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Research Article

Local Infiltration with 4% Articaine in the Mandible for Extraction: A Controlled Study

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Abstract

Pain management is a very important aspect of any treatment, especially in dentistry, wherein most procedures are carried out under local anaesthesia. However, to ensure maximum patient comfort and compliance during mandibular procedures, inferior alveolar nerve block is the most preferred method of local analgesia even for a surgical site with lesser surface area, as infiltrations have proven to be ineffective in mandibular procedures owing to the buccal cortical plate thickness. Four percent articaine local anaesthetic has been successfully used to attain local anaesthesia for dental procedures, especially in maxilla. Our attempt with this study is to find an alternative to the use of inferior alveolar nerve block as well as multiple infiltrations for the extraction of a single mandibular tooth thus, making the injection less painful to the patient and at the same time maintaining the depth and duration of anaesthesia.

Keywords: Local Analgesia; 4% Articaine; Mandibular Block; Mandibular Infiltration; Pain

Introduction

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage [1]. Management of pain is an important factor in reducing fear and anxiety in dental treatment. When a technique and an agent are chosen, it is important for the clinician to understand the onset, depth and duration of anesthesia [2].

In the mandible it is difficult to achieve anesthesia by infiltration method alone due to the thick cortical bone [3]. Furthermore, infiltration when used alone needs to be given buccally as well as lingually which makes it a painful process for the patient. An excellent alternative to infiltration in the mandible is the inferior alveolar nerve block which anesthetizes the pulp of all the mandibular teeth on one side along with the lingual soft tissues and buccal soft tissues anterior to the mental foramen. The inferior alveolar nerve block however does not anesthetize the buccal mucoperiosteum posterior to the mental foramen. Hence, for extraction of the mandibular posterior teeth, in addition to inferior alveolar nerve block a supplemental buccal infiltration or long buccal nerve block needs to be given to anesthetize the buccal mucoperiosteum posterior to the mental foramen. Inspite of the obvious advantages, it has a high risk of failures and complication [4].

Our endeavor is to find an alternative to the use of inferior alveolar nerve block as well as multiple infiltrations for the extraction of single mandibular teeth, thus, making the injection less painful to the patient and at the same time maintaining the depth and duration of anesthesia.

Lignocaine has long been used efficiently as the local anesthetic agent of choice for dental treatment. Lignocaine, though it achieves excellent anesthesia needs to be injected both buccally and lingually for mandibular infiltration. It has been claimed that Articaine, is able to diffuse through soft and hard tissues due to its greater depth of penetration [2] This property of Articaine has been successfully used for the extraction of maxillary teeth with single buccal infiltration thus obviating the need for painful palatal injections [2].

Our study evaluates the efficacy of 4% articaine buccal infiltration technique in the mandible for extraction of mandibular permanent teeth anterior to the permanent first molar thus obviating the need for supplemental lingual infiltration.

Materials and Methods

The study was carried out on 50 subjects visiting the outpatient desk of the Department of Oral and Maxillofacial Surgery at our institute requiring extraction of mandibular permanent anterior and premolar teeth. This study was approved by the Ethics and Research Committee of the University. All the enrolled patients were explained about the benefits and risks involved in the current procedure in their native language and an informed, written consent was obtained. All patients were also explained about the Visual Analogue Proforma preoperatively.

Patients between age groups of 18 and 59 who met all the criteria under ASA 1 requiring a single mandibular premolar or molar extraction (due to caries or as a part of orthodontic treatment) and with no known allergy to local anaesthetis agents were selected for the study.

A 27-gauge long needle was injected into the depth of the mucobuccal fold below the apex of the tooth to be anaesthetized. The target area was the apical region of the tooth to be extracted. After orienting the needle so that the bevel faces the bone, osseous contact was made while holding the needle parallel to the long axis of the tooth. After withdrawing the needle slightly, and confirming negative aspiration, the local anaesthetic solution was deposited slowly over 60 seconds.

Figure 1: Supra-periosteal injection technique.

Methodology

The entire study was conducted by a single operator with a consistent technique and no additional anaesthetics were utilized. All patients were explained about the Visual Analogue Proforma preoperatively.

In each patient, 1.8 ml. of 4% articaine hydrochloride with 1:100000 adrenaline was injected in the depth of the muco-buccal fold in the buccal vestibule (only) adjacent to the mandibular tooth to be extracted. The technique used for injecting the local anaesthetic agent was supraperiosteal injection technique. The need of a supplementary injection would be considered as a failure.

After extraction, patients were given usual postoperative instructions and the intra-operative pain (pain during extraction) was recorded on the 10cm visual analogue scale (VAS).

All patients were prescribed the following medication

- Cap Amoxicillin (500mg)-TDS for 5 days
- Tab Paracetamol (650mg)-TDS for 5 days
- Chlorhexidine Mouthwash-TDS for 5 days (24hours after extraction)

All patients were told to report to the operating surgeon in case of any complications.

Acquisition of data

Reason for extraction, pain during injection, Time of onset of anaesthesia, amount of anaesthetic agent injected and pain during extraction were recorded.

Parameters

Drug volume

Amount of anaesthetic used (1.8 ml) and any additional injections required were recorded (considered as failure).

Reason for extraction

Reasons for extractions could be orthodontic extraction, extraction of a fractured tooth, periodontally compromised tooth, chronic irreversible pulpitis and pulpal necrosis.

Onset of anaesthesia

Time of onset = time of injection - Time of soft tissue anaesthesia.

Profoundness of anaesthesia

Efficacy is determined by measuring pain ratings on extraction on 10 mm VAS scale. Readings were taken after extraction for both groups ranging from 0 (no pain) to 10 (worst pain imaginable).

Post anaesthetic complications.

Any post anaesthetic complications observed, local or systemic were recorded.

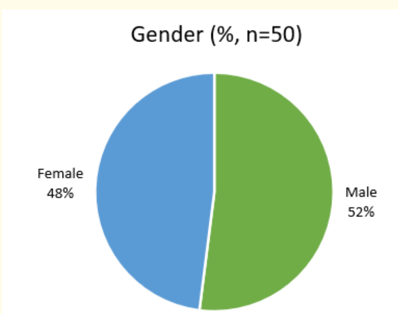
Results

Demography

Gender

	No.	%
Male	26	52.0%
Female	24	48.0%

Table a



Graph 1

In the study, 50 patients were studied. 26 male and 24 female patients were studied.

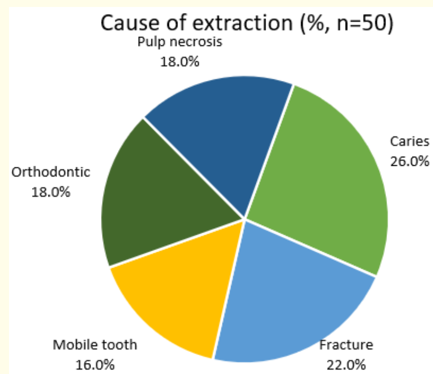
Cause of extraction

When extraction reasons are ranked according to success rate of the study conducted, the order of success is Caries > Fracture > Orthodontic = Pulp necrosis > Mobile tooth.

In this study conducted, the case distribution was caries 26%, fracture 22%, pulp necrosis and orthodontic 18%, mobile tooth 16%.

	Male (n = 26)		Female (n = 24)		Total (n = 50)	
	No.	%	No.	%	No.	%
Caries	6	23.1%	7	29.2%	13	26.0%
Fracture	5	19.2%	6	25.0%	11	22.0%
Mobile tooth	4	15.4%	4	16.7%	8	16.0%
Orthodontic	6	23.1%	3	12.5%	9	18.0%
Pulp necrosis	5	19.2%	4	16.7%	9	18.0%

Table b

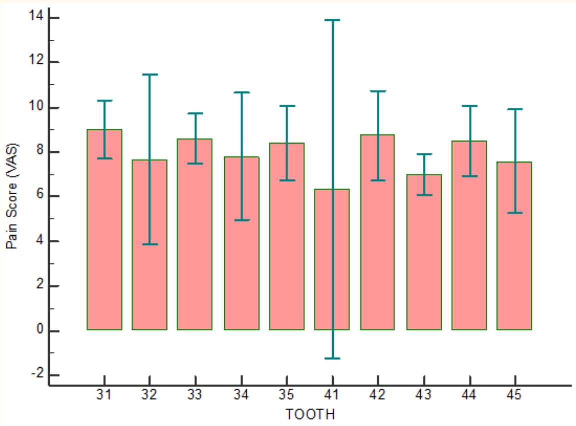


Graph 2

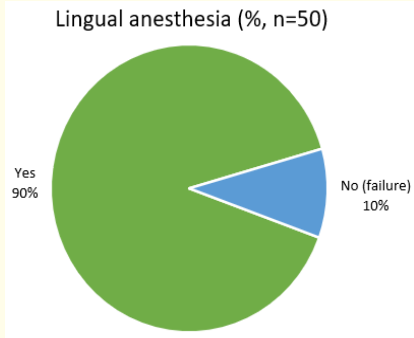
Pain score and tooth

Tooth	n	Mean	SD
(1) 31	4	9.0000	0.8165
(2) 32	3	7.6667	1.5275
(3) 33	5	8.6000	0.8944
(4) 34	5	7.8000	2.2804
(5) 35	5	8.4000	1.3416
(6) 41	3	6.3333	3.0551
(7) 42	4	8.7500	1.2583
(8) 43	6	7.0000	0.8944
(9) 44	4	8.5000	1.0000
(10) 45	7	7.5714	2.5071

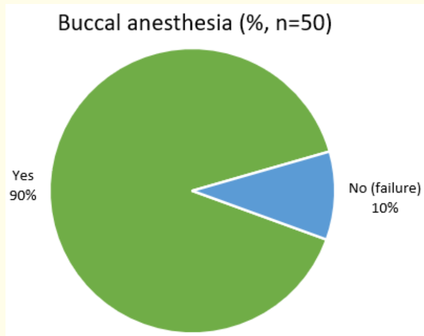
Table 3



Graph 3



Graph 5



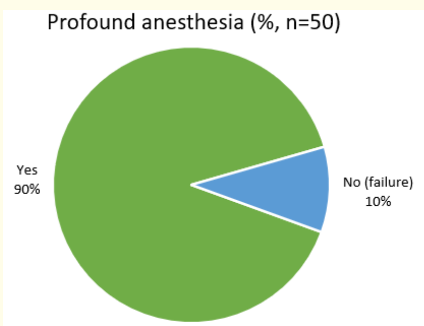
Graph 6

Anaesthesia

Profoundness of anesthesia was evaluated based on VAS. Extractions were conducted if buccal and lingual anesthesia was achieved.

	Yes		No (Failure)	
	No.	%	No.	%
Profoundness of Anaesthesia	45	90.0%	5	10.0%
Lingual Anaesthesia Rating	45	90.0%	5	10.0%
Buccal Anaesthesia Rating	45	90.0%	5	10.0%

Table d



Graph 4

In the following study, 45 out of 50 patients achieved buccal and lingual anesthesia. The success rate of the infiltration was 90%. 5 patients out of 50 did not achieve lingual anesthesia. 10% failure was noted in this study.

Discussion

Local anesthesia forms the backbone of pain control techniques and plays an important part in the success of dental treatment itself [5]. Providing effective pain control is one of the most important aspect of dental care. Indeed, patients rate a dentist as one who can give painless injections and "one who does not hurt" as meeting the first and second most important criteria used in evaluating dentists [6]. An inferior alveolar nerve block is extensively used for restorative procedures in the mandible. For the success of an inferior alveolar nerve bock, an adjuvant long buccal nerve block is always necessary for the extraction of mandibular molars to anesthetize the buccal mucoperiosteum posterior to the mental foramen. It is regarded as the standard technique for mandibular anesthesia regardless of its higher risk for complications including vessel and nerve damages as well as a significant failure rate [8,9].

The success of inferior alveolar nerve block ranges from 53% to 100% as it is technique sensitive and requires skill. Recently, studies are being performed to find an alternative for a nerve block and the efficacy of local infiltration is being evaluated [6,8,13-15]. Hence, practitioners have been searching for safer alternatives for IANB over the past few years. Iinfiltration anesthesia (INF) was often described to meet the requirements of easier and safer administration together with equal qualities of anesthetic effects [11,16,17]. The successful use of primary infiltration anesthesia for treatments in the mandibular deciduous and permanent dentition was reported in several studies [11,18,19].

Despite the gold standard status of lidocaine hydrochloride, numerous reports have advocated the use of articaine hydrochloride as a superior anesthetic agent, primarily on the basis of its enhanced anesthetic potency, which is 1.5 times greater than that of lidocaine, with faster onset and increased success rate [21]. Articaine represents the first and still only local anesthetic developed specifically for use in dentistry [9]. However, only recently infiltration with an articaine formulation has been used to anesthetize mandibular first molars with promising results [22]. There is also evidence that infiltration anaesthesia is efficient for primary teeth in the mandible [11].

The advantages of 4% articaine with 1:100,000 adrenaline infiltration over 2% lignocaine with 1:80,000 adrenaline classical inferior alveolar nerve block are that 4% articaine infiltration is a simpler technique than the classic 2% lignocaine inferior alveolar nerve block, articaine infiltration anesthetizes less soft tissue [29], It has a shorter duration of anesthesia as it is metabolized both in the liver and plasma [29] and avoids trismus and non-surgical paresthesia as a result of damage from the needle to inferior alveolar and lingual nerves [30]. It reduces concentration-related neurotoxicity [30]. Previous studies have shown the superiority of 4% articaine with 1:100,000 epinephrine over 2% lidocaine with 1:100,000 epinephrine when used as a primary buccal infiltration of the mandibular first molar [1]. Skjevik., *et al*. suggested that after the hydrogen bond forms within articaine, the molecule folds over on itself. Kuhn., *et al*. [4] showed that the contribution of the intramolecular hydrogen bonds leads to increased lipophilicity. Nydegger., *et al*. [2] also showed that the chemical makeup of articaine and not the 4% concentration of the anesthetic formulation appeared to be responsible for articaine's superiority [10]. Articaine infiltration can be advantageous in hemophilic patients in order to reduce the chances of dangerous hemorrhage. The articaine infiltrations have shown to be more successful in an adult mandible which was thought to be due to the relatively less thickness of the mandiblular buccal and lingual cortex [9]. Buccal infiltration with 4% articaine with 1:100,000 adrenaline has been shown to achieve higher success rates in mandibular molar anesthesia than that reported with a buccal infiltration of 2% lignocaine with 1:100,000 adrenaline. This increase in efficacy may be a result of a concentration effect or greater diffusion of articaine because of the thiophene ring which helps the anesthetic agent to readily diffuse through the buccal bone [15].

With facial infiltrations, access to these nerves requires that the articaine penetrates the cortical and trabecular bone to be in contact with the apical neural supply. Cortical bone is permeable to nutrients, waste products, and signal molecules. Articaine would most likely permeate cortex as well. However, increased cortical thickness may attenuate the passage of molecules. Intra-osseous lipids and the osseous collagen matrix constituents of a particular bone site and canalicular distribution may influence permeability [22]. Thus, different sites on a bone or different bones may allow drug penetration more or less depending on the microanatomy and biochemistry of a particular osseous site.

The buccal cortical bone is relatively more thin and porous as compared to the lingual cortical bone. The trabecular pattern also changes as per age of the medullary bone and the marrow spaces are found to decrease in size. mandibular apparent bone density showed a significant increase with age (midline males: r¯0.53, n¯18) especially for dentate individuals (r¯0.91, n¯8). The mandible shows great inter individual variability, but there may be a considerable reduction in cross sectional girth of the mandible following tooth loss, and, unlike postcranial sites, an increase in apparent density with age. The density of the bone does not change significantly.

Conclusion

The overall success rate of tooth extraction with single buccal infiltration with 4% Articaine HCl with 1:100000 adrenaline was found to be 90%. It can be concluded that only buccal infiltration with 4% Articaine with 1:100000 adrenaline is an effective technique for the extractions of permanent mandibular anterior and premolar teeth.

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