Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(3), 1124-1128 | ISSN:2251-6727

Comparison of Effect of Amoxicillin Administered Locally Vs Systemically on Healing of Mandibular Third Molar Surgical Extraction Socket

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(Received: 16 March 2025 Revised: 20 April 2025 Accepted: 01 May2025)

KEYWORDS

Amoxicillin, Healing, Mandibular Third Molar, Surgery, Extraction Socket, Clavulanic Acid, Pain, Edema, Trismus

ABSTRACT:

Background: Mandibular third molar impaction is a common clinical condition often necessitating surgical extraction, which is frequently accompanied by postoperative complications such as pain, edema, trismus, and localized infection. Although systemic antibiotics are routinely employed to mitigate these sequelae, concerns over adverse reactions and antimicrobial resistance have prompted interest in localized antibiotic delivery. This study aims to compare the clinical efficacy of local versus systemic amoxicillin administration in promoting postoperative healing and minimizing complications.

Materials and Methods: A prospective analytical cross-sectional study was conducted on 200 patients (18–50 years) undergoing mandibular third molar surgery. Patients were randomly assigned to two groups:

- **Group A (Systemic):** Oral amoxicillin–clavulanic acid 625 mg twice daily for 5 days.
- **Group B (Local):** 1 g of amoxicillin powder placed intra-alveolarly prior to surgical closure.

Postoperative evaluations on Days 3 and 7 included pain intensity (VAS), mouth opening (interincisal distance), swelling (clinical observation), wound healing (Landry Index), and adverse drug reactions. Data were analyzed using independent t-tests ($p < 0.05$ significant).

Results: The local group demonstrated superior trismus reduction (Day 3: 34.92 mm vs. 33.34 mm; $p < 0.05$) and early wound healing, with fewer adverse effects (0% vs. 4%). Pain scores were slightly lower in the local group on Day 3. While systemic antibiotics showed improved healing by Day 7, they were associated with gastrointestinal side effects.

Conclusion: Local administration of amoxicillin is a clinically effective alternative to systemic therapy, offering enhanced early healing and reduced systemic complications in mandibular third molar surgeries.

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Introduction

Impaction is the failure of a tooth to erupt into its functional position, often due to space limitations or misalignment. In India, studies report the prevalence of impacted third molars between 16.7% and 73.82%, with some studies noting 22% and 37.13% prevalence.[1] Factors influencing impaction include genetics, crown width, masticatory function, and diet.[2] A higher rate is observed in females.[3,4] Surgical removal of impacted third molars is a routine oral procedure but carries risks such as hemorrhage, alveolar osteitis, infection, nerve damage, trismus, edema, and fractures.[1] Infection-related complications—surgical wound infection (1–6%) and alveolar osteitis (20–30%)—are particularly common.[5,6,7] Local antibiotic application in the socket post-extraction is explored to reduce such issues.[8] Though antibiotics target bacterial infections, they are often unnecessary in healthy individuals and may cause allergies, gastrointestinal issues, and antimicrobial resistance.[9] Amoxicillin, a broad-spectrum beta-lactam, is effective against *Streptococcus*, *Enterococcus*, *Listeria*, and some gram-negative bacteria, reducing infection and osteitis risk by nearly 50%.[2] Topical antibiotic delivery (e.g., gels or powders) ensures high local concentration with minimal systemic side effects.[3,4] Studies support this method's effectiveness.[10–11] However, Busa et al. found no significant effect on post-extraction bacteremia with topical amoxicillin.[12–13] This study compares the efficacy of systemic and local amoxicillin in reducing complications after mandibular third molar surgery.

Materials and Methods

An analytical cross-sectional study was conducted in the Department of Oral and Maxillofacial Surgery at Sri Aurobindo College of Dentistry, after ethical approval. The goal was to assess outcomes of local vs. systemic antibiotics following third molar extraction. A total of 200 patients aged 18–50 years with impacted mandibular third molars were enrolled.

Exclusion Criteria included systemic illnesses, prolonged opioid use, substance abuse, pregnancy/lactation, antibiotic allergy, trismus, or active infection.

Group Allocation:

- **Group A (Systemic)**: Oral amoxicillin–clavulanic acid (625 mg) twice daily for 5 days.
- **Group B (Local)**: 1 g amoxicillin (500 mg × 2) placed in the socket before closure. (Fig.1)

All procedures were done under local anesthesia using aseptic protocols. Standard preoperative blood and radiographic assessments were done. Both groups received analgesics for 3 days.

Postoperative assessments included:

- Pain (Visual Analogue Scale)
- Wound healing (Landry Index)
- Trismus (interincisal distance via Vernier caliper)
- Swelling (presence/absence)
- Adverse drug reactions

Evaluations were conducted on Days 3 and 7.

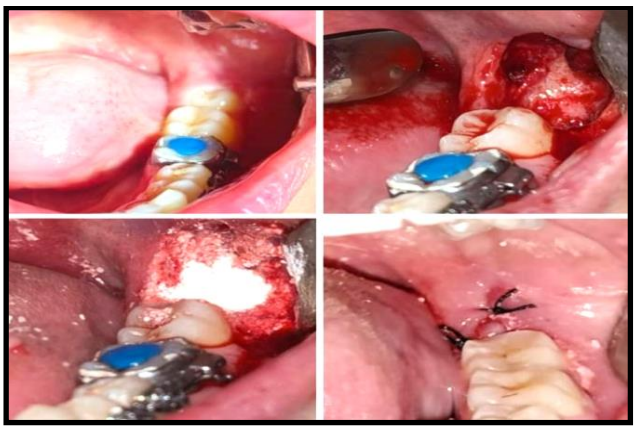

Figure 1: Local antibiotic placement in extraction socket

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JCHR (2025) 15(3), 1124-1128 | ISSN:2251-6727

Statistical Analysis

Data was tabulated using MS Excel 2010. Descriptive statistics summarized the data. Quantitative data comparisons were done using independent t-tests. A p-value <0.05 was considered statistically significant.

Results

The study involved 200 patients equally divided between systemic and local groups. Mean age in the systemic group was 33.99 ± 8.33 and in the local group 32.93 ± 8.81. Males and females were nearly equally distributed in both groups. (Fig.2)

Types of Impactions Observed:

- **Mesioangular**: 22 (systemic), 25 (local)
- **Distoangular**: 28 (systemic), 25 (local)
- **Vertical**: 18 (systemic), 25 (local)
- **Horizontal**: 32 (systemic), 28 (local)

Trismus

Mouth opening was significantly better in the local group:

- Day 3: 34.92 ± 1.43 mm vs. 33.34 mm
- Day 7: 37.02 ± 1.00 mm vs. 36.52 mm (Mean difference: 2.10 mm)

Pain

- Day 3: Systemic group reported slightly higher pain (1.08 ± 0.51) than the local group (0.99 ± 0.83).
- Day 7: Pain levels decreased in both groups with no significant difference (p > 0.84).

Swelling

- Day 3: 82% of systemic group had no swelling vs. 67% in the local group.
- Day 7: No swelling in the systemic group; 8% in the local group still had swelling.

Wound Healing (Landry Index)

- Day 3: Good healing in 76% (local) vs. 55% (systemic); very good healing in 40 (systemic) vs. 22 (local).
- Day 7: Very good healing: 54 (local) vs. 38 (systemic); excellent healing: 60 (systemic) vs. 25 (local) (p = 0.01).

Side Effects

- Systemic group: 4% experienced side effects (e.g., diarrhea).
- Local group: No reported side effects (p = 0.04).

VARIABLES	GROUP	MEAN	STD. DEVIATION	P-VALUE
PAIN DAY 3	GROUP A- SYSTEMIC ANTIBIOTICS	1.08	.506	.358
	GROUP B – LOCAL ANTIBIOTICS	.99	.835	
PAIN DAY 7	GROUP A- SYSTEMIC ANTIBIOTICS	.24	.429	.120
	GROUP B – LOCAL ANTIBIOTICS	.34	.476	
TRISMUS DAY 3 IN MM	GROUP A- SYSTEMIC ANTIBIOTICS	33.34	2.244	.001
	GROUP B – LOCAL ANTIBIOTICS	34.92	1.433	
TRISMUS DAY 7 IN MM	GROUP A- SYSTEMIC ANTIBIOTICS	36.52	1.418	.004
	GROUP B – LOCAL ANTIBIOTICS	37.02	1.005	
WOUND HEALING DAY 3	GROUP A- SYSTEMIC ANTIBIOTICS	3.35	.575	.041
	GROUP B – LOCAL ANTIBIOTICS	3.20	.449	
WOUND HEALING DAY 7	GROUP A- SYSTEMIC ANTIBIOTICS	4.58	.535	.001
	GROUP B – LOCAL ANTIBIOTICS	4.04	.680	

Figure 2: Comparison of all variables in both the groups

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Discussion

This analytical cross-sectional study aimed to compare the postoperative healing outcomes of local versus systemic antibiotic administration in mandibular third molar extractions. A total of 200 patients were enrolled, with 100 in each group: the systemic group received amoxicillin with clavulanic acid (625 mg twice daily for five days), while the local group received 1 gram of amoxicillin directly into the extraction socket. The study investigated key postoperative complications, including trismus, pain, swelling, wound healing, and side effects. The findings revealed that local antibiotics provided better post-operative outcomes, with mean mouth opening significantly greater on Day 3 (34.92 mm vs. 33.34 mm) and Day 7 (37.02 mm vs. 36.52 mm) compared to the systemic group. These results suggest enhanced anti-inflammatory effects from local antibiotics, which may reduce muscular spasm and edema, as noted by Bhargava et al. (2020)[14]. Pain scores were marginally lower in the local group on Day 3 (0.99 vs. 1.08), but no significant difference was observed on Day 7. These findings align with Siddiqi et al. (2018)[15], who highlighted the accelerated pain reduction in patients treated with local doxycycline. Interestingly, swelling was higher in the local antibiotic group on Day 3 (49% vs. 18%), though it resolved by Day 7 in both groups. This unexpected trend may reflect the multifactorial nature of swelling and the localized drug dispersion (Arteagoitia et al., 2005)[16]. Regarding wound healing, significant differences were observed between the groups: on Day 3, the local antibiotic group showed good healing, while the systemic group demonstrated excellent healing on Day 7, consistent with studies by Ushirozako et al. (2021)[17] and Polak et al. (2019).[18] Notably, the systemic antibiotic group experienced more side effects like diarrhea (4%) compared to the local group (0%), underscoring the advantage of localized drug delivery in minimizing systemic exposure and adverse reactions, as supported by Lodi et al. (2012).[19] In conclusion, this study reinforces the efficacy of local antibiotics in enhancing postoperative outcomes with fewer side effects, aligning with the growing body of literature advocating for localized delivery as a safer and more targeted alternative to systemic administration (Dar-Odeh et al.[20], 2010; Lalla et al., 2013[21]). These findings contribute to a paradigm shift in postoperative care, suggesting that local antibiotics can effectively manage postoperative complications while reducing systemic risks.

Conclusion

This study supports the effectiveness of local antibiotic administration in enhancing healing and minimizing side effects after third molar extraction. Local application resulted in better mouth opening, early wound healing, and fewer complications, although systemic antibiotics led to slightly superior healing by Day 7. As antibiotic resistance and adverse reactions become growing concerns, localized drug delivery offers a promising strategy in post-surgical care.

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