

Original Research Article

BUFFERED VERSUS UNBUFFERED LIDOCAINE-EPINEPHRINE FOR EXTRACTION OF INFECTED MANDIBULAR THIRD MOLARS: A RANDOMIZED CLINICAL TRIAL FROM KARACHI

Hijab Farid¹, Samreen Malik², Amna Rehman³, Amna Afridi⁴, Samir Azeem⁵, Navid Rashid Qureshi⁶

¹Assistant Professor of Oral Medicine, Liaquat College of Medicine & Dentistry Karachi Pakistan.

²Assistant Professor of Oral Medicine, Liaquat College of Medicine & Dentistry Karachi Pakistan.

³Associate Professor, of Oral medicine Maxillofacial Surgery, Liaquat College of Medicine & Dentistry Karachi Pakistan.

⁴Registrar of Oral medicine Maxillofacial Surgery, Liaquat College of Medicine & Dentistry Karachi Pakistan.

⁵Associate Professor, of Oral Medicine, Liaquat College of Medicine & Dentistry Karachi Pakistan.

⁶Principal, College of Dentistry Liaquat College of Medicine & Dentistry Karachi Pakistan.

Received : 05/08/2026
Received in revised form : 04/09/2026
Accepted : 18/09/2026

Corresponding Author:

Dr. Hijab Farid,
Assistant professor of Oral medicine,
Liaquat College of Medicine &
Dentistry Karachi Pakistan.
Email: drhijabkhan@gmail.com

DOI: 10.70034/ijmedph.2026.3.913

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 5931-5934

ABSTRACT

Background: Infected mandibular third molars are frequently difficult to anesthetize, and commercial lidocaine–epinephrine solutions are acidic, causing injection discomfort and delayed onset. Buffering with sodium bicarbonate may improve patient comfort and anesthetic efficacy.

Materials and Methods: A randomized clinical trial was conducted in Karachi among 109 adults (18–65 years) requiring extraction of infected mandibular third molars. Participants received either buffered 2% lidocaine with epinephrine (1:100,000) prepared chairside with 8.4% sodium bicarbonate (1:10) or standard unbuffered anesthetic. Outcomes included injection pain (VAS), onset time, cartridges used, anesthetic adequacy, and perioperative complications.

Results: Compared with unbuffered anesthetic, buffered anesthetic reduced injection pain (VAS 2.91 ± 0.89 vs 4.22 ± 1.13 ; $p < 0.0001$), shortened onset time (115.35 ± 21.94 s vs 222.06 ± 50.03 s; $p < 0.0001$), and decreased cartridges required (1.47 ± 0.60 vs 2.04 ± 0.87 ; $p < 0.0001$). Complication rates were similar between groups.

Conclusion: Chairside buffering of lidocaine–epinephrine significantly improves comfort and anesthetic performance during extraction of infected mandibular third molars without increasing complications.

Keywords: buffered local anesthesia; lidocaine; sodium bicarbonate; third molar; infection; randomized clinical trial.

INTRODUCTION

Mandibular third molar extraction is one of the most frequently performed oral surgical procedures and is commonly complicated by pericoronitis, periodontal pathology, or periapical infection. Infected tissues are often acidic and hyperemic, which can reduce the effectiveness of local anesthetics, delay onset, and increase the likelihood of inadequate anesthesia requiring repeated injections. In addition, patients frequently report burning or stinging during administration, a discomfort partly attributable to

the low pH of commercially available lidocaine solutions containing epinephrine.^[1-5]

Standard dental cartridges of lidocaine with epinephrine are formulated at an acidic pH to improve stability of the vasoconstrictor and extend shelf life. However, local anesthetic molecules must be present in a sufficient non-ionized fraction to diffuse through neural membranes and achieve sodium channel blockade. In inflamed or infected environments, a lower tissue pH shifts the equilibrium toward the ionized form, potentially leading to slower onset and reduced depth of anesthesia. Buffering with sodium bicarbonate

immediately prior to injection increases solution pH toward physiologic values and may reduce injection pain while improving onset and anesthetic success.^[6,7]

Although buffered local anesthesia has shown benefits in various dental and surgical settings, its use in routine practice remains limited, and evidence specific to infected mandibular third molar extractions in outpatient settings is still evolving. Therefore, this randomized clinical trial was designed to compare buffered versus unbuffered 2% lidocaine with epinephrine (1:100,000) for pain on injection, onset time, anesthetic requirement, adequacy of anesthesia, and perioperative safety during extraction of infected mandibular third molars in Karachi.^[8-12]

Objectives: To compare inter-operative pain control and anesthetic performance of buffered versus unbuffered 2% lidocaine with epinephrine (1:100,000) in extraction of infected mandibular third molars.

MATERIALS AND METHODS

This randomized clinical trial was conducted at Khidmat-e-Khalq Foundation under supervision of Liaquat College of Medicine and Dentistry, Karachi, over 8 months after IRB approval. Adults aged 18–65 years requiring extraction of infected mandibular third molars (acute/chronic infection; Pederson difficulty 1–6) were enrolled. Patients were randomized to receive either: (a) buffered LA prepared immediately before injection using a 1:10 dilution (1 mL of 8.4% sodium bicarbonate mixed with 10 mL lidocaine-epinephrine), or (b) standard unbuffered LA. Outcomes included pain on injection (VAS 0–10), onset time (seconds), number of cartridges used, and anesthetic profoundness categories. Inter- and post-operative complications were recorded. Data were analyzed using SPSS v24 with $p < 0.05$ considered significant.

RESULTS

A total of 109 participants were randomized to buffered ($n=55$) and unbuffered ($n=54$) groups; baseline demographics and clinical variables were comparable. Buffered LA significantly reduced injection pain (VAS 2.91 ± 0.89 vs 4.22 ± 1.13 ; $p < 0.0001$), shortened onset time (115.35 ± 21.94 s vs 222.06 ± 50.03 s; $p < 0.0001$), and reduced cartridges required (1.47 ± 0.60 vs 2.04 ± 0.87 ; $p < 0.0001$). Sufficient anesthesia occurred more often in the buffered group (80.0% vs 63.0%), while insufficient anesthesia (>2 cartridges) was lower (5.5% vs 20.4%), although profoundness distribution did not reach statistical significance ($p=0.219$). Inter-operative complications were similar (12.7% vs 11.1%; $p=0.219$), as were post-operative complications (29.1% vs 25.9%; $p=0.439$), with no significant difference in complication types.

DISCUSSION

This randomized clinical trial from Karachi demonstrates that chairside buffering of 2% lidocaine with epinephrine (1:100,000) using 8.4% sodium bicarbonate meaningfully improves anesthetic performance during extraction of infected mandibular third molars. In the buffered group, injection pain was lower by 1.31 VAS points, onset was faster by about 107 seconds, and fewer cartridges were required, while inter- and post-operative complication rates remained comparable. These findings are clinically relevant because infected and inflamed tissues are a common setting where local anesthesia becomes unreliable and patients often experience both procedural pain and heightened anxiety.^[13-16]

The reduction in injection pain observed with buffered anesthesia is consistent with the physiologic explanation that acidic solutions activate peripheral nociceptors and produce a burning sensation, whereas pH-adjusted solutions closer to physiologic pH reduce chemical irritation at the injection site. Buffered local anesthetic has been repeatedly associated with improved patient comfort in dental settings, including third molar procedures, and the present results align with reports showing less pain with buffered agents compared with conventional formulations.^[2,3] Improved comfort at the moment of injection may also have secondary benefits such as reducing anticipatory fear and improving cooperation during difficult mandibular blocks and extractions.^[11,13]

A key finding was the markedly shorter onset time with buffering. This outcome is biologically plausible: alkalinization increases the proportion of non-ionized local anesthetic available to cross the nerve membrane, thereby accelerating sodium channel blockade. In the context of infection, where tissue pH is reduced and vascularity is increased, this advantage becomes more pronounced because unbuffered solutions start from a low pH and may further acidify the local microenvironment. The faster onset in our trial is consistent with other controlled studies in third molar surgery where buffered local anesthetics reduced latency and improved block quality.^[2,3] The magnitude of onset reduction in seconds also has practical value in high-volume outpatient clinics by decreasing chairside waiting time, potentially improving workflow and patient throughput without compromising safety.^[17]

Buffered anesthesia also reduced total anesthetic requirement, reflected by fewer cartridges used. This suggests a more efficient block and possibly better diffusion/penetration in inflamed tissues. Reduced cartridge use has patient-level implications (fewer repeat injections, less overall discomfort) and safety implications (lower total dose exposure). Although our categorical measure of “profoundness of anesthesia” did not reach statistical significance,

the buffered group showed a higher proportion of sufficient anesthesia and a lower proportion of insufficient anesthesia (>2 cartridges). This pattern supports the clinical impression that buffering improves the likelihood of achieving adequate anesthesia in difficult infected cases.^[2-4]

Importantly, the improvement in efficacy did not come at the cost of increased complications. Both groups showed similar rates and distributions of inter-operative and post-operative complications, including swelling, bleeding, dry socket, and infection, which are known to occur after third molar removal.^[7,9,16] The comparable safety profile is consistent with prior literature indicating that buffering itself does not increase adverse events when prepared and administered appropriately.^[2,3] Given ongoing concerns about epinephrine stability at higher pH, our findings support the recommendation that buffering be performed immediately before injection to balance efficacy with pharmacologic stability.^[18-20]

This study has several strengths: randomized allocation, comparable baseline demographic and clinical characteristics, and evaluation of outcomes that matter to both patients (pain) and clinicians (onset time, anesthetic volume, complications). Nonetheless, some limitations should be acknowledged. First, this was a single-center trial, which may limit generalizability beyond similar outpatient oral surgery settings. Second, pain assessment using VAS is subjective and may be influenced by individual anxiety and expectations. Third, the trial focused on infected mandibular third molars with mild-to-moderate Pederson difficulty, so results may not apply to highly complex surgical cases or to patients excluded due to systemic disease. Finally, although complications were recorded, the study was not powered primarily for detecting differences in uncommon adverse outcomes.

From a clinical and public health perspective, optimizing pain control in infected third molar extraction can improve patient trust and willingness to seek timely dental care, reducing the risk of progression to more severe odontogenic infections and their complications.^[18,20] Buffered anesthesia is a low-cost, feasible chairside modification that may be especially useful in resource-constrained settings where avoiding procedural delays and minimizing repeat injections are valuable. Larger multicenter studies, ideally with standardized blinding and assessment of cost-effectiveness, would further clarify implementation benefits and inform routine adoption in oral surgery practice.

CONCLUSION

In infected mandibular third molar extraction, buffering 2% lidocaine with epinephrine using 8.4% sodium bicarbonate improved patient comfort, accelerated onset, and reduced anesthetic volume

requirements without increasing complications. Buffered local anesthesia may be considered a practical strategy for better pain control in infected third molar procedures in outpatient settings.

REFERENCES

1. Amorim KdeS, Gercina AC, Ramiro FMS, Medeiros LdeA, de Araújo JSM, Groppo FC, et al. Can local anesthesia with ropivacaine provide postoperative analgesia in extraction of impacted mandibular third molars? A randomized clinical trial. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2021;131(5):512-518. doi:10.1016/j.oooo.2020.09.010.
2. Tole N, Neeli A. Evaluation of the efficacy of buffered local anesthetic in extraction of infected teeth-Randomized double-blind study. *Oral Maxillofac Surg.* 2024;28(2):803-807. doi:10.1007/s10006-024-01206-5.
3. Staedt H, Palarie V, Heimes D, Ottl P, Fan S, Kämmerer PW. Buffered 4% articaine reduces pain and enhances anesthesia in maxillary third molar extractions: a randomized, double-blind split-mouth study. *Biomedicines.* 2024;12(12):2691.
4. Tokuç B, Coşkunses FM. Comparison of the effects of articaine and bupivacaine in impacted mandibular third molar tooth surgery: a randomized, controlled trial. *J Dent Anesth Pain Med.* 2021;21(6):575-582. doi:10.17245/jdpm.2021.21.6.575.
5. Gholami M, Banihashemrad A, Mohammadzadeh A, Ahrari F. The efficacy of 4% articaine versus 2% lidocaine in inducing palatal anesthesia for tooth extraction in different maxillary regions. *J Oral Maxillofac Surg.* 2021;79(8):1643-1649. doi:10.1016/j.joms.2021.02.019.
6. Santos-Sanz L, Toledano-Serrabona J, Gay-Escoda C. Safety and efficacy of 4% articaine in mandibular third-molar extraction: a systematic review and meta-analysis of randomized clinical trials. *J Am Dent Assoc.* 2020;151(12):912-923.e10. doi:10.1016/j.adaj.2020.08.016.
7. Cheng Y, Al-Arooomi MA, Al-Worafi NA, Al-Moraissi EA, Sun C. Influence of inflammation on bleeding and wound healing following surgical extraction of impacted lower third molars. *BMC Oral Health.* 2023;23(1):83. doi:10.1186/s12903-023-02754-0.
8. Miyazaki R, Sukegawa S, Nakagawa K, Nakai F, Nakai Y, Ishihama T, et al. Risk factors for delayed-onset infection after mandibular wisdom tooth extractions. *Healthcare (Basel).* 2023;11(6):871.
9. Fehlfhofer J, Fernandez-Ulrich C, Wohlers A, Kesting MR, Rau A, Buchbender M. A retrospective analysis of postoperative abscess formation following wisdom tooth removal and their clinical condition and localization. *J Contemp Dent Pract.* 2023;23(11):1079-1084.
10. Park SU, Kim T, Do J, Cho M, An JS, Karm MH. Comparison of safety of general anesthesia and intravenous sedation during third-molar extraction surgery. *Sci Rep.* 2024;14(1):16687. doi:10.1038/s41598-024-67045-2.
11. Astramskaite-Januseviciene I, Petronis Z, Juodzbalsys G. The influence of sedation and general anesthesia to patients' psycho-emotional status undergoing wisdom teeth extraction: a pilot clinical trial. *J Oral Med Oral Surg.* 2022;28(4):43.
12. Bedeloğlu E. Evaluation of the effect of conscious sedation on patient satisfaction and pain after wisdom tooth extraction. *J Stomatol Oral Maxillofac Surg.* 2022;123(3):292-296.
13. Shuborna NS, Khoo LK, Bhattarai BP, Chaiyasamut T, Kiattavorncharoen S, Pairuchvej V, et al. Intra-socket application of hyaluronic acid reduces pain and swelling following wisdom teeth removal. *J Oral Med Oral Surg.* 2022;28(1):14.
14. Ramanathan M, Ramanuj S, Ponvel K. Efficacy and reliability of single tooth anesthesia (STA) for surgical removal of impacted wisdom teeth: a comparative study. *J Maxillofac Oral Surg.* 2024;23(1):88-96. doi:10.1007/s12663-023-02017-z.

15. Doshi A, Bhola N, Agarwal A. Comparing the efficacy of adrenaline, clonidine, and dexmedetomidine in enhancing local anesthesia for impacted third molar extraction: a randomized controlled trial. *J Dent Anesth Pain Med.* 2024;24(4):285-295. doi:10.17245/jdapm.2024.24.4.285.
16. Kim JY, Han MD, Lee H, Ko JH, Park YL, Huh JK. Are there differences in the causes and complications of mandibular third molar extraction in older patients compared to younger patients? *J Oral Maxillofac Surg.* 2024;82(11):1416-1424. doi:10.1016/j.joms.2024.06.182.
17. Raiesian S, Ahmadiyeh ADP, Rad MM. A systematic review on prior/postoperative antibiotics therapy efficiency in reducing surgical complications after third molar extraction surgery. *J Maxillofac Oral Surg.* 2025;24(5):1427-1433. doi:10.1007/s12663-024-02355-6.
18. Chen J. Anesthesia for oral and maxillofacial head and neck infections. In: Jiang H, Xia M, editors. *Anesthesia for Oral and Maxillofacial Surgery.* Singapore: Springer Nature; 2023. p.167-176. doi:10.1007/978-981-19-7287-4_12.
19. Gadhia A, Pepper T. Oral surgery, extraction of teeth. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK589654/>
20. Kano K, Kawamura K, Yoshimatsu H, Doi T, Miyake T. Clinical analysis of antibiotic prophylaxis and surgical site infection in third molar surgery. *J Oral Maxillofac Surg Med Pathol.* 2024. Available from: <https://www.sciencedirect.com/science/article/pii/S2212555824002540>