IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 24, Issue 5 Ser. 4 (May. 2025), PP 54-58
www.iosrjournals.org

Management Of Pain In Mandibular Fracture By Comparing The Efficacy Of Two Different Long Acting Local Anesthetics: An In Vivo Study

Dheeraj Sharma, Ajay K Pillai, Neha Jain, Abdul Rajjak Khandakar, Md Shaklin, Anamika Juhi
Resident, Dept Of Omfs, Peoples Dental Academy. Peoples University Bhopal
Prof & Hod, Dept Of Omfs, Peoples Dental Academy. Peoples University Bhopal
Prof, Dept Of Omfs, Peoples Dental Academy. Peoples University Bhopal
Resident, Dept Of Omfs, Peoples Dental Academy. Peoples University Bhopal
Resident, Dept Of Omfs, Peoples Dental Academy. Peoples University Bhopal
Resident, Dept Of Omfs, Peoples Dental Academy. Peoples University Bhopal

Abstract:
Management of post operative pain is extremely important for patient as well as the operating surgeon. In this context administration of long acting local anesthesia post fixation of mandibular fracture play an important role in management of pain post operatively. The purpose for this study was to evaluate the effect of inferior alveoler nerve block with articaine versus bupivacaine on post operative pain control in mandibular body fracture.
***Method**: 10 patient with isolated body fracture were divided in two groups. Group A who got injected by articaine and group B who got injected by bupivacaine. There onset of action, the amount of solution used, duration of post operative anesthesia and analgesia and need for rescue drugs was compared.*
***Results:** Long acting local anesthesia played a significant role in management of post operative pain after open reduction and internal fixation. Onset of action was less for articaine but duration of anesthesia and analgesia and duration of need for rescue drugs was higher with bupivacaine.*
***Conclusion:** Efficacy of articaine in achieving faster onset of anesthetic action is much better than bupivacaine, however bupivacaine was superior in duration of post operative anesthesia, reduction in post operative pain because of its residual anesthetic and analgesic effect.*
***Keywords:** Anesthesia, articaine, bupivacaine, post operative pain, mandible fracture, ORIF.*

Date of Submission: 11-05-2025 Date of Acceptance: 21-05-2025

I. Introduction:

The basic principle of management of maxillofacial trauma is proper reduction and fixation of fractured segment under local or general anesthesia and the management of post operative complication and pain [1].

Effective treatment of post-operative pain and complications not only enhances the patient's quality of life but also allows for an early discharge. For the management of pain maxillofacial surgeons usually uses opioid analgesics and NSAID’S. [1,2] According to many published literature it was reported that many patient is USA, Brazil avoid dental treatment due to the fear of pain [3]. Hence the proper management of pain provide better quality of life of patient.

Administration of opioids and NSAID’S posses increased risk of respiratory distress, Nausea, vomiting and other drug related complication to patient [1].

In this regard the use of long acting local anesthesia Peri-operatively reduces the administration of opioids and and NSAID’S in post operative period. This study was aimed to know the efficiency of two different molecules of long acting local anesthesia (articaine and bupivacaine) in management of pain with patients having open reduction internal fixation of mandibular body fracture.

II. Aim And Objective:

Aim and objective of our study was to compare the efficiency of articaine and bupivacaine for the management of post operative pain in the fracture of body of mandible. We also evaluate duration of post operative anesthesia and duration and need to take rescue medication by the patient.

III. Material And Method:

We did a prospective randomised study in our institute.

Total cases of 10 patient randomly divided into two groups group A who got inferior alveolar nerve block with 4% articaine and group B who got inferior alveolar nerve block with bupivacaine just after fixation of fracture.

Fig 1 showing OPG of patient showing right body fracture of mandible after fixation

Fig 2 showing inferior alveolar nerve block with 4% articaine after suturing.

(by closed mouth Vazirani Akinosi technique)

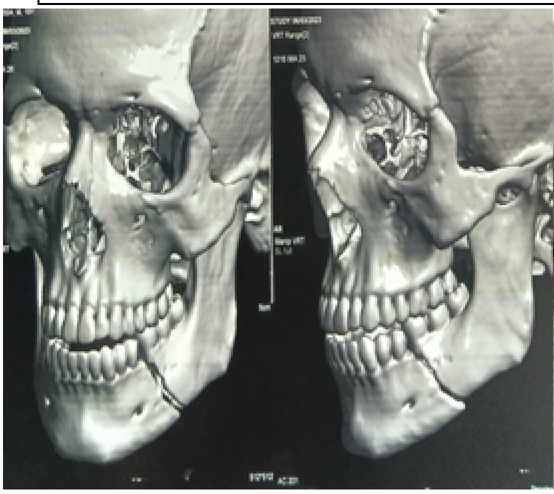

Fig 3 Showing 3D CT face image of patient showing left body fracture of mandible.

Fig 4 Showing inferior alveolar nerve block with 0.5% after suturing.

(By closed mouth Vazirani Akinosi technique)

Statistical Analysis The collected data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 30.0 (IBM Corp., Armonk, NY, USA).

IV. Results

Table 1- Demographic Distribution of Study Participants between Bupivacaine and Articaine Groups (n = 10)

Variables		Group 1- Bupivacaine 0.5% (n-5)	Group 2- Articaine 4% (n-5)	p-value (Test Statistic)
Sex n (%)	Male	3(60.0%)	4(80.0%)	p-0.256 (χ2-1.290)
	Female	2(40.0%)	1(20.0%)	
Age (Years)	Mean±SD	35.85±11.30	32.05±9.20	p-0.251 (t-1.166)

Table 2 -Comparison of Mean Duration of Postoperative Analgesia between Bupivacaine and Articaine Groups (n = 10)

Groups	N	Mean (hours)	SD	Mean Difference	95% CI		t-value	p-value
					Lower	Upper		
Group 1- Bupivacaine 0.5%	05	9.62	1.17	2.575	1.970	3.179	8.623	0.000*
Group 2- Articaine 4%	05	7.05	0.62		1.964	3.185		

***Statistically significant**

Table 3 -Comparison of Postoperative Pain Severity between Bupivacaine and Articaine Groups Based on VAS Scores (n = 10)

Groups	N	Mean	SD	Minimum	Maximum	25th Percentile	Median (50th)	75th Percentile
Group 1- Bupivacaine 0.5%	05	1.38	0.49	1	2	1.00	1.00	2.00
Group 2- Articaine 4%	05	1.50	0.50	1	2	1.00	1.50	2.00

Figure 5- Comparison of Mean Duration of Postoperative Analgesia between Bupivacaine and Articaine Groups

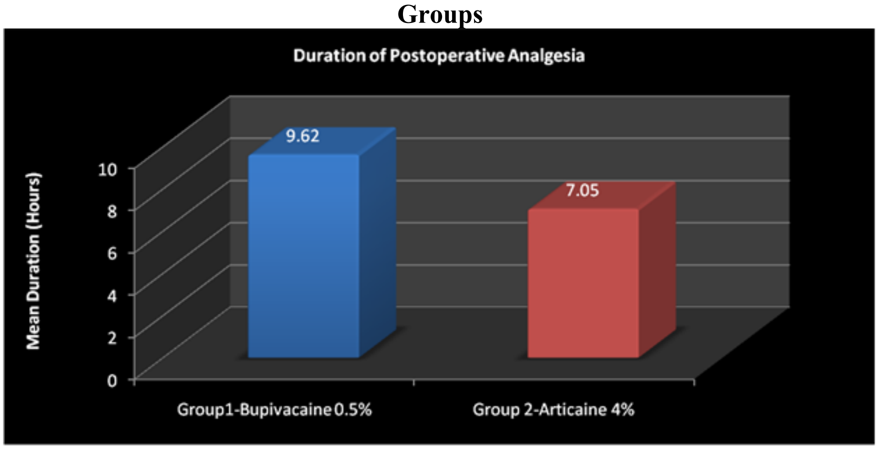

Table 4- Comparison of Mean Time to Rescue Analgesic Administration between Bupivacaine and Articaine Groups (n = 10)

Groups	N	Mean (hours)	SD	Mean Difference	95% CI		t-value	p-value
					Lower	Upper		
Group 1- Bupivacaine 0.5%	05	10.40	1.16	3.10	2.49	3.70	10.44	0.000*
Group 2- Articaine 4%	05	7.30	0.63		2.49	3.70		

***Statistically significant**

Table 1 presents the demographic profile of study participants, with 10 individuals evenly split between two intervention groups: Group 1 (0.5% Bupivacaine) and Group 2 (4% Articaine), each containing 5 participants. In Group 1, 60% were male (n = 3) and 40% female (n = 2); in Group 2, 80% were male (n = 4) and 20% female (n = 1). The difference in sex distribution was not statistically significant ($p = 0.256$, $\chi^2 = 1.290$), indicating gender balance. The mean age was 35.85 ± 11.30 years for Group 1 and 32.05 ± 9.20 years for Group 2, with no significant age difference ($p = 0.251$, $t = 1.166$). These findings suggest effective random allocation, with comparable demographic characteristics between the two groups.

Table 2 compares the mean duration of postoperative analgesia between groups. Bupivacaine provided significantly longer pain relief (9.62 ± 1.17 hours) than Articaine (7.05 ± 0.62 hours), with a mean difference of 2.575 hours ($t = 8.623$, $p < 0.001$; 95% CI: 1.970–3.179). These findings (Table 2, Figure 5) indicate that Bupivacaine offers superior postoperative analgesia following inferior alveolar nerve block in mandibular fracture patients.

Table 3 compares postoperative pain severity using VAS scores. The Bupivacaine group had a mean score of 1.38 ± 0.49, slightly lower than the Articaine group's 1.50 ± 0.51. Both groups showed similar score ranges (1–2), with medians of 1.00 and 1.50, respectively. The difference was not statistically significant, indicating comparable postoperative pain levels between the two groups.

Table 4 compares the time to first rescue analgesic postoperatively. Bupivacaine significantly delayed analgesic need (10.40 ± 1.16 hours) compared to Articaine (7.30 ± 0.63 hours), with a mean difference of 3.10 hours ($t = 10.44$, $p < 0.001$; 95% CI: 2.49–3.70). This indicates Bupivacaine offers more prolonged pain relief after mandibular fracture surgery.

V. Discussion:

Fractures of the mandible are the most common fractures of the facial bone. which are treated under local or general anesthesia with appropriate reduction and fixation. Managing post-operative discomfort and complications following fixation is one of the most important phases. Intolerable postoperative pain can lead to adverse physiological effects. Opioid and NSAID'S medication is frequently used in maxillofacial surgeries to reduce pain. Patients frequently develop an intermaxillary fixation during maxillofacial surgeries, which hinders the proper vomiting removal through oral means adding an increased risk of pulmonary aspiration and GIT problems with NSAID'S drugs. Therefore, reducing the quantity of opioids and NSAID'S needed for good recovery following maxillofacial surgeries might be a prudent clinical objective. Using long-acting anesthetic can help patients feel less pain and reduce the need for opioids. Studies have examined these anesthetics efficacy in various surgical contexts [1].

The mandible is innervated by the inferior alveolar nerve, a branch of the mandibular nerve (V3). An inferior alveolar nerve block (IANB) is a common dental procedure used to anesthetize the lower teeth, lip, and chin on the ipsilateral side of the mouth. It involves the injection of a local anesthetic near the inferior alveolar nerve as it enters the mandibular foramen. The nerves typically anesthetized during this procedure include the inferior alveolar nerve, the incisive nerve, the mental nerve, and often the lingual nerve. As a result, anesthesia is achieved in the mandibular teeth up to the midline, the body of the mandible and the inferior portion of the ramus, the buccal mucoperiosteum and mucous membrane anterior to the mental foramen (via the mental nerve), and the anterior two-thirds of the tongue, floor of the oral cavity, lingual soft tissues, and periosteum (via the lingual nerve) [5].

Regional anesthetic techniques can enhance pain control and also facilitate improved postoperative recovery and rehabilitation.

Articaine is an amide local anesthetic unique for its thiophene ring and ester group, allowing dual metabolism in both plasma (via esterases) and liver (via hepatic enzymes). It is excreted primarily as metabolites (≈90%) through the kidneys, with 5–10% excreted unchanged. Articaine has a rapid onset: 1.5–1.8 minutes for infiltration and 1.5–3.6 minutes for mandibular blocks. Its pH ranges from 4.0 to 5.5, and its half-life is approximately 27 minutes. Its lipid solubility, due to the presence of benzene and thiophene rings, enhances tissue tolerance. Articaine is the second most commonly used dental anesthetic globally. Literature over the past decade suggests articaine often outperforms lignocaine in anesthetic efficacy.[3,4]

Bupivacaine, a widely used long-acting amide anesthetic, was developed in 1957 and FDA-approved in 1972. It has high lipid solubility and strong protein binding, contributing to its prolonged action. Chemically known as 1-butyl-2',6'-pipecoloxylidide hydrochloride, it is four times more potent than lidocaine, though less than four times as toxic. It is metabolized in the liver and excreted renally, with 16% appearing unchanged in urine. The pH of its plain solution is 4.5–6.0, and with epinephrine, 3.0–4.5. Bupivacaine has a slower onset (6–10 minutes) and a half-life of 2.7 hours. It is not recommended for children under 12 or patients at risk of self-injury. Due to its long duration and effectiveness, it is well-suited for managing postoperative pain in maxillofacial trauma. [2,3] However, Use of long acting local anesthetics in children under 4 years is not recommended due to the risk of self-inflicted injury from prolonged numbness.

We compared efficacy of these two local anesthetic molecules. The onset of local anesthesia is faster when the anesthetic's pKa is closer to tissue pH (7.4). Articaine (pKa 7.8) is closer to this value than bupivacaine (pKa 8.1), allowing more free base to diffuse effectively into nerve membranes, leading to quicker onset. However, articaine undergoes rapid hydrolysis in both plasma and liver, resulting quick onset of action, faster elimination and a shorter duration of postoperative analgesia compared to bupivacaine. [2,6]

Various studies have been conducted to determine the mean time of onset of anesthesia and duration of postoperative anesthesia. Shehryar Alam Khan et al reported in their study 0.5% bupivacaine post operatively was safe and effective than tramadol in mandibular fractures without any adverse effects [1]. Pavan tenglikar et al (2022) compared anesthetic efficacy of 4% articaine and 0.5% bupivacaine for lower 3rd molar extraction and concluded that both bupivacaine and articaine are effective local anesthetics, articaine offers a faster onset of action, while bupivacaine provides a longer duration of anesthesia [2]. Naichuan Su et al concluded in their meta analysis study that0.5% bupivcaine has longer duration of anesthesia thus can relieve pain and discomfort for long time [3]. Erica Martin et al (2021) found articaine is safe and effective local anesthetic with higher success rate [4]. Rajagopalan Venkatraman et al (2022) concluded mandibular nerve blockwith local anesthetic decreses consumption of morphine post operatively. Van Lancker studied in mandibular osteotomy surgeries [5]. The results are similer to our study. Burak ERGUDER in their comparative study reported that 0.5% levobupivacaine was much effective than articaine [6]. Berkay Tokuç et al reported that Articaine demonstrated greater intraoperative efficacy with a faster onset, However, bupivacaine provided superior postoperative pain control due to its longer-lasting anesthetic effects [7]. Ali Hossein Mesgarzadeh et al used mental nerve block in parasymphysis fracture and concluded that bupivacaine decreased the need of opioid analgesic and showed positive effect on post operative pain control [8]. Kumar KC et al concluded When compared to normal saline, postoperative bupivacaine administration did not demonstrate a higher analgesic efficacy in managing acute postoperative pain following BSSO. [9]

Inferior alveolar nerve block with bupivacaine reduces immediate opioid need and total analgesic dose, allowing time for reassessment without sedative interactions. Opioid addiction risk remains under clinical and psychosocial study, particularly for vulnerable patients.[6,8] The Visual Analog Scale (VAS) is widely used to assess postoperative pain in oral surgery. In our study, bupivacaine showed superior efficacy due to its long-lasting analgesic effect. Its 8–12-hour duration effectively covers the peak pain period after open fracture reduction.[7]

VI. Conclusion:

For both the patient and the surgeon, post-operative pain management is crucial, for that peri-operatively nerve block with long acting local anesthetic can reduce post operative intake of drugs like opoids and NSAID'S thus reducing the complications of these drugs. Articaine was superior in onset time, intraoperative comfort, and required volume. Bupivacaine, however, provided better postoperative comfort, longer anesthesia, and analgesia as shown by VAS scores. For patients prioritizing postoperative pain control, bupivacaine is the preferred choice. Its extended duration ensures effective pain relief after surgery.

Conflict of interest:
The auther reports no conflicts of interest for this work & no external funding taken.

References

[1] Khan SA, Zulfiqar G, Aslam AB. Efficacy Of Bupivacaine Inferior Alveolar Nerve Block Versus Intravenous Use Of Tramadol For Postoperative Pain Control In Mandibular Parasymphysis Fractures. Pakistan Journal Of Medical & Health Sciences. 2023 May 22;17(03):689-.

[2] Tenglikar P, Manas A, Sahoo AR, Bhoi S, Singh A, Patil PB, Mathpati SK. A Comparative Evaluation Of Anesthetic Effectiveness Of 4% Articaine Vs 0.5% Bupivacaine For Lower Molar Tooth Extraction. Cureus. 2022 Dec 16;14(12).

[3] Su N, Wang H, Zhang S, Liao S, Yang S, Huang Y. Efficacy And Safety Of Bupivacaine Versus Lidocaine In Dental Treatments: A Meta-Analysis Of Randomised Controlled Trials. International Dental Journal. 2014 Feb 1;64(1):34-45

[4] Martin E, Nimmo A, Lee A, Jennings E. Articaine In Dentistry: An Overview Of The Evidence And Meta-Analysis Of The Latest Randomised Controlled Trials On Articaine Safety And Efficacy Compared To Lidocaine For Routine Dental Treatment. BDJ Open. 2021 Jul 17;7(1):27.

[5] Venkatraman R, Karthik K, Belinda C, Balaji R. A Randomized Observer-Blinded Controlled Trial To Compare Pre-Emptive With Postoperative Ultrasound-Guided Mandibular Nerve Block For Postoperative Analgesia In Mandibular Fracture Surgeries. Local And Regional Anesthesia. 2021 Feb 10:13-20.

[6] Ergüder B, Kıpçak ÖA, Köymen R. A Comparison Of The Postoperative Pain Relief And Clinical Local Anesthetic Efficacy Of Levobupivacaine And Articaine For Impacted Lower Third Molar Removal. Süleyman Demirel Üniversitesi Sağlık Bilimleri Dergisi. 2022;13(2):253-62.

[7] Tokuç B, Coşkunses FM. Comparison Of The Effects Of Articaine And Bupivacaine In Impacted Mandibular Third Molar Tooth Surgery: A Randomized, Controlled Trial. Journal Of Dental Anesthesia And Pain Medicine. 2021 Nov 26;21(6):575.

[8] Ali Hossein M, Hosein A, Sohrab P, Mohamadreza S. Efficacy Of Bilateral Mental Nerve Block With Bupivacaine For Postoperative Pain Control In Mandibular Parasymphysis Fractures.

[9] Kumar KC, Arunakul K, Apipan B, Rummasak D, Kiattavorncharoen S, Shrestha M. Postoperative Pain Management Using Supplemental Bupivacaine After Mandibular Orthognathic Surgery: A Triple-Blind Randomized Controlled Clinical Trial. Journal Of Oral And Maxillofacial Surgery. 2022 Feb 1;80(2):248-55.