EVALUATION OF CLINICAL EFFICACY OF 4% ARTICAINE WITH 1:100,000 EPINEPHRINE FOR SURGICAL REMOVAL OF IMPACTED MAXILLARY CANINE

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CHENNAI

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled **"EVALUATION OF CLINICAL EFFICACY OF 4% ARTICAINE WITH 1:100,000 EPINEPHRINE FOR SURGICAL REMOVAL OF IMPACTED MAXILLARY CANINE"** is a bonafide record and genuine research work done by me under the guidance of **Dr. D. SANKAR, M.D.S, FIBOMS, FIBCSOMS,** Professor, Department of Oral & Maxillofacial Surgery, Ragas Dental College and Hospital, Chennai.

Date: 30-01-2019

Place: Chennai

M. Manojkumar

Dr. MUSUNURI MANOJ KUMAR,
Post Graduate Student,
Department of Oral & Maxillofacial Surgery,
Ragas Dental College and Hospital,
Chennai – 119

CERTIFICATE

This is to certify that this dissertation titled **"EVALUATION OF CLINICAL EFFICACY OF 4% ARTICAINE WITH 1:100,000 EPINEPHRINE FOR SURGICAL REMOVAL OF IMPACTED MAXILLARY CANINE"** is a bonafide record of work done by **Dr. MUSUNURI MANOJ KUMAR,** under our guidance and to our satisfaction during his postgraduate study period **2016-2019.**

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RAGAS DENTAL COLLEGE Chennai

Guided by:

Dr. D. SANKAR, M.D.S.,FIBOMS.,FIBCSOMS.
PROFESSOR
DEPARTMENT OF ORAL & MAXILLOFACIAL SURGERY
RAGAS DENTAL COLLEGE & HOSPITAL
CHENNAI - 600 119.

Dr. D.SANKAR,M.D.S.,FIBOMS.,FIBCSOMS,
Professor
Department of Oral &
Maxillofacial Surgery,
Ragas Dental College & Hospital,
Chennai.

Head of the department:

Dr. M. VEERABAHU, MDS,IBOMS
Professor & HOD
Dept of OMFS
RAGAS DENTAL COLLEGE & HOSPITAL
Uthandi, Chennai - 600 119.

Dr. M. VEERABAHU,M.D.S.,IBOMS.,
Professor and Head,
Department of Oral &
Maxillofacial Surgery,
Ragas Dental College & Hospital,
Chennai.

Dr. N. S. Azhagarasan, M.D.S.,
Principal,
Ragas Dental College & Hospital,
Chennai.

PRINCIPAL
RAGAS DENTAL COLLEGE AND HOSPITAL
UTHANDI, CHENNAI-600 119.

THE TAMILNADU Dr. MGR MEDICAL UNIVERSITY

CHENNAI

PLAGIARISM CERTIFICATE

This is to certify that the dissertation titled **"EVALUATION OF CLINICAL EFFICACY OF 4% ARTICAINE WITH 1:100,000 EPINEPHRINE FOR SURGICAL REMOVAL OF IMPACTED MAXILLARY CANINE"** done by the candidate **Dr. MUSUNURI MANOJ KUMAR,** for the award of **MASTER OF DENTAL SURGERY in BRANCH III – Oral and Maxillofacial Surgery.**

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Date: 30-01-2019

Place: Chennai.

Guide sign with seal:

Dr. D. SANKAR, M.D.S.,FIBOMS.,FIBCSOMS,
PROFESSOR
DEPARTMENT OF ORAL & MAXILLOFACIAL SURGERY
RAGAS DENTAL COLLEGE & HOSPITAL
CHENNAI - 600 119.

M. Manoj Kumar

Dr. MUSUNURI MANOJ KUMAR
Post Graduate Student,
Department of Oral & Maxillofacial Surgery,
Ragas Dental College and Hospital,
Chennai.

Dr.D.SANKAR, M.D.S.,FIBOMS.,FIBCSOMS,
Professor,
Department of Oral & Maxillofacial Surgery,
Ragas Dental College & Hospital,
Chennai.

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Introduction

INTRODUCTION

Local anesthesia forms the fortitude of pain control techniques in dentistry. They are chemicals that block the nerve conduction in a specific, temporary, and completely reversible manner without affecting the consciousness of the patient. Though cocaine has significant limitations like it has as a low therapeutic index, the risk of addiction and potentially lethal arrhythmias, it was the drug of choice for the control of surgical and dental pain until the beginning of the twentieth century. New amino amide local anesthetics were synthesized between 1891 and 1930, such as Tropicalize, Holocaine, Benzocaine, and Tetracaine. In addition, amino amide local anesthetics were prepared between 1898 and 1972, including Procaine, Chloropropane, Cinchocaine, Lidocaine, Mepivacaine, Prilocaine, Bupivacaine, Etidocaine, and Articaine.[59]

In 1904, Alfred Einhorn synthesized Procaine that became the main local anesthetic in medicine and dentistry. Later in 1943, Nils Lofgren synthesized Lidocaine which was the first amide anesthetic prepared for local application. With the progressive introduction of Cocaine (1884), Procaine (1904), Lidocaine (1949), dentistry has been in the leading edge to provide patients with pain-free care.[42]

One of the most important prerequisites of dentistry is to achieve effective pain control during dental procedures. Lidocaine was marketed in 1948 and is presently the most commonly used local anesthetic in dentistry worldwide as it was more potent and less allergenic than Procaine. In the succeeding years, another amide local anesthetics (Prilocaine in 1953 by Lofgren and Tegner, Bupivacaine and Mepivacaine in 1957 by A.F Ekenstam, Etidocaine in 1971 by Takman) were introduced. Because of its high efficacy and safety, Lidocaine has become the gold standard drug among the newer

local anesthetic agents. The local anesthetics used in dentistry are classified based on their chemical structure into amides and esters. Unlike ester agents amides produce more rapid and reliable profound surgical anesthesia. Articaine hydrochloride was synthesized by Rusching et al. in 1969 under the name Carticaine and was first marketed in Germany (1976). Articaine differs from the previous amide local anesthetics in that it has a thiophene ring in its molecule instead of the usual aromatic ring which imparts Articaine more lipid solubility.[52] Articaine being a relatively new drug, which needs to be tested to be used as widely accepted anesthesia drug worldwide.

Bhagat et al.[8] conducted a study to compare the anesthetic efficacy of both 4% Articaine and 2% Lignocaine with epinephrine in the truncal block of the inferior alveolar nerve during surgical removal of the impacted mandibular third molars and opined that 4% Articaine has better anesthetic efficacy as compared to 2% Lignocaine. Batista da Silva et al.[7] conducted a study to compare the anesthetic efficacy of 4% Articaine and 2% Lidocaine both with 1:100,000 epinephrine concentration administered as inferior mandibular nerve block and observed that the duration of anesthesia for Lignocaine was 135.5–184.5 min and 145.75–198.75 min for Articaine and providing higher anesthetic success rate and longer duration of anesthesia than Lidocaine.

Shruthi et al.[56] conducted a study to compare the efficacy of Articaine with that of lidocaine and found out that Articaine has similar efficacy as that of Lignocaine with slightly longer duration and can be used as an alternative to Lignocaine in the third molar surgery. Tortamano et al.[10] found a higher success rate with Articaine in pulpectomy of mandibular posterior teeth by inferior alveolar nerve block than Lignocaine. Kanaa et al.[11] found in his study that Articaine buccal infiltration along with inferior alveolar nerve block was more successful than it was with inferior alveolar nerve block alone.

Supplemental injections are essential when, as frequently occurs in patients diagnosed with irreversible pulpitis, pulpal anesthesia from the inferior alveolar nerve block is inadequate, and the pain is too severe for the endodontist to proceed. The success rate of supplemental intraosseous injection of 1.8 ml of 4% Articaine with 1:100,000 epinephrine is like the success rates of 82% to 91% reported for the supplemental intraosseous injection of 1.8 ml of 2% lidocaine with 1:100,000 epinephrine in the posterior mandible. Thus, Articaine has proved to be a successful local anesthetic in all areas of dentistry including endodontics, periodontics, and exodontia and as well as supplementary injection.[12, 56]

It should be aware that Articaine delivers nearly twice the concentration of active anesthetic to the patient; as compared to Lignocaine, thus one half of the amount should achieve similar anesthetic delivery. Due to a dense vascularization and innervation of the palatal mucosa, as well as, it's strong attachment to bone, palatal local anesthesia injections are frequently associated with at least some level of discomfort. With increased diffusion, Articaine can produce profuse pulpal as well as palatal anesthesia after maxillary buccal infiltrations, thus enabling the clinicians to avoid painful palatal infiltration. Shahid et al.[55] found that Articaine can be used as an alternative to Lignocaine in the extraction of maxillary premolars for orthodontic reasons avoiding palatal injections that are painful. But AB Bataineh et al.[3] found that buccal infiltration of 4% Articaine only is not adequate when manipulation of the palatal soft tissue is needed, and an extra palatal infiltration is recommended to produce pain-free extraction.

There are differences between the anterior and posterior regions of the maxilla in innervation and bone quality. The anterior region of the maxilla has greater innervation density than the posterior region, which can affect the diffusion and anesthetic ability of Articaine when used as a buccal infiltration

for tooth extraction without a palatal injection. Different regions of the maxilla have different bone compositions. Age, gender, and race are factors that contribute to variation in bone composition of the maxilla. The anterior region of the maxilla has denser bone than the posterior region, which can affect the diffusion and anesthetic ability of Articaine when used as a buccal infiltration.[3] Thus, the aim of the study is to evaluate the anesthetic efficacy of the Articaine in the surgical removal of the impacted maxillary canine tooth.

Aims & Objectives

AIMS AND OBJECTIVES

The purpose of the study was to evaluate the anesthetic efficacy of 4% Articaine with 1:100,000 epinephrine for surgical removal of impacted maxillary canine in terms of the following.

- Time of onset
- Pain
- Duration of anesthesia
- Hemodynamic changes after the administration of 4 % Articaine with 1:100,000 adrenaline.

Review of Literature

REVIEW OF LITERATURE

Kimmo Vahatalo et al (1993)[28], conducted a study on Articaine and Lidocaine for Maxillary Infiltration Anaesthesia and concluded that infiltration of both 4% Articaine with 1:200,000 epinephrine and 2% Lidocaine with 1:80,000 epinephrine produced adequate anesthesia in all subjects with no side effects and no statistically significant differences between these two local anaesthetics with respect to onset or duration of action.

Reinhard Oertel et al (1997)[52], stated that Articaine is the most widely used local anesthetic agent in dentistry in a number of European countries The amide structure of Articaine is similar to that of other local anesthetics, but it contains an additional ester group which is quickly hydrolysed by esterase's. Rapid sample preparation is critical in the accurate determination of Articaine serum concentrations, since blood and serum are the sites of metabolism. The time to maximum drug concentrations of Articaine occurs about 10 to 15 minutes after submucosal injection of Articaine 4% 80mg, irrespective of epinephrine (adrenaline). The mean maximum plasma drug concentration is about 400 μg/L for Articaine with epinephrine 1:200,000 and 580 μg/L for Articaine without epinephrine. The elimination half-time of Articaine is about 20 minutes. Complete anesthesia can be observed in nearly 90% of all cases, using Articaine 4% 60 to 80mg with epinephrine 1:200,000. Articaine is better able to diffuse through soft tissue and bone compared to other local anesthetics. The concentration of Articaine in the alveolus of a tooth in the upper jaw after extraction was about 100 times higher than that in the systemic circulation. The plasma protein binding rate of Articaine and articainic acid is 70%. It has been concluded that an unintentional intravascular injection of Articaine 80mg does not cause toxic effects in healthy individuals.

Stanley F. Malamed et al (2001)[60], Conducted a study to compare the safety and efficacy of Articaine (4 % with epinephrine 1:100,000) with that of Lidocaine (2 % with Epinephrine 1:100,000). A total of 1,325 subjects participated in these studies, 882 of whom received Articaine 4% with epinephrine 1:100,000 and 443 of whom received Lidocaine 2% with epinephrine 1:100,000. The overall incidence of adverse events in the combined studies were 22% for the Articaine group and 20% for the Lidocaine group. The most frequently reported adverse events in the Articaine group, excluding postprocedural dental pain, were headache 4%), facial edema, infection, gingivitis and paraesthesia (1% each).

Necdet Dogan et al (2003)[41], Forty rats were used in this study. The rats were randomly separated into 4 groups. Three groups were given 2% Lidocaine, 4% Articaine hydrochloride (AH), or injectable saline, and the fourth was a control group. Skin specimens underwent the breaking strength test (BST) and histologic examination at 1 week after the surgical procedure to examine the effect of Articaine hydrochloride on the healing of surgical wounds and to compare healing with that of Lidocaine. The author concluded that the study showed that Articaine hydrochloride is as safe a local anesthetic agent as Lidocaine from the standpoint of wound response.

Costa CG et al (2005)[11], Twenty healthy patients randomly received 1.8 mL of one of the three local anesthetics during operative dentistry procedures of low complexity on three maxillary posterior teeth to compare the onset and duration of pulpal anesthesia by maxillary infiltration using 2% Lidocaine with 1:100,000 epinephrine, 4% Articaine with 1:200,000 epinephrine, and 4% Articaine with 1:100,000 epinephrine. The author concludes both Articaine solutions produced shorter onset and longer duration of pulpal anesthesia by maxillary infiltration than the use of the Lidocaine solution. Statistical analysis did not confirm better clinical results of 4%

Articaine with 1:100,000 epinephrine than with 4% Articaine with 1:200,000 epinephrine.

Feck AS et al (2005)[15], local anesthetic failures in dental patients can have many causes, including anatomical variations, technique and anxiety/fear. By understanding the mechanisms responsible for the failure of local anesthesia, patients can be treated more comfortably. Sedation in oral dentistry is highlighted as a way to reduce anxiety/fear and the patients perception of pain. Profound anesthesia can be accomplished more easily in relaxed patients with diminished or elevated anxiety /fear.

Mohammad Dib Kanaa et al (2005)[38], conducted a study on Articaine and Lidocaine Mandibular Buccal Infiltration Anaesthesia and concluded that 4% Articaine with epinephrine was more effective than 2% Lidocaine with epinephrine in producing pulp anesthesia in lower molars after buccal infiltration (64.5% for Articaine and 38.7% for Lidocaine infiltrations). Both solutions produced mild discomfort during mandibular buccal infiltration.

Hersh Ev et al (2006)[22], conducted a study on the pharmacokinetics and cardiovascular effects of high dose of 4% Articaine with 1:100,000 and 1:200,00 epinephrine in maxillary right first molar infiltration, maxillary left first molar infiltration, maxillary right first premolar infiltration, maxillary left first premolar infiltration, right inferior alveolar nerve injection, left inferior alveolar nerve injection, right and left long buccal infiltrations and analysed venous blood samples of Articaine levels by non-invasive acoustic tonometry to measure a variety of cardiovascular parameters over a two hour period and stated that A200 is as safe as A100 and may be preferred in patients with cardiovascular disease and in those taking drugs that reportedly enhance the systemic effects of epinephrine.

Jason Bigby et al (2006)[25], conducted a study to determine the anesthetic efficacy and effect on heart rate of 4% Articaine with 1:100,000 epinephrine for supplemental intraosseous injection in mandibular posterior teeth diagnosed with irreversible pulpitis. The results demonstrated that anesthetic success was obtained in 86% (32 of 37) of the patients. Maximum mean heart rate was increased by 32 beats/minute during the intraosseous injection. The authors have concluded that when the inferior alveolar nerve block fails to provide profound pulpal anesthesia, the intraosseous injection of 4% Articaine with1:100,000 epinephrine would be successful 86% of the time in achieving pulpal anesthesia in mandibular posterior teeth of patients presenting with irreversible pulpitis.

S**ina Uckan et al (2006)[59],** experiments to know whether Articaine HCl could provide palatal anesthesia in maxillary tooth removal without the need for a second palatal injection. Results demonstrated permanent maxillary tooth removal with palatal injection (97.5%)and without palatal injection (96.8%) were compared the difference was not statistically significant (*P* _ .05). The author suggested permanent removal of maxillary teeth without palatal injection is possible by depositing 2 mL Articaine to the buccal vestibule of the tooth.

Alejandro Sierra Rebolledo et al (2007)[1], conducted a randomized double-blind clinical trial with 30 patients programmed for the bilateral surgical extraction of symmetrical lower third molars compared with anesthetic efficacy of 4% Articaine versus 2% Lidocaine in inferior alveolar nerve block during surgical extraction of impacted lower third molars. Statistically significant differences (p = 0.003) were observed in the mean duration of anaesthetic effect (220.86 min. for 4% Articaine vs. 168.20 min. for 2% Lidocaine). The author suggests that 4% Articaine offers better clinical performance than 2% Lidocaine, particularly in terms of latency and duration

of the anesthetic effect. However, the differences in anesthetic efficacy of the two solutions were not significant.

M. Anthony Pogrel (2007)[33], reported that permanent nerve involvement following inferior alveolar nerve block may occur from 1 in 20,000 to 850,000 patients with little information on local anesthetic used by the author. Patients with permanent nerve damage from blocks were recorded. Lidocaine was associated with 35 %, with Articaine causing approximately 30 % of the cases. Nerve blocks may cause permanent damage to the nerves, independent of the local anesthetic used. The author concludes that Articaine is associated with this phenomenon in proportion to its usage.

Carlos F. Santos et al (2007)[9], Fifty healthy volunteers underwent removal of symmetrically positioned lower third molars, in 2 separate appointments, under local anesthesia with either A100 or A200, in a double-blind, randomized, and crossed manner to compare the use of 4% Articaine in association with 1:100,000 or 1:200,000 epinephrine in the lower third molar removal. The results demonstrated that A100 and A200 similar latency (1.64 +/- 0.08 and 1.58 +/- 0.08 minutes, respectively; *P* >.05). The 2 solutions provided a similar duration of postoperative analgesia regardless of bone removal (around 200 minutes; *P*> .05). The 2 solutions also had a similar significant duration of anesthetic action on soft tissues (around 250 minutes; *P* >.05). The surgeon's rating of intraoperative bleeding was considered very close to minimal. Transient changes in hemodynamic parameters were observed, but these were neither clinically significant nor attributable to the type of anesthetic used (*P*>.05). The authors conclude an epinephrine concentration of 1:100,000 or 1:200,000 in 4% Articaine solution does not affect the clinical efficacy of this local anesthetic. It is possible to successfully use the 4% Articaine formulation with a lower concentration of epinephrine (1:200,000) for lower third molar extraction with or without bone removal.

Foster W et al (2007)[16], conducted a study on 3 sets of injections – an inferior alveolar nerve block plus a mock buccal and a mock lingual infiltration of the mandibular first molar, an inferior alveolar nerve block plus a buccal infiltration and a mock lingual infiltration of the mandibular first molar in three separate appointments spaced at least one week apart. For the IANB plus mock buccal plus mock lingual infiltrations successful pulpal anaesthesia ranged from 53–74%. For IANB mock lingual plus buccal infiltration successful pulpal anaesthesia ranged from 57–69%. The success rate for the IANB for mock buccal plus lingual infiltration ranged from 54-76% and concluded that adding a buccal or lingual infiltration of 1.8ml of 2% Lidocaine with 1:100,000 epinephrine to and IANB did not significantly increase anaesthetic success.

Lacet-Lima et al (2007)[29], Evaluated the buccal vestibular - palatal diffusion of 4% Articaine with epinephrine 1:100,000 and 1:200,000 in maxillary impacted third molars without palatal injection on two hundred teeth and resulted the lack of necessity of supplemental palatal anaesthesia was 1A(84%), 1B(98%), 2A(78%), 2B(82%). The author concluded that most of the extractions could be performed only with buccal vestibular anesthesia and vasoconstrictor concentration and the time interval between administration of the anesthetic and initiation of surgery did influence buccal palatal diffusion.

Paul A. Moore et al (2007)[45], conducted a study on Haemostatic and Anesthetic Efficacy of 4% Articaine HCl With 1:200,000 Epinephrine and 4% Articaine HCl With 1:100,000 Epinephrine When Administered Intraorally for Periodontal Surgery. Significant differences between the A100 and A200 treatments were found for the surgeon's ability to visualize the surgical field (rated as clear 83.3% of the time with A100 and 59.5% of the time with A200; P = 0.008), bleeding expectation (rated as equal to or better than expected 85.7% of the time with A100 and 71.4% of the time with A200; P = 0.034), and volume of blood loss (54.9 +/- 36.0 ml for A100 and 70.2 +/- 53.0 ml for

A200; P = 0.018). Sixteen patients experienced 27 mild or moderate adverse events; the most common were postoperative pain (nine patients) and swelling (eight patients. The author observed that patients undergoing periodontal surgery, 4% Articaine anesthetic formulations containing epinephrine (1:100,000 or 1:200,000) provided excellent surgical pain control. For patients who can tolerate higher amounts of epinephrine, the 4% Articaine With 1:100,000 epinephrine formulation had the additional therapeutic advantage of providing better visualization of the surgical field and less bleeding.

Andrew Haase et al (2008)[2], conducted a study Comparing anesthetic efficacy of Articaine versus Lidocaine as a supplemental buccal infiltration of the mandibular first molar after an inferior alveolar nerve block found that mandibular buccal infiltration of the first molar after a standard IAN block, 4 % Articaine with 1:100,000 epinephrine resulted in a higher success rate (88 %) than 2 % Lidocaine with 1:100,000 epinephrine (71 % success rate).

Aurelia Alemany-Martínez et al (2008)[5], prospective study was made of 80 normotensive individuals (40 females and 40 males, mean age, 27 years [range, 18 to 67 years]) for surgical extraction of the lower third molars to determine the hemodynamic changes in healthy patients during the surgical removal of lower third molars, and to evaluate whether these variations are attributable to patient anxiety and pain experienced during the surgical procedure. The results showed that the females have higher levels of anxiety.

The most anxious patients had the lowest blood pressure value and the highest heart rate, although the differences did not reach statistical significance. The variations in blood pressure and heart rate during surgical extraction of the molars was within the normal limits. In the case of blood pressure, no significant changes were recorded; the highest mean systolic blood pressure and diastolic blood pressure values were observed at the time of ostectomy and/or tooth sectioning. The lowest heart rate values were

recorded at baseline, before the start of the surgical procedure, whereas the highest values were obtained during incision and flap raising. The oxygen saturation values showed no significant changes and were lower at the start of the surgical procedure. The authors observed most of the cardiovascular changes induced by surgical extraction of molars were within normal ranges, experienced due to the anxiety and stress induced by surgery.

IL Young Jung et al (2008)[23], conducted a study on Evaluation of Buccal Infiltrations and Inferior Alveolar Nerve Blocks in Pulpal Anaesthesia for Mandibular First Molars they opined that buccal infiltration with 4% Articaine for mandibular first molars can be a useful alternative for clinicians since IANB has a faster onset and a similar success rate.

Jose -Lacet Lima-Junior et al (2008)[26], Two hundred patients with age Group of 15-46 years was enrolled in a study comprising the evaluation of vestibular-palatal diffusion of 4% Articaine with epinephrine 1:100,000 and 1:200,000, in impacted maxillary third molar extractions without palatal injection. The authors conclude that Articaine hydrochloride 4% with epinephrine 1:100,000 produces more effective buccal vestibule-palatal anesthesia than the 1:200,000 solution, when an interval of 10 minutes is allowed between the administration of the anesthetic and the initiation of surgery and also suggests that vasoconstrictor concentration may influence anesthetic diffusion. It may be that due to a slower absorption rate of the anesthetic with epinephrine 1:100,000 is available at a higher initial concentration for diffusion (forming a higher concentration gradient) than the 1:200,000 solutions. Alternatively, the former may simply prolong in the vicinity of the neural fibres leading thus to a more efficient pain control.

M. D. Kanaa et al (2008)[31], conducted a study on Articaine buccal Infiltration that enhances the effectiveness of Lidocaine inferior alveolar nerve block and concluded that inferior alveolar nerve block injection supplemented

with Articaine buccal infiltration was more successful than inferior alveolar nerve block alone for pulpal anesthesia in mandibular teeth. Articaine buccal infiltration or dummy buccal infiltration was more comfortable than IANB.

Vasconcellos RJ, Vasconcelos BC and Genu PR (2008)[64], conducted a study to examine the effect of four different local anesthetics of the amide group (2% Lidocaine with 1:100.000 adrenaline; 3% Prilocaine with 0.30 IU felipressine; 2% Mepivacaine with 1:100.000 adrenaline; and 4% Articaine with 1:100.100 adrenaline) in patients undergoing extraction of lower third molars and verify the changes in systolic, diastolic and mean blood pressures, heart rate (HR) and oxygen saturation (SpO2). The results demonstrated increase in systolic blood pressure with Mepivacaine and Articaine; decrease in diastolic blood pressure with Lidocaine; increase in heart rate with all the anesthetics, but with no statistical significance in the case of Prilocaine. The variations in mean blood pressure and oxygen saturation were not statistically significant. All the hemodynamic changes returned to normal with no need for any further treatment.

Bahadir Ezmek et al (2010)[6], conducted a study on Comparison of hemodynamic effects of Lidocaine, Prilocaine, and Mepivacaine solutions without vasoconstrictor in hypertensive patients. Sixty-five mandibular molars and premolars were extracted in 60 hypertensive patients. Inferior alveolar and buccal nerve blocks were performed with 2% Lidocaine hydrochloride (HCl), 2% Prilocaine HCl or 3% Mepivacaine HCl without vasoconstrictor. And concluded Lidocaine, Prilocaine and Mepivacaine solutions without vasoconstrictor can be safely used in hypertensive patients.

Gabriella A. Garisto et al (2010)[18], conducted a study on the occurrence of paraesthesia after dental local anesthetic administration in the United States. The author concluded that paraesthesia arising from a local

anesthetic injection alone is a rare event. The findings show that the 4 % anesthetic solutions used in dentistry, namely Prilocaine, and Articaine, are more highly associated with the development of paraesthesia than are those of lower concentration. Therefore, dentists should consider these results when assessing the risks and benefits of using 4% local anesthetics for mandibular block anesthesia.

Daniel Torres-Lagares et al (2011)[13], conducted a prospective, randomized, single-blinded, cross-over, controlled comparative study on 10 patients with cardiovascular disease comparing cardiovascular effect of dental anaesthesia with Articaine (40 mg with epinephrine 0.5 mg % and 40 mg with epinephrine 1 mg%) versus Mepivacaine (30mg and 20 mg with epinephrine 1 mg%). During the treatment period, the authors observed statistically significant differences as regards heart rate between injections with and without adrenalin ($p< 0.039$) and as regards systolic ($p< 0.046$) and diastolic ($p < 0.046$) blood the pressure during the stabilization period. In both cases, the parameters under study increase. Age, gender, jaw treated, treatment duration and the rest of cardiovascular variables did not affect the results and of the patients underwent ischemic alterations or any other complication derived from the treatment or the anesthesia. The authors conclude although no cardiac ischemic alterations or any other cardiovascular complications have been observed, and must be cautious with the administration of anesthetics containing vasoconstrictors in patients with cardiovascular diseases.

Matthew Martin et al (2011)[36], conducted a study on Anesthetic Efficacy of 1.8 mL versus 3.6 mL of 4% Articaine with 1:100,000 Epinephrine as a Primary Buccal Infiltration of the Mandibular First Molar and concluded that anesthetic efficacy of 3.6 mL 4% Articaine with 1:100,000 epinephrine is better than 1.8 mL (higher success rate (70% vs 50%) of the same anesthetic solution in a primary mandibular buccal infiltration of the first

molar. However, the success rate of 70% is not high enough to support its use as a primary injection technique in the mandibular first molar extraction.

Shahid Hassan et al (2011)[55], conducted a study on the Efficacy of 4% Articaine hydrochloride and 2% lignocaine hydrochloride in the extraction of maxillary premolars for orthodontic reasons and concluded that Articaine can be used as an alternative to lignocaine, especially in the extraction of maxillary premolars for orthodontic reasons. The clinical advantages including rapid onset, longer duration of action and greater diffusing property over lignocaine and the elimination of the need for a painful palatal injection were demonstrated.

P Arrow (2012)[43], conducted a study on the comparison of Articaine 4%and lignocaine 2% in block and infiltration analgesia in children and opined that there were a higher success and less painful treatment with inferior alveolar nerve block and there was no statistically significant difference in local analgesia success was observed, however Articaine and lignocaine when delivered via buccal infiltration.

Peer W. Kammerer, et al (2012)[46], conducted a double-blind randomized clinical trial of anesthetic efficacy in comparison with 4% Articaine with epinephrine (1:100,000) and without epinephrine in inferior alveolar block for tooth extraction. Eighty-eight patients received inferior alveolar nerve blocks using 4% Articaine with 1:100,000 epinephrine (n = 41; group 1) or without epinephrine (n = 47; group 2) for extractions of mandibular teeth. In group 1, a significantly faster onset of the anesthetic effect (7.2 min vs. 9.2 min; *P* =.001) and a significantly longer duration of soft tissue anesthesia (3.8 h vs. 2.5 h; *P* =.0001) were observed. The author minimize the epinephrine-induced side effects, the author suggests 4% Articaine without epinephrine is a suitable anesthetic agent for dental extractions in the mandible after inferior alveolar nerve block anesthesia.

There may be less postoperative discomfort due to the shorter duration of anesthesia without increased postoperative pain.

Shruthi R et al (2013)[55], conducted a study on Articaine for surgical removal of impacted third molar - a Comparison with Lignocaine. Results demonstrated the mean onset time of anesthesia in the study group was 2.07 + 0.22 and 2.18 + 0.26 minutes in comparison group. A mean duration of 4.28 +0.78 hours was seen with Articaine group and 3.51 + 0.45 hours with the lignocaine group and concluded that Articaine has similar efficacy as that of lignocaine with slightly longer duration and can be used as an alternative to lignocaine in third molar surgeries.

Eshagh Ali Saberi et al (2013)[14], compared the Anaesthesia Efficacy of Articaine and Articaine plus Morphine for Buccal Infiltration in Mandibular Posterior Teeth with Irreversible Pulpitis and concluded that success rate of Articaine (68%), Articaine morphine (52%) and Lidocaine (64%). They stated no significant difference in the success rate between groups on self-reported pain response recorded on a VAS scale before and after local anesthetic injection during access preparation.

Hecio Henrique Araujo de Morais et al (2013)[21], In a Clinical study evaluate hemodynamic changes with the use of 4% Articaine and 2 different concentrations of epinephrine (1:100,000 and 1:200,000) in the surgical removal of symmetrically positioned lower third molars. They concluded that 4% Articaine solution influences hemodynamic parameters without perceptible clinical changes in healthy patients undergoing lower third molar removal.

M. K. Saggu et al (2014)[32], the purpose of this study is to compare the efficacy of 4% Articaine with 1:100,000 adrenaline (4AA) with that of 2% Lidocaine with 1:100,000 adrenaline (2LA) administered as buccal infiltrations for anesthesia in mandibular permanent first molar teeth. Results

demonstrate the relative efficacy of 4AA over 2LA in anesthetizing permanent first mandibular molars were calculated at 1.57 and conclude that 4AA has been shown to have greater efficacy in achieving pulpal anesthesia in mandibular permanent first molar teeth than 2LA when administered via buccal infiltration.

Anwar B. Bataineh et al (2016)[3], conducted a prospective controlled study with Forty-eight patients who needed routine extraction of permanent maxillary teeth without a palatal injection in comparison Between the Anterior and posterior regions of the maxilla. They found that Extraction of maxillary teeth were possible without an additional palatal injection for 87 teeth 90.6%), whereas only 9 teeth (9.4%) needed an additional palatal injection to complete the extraction. Of the total number of patients, 90% reported to have pain caused by tooth extraction in the anterior and posterior regions of the maxilla were mild. There was no difference in pain perception when extracting anterior and posterior teeth. Of the total number of teeth, 90.6% were extracted without the need for palatal injection. Extraction of erupted maxillary teeth using 4% Articaine without manipulation of the palatal mucosa obviated palatal infiltration during extraction. Articaine anesthesia provides adequate palatal anesthesia for maxillary teeth extraction in the anterior and posterior regions without the need for a palatal block.

G. Bartlett et al (2016)[17], conducted a study on Articaine buccal infiltration *vs* Lidocaine inferior dental block – a review of the literature. Results demonstrated that 55.6–69.2% and 65.4–70.4% of Lidocaine inferior alveolar nerve block and Articaine buccal infiltrations were successful, and opined that Articaine buccal infiltrations are no more effective than Lidocaine inferior alveolar nerve block.

Uros Marjanovic et al (2017)[37], conducted a study on two different techniques of local anesthesia in the posterior mandible using 4% Articaine

with 1: 100,000 adrenaline. 60 patients participated in the study, aged between 18 to 50 years were divided into two groups of 30 participants each – the local infiltration anesthesia group, with participants who received the local infiltration anesthesia in the projection of roots apices of the first lower molar and the inferior alveolar nerve block group with participants who received the regular IAN block. The onset of anesthesia determined by loss of sensation, changes in teeth sensitivity determined by the electric pulp test, duration of anesthesia, width of the anesthetic field and possible changes of cardiovascular parameters (systolic and diastolic blood pressure and heart rate) and concluded that the effect of the local infiltration anesthesia on tooth sensitivity of premolars and first molar were quite satisfactory the inferior alveolar nerve block was more effective for the canine and second molar. None of the tested techniques had any significant effect on the cardiovascular parameters.

Astha Jaikaria et al (2018)[4], A total of 102 patients were randomly selected for the study who required maxillary molar extractions and received buccal infiltration either using Lidocaine or Articaine to compare and evaluate the efficacy of 4% Articaine and 2% Lidocaine in children in the primary maxillary molar extractions. For subjective evaluation, the Wong Baker Facial Pain Scale (FPS) was used. For objective evaluation, the FLACC Scale was used. As hemodynamic parameters of heart rate and blood pressure recordings are physiological indicators of pain response, they were recorded using a sphygmomanometer. The authors informed that Articaine is effective as a local anesthetic and can be used as an alternative to Lidocaine in pediatric patients. Lower mean values for FPS and stable hemodynamic parameters during infiltration make Articaine a likely choice as an anesthetic in paediatric patients.

Jyoti Mitta et al (2018)[27], conducted a comparative study on the efficacy of 4% Articaine vs 2% Lidocaine in surgical removal of bilaterally

impacted mandibular third molars. Results indicated that 4% Articaine was found to have a significantly shorter onset of action than 2% Lidocaine. Duration of anesthesia and postoperative analgesia of 4% Articaine with epinephrine 1:200,000 was found to be significantly (1.44 and 1.28 times respectively) longer than 2% Lidocaine with epinephrine 1:200,000. There was no significant difference recorded in the anesthetic efficacy between the two solutions.

Mohammed Sulaiman Alsale et al (2018)[39], conducted a comparative study on the hemodynamic effects of local anaesthetics Articaine vs. Lidocaine in healthy patients and they observed are no significant differences in any of the hemodynamic parameters were observed at any stage of the investigations when the patients have injected with 4% Articaine with 1/100,000 epinephrine and 2% Lidocaine with 1:100,000 epinephrine.

Myong-Hwan Karm et al (2018)[40], conducted a study on Rats and mice were randomly allocated to experimental groups: 2% Lidocaine without epinephrine (L0), 2% Lidocaine with epinephrine 1:200,000 (L200), 1:100,000 (L100), and 1:80,000 (L80). Changes in mean arterial pressure and heart rate after administration of the anesthetic mixture. The author concluded that the L100 and L80 local anesthetic mixtures containing a higher concentration of epinephrine showed unfavourable hemodynamic changes including increases in MAP and HR. L0, plain Lidocaine, had a short duration of anesthetic action. L200 demonstrated relatively stable mean arterial pressure and heart rate values with satisfactory action duration and hemostatic effect.

Nikil Kumar Jain et al (2018)[42], conducted a study on Anesthetic efficacy of 4% Articaine versus 2% lignocaine during the surgical removal of the third molar and concluded that Articaine had a significantly faster onset of action and longer duration of action when compared to lignocaine, the pain

experienced by the patients during and after the surgical procedure was significantly less.

Paramjot Kaur et al (2018)[44], investigated and compare the response of lignocaine with and without epinephrine to evaluate hemodynamic and metabolic response in normotensive and type II controlled diabetic patients (hemodynamic and glycaemic response) undergoing tooth extractions. A total of 50 patients (25 healthy and 25 controlled type II diabetics) undergoing multiple tooth extractions (of the age group of 20–80 years). Results demonstrated the increase in blood glucose concentration following the administration of 2% lignocaine HCl with 1:200,000 epinephrine was statistically significant ($P < 0.05$). Statistically significant variability in diastolic BP (diastolic blood pressures) was also noted in controlled diabetic patients. Both systolic blood pressure and diastolic blood pressures were statistically significantly elevated after the administration of 2% lignocaine HCl. The author concluded that 2% lignocaine HCl with 1:200,000 epinephrine in type II diabetics could be safely used and 2% lignocaine HCl should be used with caution in normotensive as well as type II controlled diabetic patients.

Sunith Maruthingal et al (2018)[62], conducted a study on A comparative evaluation of 4% Articaine and 2% Lidocaine in mandibular buccal infiltration Anesthesia and concluded that Articaine showed significant results within achieving pulpal anesthesia objectively, when compared with Lidocaine and also showed very highly significant results subjectively in achieving lip numbness, when compared to Lidocaine. But the results in achieving lingual mucosa numbness with Articaine subjectively was not significant, when compared with Lidocaine.

Materials and Methods

MATERIALS AND METHODS

This study was conducted in the Department of Oral and Maxillofacial Surgery, Ragas Dental College and Hospital, Chennai. All the patients scheduled for surgical removal of impacted maxillary canine were explained about the study and the patients willing to participate were included in the study. The patients were randomly allotted to either group A (Articaine) or group B (Lidocaine). In all the patients buccal and palatal infiltration was given to administer local anaesthesia. Ethical clearance was obtained from The Institutional Review Board prior to commencing the study. A written informed consent was obtained from all the patients for both surgical procedure and radiological investigations prior to the procedure.

INCLUSION AND EXCLUSION CRITERIA

INCLUSION CRITERIA:

1. All patients requiring surgical removal of Impacted Maxillary Canines.
2. Age group between 18-48 years.
3. Both sexes to be included.

EXCLUSION CRITERIA:

1. Known or suspected allergies or sensitivities to amide-type local anesthetics or any ingredients in the anesthetic solution.
2. Medical history of any systemic disease like- Hypertension, Diabetes, Thyroid disorders, Liver diseases, Renal diseases, bleeding & clotting disorders etc.
3. Pregnancy or lactation.

4. Subjects who are under anti-depressants and sedatives.
5. Subjects who had taken analgesic medication 24 hours prior to administration of local anesthesia.
6. Patients with any local pathological conditions that can influence the local anesthetic action like infection, bony exostosis etc.

SURGICAL PHASE

ARMAMENTARIUM USED: -

1. 4% Articaine HCL with 1:100,000 Adrenaline (SEPTANEST; SEPTODONT Inc, FRANCE).
2. 2% Lidocaine HCL with 1:80,000 Adrenaline (LIGNOSPAN; SEPTODONT Inc, FRANCE).
3. Aspirating dental injection syringe. (SEPTODONT FUSION; U.S.A).
4. Sterile, siliconized, disposable needles 27 Gauge, 0.40 x 35mm.
5. Pulse oximeter (OXYWATCH; choice Med, Beijing, CHINA),
6. Automated Blood Pressure Monitor (OMRON; OMRON HEALTHCARE CO., LTD, VIETNAM).
7. No 15-Bard-Parker blade & handle with No 3 handle.
8. Molt no 9 Periosteal elevator.
9. Howards Periosteal elevator.
10. Austin Retractor.
11. Adson tissue forceps.
12. Micro motor straight handpiece with 702 straight bur.

13. Elevators.

14. Needle Holder.

15. Bone file.

16. Bone Curette.

17. Frazier Suction tip.

18. Heath scissors.

19. 3-0 silk suture material.

SURGICAL TECHNIQUE: -

All patients were positioned at a semi-reclined position on the dental chair. Patients were prepared and draped. The surgical site was irrigated with saline and hexedine mouthwash was given. 4% Articaine was injected in the buccal and palatal mucosa (infiltration) over a period of 1 minute for Group A and 2% Lidocaine was injected in the buccal and palatal mucosa (infiltration) over a period of 1 minute for Group B.

The patient was asked to inform when they feel the numbness and then the buccal and the palatal mucosa was examined using pinprick test. Surgical access is achieved by either buccal approach or palatal approach or both depending on the type of impaction. Mucoperiosteal flap was elevated and bone guttering was carried out with 702 surgical bur with continuous irrigation with saline and the impacted canine tooth was exposed.

Tooth sectioning was done when needed and the impacted canine tooth was extracted. Wound toileting was done and hemostasis achieved. The wound was closed with 3-0 silk and sutures were removed after a week.

The patients were instructed to eat only soft food and abstain from forceful mouth washing for the first 24h. For postoperative pain control, all

patients received Ketorolac Tromethamine 10mg which was administered twice daily, 500mg amoxicillin was prescribed every 8hourly (TID) for 5days to prevent infection.

For plaque control, the patient used 0.12% chlorhexidine mouth rinse for one minute twice a day for two weeks postoperatively.

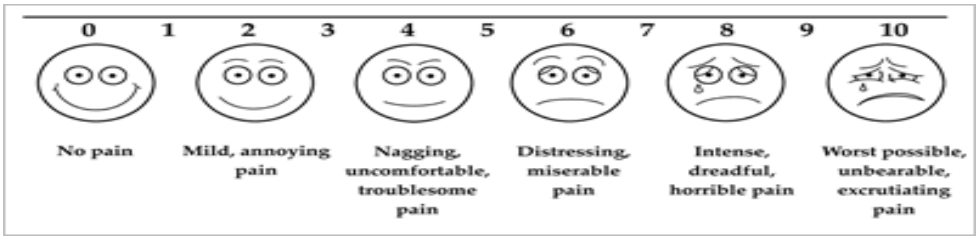
EVALUATION CRITERIA: -

1. Drug volume: - Amount of anesthetic used in each case and any additional injections required were recorded.
2. The onset of anesthesia: - Time of onset of anesthesia is calculated form the time elapsed from full needle withdrawal after injection until the patient first reports numbness and immediately checked for objective signs.
3. Duration of surgical procedure: - From the time of incision placed to the last suture placed.
4. Duration of anesthesia: - Duration of anesthesia is calculated by recording the time from initial patient perception of the anesthetic effect to the moment in which the effect began to fade.
5. Blood pressure, oxygen saturation and heart rate were recorded before the administration of local anesthesia and after 5,15,30,45 and 60 minutes.
6. Signs of systemic toxicity: - Talkativeness, slurred speech, apprehension, localized muscle twitching, and post-operative complications like paresthesia and others were noted.
7. Pain rating based on VAS score: The VAS was taken by a different operator to avoid influencing the patient during scoring.

VISUAL ANALOG SCALE

Intra operative pain was scored on visual analog scale (0–10) at 15minutes and 30 minutes (e.g. none, slight, mild, moderate, severe).

0	No Pain	The patient feels well
1-2	Mild pain	If the patient is distracted he or she does not feel pain
3-4	Moderate pain	The patient feels light pain but not disturbing the procedure
5-6	Severe pain	The patient feels pain but was able to tolerate the procedure.
7-8	Very severe pain	The patient feels more pain and forces to abandon the procedure.
9-10	Worst possible pain	The procedure and every type of activity must be abandoned and patient needs medical attention.



RAGAS DENTAL COLLEGE & HOSPITAL

DEPARTMENT OF ORAL AND MAXILLOFACIAL SURGERY

IMPACTION CASE SHEET

OP.NO: DATE:

AGE/SEX:

NAME:

OCCUPATION:

ADDRESS:

CHIEF COMPLAINT:

HISTORY OF PRESENT ILLNESS:

PAST MEDICAL HISTORY:

HYPERTENSION

ASTHMA

TUBERCULOSIS

DRUG ALLERY

BLEEDING DISORDERS

CARDIOVASCULAR SYSTEM

ANEMIA

PREVIOUS HISTORY

PRESENTLY ANAEMIC?

OTHERS:

PAST DENTAL HISTORY:

PERSONAL HISTORY:

CLINICAL EVALUATION: ERUPTED / PARTIALLY ERUPTED / NON-ERUPTED:

INTERPRETATION OF RADIGRAPH/CBCT:

CLASSIFICATION:

EVALUATION:

DRUG VOLUME: (ARTICAINE/LIGNOCAINE):

ONSET OF ANAESTHESIA:

DURATION OF SURGICAL PROCEDURE:

DURATION OF ANAESTHESIA:

HEMODYNAIMICS-

VITALS	BEFORE L. A	15 MINUTES	30 MINUTES	45MINUTES	60 MINUTES
BLOOD PRESSURE					
OXYGEN SATURATION					
HEART RATE					

PAIN RATING BASED ON VAS SCORE:

Intra operatively pain was scored on visual analogue scale (0–10) at 15minutes and 30 minutes (e.g. none, slight, mild, moderate, severe).

PROCEDURE:

POSTOPERATIVE MEDICATION:

POSTOPERATIVE REVIEW:

Figures

Fig.1 ASPIRATING DENTAL INJECTION SYRINGE

(SEPTODONT FUSION; U.S.A).

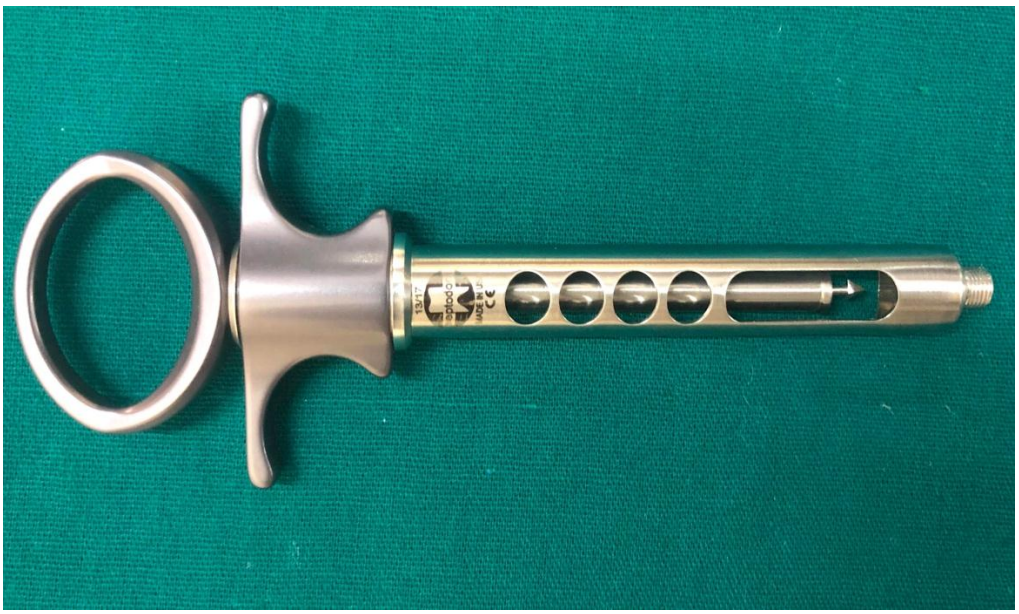


Fig.2 STERILE, SILICONIZED, DISPOSABLE NEEDLES

27 GAUZE, 0.40 x 35mm (Gauge & length in mm).

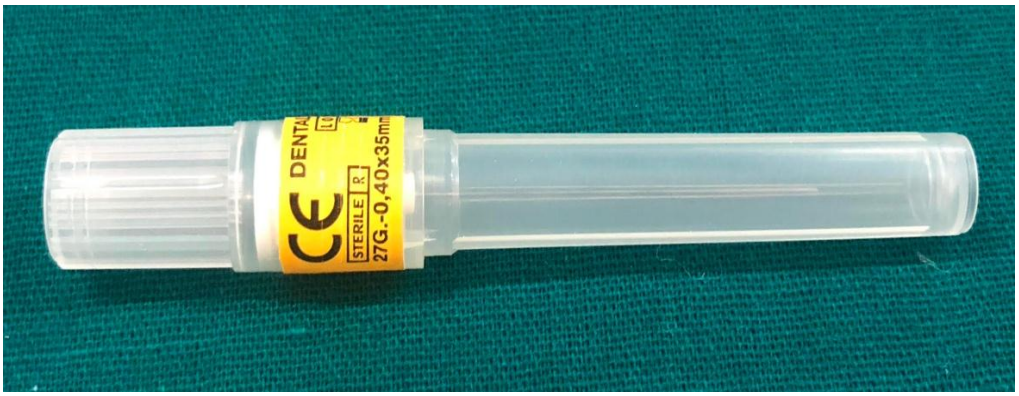


Fig.3 4% ARTICAINE HCL WITH 1:100,000 ADRENALINE (SEPTANEST; SEPTODONT Inc, FRANCE).

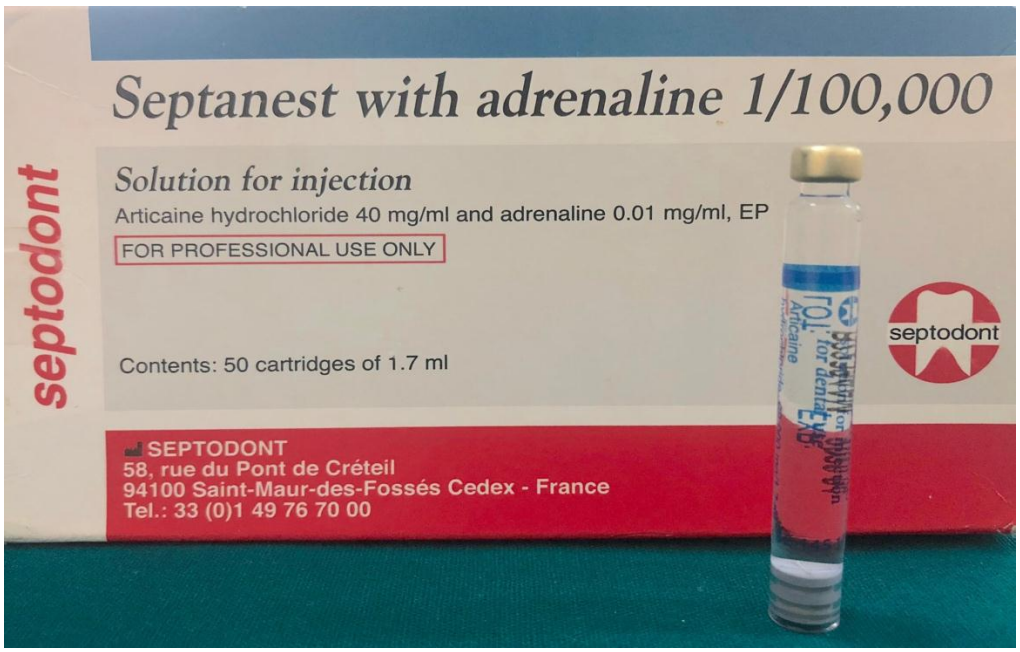


Fig.4 2% LIDOCAINE HCL WITH 1:80,000 ADRENALINE (LIGNOSPAN; SEPTODONT Inc, FRAN CE).

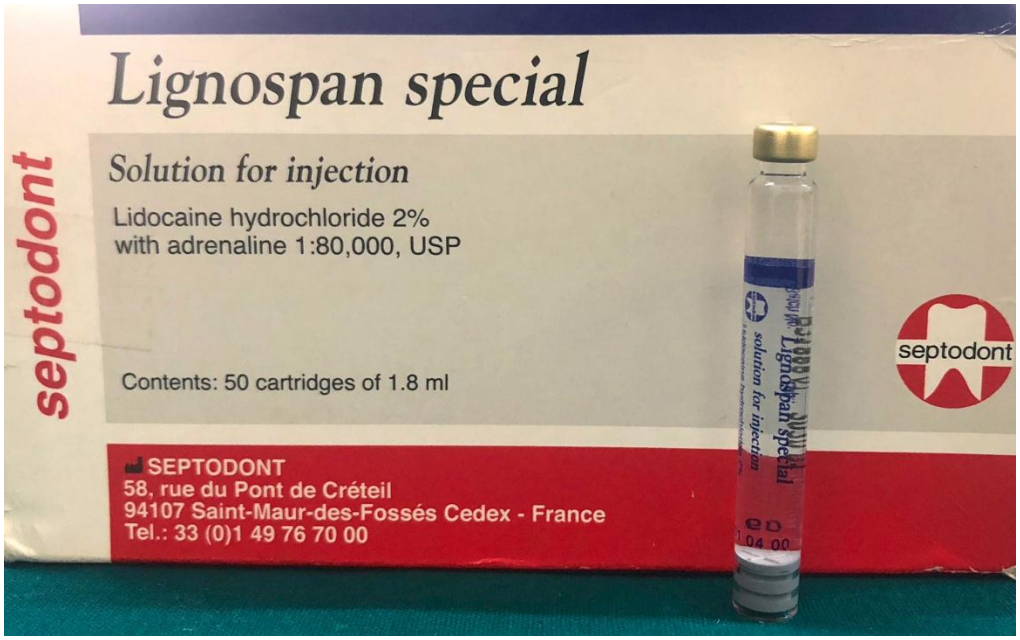


Fig.5 AUTOMATED BLOOD PRESSURE MONITOR (OMRON; OMRON HEALTH CARE CO., LTD, VIETNAM).

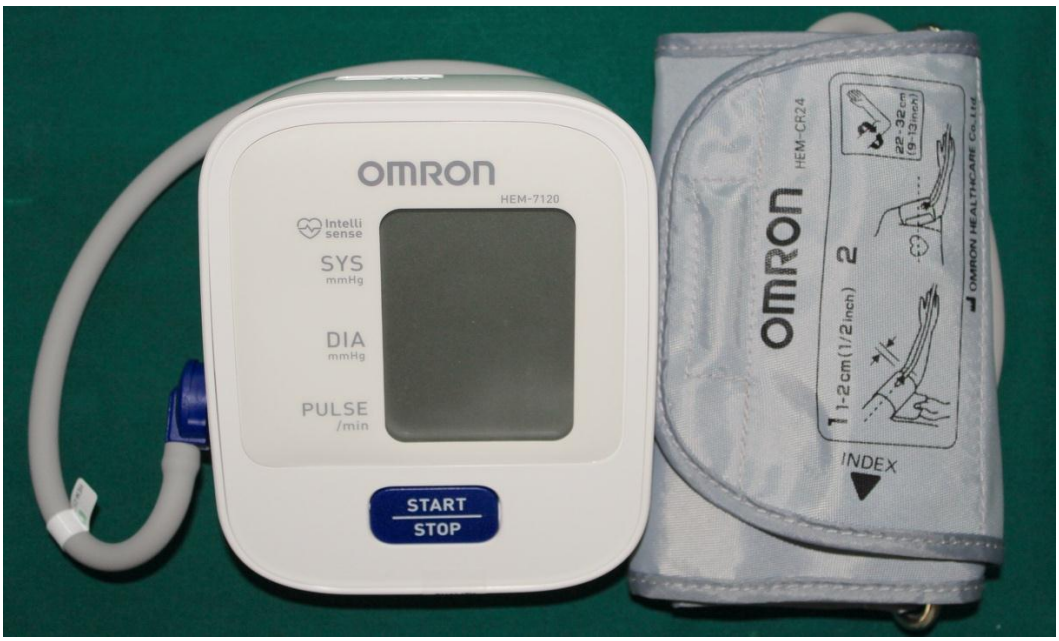


Fig.6 PULSE OXIMETER (OXYWATCH; choice Med, Beijing, CHINA),

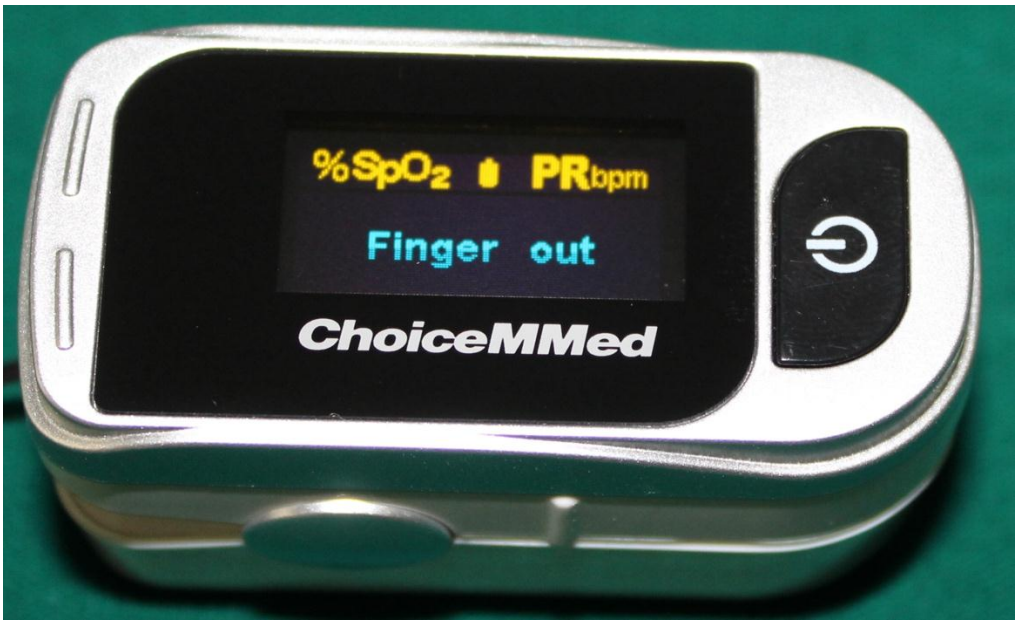


Fig.7 ARMAMENTARIUM

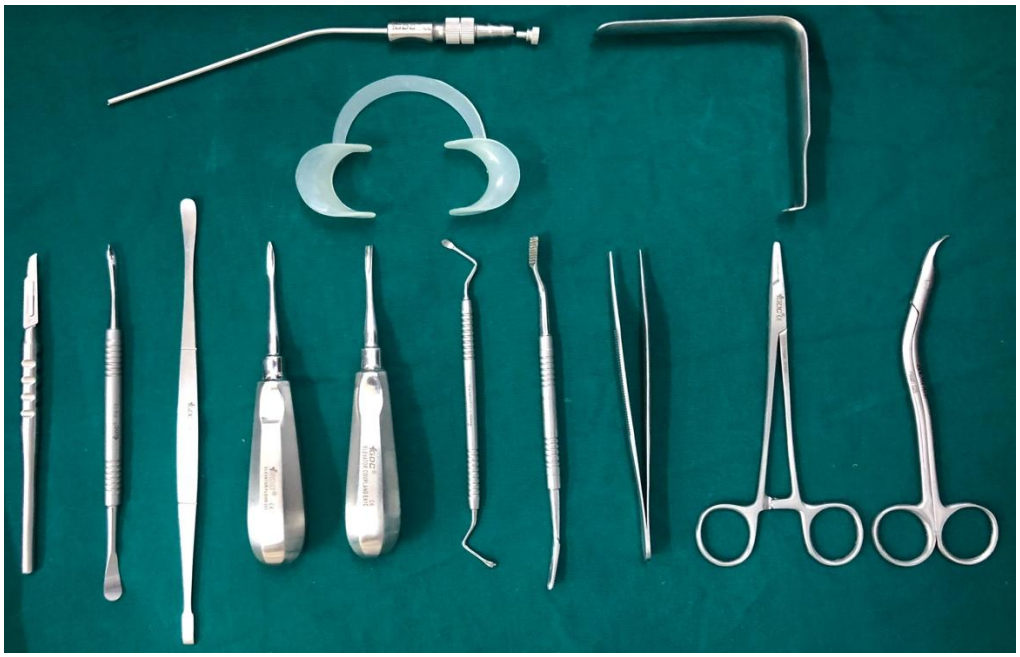


Fig.8 MICROMOTOR & HANDPIECE

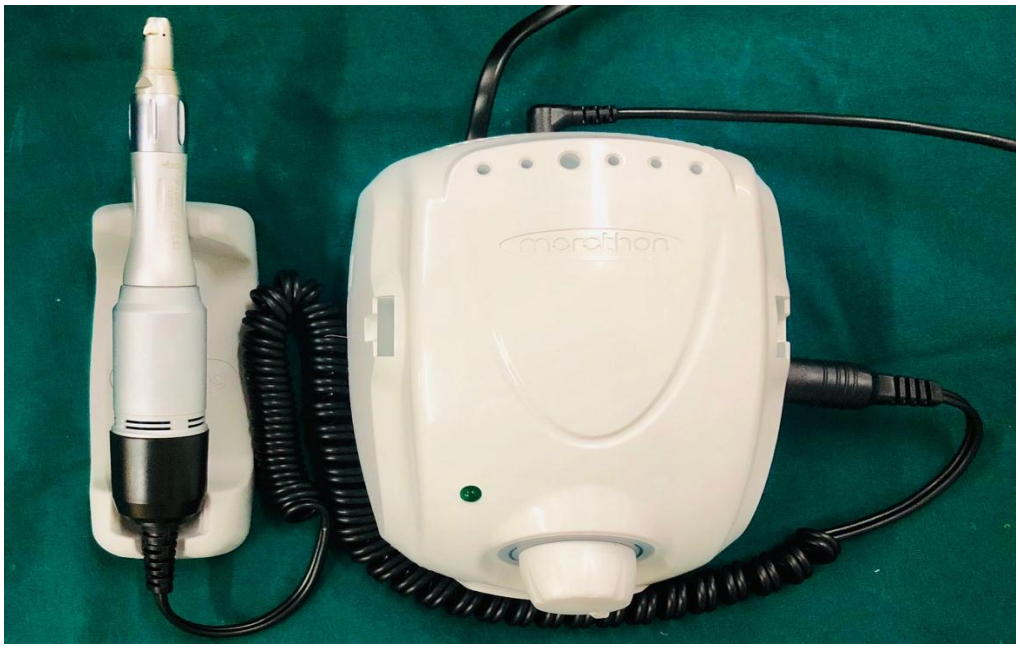


Fig.9 CASE-1 PRE-OPERATIVE CBCT

(LABIALLY POSITIONED CANINE)

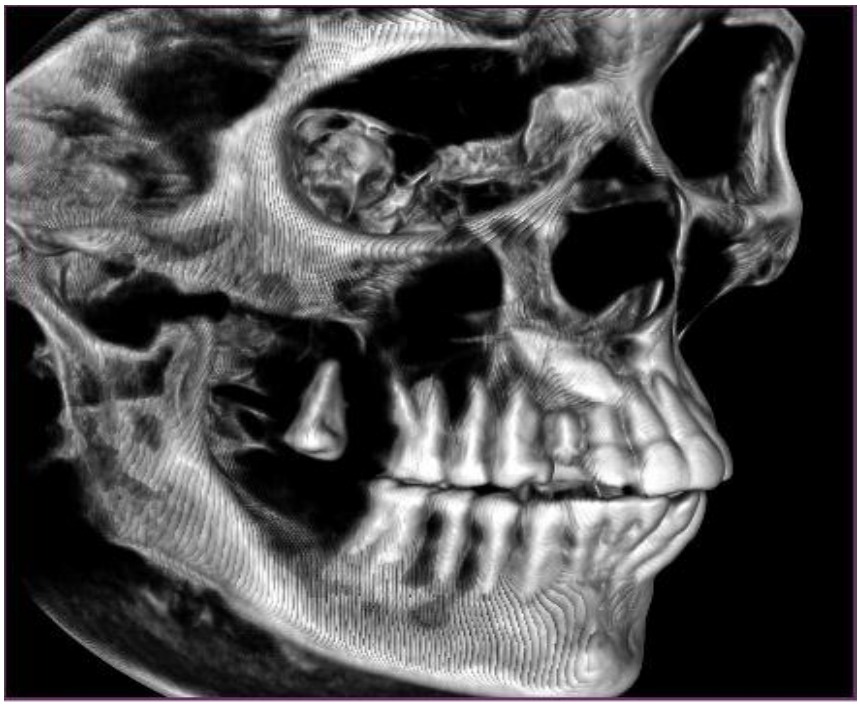


Fig.10 PRE-OPERATIVE OCCLUSAL RADIOGRAPH

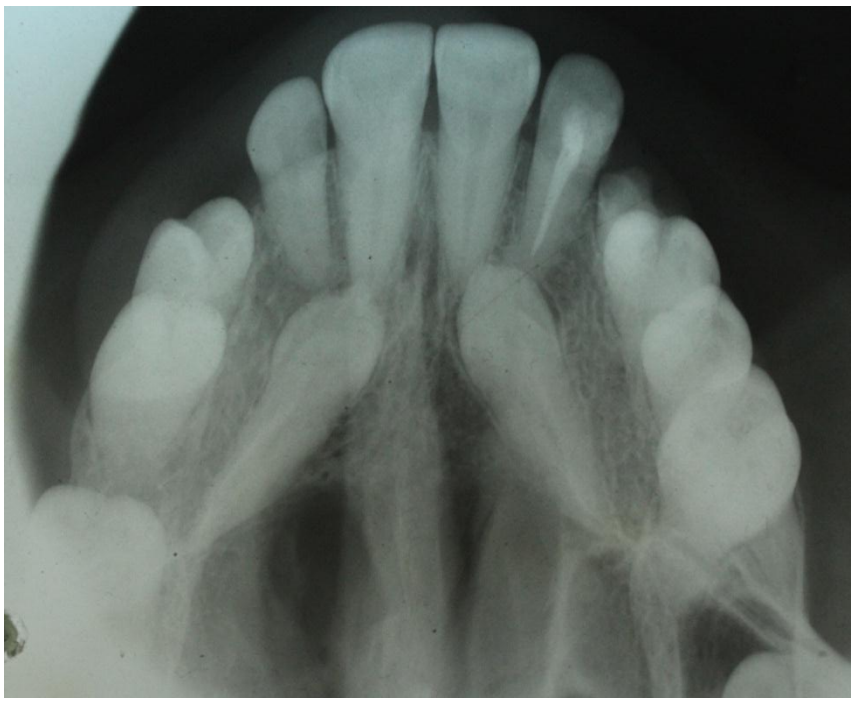


Fig.11 CREVICULAR INCISION

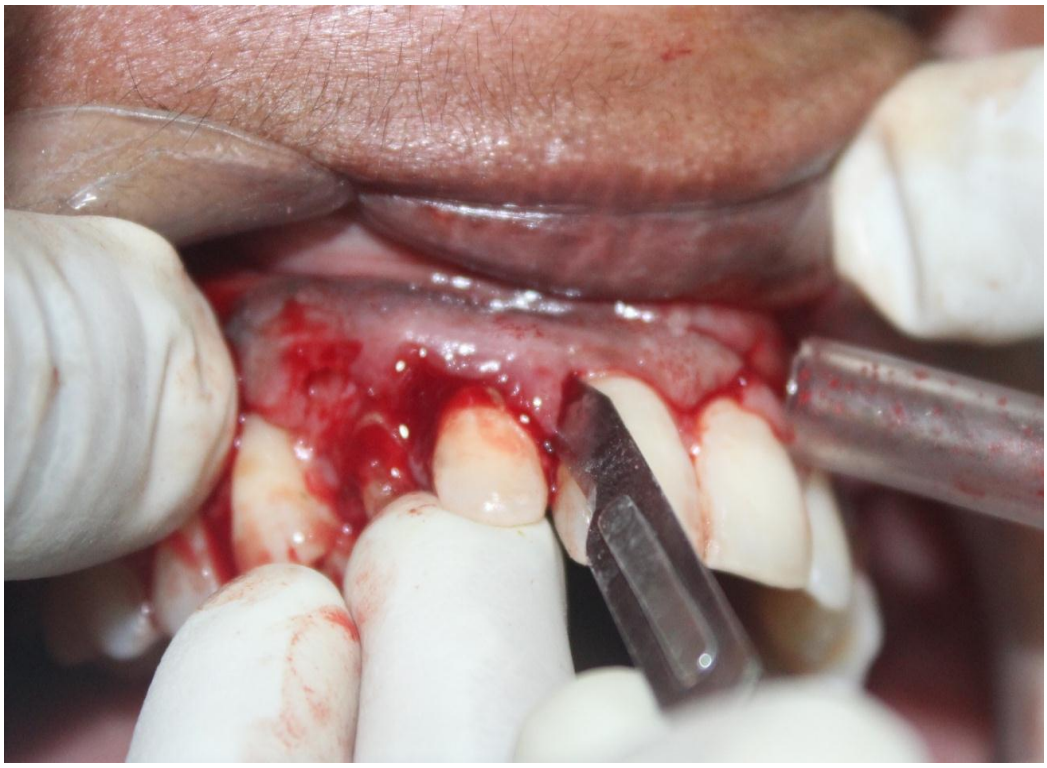


Fig.12 MUCOPERIOSTEAL FLAP ELEVATION

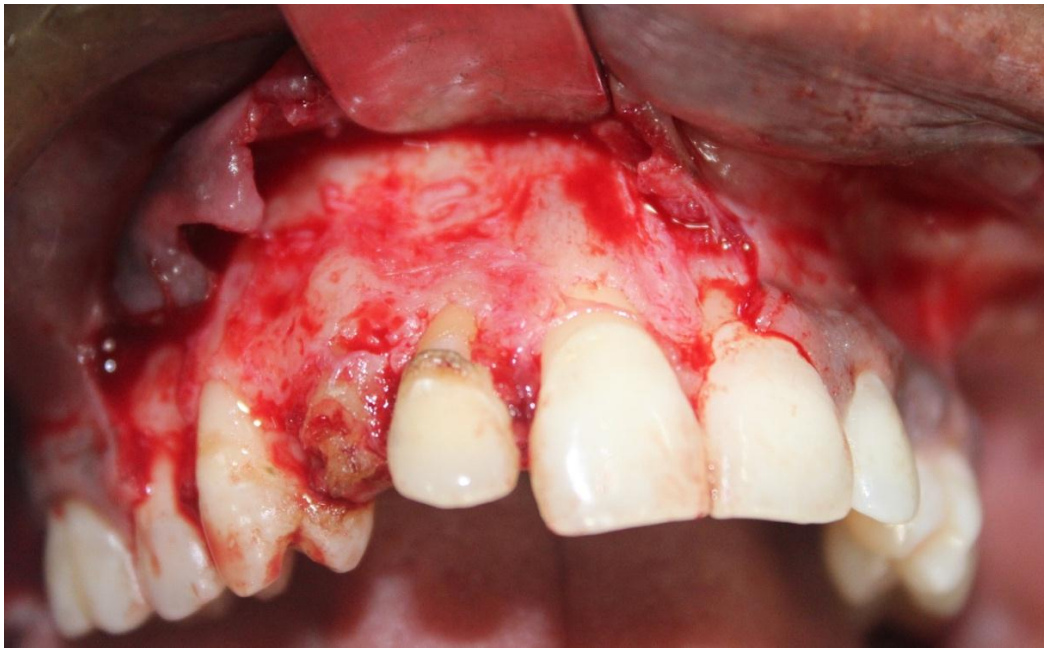


Fig.13 BONE GUTTERING

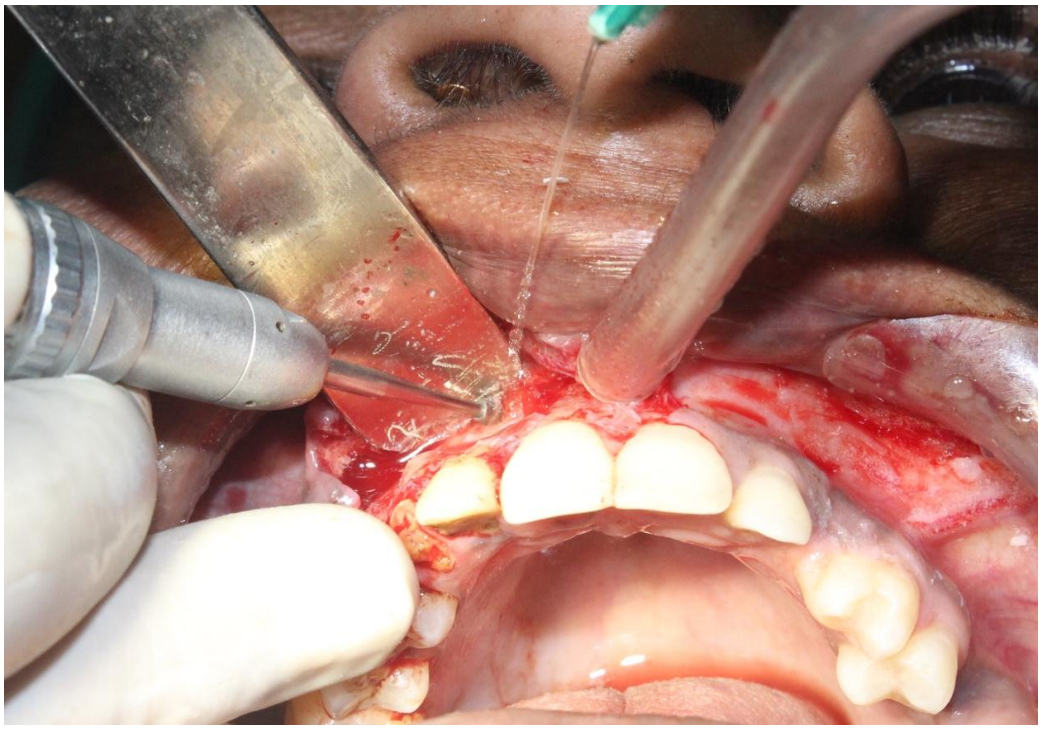


Fig.14 EXPOSURE OF IMPACTED CANINE

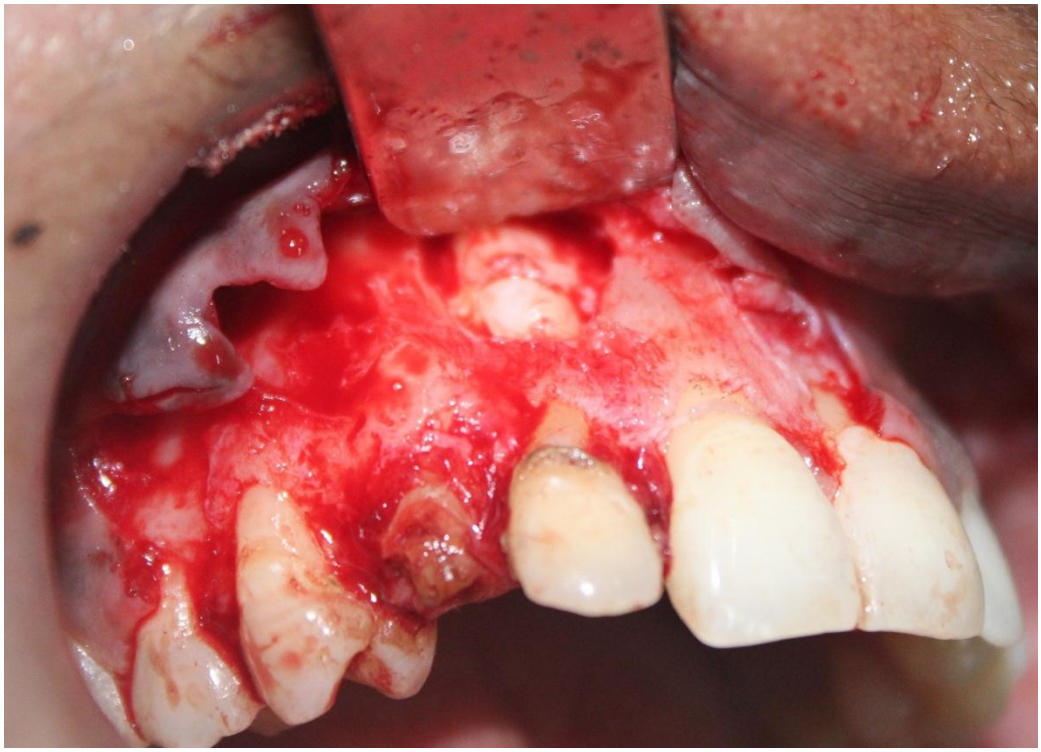


Fig.15 TOOTH SECTIONING

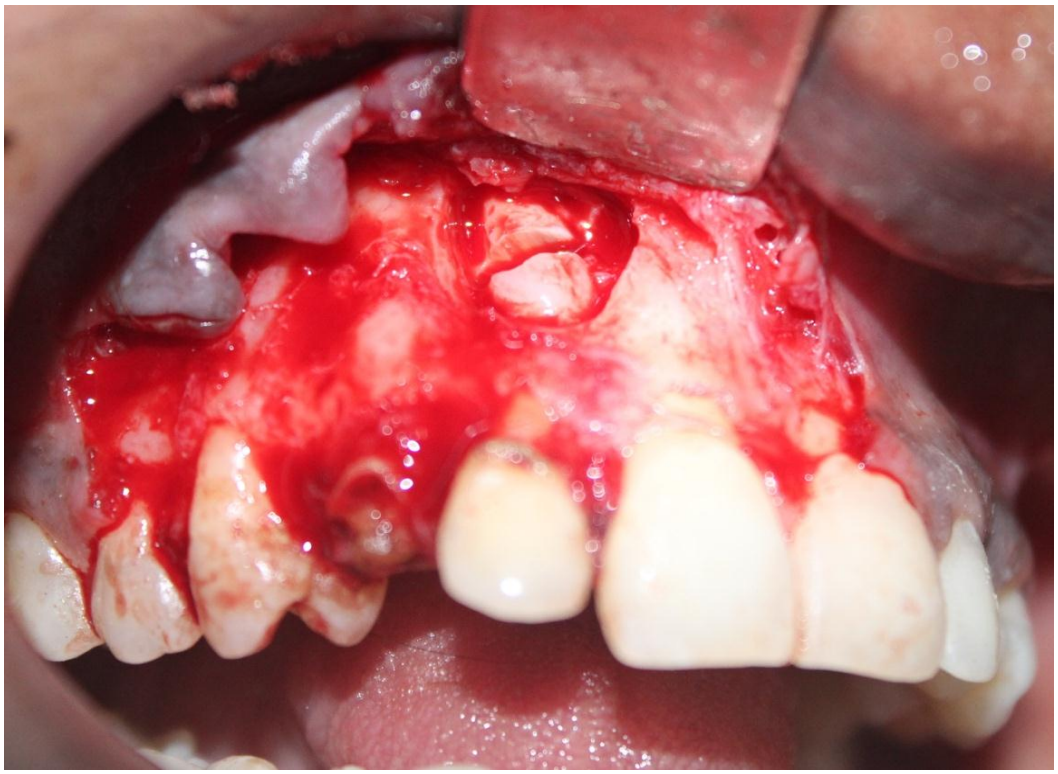


Fig.16 CROWN REMOVAL

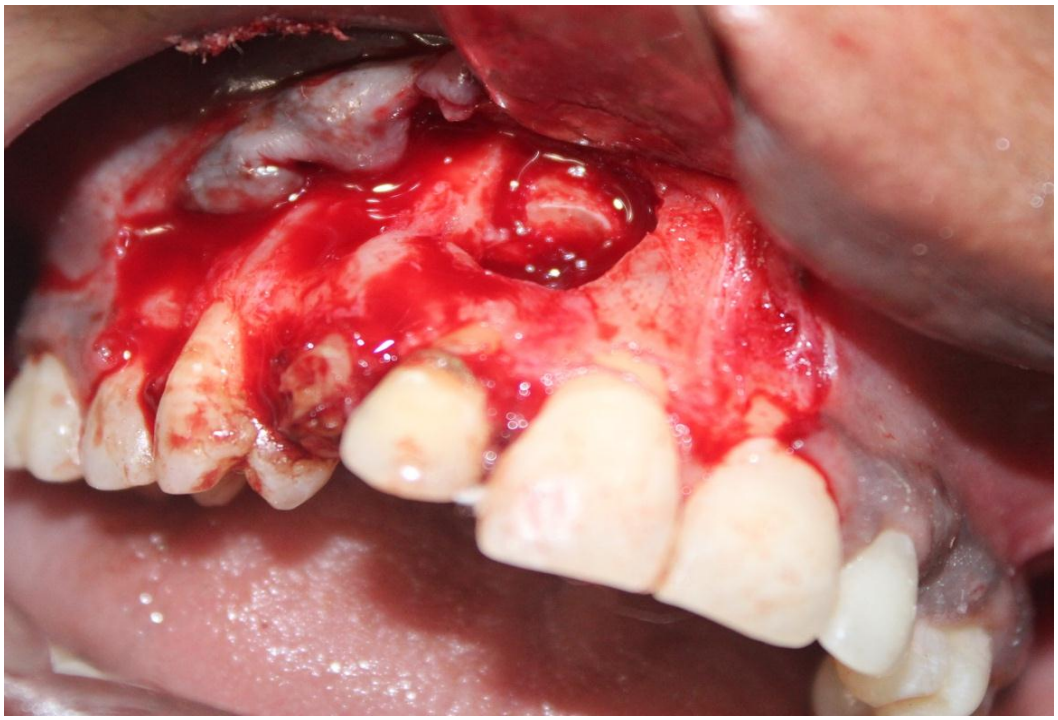


Fig.17 ROOT REMOVAL

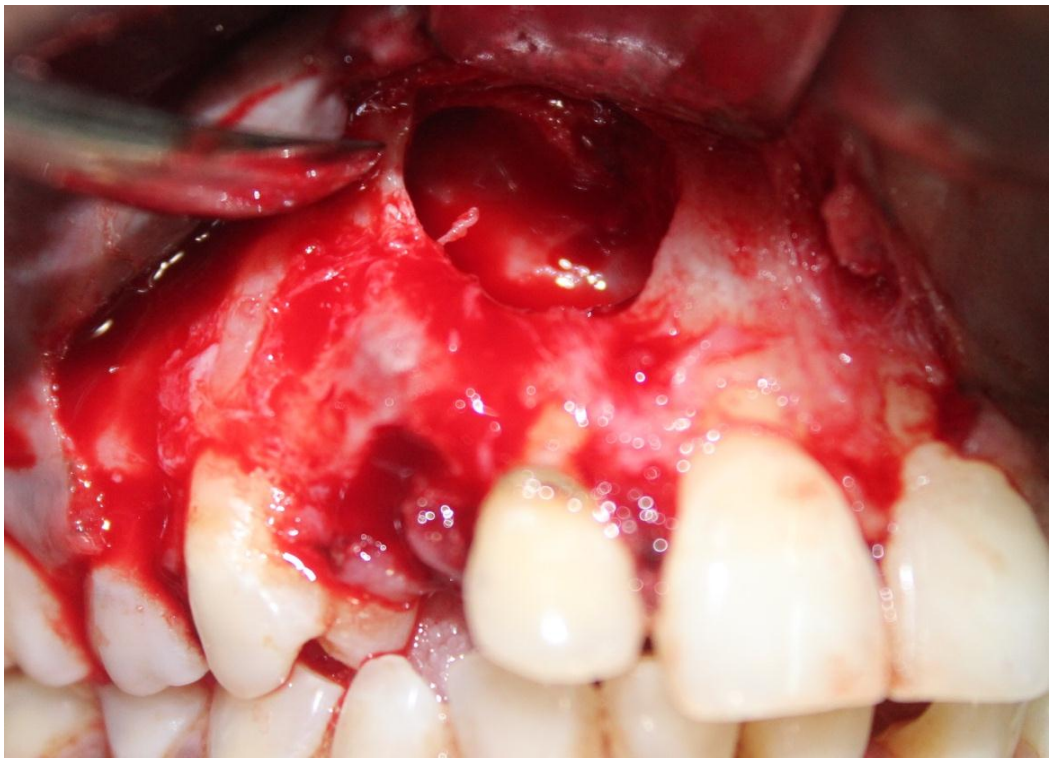


Fig.18 EXTRACTED CANINE

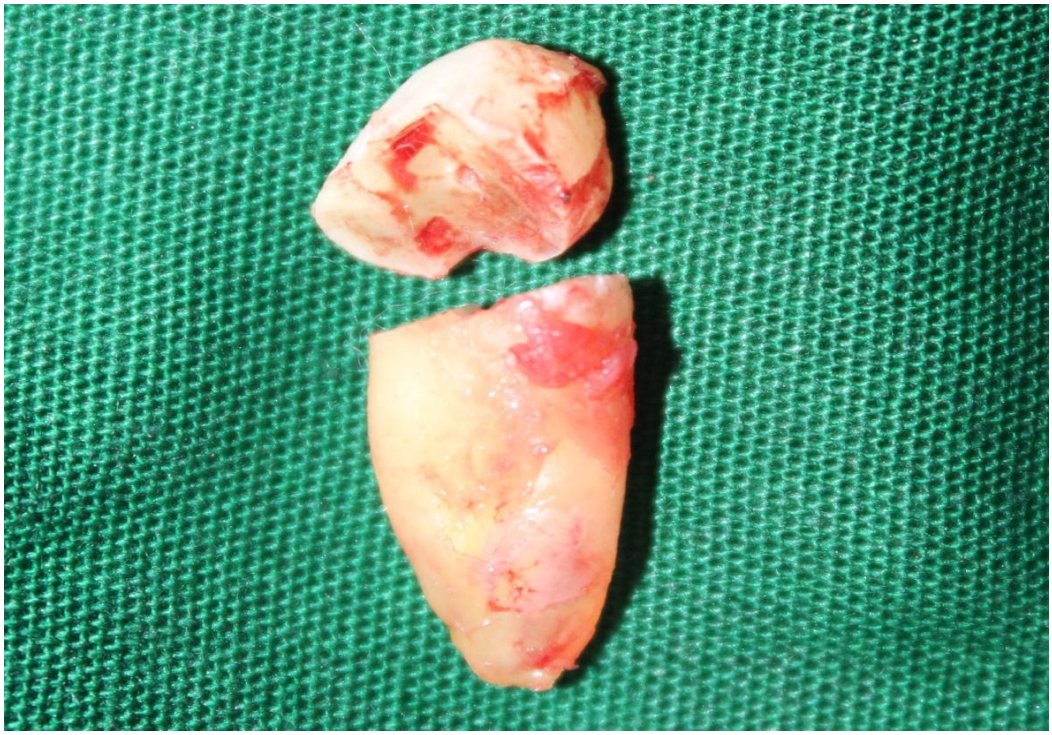


Fig.19 APPROXIMATION OF FLAPS AND SUTURING

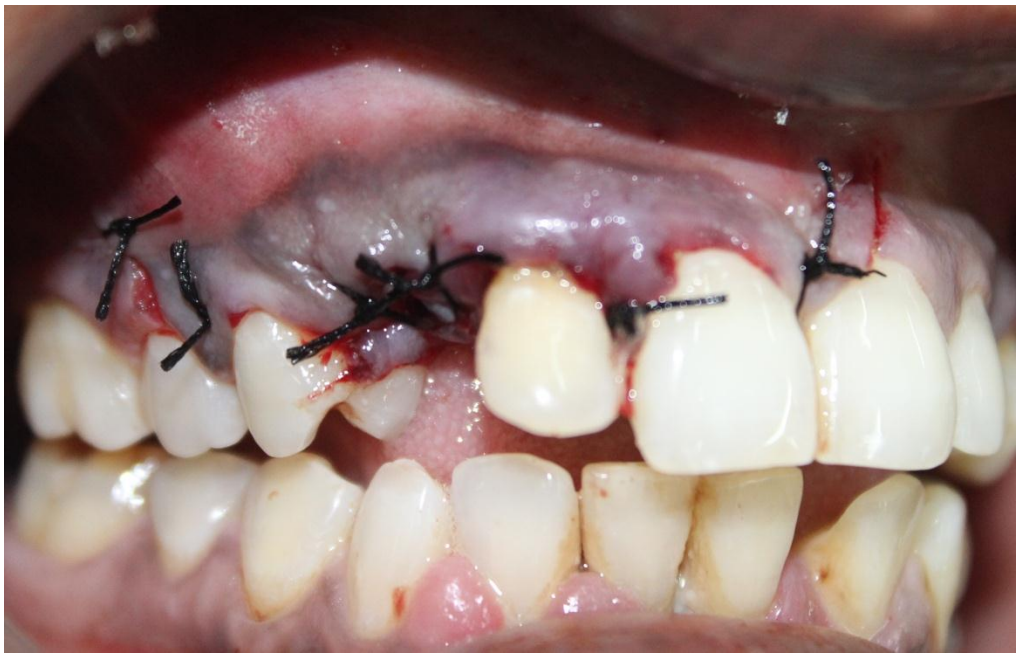


Fig.20 CASE-2 PRE-OPERATIVE CBCT

(PALATALLY POSITIONED CANINE)

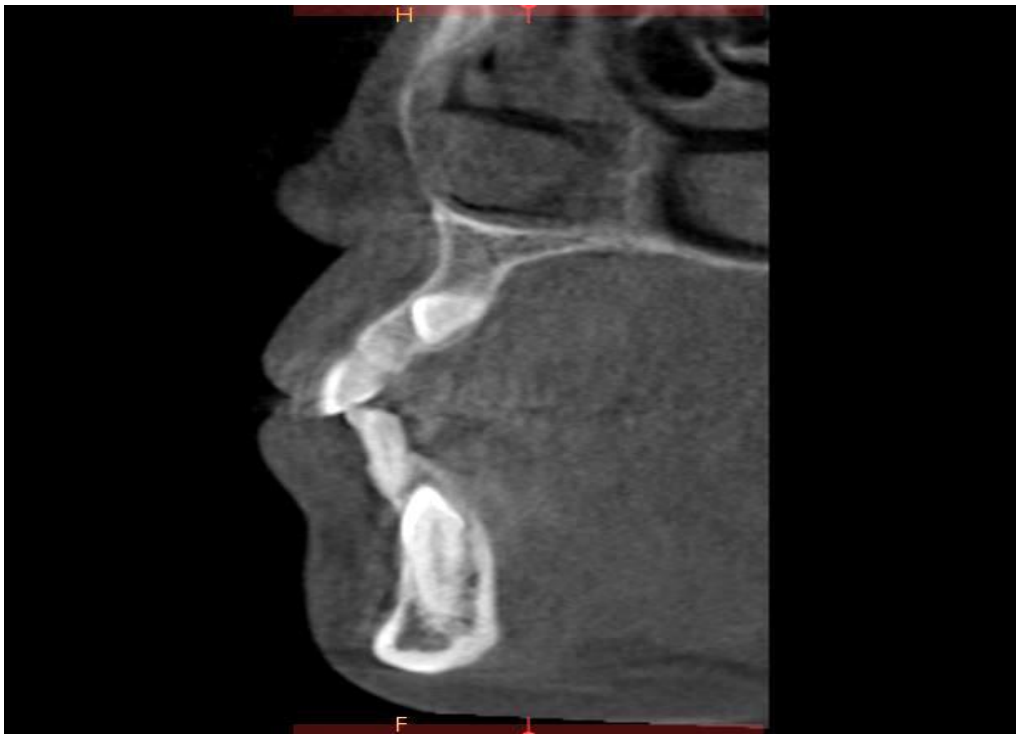


Fig.21 PRE-OPERATIVE OPG

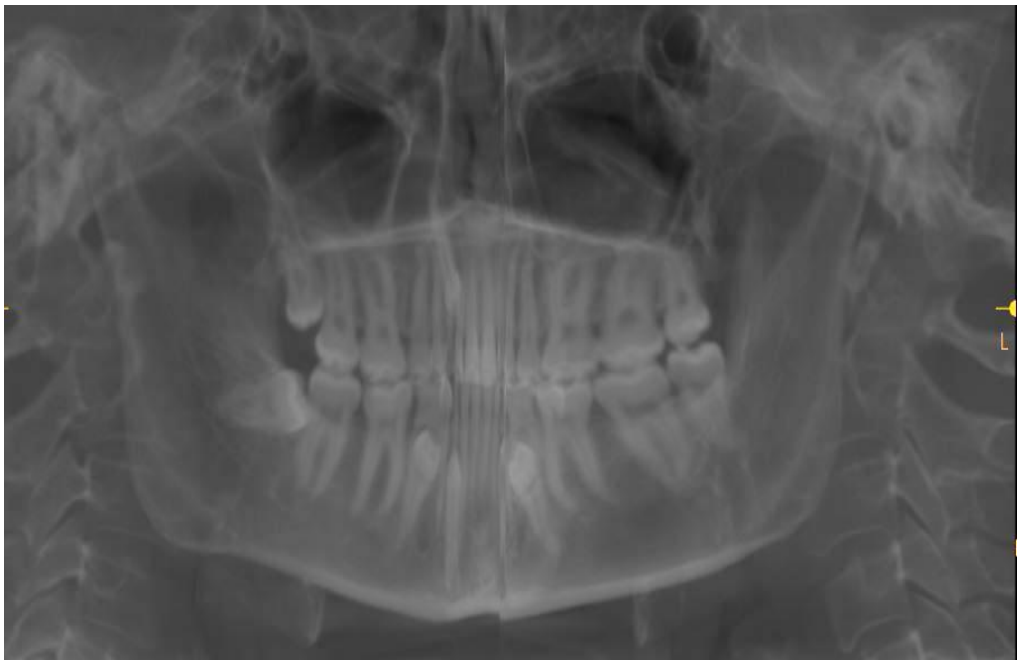


Fig.22 MUCOPERIOSTEAL FLAP ELEVATION

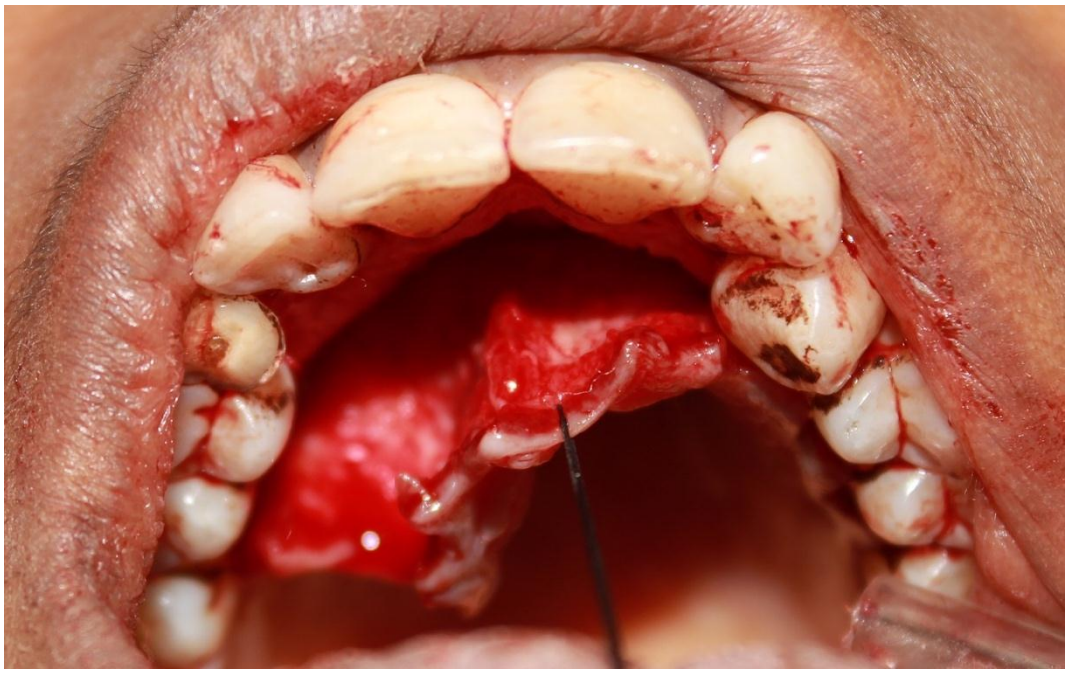


Fig.23 EXPOSURE OF IMPACTED CANINE

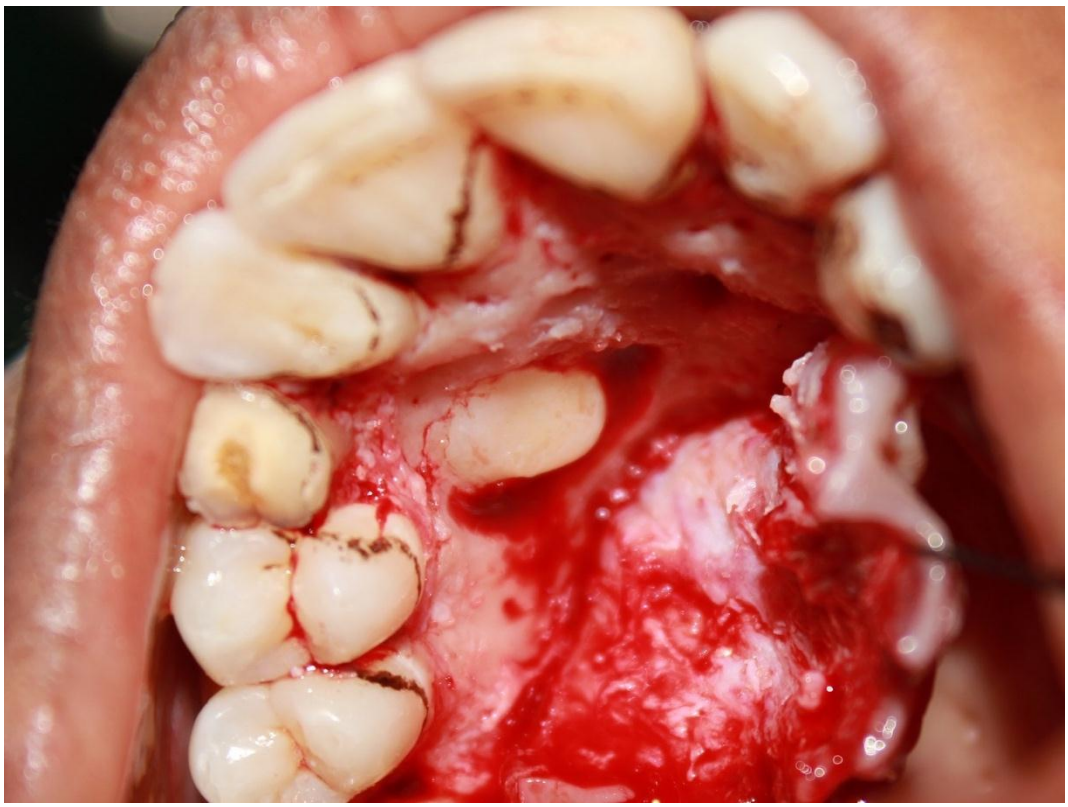


Fig.24 CROWN & ROOT REMOVAL

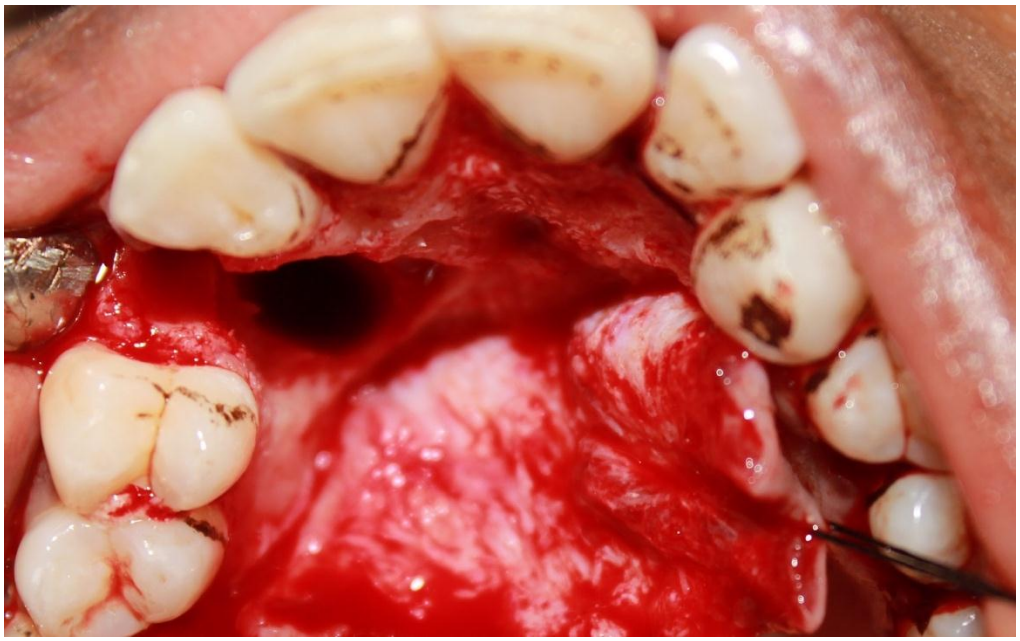


Fig.25 EXTRACTED CANINE

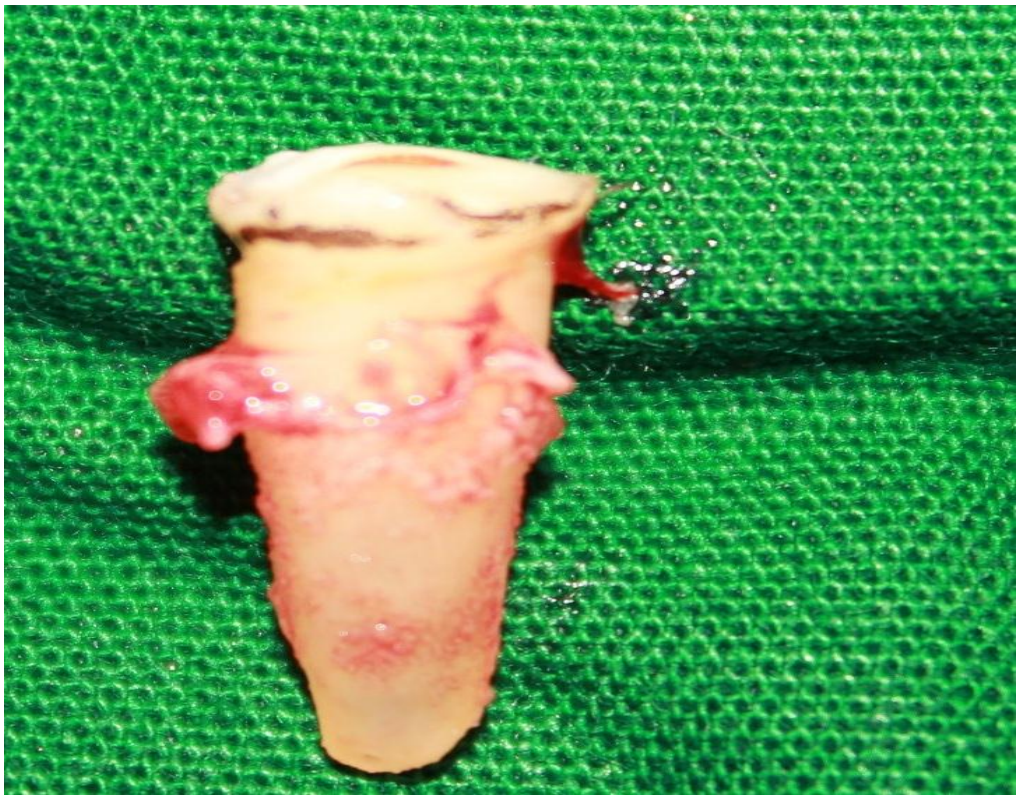
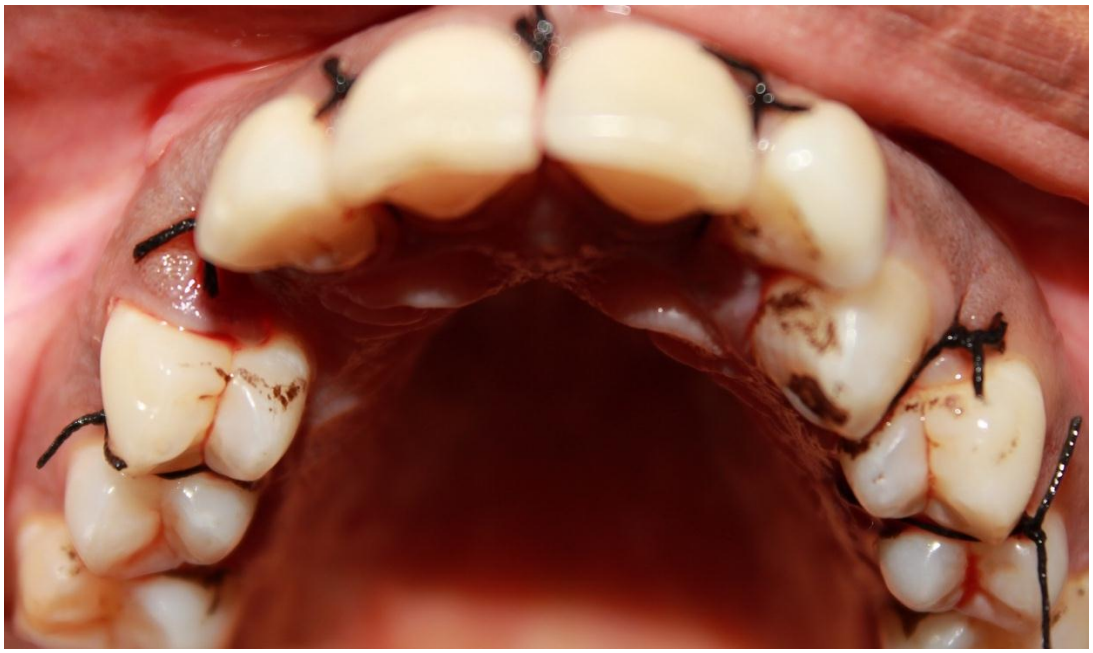


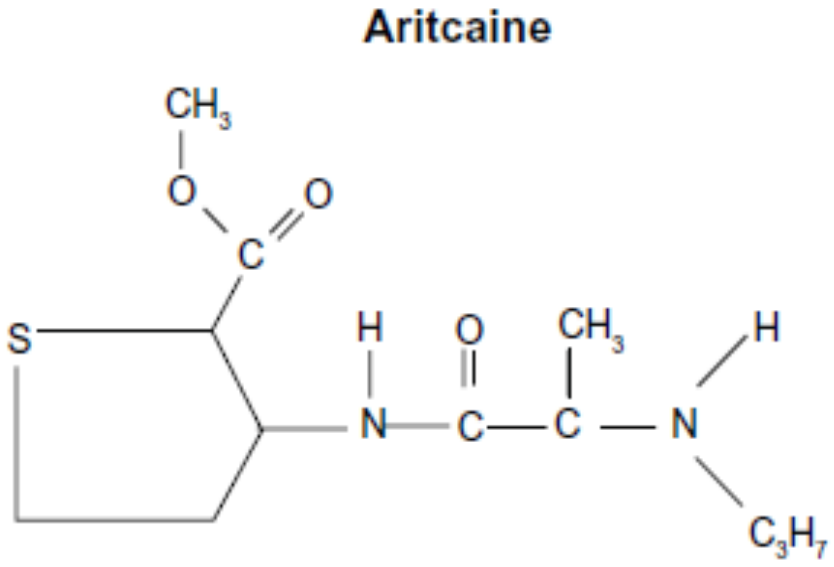
Fig.26 APPROXIMATION OF FLAPS AND SUTURING



Pharmacology

PHARMACOLOGY OF ARTICAINE HCL

Classification: It belongs to amide group of local anaesthetics. Chemical formula: 3-N-propylamino-propionylamino-2 carbomethoxy – 4 – methyl thiophene hydrochloride. Articaine differs from the previous amide local anaesthetics in that it has a thiophene ring in its molecule instead of the usual benzene ring. The thiophene ring within its structure renders Articaine more lipid-soluble. This allows more anaesthetic to diffuse across the nerve membrane, increasing its potency.[52]



Prepared by: H.Rusching et al, 1969

FDA approved: April 2000

Introduced: 1976 in Germany and Switzerland, 1983 in Canada, 2000 in U.S

Potency: 1.5 times that of Lidocaine and 1.9 times that of Procaine

Toxicity: similar to Lidocaine and Procaine

Mechanism of action:

Action of Articaine is like other local Anesthetics in reversibly blocking nerve conduction. Articaine blocks nerve conduction by reversibly binding to the α-subunit of the voltage-gated sodium channels within the inner cavity of the nerve, similar to other local anaesthetics. Binding of Articaine to the sodium channel reduces sodium influx so that the threshold potential will not be reached, and impulse conduction stops. The blocking action of Articaine on the sodium channel is state dependent: it has the highest affinity for the open state, an intermediate affinity for the inactivated state, and the lowest affinity for the resting state. The degree of neuronal block is affected by the diameter of the nerve. Articaine is lipid soluble, highly protein-bound (94%), and has a dissociation constant (pKa) of 7.8. pH with vasoconstrictor is 3.5 to 4.0.[52]

Effective dental concentration: 4% with 1:100,000 or 1:200,000.

Onset Of Action:

Articaine 1:200,000 - infiltration 1 -2 mins, mandibular block 2-3 mins. Articaine - 1:100,000 infiltration 1-2 mins, mandibular block 2 – 2 1/2 mins.

Duration of action:

The formulation with 1:100,000 epinephrine provides between 60 and 75 minutes of pulpal anaesthesia; the 1:200,000 formulation, approximately 45 to 60 minutes.

Anaesthetic half-life: 0.5 hours

Topical anaesthetic action: Not in a clinically acceptable concentration

Pregnancy classification: Unknown

Safety during lactation: Unknown

Metabolism:

Articaine differs from the other amide local anesthetics because it contains a thiophene ring and Articaine contains an ester group also, biotransformation occurs in both plasma (hydrolysis by plasma esterase) and liver (hepatic microsomal enzymes). Degradation of Articaine HCL is initiated by hydrolysis of the carboxylic acid ester groups to give free carboxylic acid. It's primary metabolite, articainic acid, is pharmacologically inactive, undergoing additional biotransformation to form articainic acid glucuronide.[60]

Excretion:

The renal clearance of Articaine is 1.35 +/- 0.83 L/h, whereas that of articainic acid is 7.18 +/= 1.81 L/h. Articainic acid glucuronide is not present in plasma. These results suggest that articainic acid is glucuronidated by the tubular cells and then excreted via kidneys approximately 5% to 10% unchanged, and 90% metabolites. The metabolite articainic acid shows a half-life of 2 to 2.5 hours. The total recovery of the dose in the urine varies between 50 and 92% over 36 hours.[60]

Vasodilating properties:

Articaine, like most local anesthetics at concentrations that are used clinically, has a vasodilatory effect, increasing its systemic absorption. Its vasodilation effect is equal to Lidocaine. Procaine is slightly more vasoactive. This is countered in preparations with epinephrine 1:100,000, and 1:200,000. The distribution of the drug is influenced by the degree of tissue and plasma protein binding of the drug. The more protein-bound the agent, the longer the duration of action, as the free drug is more slowly made available for

metabolism. Based on its physiochemical and stereochemical properties, protein binding of Articaine is 94%.[61]

Maximum dose:

Recommendations regarding maximum doses of local anesthetics lack scientific justification; therefore, the recommended highest dose of Articaine, assumed to be around 4–7 mg/kg (7.0mg/kg or 3.2mg/lb.), must be interpreted as an important guide number.[60]

Neurotoxicity:

All commonly used local anesthetics produce neurotoxicity in a concentration-dependent manner. Proposed causes for neurological deficits are neural ischemia (due to local vasoconstriction caused by the local anesthetic itself or by epinephrine) or inflammation. Clinical signs are perioral and tongue paresthesia, a metallic taste, and dizziness passing into slurred speech, diplopia, tinnitus, confusion, restlessness, and muscle twitching progressing to neuronal depression and leading to convulsions and coma. The severity of cardiovascular and central nervous system toxicity is directly related to the local anesthetic potency, dose, and rate of administration. In this context, one must distinguish acute toxicity caused by accidental intravascular administration from toxicity caused by the systemically absorbed local anesthetic. Patients with hepatic or renal impairment both metabolites can accumulate, which in theory can cause local anesthetic systemic toxicity (LAST). The American Society of Regional Anesthesia and Pain Medicine advises that heightened vigilance may be warranted in these patients particularly if they are at the extremes of age.[60]

Contraindications:

Articaine is contraindicated in patients allergic to amide type anesthetics and patients allergic to metabisulfites (preservative present in the formula to extend the life of epinephrine), as there is no cross allergenicity between sulfites (preservatives), sulphur, and the "sulpha" -type antibiotics. It is contraindicated in patients with hemoglobinopathies (sickle cell disease) and in patients with idiopathic or congenital methemoglobinemia, but methemoglobinemia is not a concern in the dental practice due to the small volumes of Articaine used. Articaine is not contraindicated in patients with sulpha allergies; there is no cross allergenicity between arcticain's Sulphur bearing thiophene ring and sulphonamides.[35]

In children 4–13 years of age, the only adverse event directly related to Articaine was accidental lip injury; no pharmacokinetic investigation was performed. Prolonged numbness appears to be the most frequent adverse event after Articaine for dental intervention, occurring primarily in children younger than 7 years old. Notwithstanding manufacturers' recommendations that Articaine not be used in children under 7 years of age.[16]

Results

RESULTS

This study was performed in Ragas Dental College and Hospital in the Department of Oral and Maxillofacial surgery during the period of January 2017 to June 2018. The study was designed to evaluate the clinical efficacy of 4% Articaine with 1:100,000 epinephrine for surgical removal of impacted maxillary canines. Data obtained was entered in excel sheet and analyzed using SPSS v20. Significance was set at $p<0.005$. Since the data was found to follow non-normal distribution, non-parametric test (Mann Whitney u test) was used to test quantitative variables and chi square test was used to test qualitative variables.

Age and Sex Distribution

A total of twenty Patients were included in the study, five male (50%) and five female (50%) patients with mean age of 30.20 years (SD: 9.12) were allocated to Group A (Table.1). Four male (40%) and six female (60%) patients with mean age of 29.30 years (SD: 8.42) were allocated to Group B (Table.2). Statistically no significant difference was seen in mean age ($p = 0.761$) & distribution of males and females ($p = 0.500$) between the two groups.

Drug Volume

The mean drug volume was 1.9ml (SD: 0.2) for Group A and 2.2 ml (SD: 0.5) for Group B (Table.3), there was no statistically significant differences between the two groups ($p > .50067$).

Pain Score

The subjective intraoperative pain scoring by the patients showed no differences between the two anesthetic solutions, ($p > 0.639$ at 15minutes and $p > 0.135$ at 30 minutes interval) for Group A and Group B (Table.4, Table.5).

Duration of Procedure

The mean duration of procedure was 39.00 min (SD: 5) for Group A and 42.00 min (SD: 4.5) for Group B (Table.3), there was no statistically significant differences between the two groups ($p = 0.202$).

Onset of Anaesthesia

The mean onset of Anaesthesia was 42 seconds (SD: 7) for Group A and 60 sec (SD: 4) for Group B (Table.3), there was statistically significant differences between the two groups ($p < 0.005 = 0.000$).

Duration of Anaesthesia

The mean duration of Anaesthesia was 120.00 min (SD: 14) for Group A and 91.00 min (SD: 10) for Group B (Table.3), there was statistically significant differences between the two groups ($p < 0.005 = 0.001$).

Hemodynamics

With respect to the hemodynamics parameters, there was no statistically significant difference in blood pressure (Table.9) (Table.10) (Table.11), heart rate (Table.6), or oxygen saturation (Table.7) (Table.8) before and during the surgery ($p > 0.05$).

Tables and Graphs

Table.1 AGE OF THE PARTICIPANTS

AGE (Years)		
ARTICAINE (Group A)	Mean	30.2000
	Std. Deviation	9.12627
LIDOCAINE (Group B)	Mean	29.3000
	Std. Deviation	8.42021

Table.2 GENDER OF THE PARTICIPANTS

GROUP		Frequency	Percent
ARTICAINE (Group A)	MALE	5	50.0
	FEMALE	5	50.0
LIDOCAINE (Group B)	MALE	4	40.0
	FEMALE	6	60.0

Table.3 DRUG VOLUME, ONSET OF ANAESTHESIA, DURATION OF PROCEDURE & DURATION OF ANAESTHESIA

GROUP		DRUG VOLUME (ml)	ONSET OF ANAESTHESIA (Seconds)	DURATION OF PROCEDURE (Minutes)	DURATION OF ANAESTHESIA (Minutes)
ARTICAINE (Group A)	Mean	1.8600	42.2000	39.5000	120.8000
	Median	1.8000	41.0000	40.0000	125.0000
	Mode	1.80	36.00	40.00	100.00
	Std. Deviation	.18974	7.33030	5.50252	14.58157
LIDOCAINE (Group B)	Mean	2.1800	60.0000	42.0000	91.8000
	Median	1.8000	59.5000	45.0000	91.0000
	Mode	1.80	54.00[a]	45.00	90.00
	Std. Deviation	.50067	4.08248	4.83046	10.72691
	p- VALUE	.091	0.000	.202	0.001

Table.4 PAIN SCORE AT 15 MINS

(Visual Analog Scale)

		No Pain	Mild Pain	p- VALUE
GROUP	ARTICAINE (Group A)	7	3	
	LIDOCAINE (Group B)	6	4	.639

Table.5 PAIN SCORE AT 30 MINS

(Visual Analog Scale)

		No Pain	**Mild Pain**	**P - Value**
GROUP	ARTICAINE (Group A)	4	6	
	LIDOCAINE (Group B)	4	6	0.135

Table.6 HEART RATE (HR)

GROUP		**HR BEFORE LA**	**HR AT 15 MIN**	**HR AT 30 MIN**	**HR AT 45 MIN**	**HR AT 60 MIN**
ARTICAINE (Group A)	Mean	76.0000	81.5000	74.8000	73.4000	74.4000
	Median	76.0000	80.0000	73.0000	70.0000	74.0000
	Mode	78.00	66.00	66.00	68.00	72.00
	Std. Deviation	8.90693	10.23339	8.59974	6.25744	8.31598
LIDOCAINE (Group B)	Mean	77.5000	83.3000	74.5000	75.0000	76.8000
	Median	78.0000	83.0000	74.0000	75.0000	78.0000
	Mode	78.00	84.00	78.00	70.00	80.00
	Std. Deviation	5.58271	6.63409	3.37474	5.43650	5.18116
	p- VALUE	.648	.543	.647	.396	.491

Table.7 OXYGEN SATURATION (OS)

GROUP		OS BEFORE LA (%)	OS AT 15 MIN (%)	OS AT 30 MIN (%)	OS AT 45 MIN (%)	OS AT 60 MIN (%)
ARTICAINE (Group A)	Mean	98.9000	96.7000	98.4000	98.5000	99.1000
	Median	99.0000	96.0000	98.5000	98.0000	99.0000
	Mode	99.00	96.00	99.00	98.00	100.00
	Std. Deviation	.73786	1.25167	.96609	.70711	.87560
LIDOCAINE (Group B)	Mean	98.8000	97.2000	98.7000	98.9000	99.3000
	Median	99.0000	97.5000	99.0000	99.0000	99.5000
	Mode	99.00	99.00	99.00	99.00	100.00
	Std. Deviation	.91894	2.20101	.82327	.99443	.82327
	P - VALUE	.902	.640	.438	.245	.598

Table.8 MEAN RANKS FOR HEART RATE & OXYGEN SATURATION

RANKS				
	GROUP	**N**	**Mean Rank**	**Sum of Ranks**
HR BEFORE LA	ARTICAINE	10	9.90	99.00
	LIDOCAINE	10	11.10	111.00
	Total	20		
HR AT 15 MIN	ARTICAINE	10	9.70	97.00
	LIDOCAINE	10	11.30	113.00
	Total	20		
HR AT 30 MIN	ARTICAINE	10	9.90	99.00
	LIDOCAINE	10	11.10	111.00
	Total	20		
HR AT 45 MIN	ARTICAINE	10	9.40	94.00
	LIDOCAINE	10	11.60	116.00
	Total	20		
HR AT 60 MIN	ARTICAINE	10	9.60	96.00
	LIDOCAINE	10	11.40	114.00
	Total	20		
OS BEFORE LA	ARTICAINE	10	10.65	106.50
	LIDOCAINE	10	10.35	103.50
	Total	20		
OS AT 15 MIN	ARTICAINE	10	9.90	99.00
	LIDOCAINE	10	11.10	111.00
	Total	20		
OS AT 30 MIN	ARTICAINE	10	9.55	95.50
	LIDOCAINE	10	11.45	114.50
	Total	20		
OS AT 45 MIN	ARTICAINE	10	9.05	90.50
	LIDOCAINE	10	11.95	119.50
	Total	20		
OS AT 60 MIN	ARTICAINE	10	9.85	98.50
	LIDOCAINE	10	11.15	111.50
	Total	20		

Table.9 SYSTOLIC BLOOD PRESSURE (SYSTOLIC BP IN mmHg)

GROUP		SYSTOLIC BP BEFORE LA	SYSTOLIC BP AT 15 MIN	SYSTOLIC BP AT 30 MIN	SYSTOLIC BP AT 45 MIN	SYSTOLIC BP AT 60 MIN
ARTICAINE (Group A)	Mean	116.6000	130.4000	118.6000	115.6000	118.4000
	Median	115.0000	132.0000	119.0000	119.0000	120.0000
	Mode	110.00	128.00	110.00	100.00	120.00
	Std. Deviation	10.06865	13.29327	10.24370	10.27619	6.31049
LIDOCAINE (Group B)	Mean	121.0000	129.4000	117.8000	112.8000	117.8000
	Median	118.0000	124.0000	114.0000	110.0000	116.0000
	Mode	118.00	124.00	110.00	110.00	110.00
	Std. Deviation	10.50926	10.83410	9.68160	7.43565	8.66410
	P - VALUE	.402	.820	.878	.418	.728

Table.10 DIASTOLIC BLOOD PRESSURE

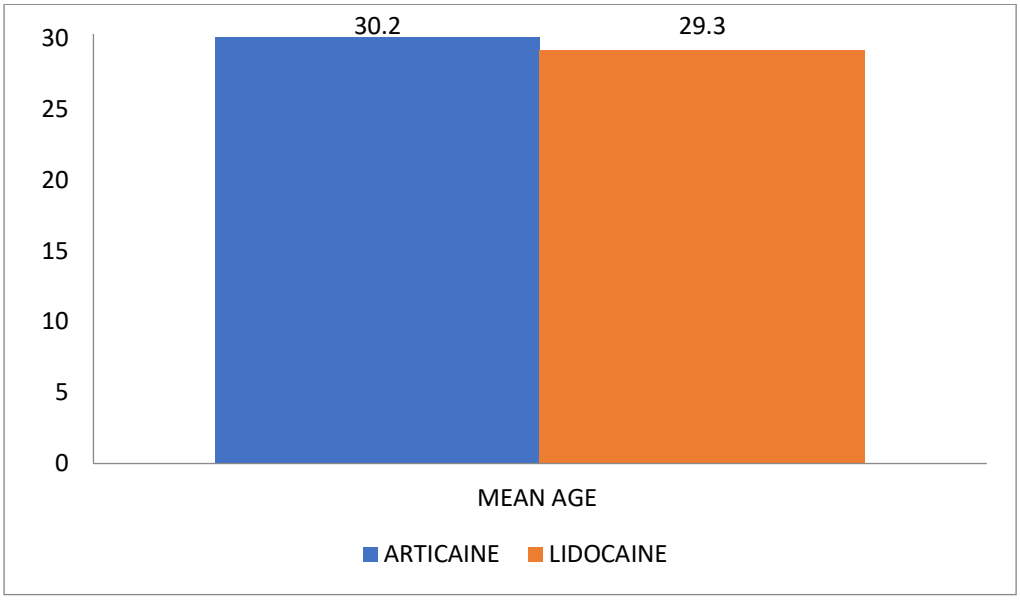
(DIASTOLIC BP IN mmHg)

GROUP		**DIASTOLIC BP BEFORE LA**	**DIASTOLIC BP AT 15 MIN**	**DIASTOLIC BP AT 30 MIN**	**DIASTOLIC BP AT 45 MIN**	**DIASTOLIC BP AT 60 MIN**
ARTICAINE (Group A)	Mean	79.2000	86.6000	80.4000	77.8000	79.4000
	Median	81.0000	87.0000	80.0000	78.0000	81.0000
	Mode	70.00	80.00	80.00	78.00	82.00
	Std. Deviation	7.25412	5.25357	3.62706	4.15799	6.04060
LIDOCAINE (Group B)	Mean	81.6000	81.0000	76.0000	75.6000	81.0000
	Median	80.0000	88.0000	79.0000	76.0000	79.0000
	Mode	80.00	88.00	80.00	76.00	78.00
	Std. Deviation	5.87272	10.03328	9.97775	4.08792	6.61648
p-VALUE		.673	.398	.333	.200	.704

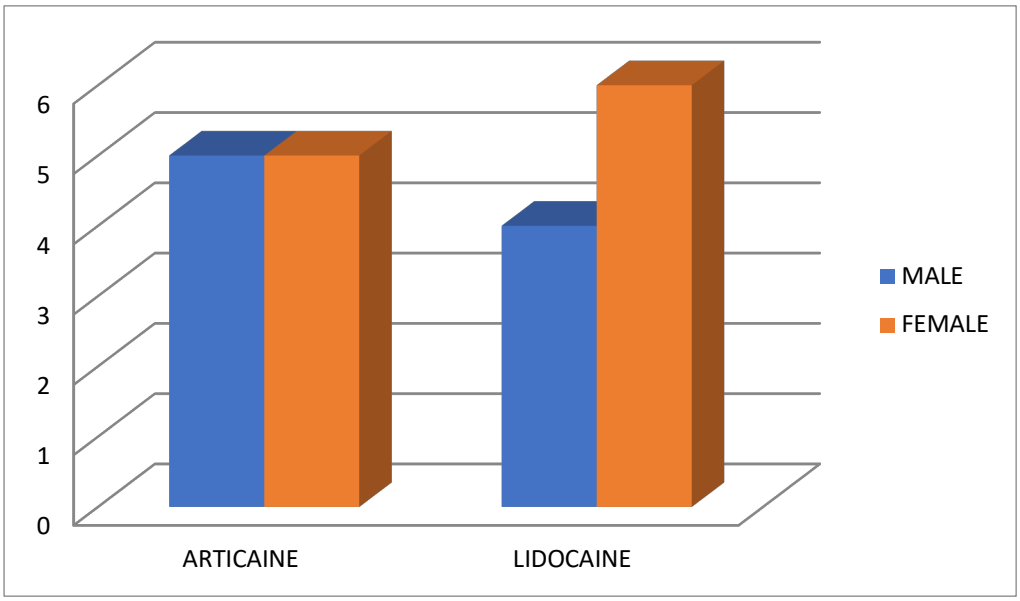
Table.11 MEAN RANKS FOR SYSTOLIC & DIASTOLIC BLOOD PRESSURE

	GROUP	N	MEAN RANK
SYSTOLIC BP BEFORE LA	ARTICAINE	10	9.40
	LIDOCAINE	10	11.60
DIASTOLIC BP BEFORE LA	ARTICAINE	10	9.95
	LIDOCAINE	10	11.05
SYSTOLIC BP AT 15 MIN	ARTICAINE	10	10.80
	LIDOCAINE	10	10.20
DIASTOLIC BP AT 15 MIN	ARTICAINE	10	11.60
	LIDOCAINE	10	9.40
SYSTOLIC BP AT 30 MIN	ARTICAINE	10	10.70
	LIDOCAINE	10	10.30
DIASTOLIC BP AT 30 MIN	ARTICAINE	10	11.75
	LIDOCAINE	10	9.25
SYSTOLIC BP AT 45 MIN	ARTICAINE	10	11.55
	LIDOCAINE	10	9.45
DIASTOLIC BP AT 45 MIN	ARTICAINE	10	12.15
	LIDOCAINE	10	8.85
SYSTOLIC BP AT 60 MIN	ARTICAINE	10	10.95
	LIDOCAINE	10	10.05
DIASTOLIC BP AT 60 MIN	ARTICAINE	10	10.00
	LIDOCAINE	10	11.00

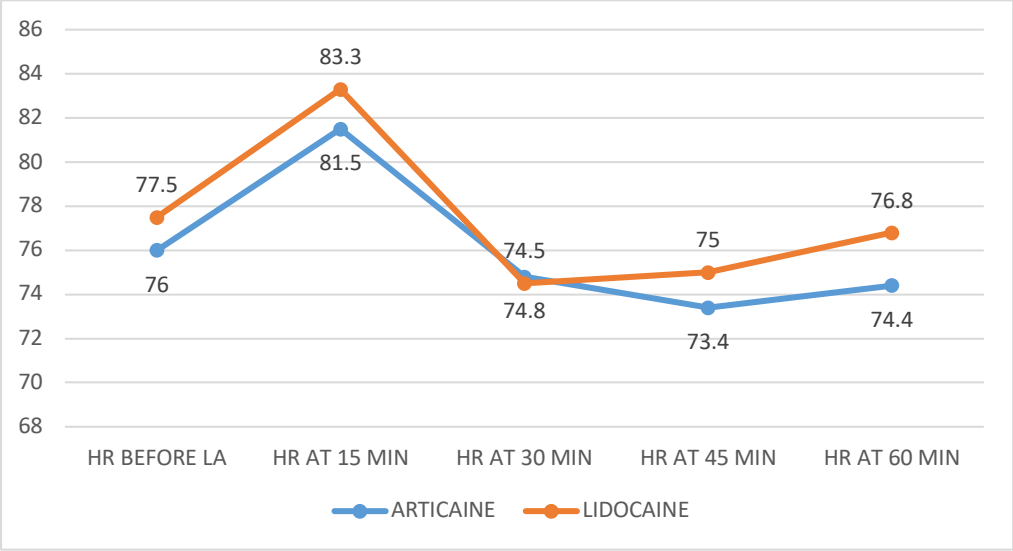
Graph.1 AGE OF THE PARTICIPANTS. (Years)



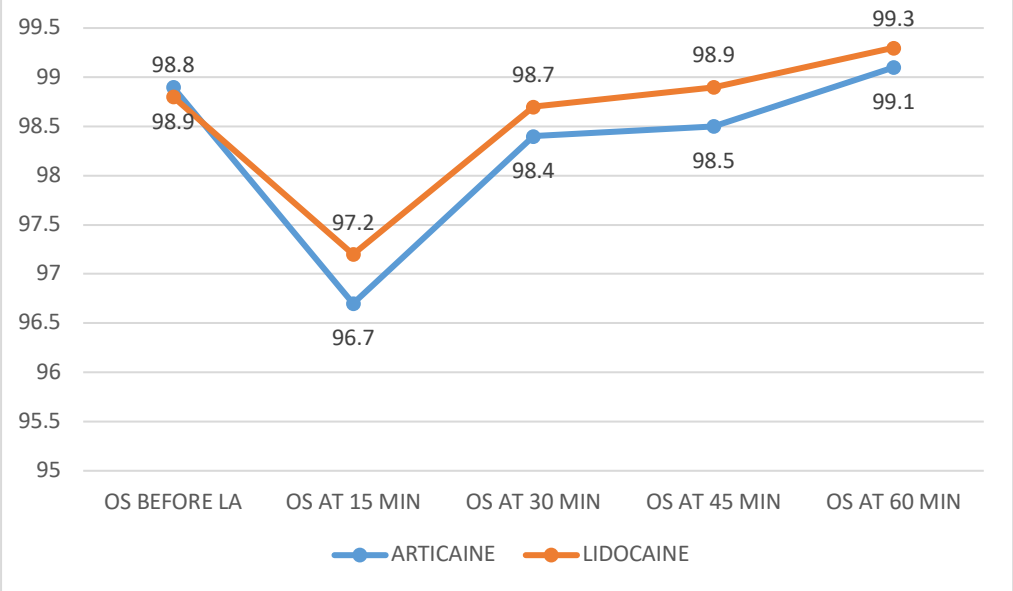
Graph.2 NUMBER OF MALES AND FEMALES IN GROUPS



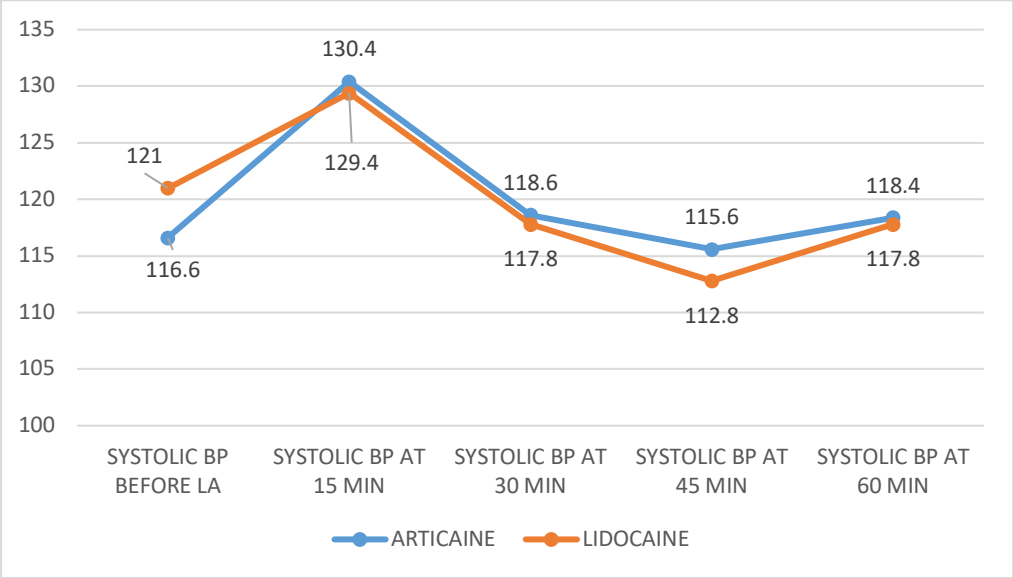
Graph.3 HEART RATE (Minutes)



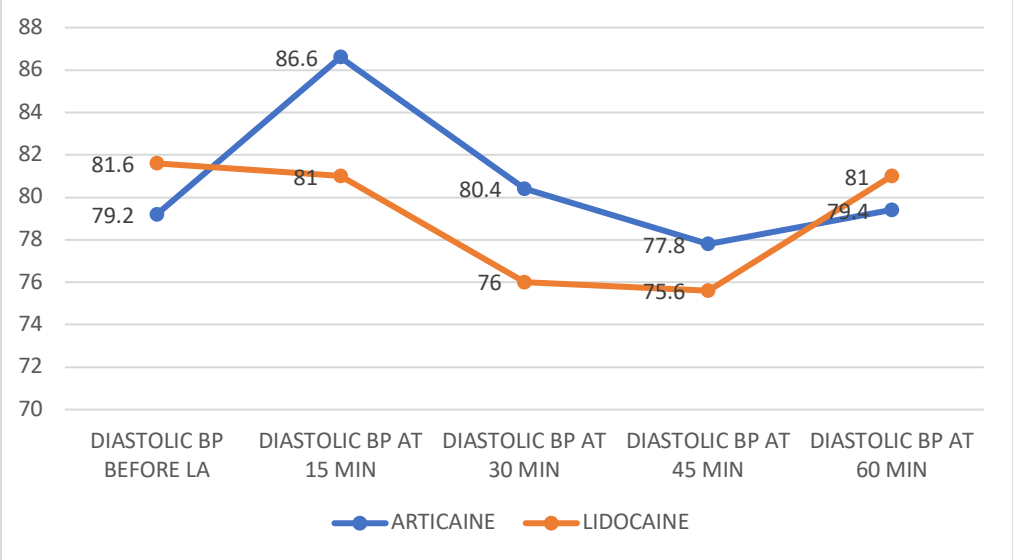
Graph.4 OXYGEN SATURATION (%)



Graph.5 SYSTOLIC BLOOD PRESSURE (mmHg)



Graph.6 DIASTOLIC BLOOD PRESSURE (mmHg)



Discussion

DISCUSSION

Local anaesthetics form the mainstay of pain control techniques in dentistry. The role of drugs used for local anaesthesia is vital in the field of dentistry as they help the dentists in the successful completion of various dental procedures by ensuring less pain and discomfort for the patients. It can be said that local anaesthesia forms the backbone of almost all dental procedures. Tooth extraction is one of the procedures that especially require a relatively pain-free arrangement. As effective as these drugs are, however, research has continued to seek safer and more effective local anaesthetics. Articaine is emerging local anesthetic which due to its comparable safety and potency has been studied extensively and being compared with Lignocaine.

Local anaesthetics provide adequate pain relief for the majority of dental procedures; however, failures do occur. These may be the result of anatomical, pharmacological, pharmaceutical, pathological, psychological or procedural factors (Byers et al. 1990, Wong & Jacobsen 1992, Quinn 1998, Hargreaves & Keiser 2002, Meechan 2005).[29] The local infiltration anaesthesia (LIA) is significantly simpler compared to the nerve block techniques and less unpleasant for patients. However, it is not efficient if used for complicated exodontia like impacted tooth removal. Factors that affect both the depth and duration of a drug's anesthetic action include individual response to drug, accuracy in deposition of local anesthetic, status of tissue at the site of drug deposition, anatomical variation and volume of anesthetic used. In this study, we used 4% Articaine with 1:100,000 epinephrine for the surgical removal of maxillary impacted canine due to its attributed effective pain control because of its better diffusion properties. Additionally, increased lipid solubility provides the enhanced diffusion through hard and soft tissues. This feature enables the passage of the anaesthetic even through thick cortical bone.

Robertson et al.[53] recorded a successful analgesia with Articaine administered via local infiltration anesthesia for mandibular posterior teeth ranging from 75% to 92%, which was significantly higher when compared to Lidocaine. Even more, supplemental local infiltration with Articaine after IANB with Lidocaine provided better pulpal anaesthesia of lower posterior teeth, enabling longer duration of anaesthesia of the first molar and second premolar. Robertson concluded that both local buccal infiltration and Inferior alveolar nerve block with Articaine proved to be highly successful, in the region of the first molars and both premolars. However, they found buccal infiltration was not as effective in mandibular second molar region. They attributed that the reasons being individual anatomical nature, such as the increased thickness of the buccal lamella in the region of the second molar, more lingual position of the mandibular canal, as well as the fact that the anaesthetic was applied proximal to the mentioned tooth.

Various authors have evaluated the success of mandibular first molar infiltrations using asymptomatic subjects, a cartridge of 4% Articaine with 1:100,000 epinephrine, and an electric pulp tester to evaluate pulpal anaesthesia. Kanaa et al, Robertson et al, Jung et al, Corbett et al, Pabst et al, and McEntee et al used a similar methodology to the current study and showed 64%, 87%, 54%, 64% to 70%, 64% to 69%, and 67% success rates, respectively. The results of previous studies confirm that the buccal infiltration of a 1.8 ml Articaine would not provide predictable pulpal anaesthesia of mandibular molars.[16,31,53]

Costa et al.[11] carried out a study to compare the onset and duration of pulpal anaesthesia by maxillary infiltration using 2% Lidocaine with 1:100,000 epinephrine, 4% Articaine with 1:200,000 epinephrine, and reported that both solutions produced shorter onset and longer duration of pulpal

anaesthesia. Sierra - Rebolledo et al.[51] carried out a comparative study on the anesthetic efficacy of 4% Articaine versus 2% Lidocaine, both with epinephrine 1:100,000, in truncal block of the inferior alveolar nerve during the surgical extraction of impacted lower third molars and found out that 4% Articaine offers better clinical performance than 2% Lidocaine, particularly in terms of latency and duration of the anesthetic effect but statistically no significant differences in anesthetic efficacy were recorded between the two solutions. Kalia et al. did a study to compare the onset and duration of anaesthesia of 4% Articaine with epinephrine (1:100,000) versus 2% Lidocaine with epinephrine during exodontias and concluded that there were some significant differences between 4% Articaine and 2% Lidocaine in terms of subjective and objective symptoms and onset of pulpal anaesthesia. The result showed that 4% Articaine had longer duration and onset of anaesthesia as compared to 2% Lidocaine.

The choice of anesthetic solution should be based on three main clinical considerations: anesthetic potency, latency (time to onset of anaesthesia), and duration of the anesthetic effect. Other important considerations are the pharmacokinetics (absorption, distribution, metabolization and excretion) and toxicity of the drug. The latency of Lidocaine varies from 2-3 minutes, with an approximate duration of anesthetic effect for 2% solutions with epinephrine 1:100,000 as vasoconstrictor of 85 minutes at pulp level, and 190 minutes in soft tissues.[52] Lidocaine is the local anesthetic most widely used for pain control, since its pharmacokinetic characteristics and low toxicity compared with other ester-type anaesthetics make it safe for use in dental practice. Its potency is presently regarded as the standard for comparison with other local anaesthetic.

Drug Volume

Malamed reported that the mean volume of Articaine required to achieve anaesthesia was 2.5 ± 0.07 ml for simple procedures like single extractions (compared to 2.6ml ± 0.09 of Lidocaine) and 4.2ml ± 0.15 ml for complex procedures like multiple extractions, alveloectomies and other osseous procedures (compared to 4.5ml ± 0.21 of Lidocaine).[59] Sreekumar and Bhargava[8] conducted a study to compare the onset and duration of action of soft tissue and pulpal anaesthesia with three different volumes 0.6 ml, 0.9 ml, and 1.2 ml of 4% Articaine with 1:100,000 epinephrine in maxillary anaesthesia and concluded that maxillary infiltration anaesthesia with Articaine and epinephrine has a faster onset, a greater success rate, and a longer duration with volume of 1.2 ml.[55] In our study the mean drug volume was 1.9ml ± 0.2ml for Group A and 2.2 ml ± 0.5ml for Group B administered via buccal and palatal infiltrations, statistically no significant difference was present in the two groups.

Onset of Action

Onset of action depends on a number of factors, such as the intrinsic properties of the drug substance used, and the anesthetic technique employed. On the other hand, latency is directly influenced by the corresponding pKa value—smaller pKa values being associated to shorter latency. Accordingly, 4% Articaine (pKa = 7.8) would at least in theory present a shorter latency than 2 % Lidocaine (pKa = 7.9). Dugal et al.[12] concluded onset of action of Lidocaine was 1.15 min when injected for nerve blocks. Moore et al. reported that the onset of action was 3.0 ± 2.1min 4 % for Articaine HCl with 1:100,000 and 3.1 ± 2.3 min for 4 % Articaine HCl with 1:200,000 after maxillary infiltration of 1.0ml anesthetic solution.[45] Colombini et al. stated 149.50 ± 14.29 s for Articaine via IANB in lower third molar removal.[9] Rebolledo et al.[52] reported 53.03 s (0.93 min) for Articaine versus 75.04 sec

(1.25 min) for Lidocaine in lower third molar removal. The mean onset of anaesthesia was 42.2 seconds for Group A and 60 seconds for Group B which was given as buccal and palatal infiltrations in our study, there was statistically significant differences between the two groups.

Duration of Anaesthesia

Duration of anaesthesia is directly proportional to its degree of protein binding. However, the duration of the effect of the local anesthetic is also dependent on the injection site or concentration of vasoconstrictor present in the anesthetic solution being used. Articaine presents the greatest protein binding capacity of all the amide local anaesthetics, comparable only to long acting substances such as Bupivacaine, Ropivacaine and Etidocaine. This in turn implies a longer duration of the anesthetic effect.[65] The duration of anaesthesia required to complete the procedure will be major consideration in the selection of local anesthetic solution. Hass et al.[28] and Costa et al.[11] stated that 4% Articaine with 1:100,000 Epinephrine clinically presented the shortest onset and the longest duration periods and Articaine solutions produced both shortest onset and longer duration of pulpal anaesthesia in maxillary infiltration than the Lidocaine solution but statistically did not conform better clinical results.

Moore et al. reported mean duration of pulpal anaesthesia with infiltration was (A100) 61.8 $\pm$ 59 minutes and (A200) 51.2 $\pm$ 55.9 minutes evaluated by electric pulp testing and there were statistically significant differences between the two groups.[45] In our study the mean duration of Anaesthesia was 120.8 min for Group A and 91.8 min for Group B by maxillary infiltration and there were statistically significant differences between the two groups, the results of the present study are in accordance with the above reported study. Colombini et al. concluded that the duration of anesthesia was 273.80 $\pm$ 15.94 minutes for Mepivacaine. Rebolledo et al.[50]

reported 220.8 minutes for Articaine and while 168.2 minutes for Lidocaine Anaesthesia by inducing inferior alveolar nerve block anaesthesia. The long period of analgesia for Articaine stated that the concentration of Articaine in the alveolus of a tooth extraction is about 100 times higher than in systemic circulation. The saturable local Articaine mechanism has been considered as possibly contributing to the observed duration of local anesthetic effect.

Depth of Anaesthesia

Depth of anaesthesia was made by means of a visual analogue scale (VAS) and was taken by a different operator to avoid influencing the patient intraoperatively during the procedure for scoring the pain intensity. In our study intraoperative VAS of 1–10 for Group A and Group B the results are statistically not significant ($p > 0.639$ at 15minutes and $p > 0.135$ at 30 minutes interval) for Articaine and Lidocaine. According to Malamed et al, Rebolledo et al, Gregorio et al, reported the intra operative analgesia evoked by Articaine may be explained by its ability to readily diffuse through tissues due to the presence of thiophene group in the molecule which increases liposolubility.[19,51]

Efficacy of Articaine

In our study, clinical evaluation of the efficacy of the two anesthetic solutions were made by comparing the need for re-anesthesia during surgery. In one intervention another dose of Articaine was administered and in three interventions another dose of Lidocaine was administered during the procedure. However, mean drug volume used for re-anesthesia of the surgical area failed to reach statistical significance. Rebolledo et al,[51] Potonick et al.[49] reported that 2 % Articaine more effectively depresses the compound action potential of the A fibers in the isolated rat sural nerve than either 2 % or 4 % Lidocaine or 3 % Mepivacaine. Paessler et al.[23] concluded that the 4 % Articaine solution did not prove superior in local anesthetic effect. Articaine 2

% with epinephrine 1:200,000, therefore, can be considered a suitable local anesthetic for tooth extractions. The most noticeable difference observed between the two injection solutions concerned the duration of anaesthesia, which was significantly shortened under the low dose solution.

Santos et al.[54] reported that epinephrine concentration in 4 % Articaine solution does not influence the clinical efficacy of local anesthetic in terms of anesthetic properties (latency, post-operative analgesia, post-operative anaesthesia and quality of anaesthesia), intra operative bleeding and hemodynamic parameters in patients undergoing lower third molar removal. Gregorio et al. stated that 4% Articaine provided shorter time of onset, comparable homeostasis and post-operative pain control with a shorter duration of soft tissue anaesthesia in lower third molar removal.

Uckan et al. and Lacet-Lima et al.[29] Reported that Articaine demonstrated relatively good vestibule palatal diffusion with efficacy rates of anaesthesia 98%. Retained maxillary third molar extractions could be performed with only buccal vestibule infiltrative terminal anaesthesia in the majority of cases with no need for supplemental palatal anaesthesia.

Hemodynamics

The major concern in dentistry is perioperative hypertension crisis in hypertensive patients. As hypertension can bring about complications such as paralysis, heart and renal problems, and acute medical problems. Hypertensive patients constitute an important risk group in dental treatment. Although it is stated in the literature that local anaesthetics with vasoconstrictors can be safely used during oral surgery in hypertensive patients, there are still some controversies about this subject. It has been reported that the use of anesthetic solutions without vasoconstrictors increase the risk of hypertensive crisis due to the potential pain caused by insufficient intraoperative anaesthesia. Most clinicians prefer using local anaesthetics without vasoconstrictors in

hypertensive patients due to the negative effects of vasoconstrictors on cardiovascular system. Therefore, hemodynamic aspects, like BP or heart rate (HR), in hypertensive patients come into prominence.[50]

In addition to HR and BP, myocardial ischemia is also important in hypertensive patients. Rate pressure product (RPP) and pressure rate quotient (PRQ) are described as the possible predictors of myocardial oxygen consumption and subsequent ischemia. RPP is defined as the product of systolic BP (SBP) and the HR, and PRQ is defined as the mean arterial pressure (MAP) divided by the HR. Significant values suggested for RPP range from 12,000 to 20,000 to indicate ischemia and over 20,000 to indicate angina pectoris. It must be noted that 75% of all episodes of myocardial ischemia is silent and develops without anginal symptoms. For this reason, an RPP of 12,000 seems to provide a reasonable target value when monitoring ischemia. The target value for PRQ has been determined to be less than 1.08.[64]

In patients with cardiovascular disorders, Anaesthesia with its lower epinephrine content is usually preferred with the aim of avoiding the systemic side effects of epinephrine. Epinephrine in anesthetic solutions causes local vasoconstriction and prolongs the duration of anaesthesia. The systemic effects of epinephrine in local anesthetic agents have been discussed. Plasma epinephrine concentrations have been shown to increase more than 10-fold after administration of 3.6 mL of 2% Lidocaine with 1:80,000 epinephrine. Despite increases in serum catecholamine concentrations, administration of local anesthetic agents appears to cause only minor hemodynamic changes. Twelve healthy patients can tolerate these abrupt increases in vasoconstrictor serum concentration, but patients with cardiovascular disease may not be able to; thus, less vasoconstrictor in the solution could be safer. However, it is generally agreed that epinephrine administration should be avoided when a patient's cardiovascular status is labile. Evaluation of blood pressure and heart rate is one of the most sensitive assays for the response to epinephrine levels.

Our results show that both local anesthetic agents tested provide adequate anaesthesia rapidly and sufficiently long for minor dental procedures without any significant hemodynamic changes. We have not included any medically compromised patients in our study.[23]

In our present study the values of cardiovascular parameters showed that pulse rate increased with injection of 4 % Articaine and 2 % Lidocaine. The increase in pulse rate was maximum after 15 min of administration of Articaine and Lidocaine. The mean rise in Articaine group was 4 beats/min and gradually decreased to the basal value after 30 min. The mean rise in Lidocaine group was 6 beats/min and gradually decreased to the basal value after 30 min and no statistically significant differences between the two groups. The change in the systolic and diastolic blood pressure was recorded after administration of the local anesthetic agent and compared with the base line value in both the groups. There was no significant change noted in the systolic or diastolic blood pressure from the base line values at different time intervals after administration of both the anesthetic solutions. Our results are comparable with that of Santos et al.[54] who reported that transient increase or decrease in blood pressure and oxygen saturation were observed but they were neither clinically significant nor statistically significant. Local anesthesia with epinephrine may cause a slight increase in blood glucose concentration in type II controlled diabetic patients, which is not found to be clinically significant and therefore safe to use on diabetic patients. Hence, we have not evaluated the blood glucose level in our study.

Oxygen Saturation

The change in oxygen saturation was recorded after administration of the local anesthetic agent and compared with the base line value in both the groups. There was no significant change noted in the oxygen saturation from the base line values at different time intervals after administration of both the

anesthetic solutions. Colombini et al, Santos et al, Martinez et al, Elad et al. reported in accordance to our result. Vasconcellos et al. suggested that all patients submitted to surgery for removal of third molars are at risk for hypoxia. Short episodes of hypoxia may have only minor consequences in healthy patients, but those in unhealth may develop serious complications.[10,20,54,64.]

Adverse Reactions

According to literature Articaine has the potential to cause methemoglobinemia, neuropathies, paraesthesia, hypersensitivity, allergy. Malamed et al. reported overall incidence of adverse events in the combined studies were 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 %. Methemoglobinemia has been shown to develop with some types of local anaesthetics. Clinical tests of Articaine, Bupivacaine and Etidocaine administered as central nerve block anesthetic for urological procedures (n = 103) indicated no elevation of methemoglobin with Articaine.[62]

Haas and Lennon[19] published a retrospective analysis of paresthesia after local anesthetic administration for nonsurgical dental procedures over a 21-year period. The analysis revealed a higher-than-expected frequency of paresthesia with Articaine, based on the number of cartridges used (2.27 per 1 million injections vs. an expected frequency of 1.20 per 1 million injections). Malamed et al also reported an increased incidence of nerve alterations, paresthesia's and hyperesthesia's, when administering 4% Articaine with epinephrine 1:100,000 versus 2% Lidocaine at the same vasoconstrictor concentration – suggesting a possible greater neurotoxic effect on the part of Articaine.[7] In this sense, Penarrocha et al[48] documented 14 cases of eye problems when using this anesthetic for infraorbital nerve block.

Among the causes for these complications, the authors mentioned the possibility of increased diffusion of this anesthetic within the soft tissues and bone – thus facilitating Articaine penetration to the orbital cavity.

One of the most controversial aspects of Articaine administration is its potential to cause paresthesia's after inferior alveolar nerve blockade, which leads some researchers to support the opinion that 4% Articaine should not be routinely used in this anesthetic application. Other authors attribute this adverse effect to the higher concentration of Articaine (4%) compared with other local anaesthetics (e.g., 2% Lidocaine in association with epinephrine). Interestingly, Haas and Lennon also observed the same side effect for Prilocaine, which is also available in the same concentration as Articaine. It may be possible to decrease the risk of paresthesia's by using a lower concentration of Articaine to block the inferior alveolar nerve. However in our study we didn't encounter any kind of complications[20]

Articaine is contraindicated in patients allergic to amide-type anaesthetics and patients allergic to metabisulfites (preservative present in the formula to extend the life of epinephrine). It is contraindicated in patients with hemoglobinopathies (sickle cell disease) and in patients with idiopathic or congenital methemoglobinemia, but methemoglobinemia is not a concern in the dental practice due to the small volumes of Articaine used. In our study we did not encounter any kind of adverse reactions. [52]

Articaine has few advantages over Lidocaine including being more potent due to its high lipid solubility, a long duration of action and having a higher rate of diffusion through both soft and hard tissue. Articaine causes a transient and completely reversible state of anaesthesia (loss of sensation) during dental procedures. Articaine is used both for infiltration and block injections, and with the block technique, it yields the greatest duration of

anaesthesia. Also, in people with hypokalemia and sensory overstimulation, Lidocaine is not very effective, but Articaine works well.[52] Several studies have linked the use of Articaine to a lower level of pain in patients undergoing extractions.

Summary and Conclusion

SUMMARY AND CONCLUSION

The study was done to evaluate the anesthetic efficacy of 4% Articaine with 1:100,000 epinephrine for surgical removal of impacted maxillary canine. A total of twenty patients with impacted maxillary canine tooth were randomly allotted to either Group A (4% Articaine with 1:100,000 epinephrine) or Group B (2% Lidocaine with 1:80,000 epinephrine) for surgical removal. From our study we concluded that,

- The mean onset of Anaesthesia for articaine was 42 $\pm$ 7 seconds which was significantly less than that of Lidocaine.
- The mean duration of Anaesthesia for articaine was 120 $\pm$ 14 minutes which was significantly higher than that of Lidocaine.
- The depth of anesthesia for surgical removal of canine tooth was adequate with Articaine and there was no significant difference when compared with Lidocaine.
- There was no significant difference between Articaine and Lidocaine in terms of pain score and in hemodynamic changes.

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Annexures

ANNEXURE – I

RAGAS DENTAL COLLEGE & HOSPITAL

(Unit of Ragas Educational Society)
Recognized by the Dental Council of India, New Delhi
Affiliated to The Tamilnadu Dr. M.G.R. Medical University, Chennai
2/102, East Coast Road, Uthandi, Chennai - 600 119. INDIA.
Tele : (044) 24530002, 24530003-06. Principal (Dir) 24530001 Fax : (044) 24530009

TO WHOM SO EVER IT MAY CONCERN

Date: 07-01-2019,
Chennai.

From,
The Institutional Review Board,
Ragas Dental College and Hospital,
Uthandi, Chennai-600119.

The Dissertation topic titled **"EVALUATION OF CLINICAL EFFICACY OF 4% ARTICAINE WITH 1:100,000 EPINEPHRINE FOR SURGICAL REMOVAL OF IMPACTED MAXILLARY CANINE"** Submitted by **DR. MUSUNURI MANOJ KUMAR** has been approved by the Institutional Review Board of Ragas Dental College & Hospital.

Dr. N S Azhagarasan, M.D.S
Member Secretary,
Institutional Ethical Board,
Ragas Dental College and Hospital,
Uthandi, Chennai-600119.

ANNEXURE - II

INFORMED CONSENT FOR PARTICIPATION IN THE STUDY
TO WHOM SO EVER IT MAY CONCERN

Date:
Place:

I, …… Give my consent to be interviewed and examined by the doctor(s). I agree to co-operate to any investigations considered necessary for the study.
I have been informed about the study "EVALUATION OF CLINICAL EFFICACY OF 4% ARTICAINE WITH 1:100,000 EPINEPHRINE IN IMPACTED MAXILLARY CANINE."
I have been explained about the nature of the study and the proposed procedure.
I have been explained the nature and necessity of the proposed procedure to treat my condition/disease. I have been informed about the risks involved and the complications likely to arise during the procedure or thereafter, in the language I understand.
I consent to the administration of such anesthetic as may be considered necessary or advisable for this service and to the performance of the procedure. I acknowledge that no guarantees have been given by anyone about the results of the procedure of medicine and surgery is not an exact science.
I was free to ask questions and have been answered satisfactorily. I consent to the taking of photographs and publication of the same to advancing health education. I understand that my identity will remain confidential.

Signature of the Patient Signature of the Guardian

ANNEXURE – III

URKUND

Urkund Analysis Result

Analysed Document:	Thesis Plagiarism Check.docx (D46408928)
Submitted:	1/4/2019 11:19:00 AM
Submitted By:	manojkumar.chowdarys@gmail.com
Significance:	5 %

Sources included in the report:

PLAGIARISM CHECK.docx (D35070978)
Dr. Vishnupriya Thesis.pdf (D34341771)
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4697230/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4864681/

Instances where selected sources appear:

20