M D J

Assessment of anesthetic efficacy of 4% articaine and 2% Lidocaine during implant pilot hole preparation in the mandibular posterior region infiltration

Dr. Jabbar J. Kareem (Lecturer**).***

Abstract

Aim.The aim of this study was to evaluate and compare the anesthetic efficacy of 4% articaine and 2% lidocaine (both with 1:100,000 epinepherine) for buccal and lingual infiltration in patients need implant placement.

Materials and methods.Forty patients have edentulus regions posterier to mental foramen were divided into 4 study groups and received buccal and lingual infiltration of either 4% articaine or 2% lidocaine. Surgical procedure was begun 5 minutes after solution deposition. Success was defined as no or mild discomfort (VAS recordings) during during pilot hole drill.

Results.The success rate for mandibular infiltration to produce anesthesia using articaine was 100% in premolar and molar area for the articaine solution and success rate was 80% in preamolar and 30% in molar area. There was high significant difference between the articaine and lidocaine solutions (ANOVA P < 0.001).

Conclusion. The efficacy of 4% articaine was superior to 2% lidocaine for mandibular posterior regoin.

Key words:Implant,Aneasthetic,pain,anticaine,lidocaine.

Introduction

Dental implantology has become a widely accepted mode of treatment. Because of its ability to restore esthetics and function, it has become the preferred option for replacing hopeless and missing natural teeth. Despite its high success rate, however, many complications have been encountered with its use. One of the most serious complications is the impairment of sensation after implant placement in the posterior region of the mandible. The prevalence of such a complication has been reported as high as 13 %[1, 2]. This can occur as a result of injury to the inferior alveolar nerve (IAN) or the lingual nerve from traumatic local anesthetic injections or, most commonly, during dental implant osteotomy or placement.[3]Adequate local anesthesia is essential for successful patients management in oral surgery. Many of local anesthetic agents have been used in dentistry, among which lidocaine, which is the most popular one. Articaine was introduced in April 2000 in the United states[4], and it is the most commonly used dental anesthetic in Germany, Italy, Netherlands, and Canada[5]. Articaine is classified as an amide and contains athiophene ring instead of a

*Department of Oral surgery & Periodontology/ Al-Mustansiria University

benzene ring like other amide local anesthetics [4]. A second molecular difference between articaine and other amide local anesthetics is the extra ester linkage incorporated into the articaine molecule,[4] which results in hydrolysis of articaine by plasma esterases.Isen[6] stated that 90% to 95% of articaine is metabolized in the blood, whereas only 5% to 10% is broken down in the liver.Local anesthesia block of the inferior alveolar nerve is routinely taught throughout dental education.This is the most commonly used technique that eliminates all somatosensory perception of the mandible, mandibular teeth, floor of the mouth, ipsilateral tongue, except the lateral (buccal) gingivae. Generally, the dentist or surgeon desires these vital tissues to be anesthetized. However, in the placement of mandibular implants, it may be useful for the patient to be able to sense when the inferior alveolar nerve is in danger of being damaged, possibly producing permanent paresthesia therefore,(IAN) block is not achieved. In this study, the technique of mandibular infiltration prior to mandibular implant placement is studied. The improvement in agents and techniques for local anesthesia are probably the most important advances in dental science that have occurred in the past 100 years.The agents currently available in dentistry have most of the characteristics of an ideal local anesthetic. Nowdays anesthetic agents can be administered with minimal irritation and a rare for allergic reactions.Therefore, The aim of this study was to evaluate and compare the anesthetic efficacy of 4% articaine and 2% lidocaine (both with 1:100,000 epinepherine) for buccal and lingual infiltration in patients need implant placement.

Materials and methods

The study was performed over one -year period. All interventions were performed in a single clinic of dental imlantology at the dental college / Al Mustansiriya University. Forty adult patients aged between 32 and 54 years participated in this study. These 40 patients were selected in such a way that 20 patients had missing mandibular premolar teeth and remaining 20 patients had missing mandibular molar teeth.

These 40 patients were randomly divided into 4 study groups as shown in Table (I) the following procedure was carried out before the surgical treatment is started,

1-A diagnostic periapical x-ray was taken for edentulus region to measure the exact height of bone superior to the IAN canal housing.

2-The patient was prescribed 500 mg of amoxicillin 3 times a day for 7 days and instructed to start prophylactic antibiotic therapy 1 day prior to implant surgery.

On the day of surgery, the patient was administered local anesthesia as the following:

Under sterile conditions, initially, extraoral antisepsis with 0.2% chlorhexidine gluconate and intraoral antisepsis with 0.12% chlorhexidine gluconate were performed [7]. Topical anesthetic gel 2% lidocaine (xylocaine jel) was passively placed at the infiltration site for 60 seconds using a cotton-tip applicator.

A single operator gave all local anesthetic injections using standard dental aspirating syringe fitted with a 27-gauge, 1.5-inch needle. After needle penetration toward the target site, aspiration was performed and anesthetic solution was deposited at the rate of 1 ml/min. Each patient was given one carpule (1.8 ml) of local

aneasthesia is deposited in the lingual side of edentulus area and one carpule of local aneasthesia is deposited in the buccal side of the same area (see Figures 1 and 2).

Group I and group II received 2 carpules of 1.8 mL of 4% articaine with epinephrine 1:100,000 (Septanest, Septodont, France), group III and group IV received 2 carpule of 1.8 mL of 2% lidocaine with epinephrine 1:100,000 (xylocaine 2% with epi 1:100000).

At 5 minutes post injection, crestal incision was made, and full-thickness, mucoperiosteal flap was reflected .The patients were instructed to rate definitively any pain felt during the surgical procedure. If the patient felt pain, the treatment was immediately stopped and the patient rated his or her discomfort using the 10-cm (using visual analogue scale [VAS]). The success of the technique was defined as the ability to access and prepare the bone without pain or mild discomfort (VAS score of 0 or 1). The VAS scores are presented in Table II. After completion of the surgeries, the surgical sites were thoroughly irrigated, suctioned, and sutured. Patients remained in the clinic for the first postoperative hour.

Comparisons of anesthetic success among the 4 groups were analyzed using 1-way analysis of variance (ANOVA) followed by t test. The differences in age were analyzed using 1-way ANOVA, whereas chi-square test was used to determine differences in gender among the groups. Comparisons were considered as significant if *P* value was <0.05.

Results

The age and gender are presented in table III.There were no significant differences among the 4 groups. Anesthetic success is presented in table IV.The success rate for the mandibular infiltration to produce anesthesia in edentulus site using articaine solution was 100% for the premolar region and molar regoin, and for the lidocaine solution, the anesthetic success was 80% in premolar regoin and only 30% in molar regoin**.** The ANOVA indicated a statistically significant difference among the groups (*P* = .001).Therefore, the data were further analyzed using the Tukey's HSD test, which indicated a statistically significant increase in VAS scores of group IV compared with the other 3 groups.

Discussion

Dental implants are now considered the treatment of choice for replacement of all forms of tooth loss. Apart from providing function and esthetics similar to natural dentition, they also provide the most conservative treatment option, especially for single-tooth restoration. One of the serious complications of posterior mandibular implant placement is IAN injury therefore, the present study presented alternative procedure that reduced the chances of such an unpleasant complication.

The patient's age and gender were not significantly different among the 4 groups (Table III).

In the present study, comparisons revealed that the 4% articaine did not statistically improve the anesthetic success of mandibular infiltration compared to 2% lidocaine in patients who need implant (*P* =0.64) (Groups III and I). Nevertheless, in the molar area, there exists a high significant difference (*P* = 0.001) (Groups II and IV) between the two anesthetic solutions (). Kanaa et al. [8] and Robertson et al.[9] found that 4% articaine with 1:100,000 epinephrine was more effective than 2% lidocaine

with 1:100,000 epinephrine in producing pulpal anesthesia in lower molars after buccal infiltration.

Interestingly, a recent study conducted by Corbett et al. [10] showed that the efficacy of 4% articaine infiltration for mandibular first molar was similar to inferior alveolar nerve block (IANB) using 2% lidocaine over a 30-minute study period. Jung et al.(11) compared the anesthetic efficacy of IANB with that of buccal infiltration in mandibular molars. They found that buccal infiltration of 4% articaine was a useful alternative to IANB.

Recently, Evans et al. [12] evaluated the anesthetic efficacy of 4% articaine and 2% lidocaine (both with 1:100,000 epinephrine) in the maxillary lateral incisor and first molar. They found that articaine exhibited a significantly higher success rate than lidocaine in maxillary lateral incisors. We found greater success in obtaining anesthesia in the premolar area and molar area with articaine. Mandibular premolar and molar sites may differ with respect to cortical bone thickness and width of alveolar bone; thereby this difference may affect the success of infiltration approaches. [13]

The mechanism of reversible nerve conduction block by articaine is similar to that of other amide local anesthetics. [14]However, articaine is unique among them, because it contains a thiophene group, which increases its lipid solubility. Lipid solubility determines to what degree the molecules penetrate nerve membranes. [15]

Therefore, articaine diffuses better through soft tissues than do other anesthetics, thereby achieving higher intraneural concentration, more extensive longitudinal spreading, and better conduction blockade. [16]

In the present study, the lack of success with 2% lidocaine in the first molar may be attributable to lower diffusibility of anesthetic solution to encompass all the region of molar, because of wider alveolar bone in the molar region compared to the premolar region. The lower concentration of lidocaine (2%) compared to articaine (4%) may also be a reason for inadequate anesthesia of lidocaine.

Oertel et al. [16] determined the concentration of 4% articaine and 2% lidocaine in alveolus blood using high performance liquid chromatography. Blood samples were collected from the alveolus of upper molars 2 to 14 minutes after submucous injection of 4% articaine and 2% lidocaine (2 mL each). They postulated that higher blood levels found for articaine in alveolus blood compared to lidocaine and this was because of higher concentration of the drug in the injection solution. Potocnik et al.[17] in an in vitro study concluded that 2% and 4% articaine is more effective than 2% and 4%lidocaine or 3% mepivacaine in depressing the compound action potential of the A fibers in the isolated rat sural nerve. In addition, the thiophene derivative (carticaine) blocks ionic channels at lower concentrations than the benzene derivative (lidocaine). The aim of this study was to evaluate and compare the anesthetic efficacy of 4% articaine and 2% lidocaine (both with 1:100,000 epinepherine) for buccal and lingual infiltration in patients need implant placement. [18, 19, 20] Hence, future studies should be aimed at comparing the efficacy of 2% articaine and 2% lidocaine. Within the limitations of the low sample size, we conclude that 4% articaine with 1:100,000 epinephrine was more effective than 2% lidocaine with 1:100,000 epinephrine in producing anesthesia in mandibular posterior area after buccal and lingual infiltration.

References

1- Bartling R, Freeman K, Kraut RA. The incidence of altered sensation of the mental nerve after mandibular Implant placement. J Oral Maxillofac Surg. 1999; 57: 1408–1412.

2- Ellies LG. Altered sensation following mandibular implant surgery: a retrospective study. J Prosthet Dent. 1992; 68:664–671.

3- Hegedus F, Diecidue RJ. Trigeminal nerve injuries after mandibular implant placement—practical knowledge for clinicians. Int J Oral Maxillofac Implants. 2006; 21:111–116.

4- Malamed SF, Gagnon S, Leblanc D. Articaine hydrochloride: a study of the safety of a new amide local anesthetic. J Am Dent Assoc 2001; 32:177-85.

5- Gouws P, Galloway P, Jacob J, English W, Allman KG. Comparison of articaine and bupivacaine/lidocaine for sub-Tenon's anaesthesia in cataract extraction. Br J Anaesth 2004; 92:228-30.

6- Isen DA. Articaine: pharmacology and clinical use of a recently approved local anesthetic. Dent Today 2000; 19:72-7.

7- 7- Hermesch CB, Hilton TJ, Biesbrock AR, Baker RA, Cain-Hamlin J, McClanahan SF, et al. Perioperative use of 0.12% chlorhexidine gluconate for the prevention of alveolar osteitis: efficacy and risk factor analysis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998; 85:381-7.

8- Kanaa MD, Whitworth JM, Corbett IP, Meechan JG. Articaine and lidocaine mandibular buccal infiltration anesthesia: a prospective randomized double-blind crossover study. J Endod 2006; 32:296-8.

9- Robertson D, Nusstein J, Reader A, Beck M, McCartney M. The anesthetic efficacy of articaine in buccal infiltration of mandibular posterior teeth. J Am Dent Assoc 2007; 138:1104-12.

10- Corbett IP, Kanaa MD, Whitworth JM, Meechan JG. Articaine Infiltration for anesthesia of mandibular first molars. J Endod 2008; 34:514-8.

11- Jung IY, Kim JH, Kim ES, Lee CY, Lee SJ. An Evaluation of buccal infiltrations and inferior alveolar nerve blocks in pulpal anesthesia for mandibular first molars. J Endod 2008; 34:11-3.

12- Evans G, Nusstein J, Drum M, Reader AL, Beck M. A Prospective, Randomized, double-blind comparison of articaine and lidocaine for maxillary infiltrations. J Endod 2008; 34:389-93.

13- Haas DA, Harper DG, Saso MA, Young ER. Comparison of articaine and prilocaine anesthesia by infiltration in maxillary and mandibular arches. Anesth Prog 1990; 37:230-7.

14- Oertel R, Rahn R, Kirch W. Clinical pharmacokinetics of articaine. Clin Pharmacokinet 1997; 33:417-25.

15- Raymond SA, Steffensen SC, Gugino LD, Strichartz GR. The role of length of nerve exposed to local anesthetics in impulse blocking action. Anesth Analg 1989; 68:563-70.

16- Oertel R, Richter K, Weile K, Gramatte T, Berndt A, Feller K. A simple method for the determination of articaine and its metabolite articainic acid in dentistry: application to a comparison of articaine and lidocaine concentrations in alveolus blood. Methods Find Exp Clin Pharmacol 1993; 15(8):541-7.

17- Potocnik I, Tomsic M, Sketelj J, Bajrovic FF. Articaine is more effective than lidocaine or mepivacaine in rat sensory nerve conduction block in vitro. J Dent Res 2006; 85(2):162-6.

18- Borchard U, Drouin H. Carticaine: action of the local anesthetic on myelinated nerve fibres. Eur J Pharmacol 1980; 62:739.

19- Abdulwahab M, Boynes S, Moore P, *et al.* The efficacy of six local anesthetic formulations used for posterior mandibular buccal infiltration anesthesia. *J Am Dent Assoc* 2009; 140**:** 1018-1024.

20- Katyal V. The efficacy and safety of articaine versus lignocaine in dental treatments: a meta-analysis. *J Dent* 2010; 38: 307-317 .

Table I. Study groups

Group	No. of patients	Area anesthetized	Anesthetic agent
I	10	Premolars	4% Articaine
4% Articaine	Molars	10	II
2% Lidocaine	Premolars	10	III
2% Lidocaine	Molars	10	IV

Table II. VAS pain ratings for patients during implant procedure

Group IV	Group III	Group II	Group I
3	1	0	0
0	5	0	0
0	0	0	0
7	2	0	0
3	0	1	0
2	0	0	0
6	1	0	1
8	0	0	0
5	1	0	0
0	0	0	0

Table III. The age and gender of patients in the study groups

p- value *	2% Lidocaine		4% Articaine		Value
	Group IV	Group III	Group II	Group I	
0.1	43±2.4 Range 36-49	45±6.4 Range 35-54	44±5.2 Range 35-35	43±7.4 Range 32-44	Age (y) ± Sd
0.8	6 F 4 M	5 F 5 M	5 F 5 M	6 F 4 M	Gender

F: female . M: male. * There was non significant difference(P>0.05)among the 4 groups.

Table IV. percentage and number of patients achieved anesthetic success

p- value *	2% Lidocaine	4% Articaine	Area
0.64	80% (8 0f 10)	100%(10 of 10)	Premolars
	Group III	Group I	
0.001*	30%(3 of 10)	100%(10 of 10)	Molars
	Group IV	Group II	

*: Highly significant

.

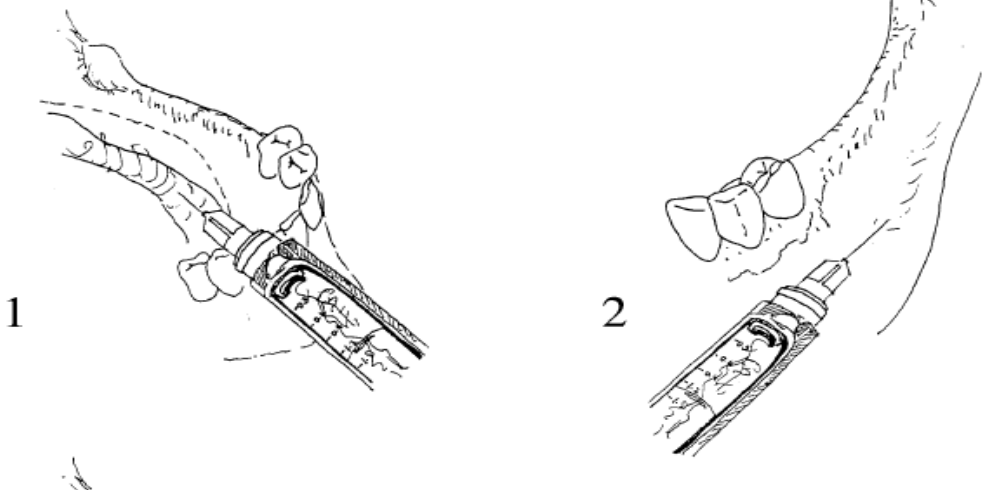

FIGURE 1. Lidocaine infiltrates into the lingual vestibule.
FIGURE 2. Lidocaine infiltrates into the buccal vestibule.