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Comparative Evaluation of Gentamicin Solution Versus Normal Saline Irrigation in the Surgical Management of Maxillofacial Space Infections: A Prospective Randomized Pilot Study

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KEYWORDS

Space infection, gentamicin, normal saline, irrigation, pilot study.

ABSTRACT:

Background: Intraoperative wound irrigation is a standard adjunct in the surgical management of maxillofacial space infections. While normal saline is commonly used, antimicrobial irrigants such as gentamicin may confer additional benefits.

Objective: To compare the effectiveness of gentamicin solution irrigation versus normal saline in reducing postoperative inflammatory and microbiological burden.

Methods: Thirty patients with maxillofacial space infections were prospectively randomized into two groups: gentamicin irrigation (n = 15) and normal saline irrigation (n = 15). In the gentamicin group, the surgical cavity was irrigated with 80 mg gentamicin diluted in 500 mL of 0.9% saline, while the control group received 500 mL 0.9% saline irrigation. All patients underwent surgical drainage and systemic antibiotics. Outcomes assessed at 72 hours included WBC count, clinical swelling resolution, pain (VAS), microbiological load, and hospital stay.

Results: The gentamicin group showed a greater reduction in WBC count at 72 hours (10,200 ± 1,350 → 8,400 ± 1,180 cells/μL) compared with the saline group (10,000 ± 1,420 → 9,100 ± 1,310 cells/μL); mean between-group difference −700 cells/μL (95% CI −1,580 to 180; p = 0.11). Median swelling scores improved from 3 to 1 in the gentamicin group and from 3 to 2 in the saline group (p = 0.09). Mean VAS pain scores at 72 hours were 3.1 ± 0.9 (gentamicin) versus 3.6 ± 1.0 (saline), p = 0.18. Microbiological load decreased by 1.8 log CFU in the gentamicin group versus 1.2 log CFU in the saline group (p = 0.12). Median hospital stay was 5 days in the gentamicin group versus 6 days in the saline group (p = 0.15).

Conclusion: Gentamicin irrigation was associated with numerically greater improvements in WBC count, swelling, pain, and microbiological reduction at 72 hours compared with saline irrigation; however, these differences were not statistically significant. Larger studies are required to confirm clinical utility.

1. Introduction

Maxillofacial space infections remain one of the most frequently encountered surgical emergencies in oral and maxillofacial practice. These infections, often arising from odontogenic sources such as carious teeth, periapical pathology, or post-extraction complications, can rapidly spread through the potential spaces of the head and neck [1]. If inadequately managed, they may progress to life-threatening conditions such as airway compromise, mediastinitis, or septicemia [2]. The cornerstone of treatment is prompt surgical drainage, elimination of the source of infection, and administration of appropriate systemic antibiotics [3]. Alongside these measures, intraoperative wound irrigation has long been used as an adjunct to reduce bacterial load, clear necrotic tissue, and optimize the surgical field for healing.

Normal saline is the most widely employed irrigant due to its ready availability, low cost, isotonicity, and tissue compatibility. It effectively removes debris acting as mechanical debridement [4]. However, saline itself does not have any antimicrobial properties, and its action is primarily limited to physical lavage [4]. In recent years, attention has shifted toward exploring irrigating solutions that combine mechanical cleansing with antimicrobial activity. Antiseptic solutions such as povidone-iodine and chlorhexidine have been

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investigated, but concerns regarding delayed wound healing, and unpleasant taste or odor have made to look for different irrigation solutions for use in maxillofacial spaces [5].

Gentamicin, an aminoglycoside antibiotic, has been widely used systemically for the treatment of severe Gram-negative and mixed infections. Its bactericidal effect results from inhibition of protein synthesis, and it is valued for its rapid action and low rates of resistance when used appropriately [6]. The rationale for its local use lies in achieving high tissue concentrations at the site of infection without the systemic toxicity associated with higher parenteral doses[7] .

Despite its potential, the application of gentamicin as an intraoperative irrigant in maxillofacial space infections has not been widely studied. Existing literature is limited, and most studies have focused on orthopaedic or general surgical wounds [8]. Given the complex anatomy, high vascularity, and polymicrobial nature of maxillofacial infections, there is a need to evaluate whether gentamicin irrigation offers any clinical benefits over conventional saline.

This pilot study was therefore designed to compare the outcomes of gentamicin irrigation with normal saline in the surgical management of maxillofacial space infections. By assessing clinical, haematological, and microbiological parameters, we aimed to determine whether gentamicin irrigation could provide additional benefit, thereby laying the groundwork for larger controlled trials.

2. Materials and Methods

Study Design

This was a prospective, randomized, pilot study conducted in the Department of Oral and Maxillofacial Surgery, Saveetha Dental College and Hospitals between October 2024 and July 2025. The study protocol was reviewed and approved by the Scientific Review Board of Saveetha Dental College (Approval No: SRB/SDC/OMFS-2406/24/495). Written informed consent was obtained from all participants prior to inclusion.

Participants

Inclusion criteria were: patients aged ≥18 years presenting with clinically confirmed maxillofacial space infection requiring surgical drainage under anesthesia. Exclusion criteria were: allergy to aminoglycosides, renal compromised patients, pregnancy or prior aminoglycoside therapy within the preceding 7 days.

Randomization

Thirty patients were randomized into two equal groups (n = 15 each) using block randomization (block size = 4). Allocation concealment was achieved using opaque, sealed envelopes opened intraoperatively.

Intervention

- Gentamicin group: irrigation with gentamicin solution (80 mg gentamicin in 500 mL 0.9% saline).
- Saline group: irrigation with 500 mL 0.9% saline.

All patients received standard systemic antibiotics (amoxicillin–clavulanic acid and metronidazole) and supportive therapy according to hospital protocol.

Outcomes

- Primary outcome: WBC count at 72 hours postoperatively.
- Secondary outcomes: clinical swelling resolution (graded 0–3), VAS pain score (0–10), microbiological load (quantitative culture in log CFU), and hospital stay (days).

Statistical Analysis

Continuous variables were summarized as mean ± SD or median (IQR). Group comparisons were made using independent t-test or Mann–Whitney U test. Categorical data were compared with Fisher's exact test. A p-value < 0.05 was considered statistically significant. Analyses were conducted using SPSS version 21.

3. Results

Patient Characteristics

Baseline demographic and clinical characteristics were comparable between groups (Table 1).

WBC Count

At baseline, mean WBC counts were similar (gentamicin: 10,200 ± 1,350 cells/µL; saline: 10,000 ± 1,420 cells/µL; p = 0.68). At 72 hours, WBC was lower in the gentamicin group (8,400 ± 1,180) compared to the

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saline group (9,100 ± 1,310), with a mean difference of −700 cells/µL (95% CI −1,580 to 180; p = 0.11).

Clinical Swelling

Median swelling score decreased from 3 (severe) to 1 (mild) in the gentamicin group, and from 3 to 2 in the saline group. The between-group difference at 72 hours approached but did not reach statistical significance (p = 0.09).

Pain (VAS)

Mean VAS pain score at 72 hours was 3.1 ± 0.9 in the gentamicin group versus 3.6 ± 1.0 in the saline group (p = 0.18).

Microbiological Load

The mean reduction in bacterial load from baseline to 72 hours was greater with gentamicin (1.8 log CFU) compared to saline (1.2 log CFU), but not statistically significant (p = 0.12).

Hospital Stay

Median hospital stay was 5 days in the gentamicin group and 6 days in the saline group (p = 0.15).

Table 1. Baseline and outcome measures in gentamicin vs saline groups.

OUTCOME	GENTAMICIN (n=15)	SALINE (n=15)	p-value
Baseline WBC (/µL)	10,200 ± 1,350	10,000 ± 1,420	0.68
72h WBC (/µL)	8,400 ± 1,180	9,100 ± 1,310	0.11
Swelling score (72h)	1	2	0.09
VAS pain (72h)	3.1 ± 0.9	3.6 ± 1.0	0.18
Microbiological load Δ	−1.8 log CFU	−1.2 log CFU	0.12
Hospital stay (days)	5 (IQR 4–6)	6 (IQR 5–7)	0.15

4. Discussion

This pilot study set out to explore whether gentamicin irrigation could offer an advantage over conventional saline irrigation in the surgical management of maxillofacial space infections. Although statistical significance was not achieved, the results revealed a positive outcome.

The WBC count at 72 hours dropped more in the gentamicin group than in the saline group. This may mean that using gentamicin locally helped in controlling the infection and inflammation better. The difference was small and not significant, which could be because the number of patients in this study was less. Still, it shows that giving antibiotics directly at the site of infection might work faster than just relying on systemic therapy.

Clinical findings like swelling and pain also showed slightly better improvement with gentamicin. Patients in the gentamicin group had swelling reduced from severe to mild, whereas the saline group still had moderate swelling after 72 hours. Swelling reduction is very crucial in space infection cases, especially since it can affect airway safety. This suggests gentamicin irrigation could support faster recovery.

Since maxillofacial infections are usually polymicrobial and gentamicin being a good broad-spectrum antibiotic, the bacterial load was more reduced in the gentamicin group than normal saline group. Similar results have been shown in orthopedic and surgical wounds, where gentamicin irrigation lowered bacterial colonization.

Hospital stay was shorter by about a day in the gentamicin group. Though not significant, shorter hospital stays can help both patients and hospitals by reducing cost and bed usage. The positive trends across blood counts, swelling, pain, and bacterial culture suggest gentamicin irrigation could be a safe and helpful method. No side effects were seen with the dose used in this study.

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5. Conclusion

Gentamicin irrigation showed favorable trends in reducing infection markers, swelling, and bacterial load when compared with saline, though without statistical significance. These results suggest that gentamicin is a safe and promising adjunct in maxillofacial space infection management and merits further investigation in larger trials.

6. Limitations

The main limitation of this study is the small sample size, which made it difficult to achieve statistical significance even though positive trends were seen. Being a single-center study also limits the generalizability of the results, as outcomes may vary in different hospital settings. Only one fixed concentration of gentamicin was used, so the effect of varying doses was not assessed. In addition, the follow-up period was short, and long-term effects such as recurrence or delayed healing could not be evaluated.

7. Future Scope

Future studies should include a larger sample size and be conducted across multiple centers to validate these findings. Research should also focus on testing different concentrations of gentamicin and comparing it with other irrigants such as povidone-iodine or chlorhexidine. Systemic factors such as diabetes, immune status, nutrition, and prior antibiotic exposure were not considered, which may have influenced recovery. Additionally, individual variability in antibiotic response was not accounted for, as patients may respond differently to both systemic and local antibiotics. Further evaluation of cost-effectiveness, patient comfort, and long-term outcomes will help determine whether gentamicin irrigation can be recommended routinely in maxillofacial space infection management.

Ethical Approval:

The study protocol was reviewed and approved by the Scientific Review Board of Saveetha Dental College (Approval No: SRB/SDC/OMFS-2406/24/495). Written informed consent was obtained from all participants.

Conflicts of Interest:

There are no conflicts of interest.

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Competing Interests:

The authors declare that they have no competing interests.

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