Forum Article

Anesthetic efficacy of 4% articaine and 2% lignocaine in achieving palatal anesthesia following a single buccal infiltration during periodontal therapy: A randomized double-blind split-mouth study

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Abstract

Background: The aim of this randomized split-mouth double-blind study was to evaluate whether 4% articaine hydrochloride with 1:100,000 epinephrine administered as a single buccal infiltration in the maxillary posterior sextant can provide palatal anesthesia when compared with 2% lignocaine with 1:100,000 epinephrine during scaling and root planing and access flap surgery (AFS).
Material and Methods: A total of 40 patients with chronic generalized periodontitis requiring periodontal therapy in the maxillary posterior sextants were recruited in this study. About 4% articaine and 2% lignocaine were administered as buccal infiltration in a split-mouth design randomly. The pain scores in the palatal aspect were recorded during scaling and root planing and open flap debridement using Heft-Parker visual analog scale. The onset of anesthesia was also recorded and compared.
Results: The success rate for maxillary buccal infiltration to induce palatal anesthesia using articaine was 90% during scaling and root planing and 82.5% during AFS and for lignocaine solution was 20% and 15%, respectively. The difference between the two agents was statistically significant ($P < 0.05$). The onset of anesthesia between articaine and lignocaine was also found to be statistically significant ($P < 0.05$).
Conclusion: In this study, we observed that the efficacy of 4% articaine was superior to 2% lignocaine to induce palatal anesthesia following maxillary buccal infiltration in maxillary posterior sextants.

Keywords: Articaine, lignocaine, nonsurgical periodontal therapy, palatal infiltration, visual analog pain scale

Introduction

Achieving profound local anesthesia is essential for successful patient management in clinical dental practice. The selection of a particular anesthetic technique and agent depends on the arch, number of teeth requiring anesthesia, the area of soft tissue anesthesia required, and duration of the effect.[1]

Lidocaine, an amide local anesthetic continues to remain the anesthetic agent of choice in the dental practice.[1] Articaine hydrochloride, introduced in 1984 as carticaine possesses a thiophene ring instead of a benzene ring and an extra ester linkage.[2] It is less toxic due to hydrolysis by plasma esterases where 90–95% is metabolized in blood and the remaining in the liver.[3] The primary advantage of articaine is its property of diffusion

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through soft tissue and bone enabling palatal anesthesia following buccal infiltration.[3]

Periodontal therapy necessitates separate buccal as well as palatal infiltration of local anesthetics. The ability of articaine to effectively anesthetize the palatal soft tissues of the maxillary arch following a labial infiltration alone has been proven previously during endodontic treatment and tooth extraction.[4-6] The aim of this randomized, double-blind split-mouth prospective study is to compare the anesthetic efficacy of 4% articaine and 2% lidocaine for buccal infiltration in patients undergoing scaling and root planing (SRP) and access flap surgery (AFS) in the maxillary posterior sextants.

Material and Methods

The study was conducted between October 2014 and January 2015. Ethical approval was obtained from the Institutional Ethics Committee and all the subjects signed a written informed consent. This study was planned as a randomized double-blind split-mouth study. Subjects underwent SRP as part of phase-I periodontal therapy and subsequently AFS 4 weeks following SRP. F-test was used to calculate the sample size based on a study by Srinivasan *et al*.[7] To have adequate power, a sample size of 24 cases was found to be required (1-β error). Hence, we incorporated 40 subjects per group in the study.

The inclusion criteria for this study were: (1) Chronic generalized periodontitis diagnosed clinically and radiographically; (2) presence of probing depth of >5 mm in the maxillary posterior sextant bilaterally. The exclusion criteria were: (1) Systemic diseases such as diabetes mellitus type II, hypertension, cardiovascular diseases; (2) allergy to amide local anesthetics; (3) tobacco use in any form; (4) pregnant or lactating women; (5) presence of acute conditions such as periodontal or periapical abscess; (6) immunocompromised patients; (7) previous periodontal therapy in the past 6 months; (7) AFS requiring osseous recontouring; (8) gingival recession.

Nearly 4% articaine hydrochloride with epinephrine 1:100,000 (Septanest, Septodont, France) and 2% lignocaine hydrochloride with epinephrine 1:100,000 (2%, Xylocaine Dental Dentsply Pharmaceuticals, USA) was used in this study. An experienced operator performed SRP and AFS for both the maxillary posterior sextants for all the subjects. Pain score was recorded using Heft-Parker visual analog scale (HP VAS) for both the maxillary sextants before and after administration of the local anesthetic. Briefly, the HP VAS[8] is divided into eight categories - faint (26 mm), weak (36 mm), mild (54 mm), moderate (85 mm), strong (114 mm), and intense (144 mm) pain were rated between none and maximum possible. If any subject reported pain, the score was recorded and palatal anesthesia was administered and the procedure was completed. A single experienced operator gave the injections for all the subjects using a standard aspirating syringe with 27-gauge, 1.5-inch needle. The cartridge was loaded by the staff nurse to ensure that neither the patient nor the dentist was aware of the preparation being injected. Each subject was randomly assigned to receive 4% articaine hydrochloride on one side of the maxillary posterior sextant and 2% lidocaine hydrochloride for the opposite side using a coin toss.

The primary outcome measure of this study was the achievement of palatal anesthesia following only buccal injection to allow for painless instrumentation on the palatal aspect of the maxillary posterior sextant. The secondary outcome measures were the onset and duration of anesthesia.

For statistical analysis, the Statistical Package for Social Science version 15 IBM corporation, Chicago, IL, USA was used. The Mann–Whitney test was used to check for the significant difference between 4% articaine and 2% lignocaine in achieving palatal anesthesia. The "*t*-test" was utilized to evaluate the difference in onset of anesthesia between 4% articaine and 2% lignocaine.

Results

A total of 40 subjects (24 males and 16 females; mean age: 42.7 years) who required SRP and AFS bilaterally in the maxillary posterior sextants participated in the study.

The baseline clinical parameters and the initial pain scores are shown in Table 1. There was no significant difference between the two groups for any of the baseline parameters of probing pocket depth and clinical attachment level ($P < 0.05$). The onset of anesthesia for 4% articaine ranged from 0.5 to 1.2 min and 2% lignocaine ranged between 2.2 and 4 min [Table 2]. There was a statistically significant difference in the onset of anesthesia between the two agents with 2% lignocaine having a longer onset time ($P < 0.05$).

The HP VAS score was recorded both buccally and palatally for all subjects. Data are presented in Table 3. There was no significant difference both within and between the two agents used before injection of the local anesthetic solutions.

The VAS scores were recorded separately for both the anesthetic agents during SRP and AFS and the data are presented in Table 4. The mean VAS score for the articaine group during SRP was 15.60 ± 13.81 and during AFS

Table 1: Baseline clinical parameters

Clinical Parameter	Mean±SD		*P*
	4% articaine	2% lidocaine	
PPD (mm)	5.4±0.966	5.6±0.910	0.67#
CAL (mm)	4.6±1.046	4.7±0.688	0.63#

#Statistically not significant at P>0.05 using the t-test. SD = Standard deviation, PPD = Probing pocket depth, CAL = Clinical attachment loss

Table 2: Onset of anesthesia

Local Anesthetic Formulation	*n* (SRP + AFS)	Mean±SD	*P*
4% articaine	40+40	0.862±0.13	<0.05*
2% lidocaine	40+40	3.01±0.72	

**Statistically significant at P<0.05 using the t-test. 40+40 signifies 40 samples for SRP and 40 samples for AFS. n = Total subjects, SD = Standard deviation, SRP = Scaling and root planning, AFS = Access flap surgery*

Table 3: Initial pain scores between 4% articaine and 2% lidocaine prior to scaling and root planing and access flap surgery

Treatment Procedure	Pain score using HP VAS (mean±SD)			*P*
	n	4% articaine	2% lidocaine	
SRP	40	92.66±23.81	97.32±17.13	>0.05#
AFS	40	89.54±19.01	95.44±20.21	>0.05#

#Statistically not significant at P>0.05 using the t-test. n = Total subjects, SD = Standard deviation, SRP = Scaling and root planning, AFS = Access flap surgery, HP VAS = Heft-Parker visual analog scale

Table 4: Palatal pain scores between 4% articaine and 2% lidocaine during scaling and root planing and access flap surgery

Treatment Procedure	*n*	Pain score using HP VAS (mean±SD)		*P*
		4% articaine	2% lidocaine	
SRP	40	15.60±13.81	87.32±21.84	<0.05*
AFS	40	17.83±14.33	92.51±18.41	<0.05*

**Statistically significant at P<0.05 using the Mann–Whitney U-test. n = Total subjects, SD = Standard deviation, SRP = Scaling and root planning, AFS = Access flap surgery, HP VAS = Heft-Parker visual analog scale*

was 17.83 ± 14.33. The mean VAS scores in the lignocaine group were 87.32 ± 21.84 during SRP and 92.51 ± 18.41 during AFS. There was a statistically significant difference between 4% articaine and 2% lignocaine ($P < 0.05$) during both SRP and AFS.

Only four subjects required additional palatal injection during SRP and seven subjects during AFS in the articaine group, whereas 32 and 34 subject's, respectively, reported pain/discomfort in the lignocaine group.

Discussion

Mechanical debridement of the periodontal pocket is essential to control and prevent progression of periodontal diseases. This requires administration of local anesthetic formulations before the commencement of surgical periodontal therapy. The injection of local anesthetic solutions can cause a profound sense of fear and anxiety to the patient.[9,10] Reduction of pain perception would directly be beneficial in reducing patient anxiety and improving the patient comfort.

The comparison of the VAS pain scores confirmed the lack of patient perceived pain during palatal instrumentation and incision placement following buccal infiltration with 4% articaine.

The results of this study indicate that 4% articaine is superior to 2% lignocaine in achieving palatal anesthesia with a buccal infiltration alone. Although the mechanism of reversible nerve conduction block by articaine is similar to that of other amide-type local anesthetic formulations,[11] articaine diffuses better through soft tissues achieving higher intraneural concentration, more extensive longitudinal spreading, and better conduction blockade.[12] The increasing popularity of articaine as a local anesthetic can be attributed to its superior tissue diffusion properties allowing it to induce palatal anesthesia in the maxilla when administered labially. A confounding factor that could affect the ability of the anesthetic agent to diffuse to the palatal aspect is the cortical bone thickness.

The significantly faster onset of action with 4% articaine in our study can be attributed to the presence of a thiophene ring in its structure enabling it to be more lipophilic is similar to the study results of Hassan *et al.*[13] Oertel *et al.*[14] in a study comparing concentration of 4% articaine and 2% lignocaine showed higher blood levels for articaine in alveolus blood because of higher concentration of 4% articaine when compared with 2% lignocaine in the injection solution.

The palatal mucosa is compact and tightly bound to the underlying periosteum and the palatal tissues have an abundant nervous supply. The pain of the palatal injection is due to the displacement of the mucoperiosteum, rather than the needle piercing the mucosa and is relatively poorly tolerated by patients who have experienced this procedure.[15] A meta-analysis performed in 2010 also shows the superiority of 4% articaine over 2% lignocaine in their use in routine dental procedures.[16]

Anterior and posterior maxillary regions usually differ with respect to cortical bone thickness, thereby possibly affecting the success of infiltration approaches.[4] Therefore, future studies can focus on additionally evaluating cortical bone thickness and comparing it with tissue diffusing capacity of the agents used.

Conclusion

The findings of this study indicate the efficacy of 4% articaine in providing adequate palatal anesthesia following a buccal infiltration in maxillary posterior sextants, thereby avoiding the discomfort associated with palatal injections. This should make clinical practice simpler and more comfortable for patients.

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Conflicts of interest

There are no conflicts of interest.

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