ORIGINAL RESEARCH

Assessing Tramadol Hydrochloride as an Alternative to Lignocaine Hydrochloride in Dental Implant Procedures: A Randomized Trial

Akshita N Parlawar[1], Bhushan P Mundada[2]

Received on: 05 July 2024; *Accepted on*: 03 September 2024; *Published on*: 30 October 2024

Abstract

Aim: To evaluate tramadol hydrochloride, an atypical opioid with potential analgesic properties, as a viable alternative to lignocaine hydrochloride in supraperiosteal anesthesia for dental implants.

Materials and methods: A split-mouth, double-blind, randomized controlled trial was conducted in patients requiring maxillary dental implants. Patients meeting inclusion criteria received either 5% tramadol hydrochloride with adrenaline or 2% lignocaine hydrochloride with adrenaline via supraperiosteal infiltration. Onset, duration of anesthesia, visual analog scale (VAS) pain scores, and adverse effects were recorded.

Results: Forty patients were included, with a mean age of 39.35 years, 62.5% male. No significant differences were observed in VAS pain scores between tramadol (2.08 ± 1.328) and lignocaine (2.05 ± 1.260) groups ($p = 0.931$). Onset of anesthesia showed no significant difference between the tramadol (128.00 ± 18.207 seconds) and lignocaine (128.30 ± 18.287 seconds) groups ($p = 0.736$). The duration of anesthesia was comparable between tramadol (59 ± 12.092 minutes) and lignocaine (59.90 ± 11.705 minutes) groups ($p = 0.0736$). Adverse effects included nausea in two tramadol and one lignocaine patient.

Conclusion: Tramadol hydrochloride demonstrated comparable local anesthetic efficacy to lignocaine hydrochloride in dental implant surgery

Clinical significance: Both drugs provided effective pain control with similar onset and duration of anesthesia. Tramadol may offer an alternative for patients with lignocaine contraindications, although further studies are warranted to validate its safety and efficacy in dental procedures.

Keywords: Analgesia, Dental anxiety, Dental implant(s), Lignocaine, Local anesthesia, Local infiltrations, Pain, Supraperiosteal injections, Tramadol.

The Journal of Contemporary Dental Practice (2024): 10.5005/jp-journals-10024-3720

Introduction

Implant supported partial or full mouth rehabilitation has become increasingly popular in last two decades owing to its high success rate, improved functionality and highly esthetic outcomes.[1] However, the surgical procedure is often complicated by preoperative anxiety, with a prevalence of 22.2–50% among patients who undergo dental implantations.[2] This may be attributed to the anticipation of a long appointment, the idea of drilling a foreign object into the bone as well as limited knowledge regarding the procedure. Anxiety makes patients less cooperative during implant surgery, leads to increased pain sensation, prolongs the procedure, and eventually leads to displeased patients.[3,4] A comprehensive strategy involving preoperative, intraoperative, and postoperative therapies is required to achieve effective pain control. Dentists employ several methods, including local anesthesia and other non-pharmacological techniques, to reduce pain and relieve patient anxiety, thereby ensuring a more seamless and enjoyable treatment experience.

Several local anesthetic drugs, including lignocaine, bupivacaine, and mepivacaine, have been developed and proven to be useful in managing pain during treatment; nevertheless, the ideal anesthetic solution should match the patient's systemic condition as closely as possible and facilitate the optimal surgical outcome.[5] While the specific receptor theory is widely acknowledged, numerous pain control hypotheses have been suggested. By blocking sodium channels found in neuronal membranes, local anesthetic lowers the amount of sodium ions entering the cell and keeps the firing threshold from being reached. This impedes the transmission of nerve signals, resulting in a numbing effect.[6] Tramadol, an atypical opioid, chemically similar to codeine, specifically a 4-phenyl piperidine derivative, exerts its effects primarily on the central nervous system and is mostly employed for palliative management of moderate to severe pain.[7,8] The effects of the drug on numerous mechanisms, including nerve transmission, inflammation regulation, and immune cell behavior provide a strong rationale for its targeted application as a local anesthetic agent. A substantial amount of research supports its use in the oral tissues.[9,10] The efficacy of this method is influenced by two crucial factors: Its local

[1,2]Department of Oral and Maxillofacial Surgery, Sharad Pawar Dental College and Hospital, Datta Meghe Institute of Higher Education and Research, Sawangi, Wardha, Maharashtra, India

Corresponding Author: Akshita N Parlawar, Department of Oral and Maxillofacial Surgery, Sharad Pawar Dental College and Hospital, Datta Meghe Institute of Higher Education and Research, Sawangi, Wardha, Maharashtra, India, Phone: +91 9561060156, e-mail: akshitaparlawar@gmail.com

How to cite this article: Parlawar AN, Mundada BP. Assessing Tramadol Hydrochloride as an Alternative to Lignocaine Hydrochloride in Dental Implant Procedures: A Randomized Trial. J Contemp Dent Pract 2024;25(7):639–644.

Source of support: Nil

Conflict of interest: None

anesthetic activity, which occurs due to the blocking of Na+ and K+ channels, and its capacity to reduce peripheral inflammatory reactions.[10] Moreover, following local administration, the drug demonstrates a particular antibacterial action against *Pseudomonas aeruginosa* and *Staphylococcus aureus*. Tramadol's bactericidal effect against *Escherichia coli* and *Staphylococcus epidermidis* has been observed to increase with dose and time.[11,12] However, tramadol causes dilation of blood vessels, thereby complicating the surgical field. Therefore, it is important to use the drug in conjunction with adrenaline.[6] Adrenaline is commonly used as a vasoconstrictor in lidocaine cartridges. This addition improves the effectiveness of anesthetic, reduces the required dosage, slows the quick absorption of the anesthetic into the bloodstream, and enhances the visibility of the surgical area.[13]

Lignocaine is recognized for its proven effectiveness and safety. Due to its quick onset and reliability, it is the primary choice for pain control in dental surgical procedures including implants. It guarantees maximum patient comfort and satisfaction throughout the long surgery, especially when used along with adrenaline.[14] Based on the literature, tramadol has been found to cause peripheral anesthesia when injected supraperiosteally.[14] Therefore, the objective of this study was to compare the local anesthetic effect of tramadol hydrochloride to that of lignocaine hydrochloride, which is widely regarded as the gold standard in local anesthesia, in patients undergoing dental implants.

Materials and Methods

A split-mouth double-blind cross-sectional randomized controlled trial was conducted in the Outpatient Department of Oral and Maxillofacial Surgery, of Sharad Pawar Dental College, Sawangi, District Wardha, Maharashtra in between October through December 2023. Institutional Ethical Clearance was obtained [(DMIHER(DU)/IEC/2023/710], followed by its registration at the Clinical Trial Registry–India [CTRI/2023/05/052895]. The study was performed in accordance with the CONSORT statement guidelines and the guidelines of the Declaration of Helsinki.

Sample Size Calculation

Sample size calculation was done using the OpenEpi software; using the empirical data from previous studies. The confidence interval was kept at 95%; power at 80%, and ratio of group I to group II as 1. The mean score for the group I was 43 and the SD of 7. The mean score for group II was 36 and the SD of 14. The sample size was derived to be 40 in each group adding up to a total of 80 in both the groups.

Inclusion Criteria

- Patients requiring an implant on each side of the posterior maxillary arch.
- 18–60 years of age.
- Patients with bilaterally missing teeth in the posterior maxillary arch for ≤12 months and ≥3 months.
- Patients with ASA physical status 1.

Exclusion Criteria

- Patients with localized infections in the posterior maxilla.
- History of smoking, tobacco chewing, and/or alcoholism.
- Patients on long-term steroid therapy.
- Patients with any systemic diseases.
- Patients allergic to the drugs in consideration.

Methodology

A detailed history and written informed consent were collected from all the patients who were included in the study. This study was conducted as a double-blind trial, meaning that both the operating surgeon and the patients included were unaware of certain information. A third clinician was tasked with obtaining the patient's medical history and preparing syringes with tramadol and lignocaine. The surgeon who performed the surgical procedure was not made aware of the administered local anesthetic solution. Prior to initiating each procedure, a patch test was conducted, following all necessary aseptic measures.

Group T (n = 40): Received freshly prepared 2 mL of 5% tramadol hydrochloride with 1:80000 adrenaline solution through the supraperiosteal infiltration technique in the first quadrant.

Group L (n = 40): Received 2 mL of commercially available lignocaine hydrochloride with 1:80000 adrenaline solution through the supraperiosteal infiltration technique in the second quadrant.

The onset of anesthesia was determined by recording the time interval from the completion of injection (regarded as time zero) to when the patient felt numbness at the injection site. This was measured using a stopwatch and reported by the patient. Subsequently, 1 minute after the injection procedure was completed, and at 10-second intervals thereafter, the initiation of anesthesia was objectively evaluated by inserting a dental probe into the mucosa around the surgical site on the buccal surface. Pain levels were assessed using a visual analog scale (VAS) of 100 mm. Prior to commencing the process, each patient was provided with a comprehensive explanation of the VAS. The objective onset of anesthesia was determined by recording the time when the patient reported no discomfort, indicated by a VAS score of 0.

The total duration of anesthesia was determined as the time interval between the onset and resolution of numbness at the drug delivery site, as reported by the patient. The patient was assessed at 5-minute intervals to monitor the cessation of anesthesia by inserting a dental probe into the buccal mucosa at the injection site. The patient was required to wait in the department for a maximum of 6 hours during which the VAS score was recorded hourly.

Heart rate, systolic and diastolic blood pressure of the patients were recorded pre-, intra- and postoperatively for each case of implant. Any adverse effects including nausea and vomiting after 24 hours of the surgery were also recorded for each subject.

MS Excel 2016 was used to fabricate the datasheet. IBM SPSS Corp. in Armonk, New York for Windows, Version 25.0, was used for the statistical analysis. Descriptive statistics for the continuous variables are computed and presented in terms of mean and standard deviation. Frequency and percentages were calculated for the categorical variables. One-way ANOVA statistics were applied to calculate the inferential statistics between the variations. The statistical constant was fixed at $p < 0.05$. The data followed normal distribution, hence, parametric tests of significance was followed.

Results

A sample of 40 patients requiring an implant on each side of the posterior maxillary arch was included in the study. The mean age of the study population was 39.35 ± 13.904 years. 62.5% of the sample consisted of males and 37.5% of females, with no statistically significant difference between the categories ($p = 0.114$). The same have been graphically represented in Figure 1.

The VAS pain scores for both the groups, that is, tramadol and lignocaine were compared and it was found that for the tramadol (2.08 ± 1.328) group VAS score was higher than lignocaine (2.05 ± 1.260). No statistically significant difference was noted between the category ($p = 0.931$). The same has been represented in Table 1.

The onset of anesthesia for both the groups, that is, tramadol and lignocaine were compared and it was found that lignocaine (128.30 ± 18.287) seconds is higher than tramadol (128.00 ± 18.207) seconds. No statistically significant difference was noted between the categories ($p = 0.736$). The same has been represented in Table 2.

The duration of anesthesia for both the groups, that is, tramadol and lignocaine were compared, and it was found that lignocaine (59.90 ± 11.705) is higher than tramadol (59 ± 12.092). No statistically significant difference was noted between the category ($p = .0736$). The same has been represented in Table 3.

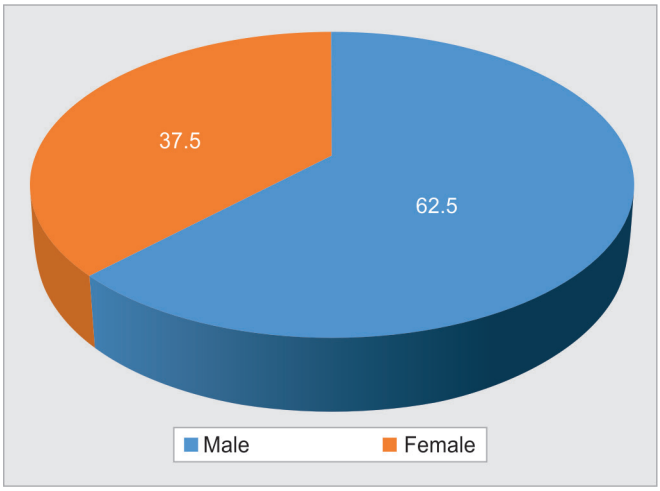

Fig. 1: Graphical representation of the gender distribution of the study population

At baseline, the heart rate for both the groups, that is, tramadol and lignocaine were compared and it was found that lignocaine (75 ± 4.291) is higher than tramadol (74.33 ± 4.643). No statistically significant difference was noted between the category ($p = 0.502$). At 15 minutes, when a comparison was made between the groups; it was seen that tramadol (81.23 ± 3.880) was higher than lignocaine (80.83 ± 4.500). No statistically significant difference was noted between the category ($p = 0.671$). For, heart rate post-implant surgery, it was seen that lignocaine (76.75 ± 4.343) is higher than tramadol (76.33 ± 4.227). No statistically significant difference was noted between the category ($p = 0.659$).

At baseline, the blood pressure for both the groups, that is, tramadol and lignocaine were compared and it was found that systolic blood pressure was higher for lignocaine (116.88 ± 4.853) as compared with tramadol (116.58 ± 6.320). No statistically significant difference was noted between the category ($p = 0.812$). The diastolic blood pressure was compared for both the groups, that is, tramadol and lignocaine. It was found higher for the tramadol (80.4 ± 3.045) is higher than lignocaine (79.13 ± 2.255). No statistically significant difference was noted between the category ($p = 0.36$). At 15-minutes interval, the systolic blood pressure for both the groups, that is, tramadol and lignocaine were compared and it was found that systolic blood pressure was higher for lignocaine (125.33 ± 4.649) as compared with tramadol (122.65 ± 16.504). No statistically significant difference was noted between the category ($p = 0.327$). The diastolic blood pressure was compared for both the groups, that is, tramadol and lignocaine. It was found higher for the tramadol (83.35 ± 3.199) is higher than lignocaine (82.33 ± 3.041). No statistically significant difference was noted between the category ($p = 0.146$). Post-implant placement, the systolic blood pressure for both the groups, that is, tramadol and lignocaine were compared and it was found that systolic blood pressure was higher

Table 1: Visual analog scale score comparison between the groups

				95% Confidence interval for mean			
	N	*Mean*	*Std. deviation*	*Lower bound*	*Upper bound*	*F Score*	*p-value*
Group T	40	2.08	1.328	1.65	2.50	0.007	0.931
Group L	40	2.05	1.260	1.65	2.45		
Total	80	2.06	1.286	1.78	2.35		

Table 2: Onset of anesthesia as compared between the groups (in seconds)

				95% Confidence interval for mean			
	N	*Mean*	*Std. deviation*	*Lower bound*	*Upper bound*	*F Score*	*p-value*
Group T	40	128.00	18.207	122.18	133.82	0.005	0.942
Group L	40	128.30	18.287	122.45	134.15		
Total	80	128.15	18.132	124.11	132.19		

Table 3: Duration of anesthesia as compared between the groups (in minutes)

				95% Confidence interval for mean			
	N	*Mean*	*Std. deviation*	*Lower bound*	*Upper bound*	*F Score*	*p-value*
Group T	40	59.00	12.092	55.13	62.87	0.114	0.736
Group L	40	59.90	11.705	56.16	63.64		
Total	80	59.45	11.833	56.82	62.08		

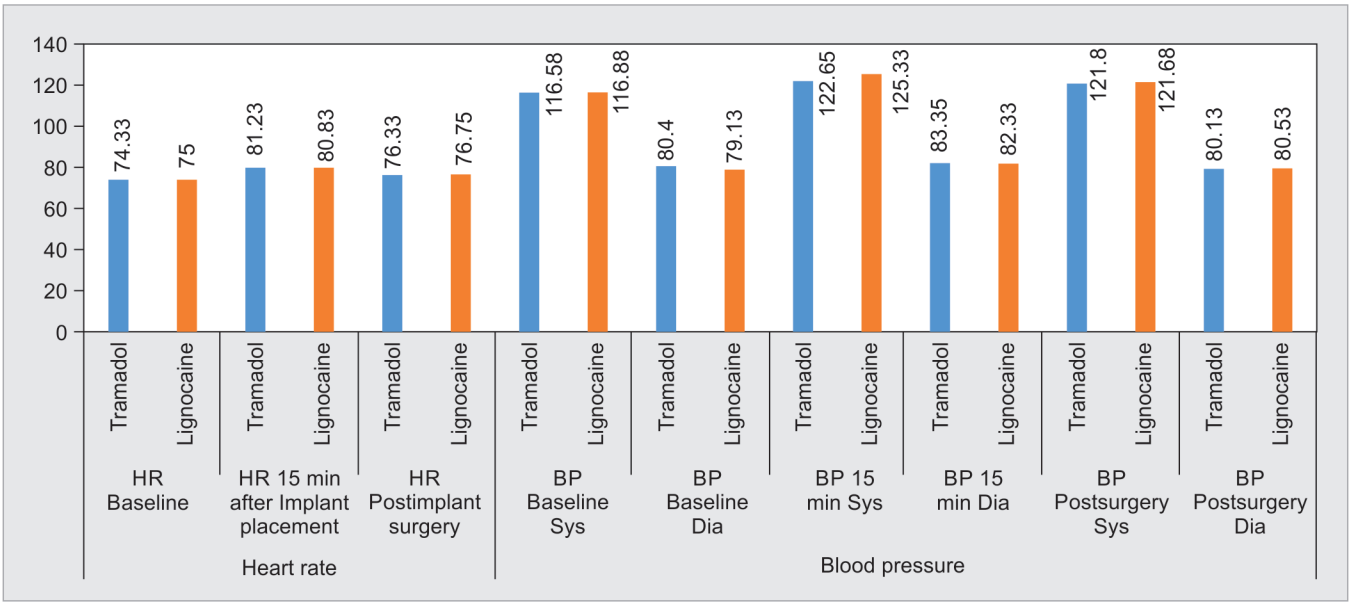

Fig. 2: Graphical representation of heart rate and blood pressure comparison at different intervals

for tramadol (121.8 ± 5.258) as compared with lignocaine (121.68 ± 4.693). No statistically significant difference was noted between the category ($p = 0.911$). The diastolic blood pressure was compared for both the groups, that is, tramadol and lignocaine. It was found higher for the lignocaine (80.53 ± 2.650) is higher than tramadol (80.13 ± 2.244). No statistically significant difference was noted between the category ($p = 0.469$). The same has been graphically represented in Figure 2.

As for adverse reactions, nausea was reported by two subjects in tramadol group and one in lignocaine group.

Discussion

The optimal local anesthetics utilized in dentistry possess a highly effective anesthetic effect. However, there are no local anesthetics that possess both anesthetic and analgesic properties. Therefore, it is necessary to determine a medication that provides exceptional local anesthesia as well as effective pain relief after surgery.[15] Opioids have effectively been employed for pain control for numerous decades.[6] Certain opioids also possess local anesthetic properties. Among all the opioids with local anesthetic properties, tramadol is recognized for its low addiction rate.[6] The first study to show that injecting 25 mg of tramadol intradermally can effectively prevent pain from propofol injection was published by Pang et al. The researchers noted that administering tramadol has a comparable impact to prilocaine and might be employed in skin excision procedures.[16] Subsequent attempts were made in dentistry as well. Combining tramadol with articaine was discovered to enhance the duration of the inferior alveolar nerve block in the mandible.[17] When plain tramadol is injected into oral soft tissues, it has a comparable numbing effect as lignocaine.[18] The use of infiltrative supra-periosteal injections of tramadol effectively provided local anesthesia during maxillary extractions, resulting in the successful completion of the procedure.[19]

The present study utilized freshly prepared 5% tramadol hydrochloride combined with 1:80000 adrenaline, that is, the presence of 0.225 mg of adrenaline in 1.8 mL of solution.[20] Similar solution has been effectively processed and used in studies by Al-Haideri YA, Srivastava M et al., and Ege B et al.[6,21,22]

Comparable VAS scoring was observed when the patients underwent implants with tramadol-assisted anesthesia and that with Lignocaine. Al-Haideri employed tramadol hydrochloride with adrenaline (1:80,000) in the closed method for extracting maxillary molars. The study concluded that this solution effectively acts as a local anesthetic, allowing for painless tooth extraction when applied supraperiosteally.[6] Alsandook conducted a study on the anesthetic properties of tramadol when administered as a nerve block for both routine and surgical tooth extractions.[15] Contrary to the present results, the studies by Goel et al. and Polat et al. claim tramadol to be a weaker local anesthetic in comparison to lignocaine.[14,23] Bennett CR explains that an inverse relationship exists between the pKa value of the drug and its potency. Hence lignocaine with a pKa value of 7.9 exhibits better anesthetic quality than tramadol who has a pKa of 9.41.[24,25]

The present study determined the onset for tramadol hydrochloride with epinephrine to be 128.0 seconds which is similar to the report by Jendi SK and Talathi A.[18] The authors reported onset time as 2.86 minutes.[18] Kalyan et al. reported 4.5 minutes and Alsandook reported 3.41 minutes as the mean time of onset for tramadol without epinephrine.[15,26] In the research conducted by Ege B et al., the mean onset time was significantly shorter compared with the present study, with values of 43.91 seconds.[22] The authors attributed this to the inclusion of a vasoconstrictor in the tramadol solution, which restricted the drug's distribution to the peripheral areas and facilitates a quicker start of action.[22] In another study Jendi et al. observed the onset for tramadol as 33.66 seconds as per subjective analysis of the patient.[27] The onset for lignocaine was higher than that of tramadol in the present research but there was no statistically significant difference. This is in accordance with the previously published literature.[14,15,21,22]

The duration of anesthesia was found to be higher for lignocaine than tramadol in this study but the results are comparable. Similar findings were reported by Jendi et al. who observed the duration

of action in tramadol group to be 55.60 minutes, 57.50 minutes for lignocaine group ($p = 0.432$).[27] In contrast to the present results, investigations conducted by Alsandook TA, Al-Haideri YA, and Ege B et al. evaluated the duration of action between tramadol with adrenaline and lignocaine with adrenaline. The results showed that the mean duration of tramadol was 148.6 minutes, whereas the mean duration of lignocaine was 117.38 minutes.[6,15,22]

The heart rates and blood pressures for both groups were comparable in the study and within physiologic limits at all the time intervals. Srivastava et al. reported similar findings for pulse readings and systolic and diastolic blood pressure pre-, intra- and post-procedure, along with stable respiratory rate reading.[21]

Nausea was reported after administration of the drug by two patients in tramadol group and 1 in lignocaine group. This result is congruent with the study by Jendi et al.[27] Pang et al., Ege et al., and Kakagia et al. also reported nausea, dizziness, and erythema at injection site in their respective studies post-administration of tramadol hydrochloride.[16,28,29] Cossman and Kohnen documented that the predominant adverse reaction associated with tramadol is nausea, followed by dizziness, drowsiness, sweating, vomiting, and postural hypotension. In a separate investigation conducted by Haidari YA et al., it was found that tramadol (administered with adrenaline) caused nausea in 6.45% of patients and vomiting in 1.61% of patients. On the other hand, lignocaine (administered with adrenaline) resulted in nausea in 2.23% of patients, with no reported cases of vomiting.[30]

Conclusion

The observations made in the present study establish that tramadol hydrochloride demonstrated comparable local anesthetic efficacy to lignocaine hydrochloride in dental implant surgery and may be used as a viable alternative.

Clinical Significance

The results of this study show that lignocaine and tramadol had similar pain-relieving effects when used for supraperiosteal anesthesia during implant placements in the maxillary arch. This has important implications for clinical practice. This equivalency implies that tramadol, renowned for its extended pain-relieving properties, could potentially be used as a favorable substitute for lignocaine, the traditional local anesthetic. These findings provide doctors with the ability to choose anesthesia drugs more freely, which could improve pain management techniques and increase patient comfort during lengthy dental procedures.

Orcid

Akshita N Parlawar https://orcid.org/0000-0001-5546-1902
Bhushan P Mundada https://orcid.org/0000-0003-0219-7049

References

1. Kohli S, Bhatia S, Kaur A, et al. Patients awareness and attitude towards dental implants. Indian J Dent 2015;6(4):167–171. DOI: 10.4103/0975-962X.168518.
2. González-Lemonnier S, Bovaira-Forner M, Peñarrocha-Diago M, et al. Relationship between preoperative anxiety and postoperative satisfaction in dental implant surgery with intravenous conscious sedation. Med Oral Patol Oral Cir Bucal 2010;15:e379–e382. DOI: 10.4317/medoral.15.e379.
3. Khorshidi H, Lavaee F, Ghapanchi J, et al. The relation of preoperative stress and anxiety on patients' satisfaction after implant placement. Dent Res J (Isfahan) 2017;14(5):351–355. DOI: 10.4103/1735-3327.215968.
4. Murillo-Benítez M, Martín-González J, Jiménez-Sánchez MC, et al. Association between dental anxiety and intraoperative pain during root canal treatment: A cross-sectional study. Int Endod J 2020;53:447–454. DOI: 10.1111/iej.13245.
5. Haas DA. An update on local anesthetics in dentistry. J Can Dent Assoc 2002;68(9):546–551. PMID: 12366885.
6. Al-Haideri YA. Comparison of local anesthetic efficacy of tramadol hydrochloride (with adrenaline) versus plain tramadol hydrochloride in the extraction of upper molar teeth. J Oral Maxillofac Surg 2013;71:2035–2038. DOI: 10.1016/j.joms.2013.08.009.
7. Vickers MD, O'flaherty D, Szekely SM, et al. Tramadol: Pain relief by an opioid without depression of respiration. Anaesthesia 1992;47:291–296. DOI: 10.1111/j.1365-2044.1992.tb02166.x.
8. Sacerdote P, Bianchi M, Manfredi B, et al. Effects of tramadol on immune responses and nociceptive thresholds in mice. Pain 1997;72:325–330. DOI: 10.1016/s0304-3959(97)00055-9.
9. Danić P, Salarić I, Macan D. New findings on local tramadol use in oral surgery. Acta Stomatol Croat 2017;51(4):336–344. DOI: 10.15644/asc51/4/9.
10. Barakat A. Revisiting tramadol: A multi-modal agent for pain management. CNS Drugs 2019;33(5):481–501. DOI: 10.1007/s40263-019-00623-5.
11. Farzam H, Farahani A, Tafkik A, et al. Antibacterial effect of tramadol against Staphylococcus aureus and Pseudomonas aeruginosa: An in vivo study. New Microbes New Infect 2018;24:42–46. DOI: 10.1016/j.nmni.2018.04.001.
12. Tamanai-Shacoori Z, Shacoori V, Jolivet-Gougeon A, et al. The antibacterial activity of tramadol against bacteria associated with infectious complications after local or regional anesthesia. Anesth Analg 2007;105(2):524–527. DOI: 10.1213/01.ane.0000267525.51017.b8.
13. Ito T, Utsumi N, Baba Y, et al. Considerations for satisfactory sedation during dental implant surgery. J Pers Med 2023;13(3):461. DOI: 10.3390/jpm13030461.
14. Goel M, Sen P, Maturkar T, et al. Effectiveness of tramadol compared to lignocaine as local anesthesia in the extraction of firm teeth: A randomized controlled trial. J Dent Anesth Pain Med 2021;21(3):245–252. DOI: 10.17245/jdapm.2021.21.3.245.
15. Alsandook TA, Haideri YA. A pilot double blinded clinical trial to compare between tramadol HCl and lidocaine HCl as local anaesthesia amongst hospital-outpatient adult dental attendees Mosul-Iraqi. J Oral Res 2013;1(1):13–16.
16. Pang WW, Mok MS, Chang DP, et al. Local anesthetic effect of tramadol, metoclopramide, and lidocaine following intradermal injection. Reg Anesth Pain Med 1998;23(6):580–583. DOI: 10.1016/s1098-7339(98)90085-2.
17. Pozos AJ, Martinez R, Aguirre P, et al. The effects of tramadol added to articaine on anesthesia duration. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;102(5):614–617. DOI: 10.1016/j.tripleo.2006.01.017.
18. Jendi SK, Talathi A. Tramadol hydrochloride: an alternative to conventional local anesthetics for intraoral procedures – A preliminary study. J Oral Biol Craniofac Res 2019;9(1):111–114. DOI: 10.1016/j.jobcr.2018.11.002.
19. Basu S, Mukherjee O, Sahu S, et al. Tramadol HCL as an effective alternative to lignocaine HCL for extraction of tooth under supraperiosteal infiltration. Indian J Dent Sci 2021;13(3):175–177. DOI: 10.4103/IJDS.IJDS_146_20.
20. Pasternak M. Does tramadol have a place in the dental armamentarium? An atypical opioid in dental practice from the pharmacological perspective–Part II. Local tramadol administration within orofacial tissues. Pomeranian Journal of Life Sciences 2023;69(3):28–32. DOI: 10.21164/pomjlifesci.930.

21. Srivastava M, Singh Bedi R, Aurora J, et al. Comparison of local anesthetic efficacy of tramadol hydrochloride (with adrenaline) versus lignocaine hydrochloride (with adrenaline) in non-complicated tooth extractions. Intern J Appl Dent Sci 2018;4(3):243–246. DOI: 10.1016/j.joms.2013.08.009.
22. Ege B, Ege M, Koparal M, et al. Comparison of the anesthetic efficiency of lidocaine and tramadol hydrochloride in orthodontic extractions: A split–mouth, prospective, randomized, double-blind study. J Oral Maxillofac Surg 2020;78(1):52–62. DOI: 10.1016/j.joms.2019.07.010.
23. Polat F, Tuncel A, Balci M, et al. Comparison of local anesthetic effects of lidocaine versus tramadol and effect of child anxiety on pain level in circumcision procedure. J Pediatr Urol 2013;9:670–674. DOI: 10.1016/j.jpurol.2012.07.022.
24. Bennett CR. Monheim's Local Anesthesia and Pain Control in Dental Practice. 7th ed. Ontario: B.C. Decker; 1990.
25. World Health Organization. Tramadol update review report. Available from https://www.who.int/medicines/areas/quality_safety/6_1_Update.pdf.
26. Kalyan U, Bhushan NS, Chiang KC, et al. Efficacy of tramadol hydrochloride as local anaesthetic and analgesic agent for extraction of maxillary teeth. J Clin Diagn Res 2020;14(6):26–30. DOI: 10.7860/JCDR/2020/43796.13767.
27. Jendi SK, Syed AM, Badal S, et al. Comparison of local anaesthetic efficacy of tramadol versus lignocaine for extraction of tooth under supraperiosteal infiltration. J Maxillofac Oral Surg 2019;18(1):100–105. DOI: 10.1007/s12663-018-1104-5.
28. Ege B, Calisir M, Al-Haideri Y, et al. Comparison of local anesthetic efficacy of tramadol hydrochloride and lignocaine hydrochloride. J Oral Maxillofac Surg 2018;76(4):744–751. DOI: 10.1016/j.joms.2017.11.011.
29. Kakagia D, Vogiatzaki T, Eleftheriadis S, et al. Local infiltrative anesthetic effect of tramadol compared to lidocaine for excision of cutaneous lesions: Pilot randomized double-blind clinical trial. J Cutan Med Surg 2012;16(2):101–106. DOI: 10.2310/7750.2011.11015.
30. Ahmad Qureshi A, Mousa Bakri M. Comparative study of local anesthetic efficacy of 5% tramadol versus 2 %Lignocaine with 1:100,000 adrenaline for extraction of fully erupted maxillary 3rd molars using infiltration anesthesia. Saudi Dent J 2022;34(4):306–309. DOI: 10.1016/j.sdentj.2022.03.002.