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# Role Of Antibiotics In Oral Surgery: A Review

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Abstract

Infection prevention remains a cornerstone of oral surgical practice due to the inherent exposure of sterile tissues to the oral cavity's diverse microbiota. Antibiotics play a critical role in minimizing postoperative infections; however, their widespread misuse has contributed to the alarming rise of antimicrobial resistance (AMR). This review examines the role of antibiotics in oral surgery, outlining prophylactic and therapeutic indications, commonly used agents, and evidence-based dosage regimens. It emphasizes the importance of antibiotic stewardship programs (ASPs) in promoting rational prescribing practices tailored to specific clinical needs, patient factors, and local microbial profiles. The review further highlights research gaps in standardized protocols, the necessity for regional stewardship frameworks, and the potential role of artificial intelligence (AI) and data analytics in optimizing antibiotic use. Strengthening clinician education, adherence to aseptic principles, and evidence-based decision-making are vital to ensuring safe and sustainable antibiotic use in oral surgery.

**Keywords:** Oral surgery, Antibiotic stewardship, Anti-microbial resistance, Prophylaxis, Evidence-based prescribing

## Introduction

Infection risk in oral surgical procedures remains a significant concern due to the inevitable exposure of sterile tissues to the diverse microbial flora of the oral cavity, making infection control a foundational element of safe dental surgical practice. Procedures such as extractions, periodontal surgeries, implant placements, and biopsies inherently breach the mucosal barrier, allowing microorganisms to invade deeper structures, potentially leading to local or systemic infections.[1] Reported surgical site infection rates in oral and maxillofacial surgeries average around 10%, with higher incidences (15–26%) observed in complex reconstructive, oncologic, or trauma cases. The likelihood of infection is influenced by several factors including patient comorbidities such as diabetes or immunosuppression, the duration and complexity of the procedure, pre-existing oral infections, and perioperative aseptic practices.[2] Historically, the introduction of antibiotics beginning with sulfa drugs in the 1930s, followed by penicillin

in the 1940s and tetracyclines and erythromycin in subsequent decades revolutionized infection control in dentistry, leading to widespread and often indiscriminate use for both prophylactic and therapeutic purposes.[3] However, the emergence of antimicrobial resistance (AMR), largely driven by overprescription, misuse, and "just-in-case" prescribing without clear clinical indication, has become a global health crisis. In dentistry, irrational antibiotic use, inadequate diagnostic judgment, and insufficient adherence to evidence-based protocols have contributed to escalating resistance patterns, threatening the effectiveness of standard therapies and patient safety.[4]

Contemporary dental practice therefore emphasizes antibiotic stewardship, advocating for rational, evidence-guided use of antimicrobials in conjunction with meticulous surgical technique, aseptic protocols, and comprehensive infection control measures. Current evidence suggests that routine antibiotic prophylaxis is not warranted in healthy individuals undergoing uncomplicated oral surgery but remains indicated in specific cases involving immunocompromised patients, those with cardiac or prosthetic risks, or in invasive procedures such as dental implant placement, management of active infections, or surgical extraction of impacted teeth.[5] Beta-lactams, particularly amoxicillin, remain the first-line choice, with alternatives like clindamycin, azithromycin, metronidazole, and cephalosporins reserved for penicillin-allergic patients. Importantly, systematic reviews indicate limited benefit from indiscriminate prophylactic use, underscoring that infection prevention in oral surgery relies more on sound operative principles, asepsis, and postoperative care rather than blanket antibiotic administration.[6]

## Microbial Considerations in Oral Surgery

The oral cavity harbors a complex and diverse microbiota comprising both aerobic and anaerobic organisms that coexist in a delicate balance under normal conditions but can become pathogenic when tissue integrity is compromised during surgical interventions. Commonly encountered microorganisms include Streptococcus and Staphylococcus species among the aerobic flora, and anaerobic bacteria such as Prevotella, Fusobacterium, Porphyromonas, and Peptostreptococcus, which are frequently implicated in post-surgical infections.[6] During oral surgical procedures, the disruption of mucosal barriers provides an opportunity for these microorganisms to invade deeper sterile tissues, potentially leading to localized or systemic infections. The risk of infection is further influenced by multiple factors including bacterial load, tissue trauma, impaired host immune response, inadequate aseptic technique, and the presence of necrotic or devitalized tissue that supports bacterial proliferation. Understanding the microbial ecology of the oral environment and the mechanisms by which infections develop is therefore critical for implementing effective infection prevention strategies and guiding the rational use of antibiotics in oral surgery.[7]

## Indications for Antibiotic Use in Oral Surgery

The use of antibiotics in oral surgery encompasses both prophylactic and therapeutic applications, each serving distinct but complementary roles in minimizing infection-related complications. Prophylactic antibiotic use is intended to prevent postoperative infections by temporarily reducing the bacterial load and inhibiting colonization at surgical sites where mucosal integrity is breached and the risk of contamination is high.[8] This preventive approach is particularly beneficial in procedures such as third molar extractions where prophylaxis has been shown to reduce surgical site infections and the incidence of alveolar osteitis dental implant placements, orthognathic surgeries, bone grafting, and sinus lift procedures, all of which involve extensive tissue manipulation and increased exposure to oral microorganisms. In implant cases, preoperative administration of amoxicillin (2–3 g one hour before surgery followed by postoperative doses) has been associated with a lower risk of early implant failure and localized infection, especially when performed in previously infected sites. Similarly, trauma cases involving open fractures require antibiotic coverage to prevent osteomyelitis and soft tissue infection.[9] Patient-specific factors also necessitate prophylactic use in individuals with immune compromised states such as HIV infection or chemotherapy, poorly controlled diabetes mellitus, high-risk cardiac conditions like prosthetic heart valves or prior infective endocarditis (as per AHA guidelines), and those with prosthetic implants vulnerable to hematogenous infection.[10]

On the other hand, therapeutic antibiotic use is indicated for the active management of infections, often as an adjunct to surgical intervention.[11] Conditions such as odontogenic abscesses, pericoronitis, postoperative wound infections, and osteomyelitis demand targeted antibiotic therapy alongside drainage or debridement to eliminate the source of infection.[12] Empirical therapy commonly begins with broad-spectrum agents such as amoxicillin or amoxicillin–clavulanate, which provide coverage against the predominant aerobic and anaerobic oral pathogens. For patients allergic to penicillin, alternatives such as clindamycin or macrolides (e.g., azithromycin or clarithromycin) are preferred.[13] In cases of severe, refractory, or spreading infections, culture and sensitivity testing are recommended to guide antibiotic selection and minimize the risk of resistance development. Thus, antibiotic administration in oral surgery must be evidence-based, procedure-specific, and patientcentered, ensuring effective infection control while supporting antimicrobial stewardship
principles.[14]

**Commonly Used Antibiotics in Oral Surgery[15-20]**

| Class / Drug | Spectrum of Activity | Common Oral Surgery Indications | Typical Adult Dosage & Duration |
|---|---|---|---|
| **Amoxicillin** (β-lactam) | Broad-spectrum; Gram-positive and some Gram-negative bacteria | • Routine prophylaxis in third molar extractions, implant placement, periodontal and periapical surgeries<br>• Treatment of odontogenic infections and abscesses | **Prophylaxis:** 2–3 g orally, 1 hour before surgery<br>**Therapeutic:** 500 mg every 8 hours for 5–7 days |

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| **Amoxicillin + Clavulanic Acid** (β-lactam + βlactamase inhibitor) | Extended spectrum including β-lactamase producing bacteria | • Refractory or recurrent odontogenic infections<br>• Postoperative wound infections<br>• Sinus involvement or osteomyelitis | **625 mg (500 mg + 125 mg)** every 8 hours for 5–7 days |
| **Cephalexin** (1stgen Cephalosporin) | Gram-positive cocci, limited Gramnegative coverage | • Alternative to penicillin in mild allergy<br>• Post-extraction or trauma cases | **500 mg every 6 hours** for 5–7 days |
| **Cefuroxime** (2ndgen Cephalosporin) | Broader Gram-negative coverage than cephalexin | • Severe odontogenic infections Post-traumatic wound<br>• infections | **500 mg every 12 hours** for 5–7 days |
| **Clindamycin** (Lincosamide) | Gram-positive cocci and anaerobes | • Penicillin-allergic patients<br>• Pericoronitis, abscesses, and osteomyelitis | **300 mg every 6–8 hours** for 5–7 days |

| | | | |
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| **Metronidazole** (Nitroimidazole) | Obligate anaerobes | • Adjunct to amoxicillin in severe mixed anaerobic infections Pericoronitis,<br>• abscess, and necrotizing ulcerative gingivitis | **400 mg every 8 hours** for 5–7 days |
| **Azithromycin** (Macrolide) | Gram-positive and some Gram-negative bacteria, atypicals | • Penicillin-allergic patients<br>• Soft tissue infections and periimplantitis | **500 mg on day 1**, followed by **250 mg daily for 4 days** |
| **Clarithromycin** (Macrolide) | Gram-positive cocci, some Gramnegative bacteria | • Alternative for penicillin-allergic patients<br>• Mild to moderate odontogenic infections | **250–500 mg every 12 hours** for 5–7 days |
| **Doxycycline** (Tetracycline) | Broad-spectrum; Gram-positive, Gram-negative, and anaerobes | • Adjunct in periodontal surgery or infections involving bone loss<br>• Refractory peri-implantitis | **100 mg once or twice daily** for 7–10 days |
| **Ciprofloxacin** (Fluoroquinolone) | Gram-negative and some Gram-positive coverage | • Infections with *Pseudomonas* or resistant strains<br>• Severe osteomyelitis cases (culture-guided) | **500 mg every 12 hours** for 7–10 days |

| | | | |
|---|---|---|---|
| **Erythromycin** (Macrolide) | Gram-positive bacteria and atypicals | • Penicillin-allergic patients with mild infections | **250–500 mg every 6 hours** for 5–7 days |
| **Linezolid** (Oxazolidinone) | Resistant Grampositive bacteria (e.g., MRSA) | • Culture-confirmed MRSA or resistant infections unresponsive to other drugs | **600 mg every 12 hours** for 10–14 days (guided by culture) |

# Antibiotic Stewardship in Oral Surgery

Antibiotic stewardship in oral surgery is a vital framework aimed at optimizing the use of antimicrobial agents to ensure effective infection management while minimizing the emergence of resistance. Antimicrobial Stewardship Programs (ASPs) are structured interventions that promote the appropriate selection of antibiotics with respect to drug choice, dosage, duration, and route of administration. In dentistry, the need for stewardship is particularly significant, as dental practitioners are responsible for nearly 10% of all outpatient antibiotic prescriptions, with a substantial proportion being unnecessary or inconsistent with established guidelines.[21] Such practices contribute not only to antimicrobial resistance (AMR) but also to adverse drug events and higher healthcare costs. Implementing ASPs in dental and oral surgery settings has demonstrated measurable benefits, including reduced infection rates, improved prescribing habits, and better patient outcomes. Rational antibiotic prescribing should always be indication-specific, with defined therapeutic goals, appropriate duration, and dosing tailored to the patient's systemic condition and the type of surgical intervention.[22] Empirical therapy is justified only when clinically indicated, while culture and sensitivity testing should guide treatment in persistent or severe infections. To mitigate misuse, strategies such as clinical audits with feedback, adherence to standardized evidence-based protocols, ongoing education on stewardship principles, and the integration of local antibiogram data play a critical role in guiding informed decision-making. The growing challenge of antibiotic resistance among oral pathogens driven by mechanisms such as βlactamase production, efflux pumps, biofilm formation, and genetic mutations further highlights the urgency of stewardship initiatives. The overuse, underdosing, and prolonged administration of antibiotics not only foster resistant microbial populations but also compromise therapeutic efficacy in managing odontogenic infections. Rising resistance trends in common pathogens such as Streptococcus spp., Staphylococcus aureus, and various anaerobes highlight the pressing need for vigilant, judicious, and scientifically guided antibiotic use within oral surgical practice to safeguard both current and future antimicrobial effectiveness.[23]

## Conclusion

Despite significant advances in infection control and antibiotic therapy, notable research gaps persist in defining standardized, evidence-based antibiotic protocols for various oral surgical procedures, particularly in diverse clinical and geographic settings. The absence of uniform regional guidelines often leads to inconsistent prescribing patterns and suboptimal antibiotic use, underscoring the urgent need for structured antibiotic stewardship frameworks tailored to local microbial resistance profiles and clinical practices. Optimal antibiotic use in oral surgery ultimately depends on sound clinical judgment, adherence to strict aseptic protocols, and reliance on robust scientific evidence rather than routine or empirical prescribing. Furthermore, continuous education and awareness among dental professionals remain central to fostering responsible prescribing behavior and promoting a culture of antimicrobial stewardship. A multidisciplinary, data-driven, and educational approach is therefore essential to balance

effective infection prevention with the global imperative of combating antimicrobial resistance in oral surgery.

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