Journal for ReAttach Therapy and Developmental Diversities
eISSN: 2589-7799
2023 December; 6 (10s) (2): 1846 -1851

Evaluation Of Intra-Operative Pain, Time of Onset and Duration of Action Using 2% Lignocaine With 0.5 ml Dexmedetomidine (50 Micrograms) Versus 2% Lignocaine With 1:80,000 Adrenaline in Extraction of Mandibular Molars: A Comparative Clinical In Vivo Study

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ABSTRACT:

Aim: The Aim of this study was to compare the efficacy of lignocaine and dexmedetomidine vs lignocaine and adrenaline for mandibular anaesthesia in patients who are planned for mandibular molar extraction. A number of factors were examined, such as the length and onset of analgesia, the need for postoperative analgesics.
Materials And Methods: The study involves 34 individuals requiring mandibular molar extractions, selected based on inclusion and exclusion criteria. Adhering to the Helsinki Ethical Principles, patients will be informed about the procedure, study goals, benefits, and risks. Written informed consent will be obtained. A complete case history will be collected, and a treatment plan developed after evaluation and diagnosis. Patients are divided into two groups. One group receives 2 ml of 2% Lignocaine with 0.5 ml dexmedetomidine (50 µg), and the other receives 2 ml of 2% Lignocaine with 1:80,000 adrenaline. A coin toss determines the allocation: heads for dexmedetomidine and tails for adrenaline. The onset and duration of anaesthesia are recorded using stopwatch, and extractions are performed aseptically. Pain during the procedure is assessed using a 0–10 VAS.
Conclusion: In terms of analgesia and duration of action, this study shows that Lignocaine with Dexmedetomidine is superior to Lignocaine with Adrenaline, except for the time of onset, when Lignocaine with Adrenaline is preferred.

Keywords: *Lignocaine Dexmedetomidine, Anaesthesia, Oral Surgery*, *Impactions, Lignocaine Adrenaline, Analgesia*.

Introduction:

Since humans first set foot on the planet, dental pain has been a persistent source of suffering. Saint Apollonian was punished by having each of her teeth knocked out one at a time, according to Greek legend. This serves to highlight the degree of agony endured during tooth extractions without anaesthesia and, hence, the severity of the penalty.[1]
Humanity has always made a concerted effort to discover a way to end suffering. The safest and most efficient medications for managing and preventing pain are local anaesthetics. It is true that no other medication can effectively stop a propagated nociceptive nerve impulse from entering the CNS, where it would be perceived as pain.
The foundation of pain management strategies in the speciality of oral and maxillofacial surgery is local anaesthesia. Since the invention of cocaine in 1884, procaine in 1904, and lidocaine in 1948, dentistry has led the way in attempting to treat patients without causing them any pain. Between 1891 and 1930, new amino ester local anaesthetics, including tetracaine, benzocaine, holocaine, and tropocaine, were created. Furthermore, amide local anaesthetics such as procaine,

chloroprocaine, cinchocaine, lidocaine, mepivacaine, prilocaine, bupivacaine, etidocaine, and articaine were developed between 1898 and 1972. The hunt for safer and more efficient local anaesthetics has persisted.[2]
When lidocaine was first put on the market in 1948, it was the most widely used local anaesthetic. It was created by Nils Lofgren in 1943. Lidocaine's efficacy and safety made it the standard by which other, more recent drugs were measured. Lidocaine that works for an intermediate amount of time. Local anaesthesia is used in oral and maxillofacial surgery for minor oral surgical procedures, exodontia, and some major surgical procedures. In the absence of vasoconstrictors, local anaesthetic drugs can cause vasodilatation, which speeds up the injection site's absorption of the anaesthetic.
These days, a variety of local anaesthetics and vasoconstrictors are researched and utilised for dental extractions, with lignocaine and adrenaline being popular options.

Adrenaline has effect on both alpha(α) and beta(β) receptors. Its major function in local anaesthesia is vasoconstrictor since it is a strong bronchodilator and does not serve as a central stimulant. It offers the desired haemostasis for the surgical site and lengthens and intensifies the anaesthesia. Studies have shown that in patients with normotension, adrenaline also results in tachycardia and hypertension.[3]
Dexmedetomidine has an eight-fold higher affinity and operates more selectively against the α-2 adrenoreceptor. Although its effects on the periphery are still unclear, dexmedetomidine was additionally demonstrated to improve both central and peripheral neuronal blocking by local anaesthetics. According to Yoshitomi et al., dexmedetomidine improved lignocaine's peripheral local anaesthetic effect.[4]
This study aimed to evaluate the effectiveness between combination of lignocaine and adrenaline with dexmedetomidine and lignocaine for inferior alveolar nerve block.

The haemodynamic stability (systolic and diastolic blood pressure, mean arterial pressure, and heart rate) of dexmedetomidine and adrenaline in relation to removal of mandibular molars was another goal of this study.

Materials and Method:

The study was conducted in the Department of Oral and Maxillofacial Surgery at Maharashtra Institute of Dental Science and Research, Latur from 8th July, 2023 to 8th January, 2024 involving 34 patients who require mandibular molar extractions and those who meet the inclusion and exclusion criteria. We followed the Helsinki Ethical Principles for Medical Research involving Human Subjects when completing the patient withdrawal criteria. Each patient had received information about the procedure. Each patient's valid informed written consent was taken. A treatment plan was developed following a case history evaluation and a correct diagnosis for the study's goals, benefits, and drawbacks.
Patients are split up into two groups for this investigation. Two millilitres of 2% Lignocaine will be given to one group of patients together with 0.5 ml of dexmedetomidine (50 microgrammes), and two ml of 2% Lignocaine was given to another group of patients along with 1:80,000 adrenaline, as shown in Figure 1. Patients were randomly selected by tossing the coin. For instance, we will give 2% Lignocaine with 0.5 ml of dexmedetomidine (50 microgrammes) (figure 2) to all study participants if the head side of the coin comes up when they toss it, and 2% Lignocaine with 1:80,000 adrenaline if the tail side of the coin comes up. The duration of action and its beginning time (Minutes) will be recorded using stopwatch. Once sufficient anaesthesia was achieved, the extraction process was performed in an aseptic setting. The patients were asked if they experienced any pain throughout the extraction process. A 0–10 VAS was used to assess each subject during the extraction process.

Figure 1: 2% Lignocaine With 1:80,000 Adrenaline Injection

Figure 2: 2% Lignocaine With 0.5ml (50 Micrograms) Dexmedetomidine Injection

The inclusion criteria for the study are patients aged 18 to 50 years, regardless of gender, who require the extraction of mandibular molars. Participants must also meet the American Society of Anaesthesiologists (ASA) classification status I or II, which includes normal healthy individuals (ASA I) and patients with mild or controlled systemic diseases (ASA II). The exclusion criteria for the study are designed to ensure the safety of participants and the reliability of the findings. Patients who are unwilling to participate in the study are excluded, as informed consent is a fundamental ethical requirement. Pregnant patients are also excluded to avoid any potential risks to maternal or fetal health. Individuals with uncontrolled hypertension, liver disease, or kidney disease are not included, as these conditions may pose additional health risks or interfere with the study's outcomes. Lastly, patients with a known history of allergy to lignocaine, dexmedetomidine, or adrenaline are excluded to prevent adverse allergic reactions during the procedure. These criteria help maintain the study's safety and focus.

The subject withdrawal criteria ensure that participation is voluntary and practical. Patients who choose to withdraw from the study at any point or those unable to comply with the follow-up period will be excluded. The study is designed to last for six months, with data analysis commencing immediately upon its completion.

The total sample size for the study is 34 participants, divided into two groups of 17 each. Group A will receive Lignocaine with Dexmedetomidine, while Group B will receive Lignocaine with Adrenaline. The sample size was calculated using a formula based on statistical parameters, including a mean of 1.60 for Group A and 4.00 for Group B, with a pooled standard deviation of 2.43.

The study allows voluntary participation, with patients able to withdraw at any time or if they cannot comply with follow-ups. The six-month study will analyse data immediately upon completion.

Procedure:

Informed consent will be obtained from all patients, and a single operator will perform all procedures and record parameters. Standard aseptic precautions will be maintained. Mandibular molars will be extracted under 2 ml of 2% Lignocaine with either 0.5 ml dexmedetomidine (50 µg) or 1:80,000 adrenaline using classical inferior alveolar, lingual and long buccal nerve blocks. The connective tissue fibres around the tooth will be sever using a periosteal elevator, followed by tooth luxation with a dental elevator and extraction using forceps.

Parameters of Measurement:

The study compares the efficacy of Lignocaine with Dexmedetomidine versus Lignocaine with Adrenaline during tooth extraction. Efficacy will be assessed using a 0–10 Visual Analogue Scale (VAS) for pain, onset time (in minutes), and duration of action (in minutes) for each anaesthetic.

Statistical analysis: The data was analysed using SPSS software v23.0. The level of significance was kept at 5%. Data was assessed for normality using the Shapiro-Wilk test. Results showed that data did not follow the normal distribution. Therefore, a comparison of pain, onset, and duration of action between the two groups was done using Mann Whitney test.

Results:

In this study 34 healthy patients aged between 18 to 50 years were included who required prophylactic (n=12, 08 men & 04 women) and symptomatic (n=22, 16 men & 06 women) removal of mandibular molars. With a longer duration of effect, the dexmedetomidine group's onset of action was considerably prolonged (P<0.05). When lignocaine plus dexmedetomidine solution was injected instead of lignocaine plus adrenaline, it was shown that the pain threshold was significantly raised. No post operative complications were observed like paresthesia or trismus.

Figure 3: Showing the comparison of pain between two groups.

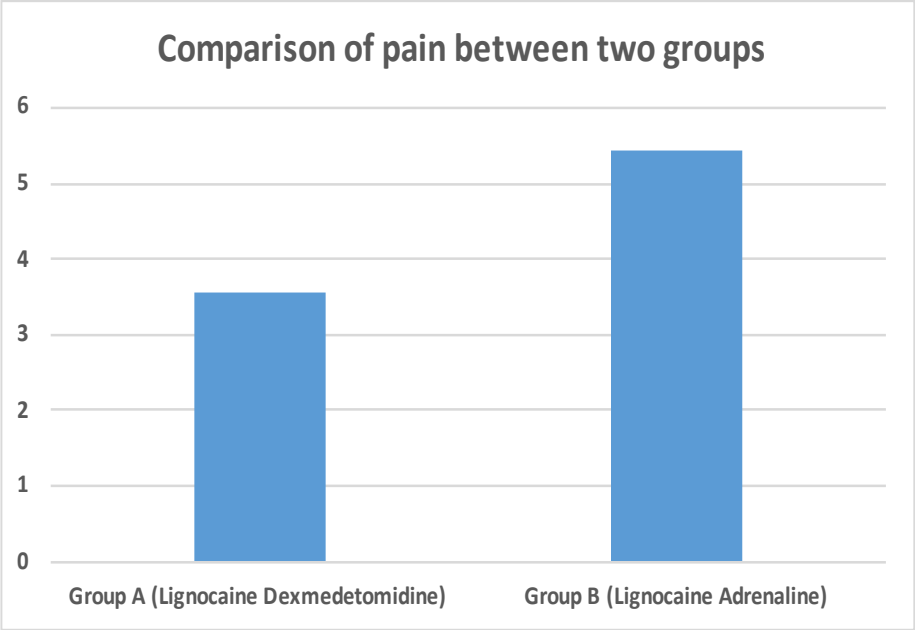

Table 1: Comparison of pain between two groups

Group	Mean	SD	SE	Difference	p-value
Group A (Lignocaine Dexmedetomidine)	3.56	0.89	0.22	-1.88	<0.001*
Group B (Lignocaine Adrenaline)	5.44	0.81	0.20		

Mann Whitney test; * indicates a significant difference at p≤0.05

The above represented Figure 3 and Table 1, compares the pain scores between the two groups. The pain in Group B (Lignocaine Adrenaline) was significantly greater than in the Group A (Lignocaine Dexmedetomidine).

Figure 4: Comparison of onset of action between two groups.

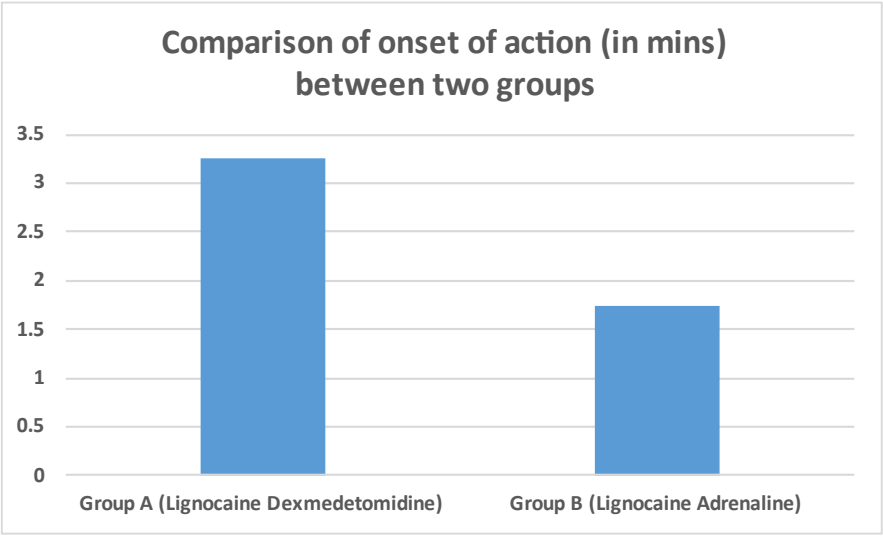

Table 2: Comparison of onset of action (in mins) between two groups

Group	Mean	SD	SE	Difference	p-value
Group A (Lignocaine Dexmedetomidine)	3.26	0.83	0.21	1.52	<0.001*
Group B (Lignocaine Adrenaline)	1.74	1.02	0.26		

Mann Whitney test; * indicates a significant difference at p≤0.05

The time required for onset in Group B (Lignocaine Adrenaline) was significantly lower than in Group A (Lignocaine Dexmedetomidine), as shown in Figure 4 and Table 2.

Figure 5: Comparison of duration of action between two groups.

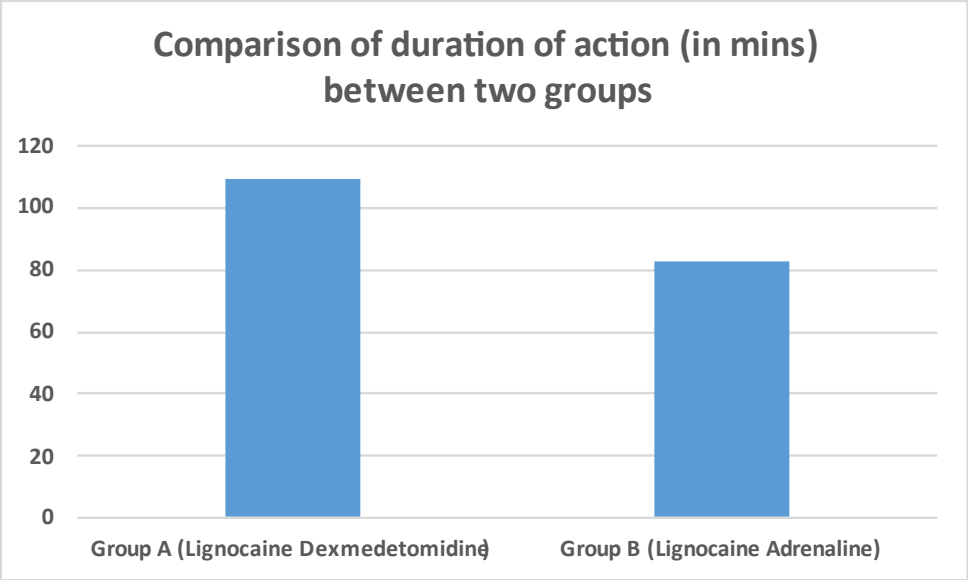

Table 3: Comparison of duration of action (in mins) between two groups

Group	Mean	SD	SE	Difference	p-value
Group A (Lignocaine Dexmedetomidine)	109.56	7.09	1.77	26.94	<0.001*
Group B (Lignocaine Adrenaline)	82.63	6.10	1.52		

Mann Whitney test; * indicates a significant difference at p≤0.05

The above-mentioned Figure 5 and Table 3, compares the two groups' duration of action (in minutes). The duration of action in Group B (Lignocaine Adrenaline) was significantly lower than in Group A (Lignocaine Dexmedetomidine).

Discussion:

Dexmedetomidine, a more selective alpha-2 adrenoceptor agonist, is also known to enhance central neural blockades. Its peripheral effect, however, has not been fully elucidated[6]. The exploration of local anaesthetics continues to evolve, with significant strides in understanding their pharmacodynamics, potential additives, and diverse clinical applications. Advancements in Long-Acting Local Anaesthetics. **Gordon et al., (2010)** [5] emphasize the utility of long-acting local anaesthetics like bupivacaine for managing perioperative pain, particularly in dental surgery.[5] These anaesthetics offer prolonged durations of pain relief, crucial for post-surgical recovery, and mitigate central sensitization when used alongside NSAIDs. However, their use must balance efficacy and toxicity, as prolonged action increases the risk of adverse effects.

In order to enhance anaesthetic efficacy some agents are added like dexmedetomidine, a selective α-2 adrenoceptor agonist, to local anaesthetic formulations shows promise. Studies like **Channabasappa et al., (2013)** [6] demonstrate how dexmedetomidine shortens onset times and prolongs analgesia in procedures such as peribulbar blocks for cataract surgery. **Yoshitomi et al., (2008)** [4] further elucidate the role of dexmedetomidine in enhancing the anaesthetic effect of lidocaine at the peripheral level via α-2A adrenoceptors.

The clinical scope of local anaesthetics extends beyond traditional boundaries. For instance, their integration in minimally invasive surgeries, ophthalmic procedures, and urology underlines their adaptability. **Saadatniaki et al., (2012)** highlights the growing trend of local anaesthetics in cosmetic and reconstructive procedures. [7]

The available studies indicates that for the first time in dental anaesthesia, lignocaine with dexmedetomidine combination could be useful and safe alternative to lignocaine with epinephrine for intraoral anaesthesia. Here the results of a

randomized clinical trial were discussed, dexmedetomidine was being compared with adrenaline for purpose of evaluating its efficacy in terms of haemodynamic changes, onset of anaesthesia, duration of anaesthesia, post-operative analgesia. Adrenaline was chosen as a reference substance, as its effects were well documented. Since the study used identical protocols, the result obtained were comparable, combined analysis of the trial was valid.
Innovative delivery methods, such as intranasal administration of dexmedetomidine explored by **Iirola et al., (2012),** [8] provide alternative avenues for achieving sedation and pain relief while minimizing systemic side effects. While the incorporation of additives and advanced formulations addresses many limitations of traditional local anaesthetics, challenges such as individual variability in response, the risk of systemic toxicity, and complications like nerve damage or allergic reactions persist.

Conclusion:

From this study, it shows that when a combination of dexmedetomidine and lidocaine were given to patients undergoing mandibular molar extraction, the number of painkillers used decreased when compared to the lignocaine and adrenaline group, and pain scores were significantly lower than if lidocaine was used alone. Dexmedetomidine and lidocaine jointly is therefore recommended to improve pain management and to reduce the desire for analgesics in patients having such procedures. As well as dexmedetomidine and lidocaine longer duration of action but combination of lignocaine and adrenaline has faster time of onset.

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