary posterior teeth removal obviating the need of painful palatal anaesthesia.

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