



## A REVIEW ON PRESCRIBING THE ANTIBIOTICS IN DENTAL DISEASES

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### ABSTRACT

**Background:** The oral infections are polymicrobial and mixed in nature that occurs due to imbalance in the normal commensal flora. Antibiotics are used to control the infection phase. Inappropriate and irrational use of antimicrobials creates favorable conditions for resistance of organisms which do not respond to the standard treatment. Therefore, antibiotics should be prescribed and administered based on the overall intended benefit along with taking into consideration of the attendant side effects.

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## INTRODUCTION

The oral cavity is a complex biological ecosystem with large number of organisms living in a biofilm (1, 2). The microorganisms present in the oral cavity are collectively known as oral microbiota or microflora or commonly as the microbiome. The term microbiome was framed by Joshua Lederberg that means "to signify the ecological community of commensal, symbiotic and pathogenic microorganisms that literally share our body space and have been all but ignored as determinants of health and disease"(2). The oral microbial flora starts to grow in the newborn's mouth about 8 hours after birth followed by a continuous change in its composition until the eruption of teeth. The interactions of these organisms are complex and the onset of disease occurs due to a shift in microbial flora. The change in the balance of the ecosystem from the resident facultative anaerobes to obligate anaerobes is associated with most pulpal and periodontal diseases. Hence, the understanding of this ecological principle is important for treating oral and dental infections.

**Oral Microflora:** The oral cavity comprises 300-500 species of bacteria, fungi and protozoa, out of which only 10% are isolated regularly, in conventional culture techniques. The most frequent and easily recovered bacteria on routine culture are alpha-hemolytic streptococci. Other oral commensal bacteria include coagulase-negative staphylococci, gram-negative cocci belonging to the families

Neisseriaceae, Veillonellaceae, Lactobacilli, Spirochaetes, Corynebacteria and Mycoplasmas. Bacteria that are potentially pathogenic and sometimes found in the oral cavity include Staphylococcus aureus, Enterococcus faecalis, Streptococcus pneumoniae, Streptococcus pyogenes, Neisseria meningitidis and members of the family Enterobacteriaceae, Haemophilus influenza and Actinomycetes (3). The most prevalent oral microbes are Streptococcus mutans, Streptococcus gordonii, Streptococcus sanguinis, Streptococcus cristatus, Streptococcus mitis, Veillonella parvula and Actinomyces. The microflora associated with odontogenic infections are typically mixed and of indigenous origin. Streptococcus, Peptostreptococcus, Peptococcus, Fusobacterium, Bacteroides and Actinomyces species are the principle microflora isolated from these infections (2).

**Principles of Antibiotic dosing:** The optimal selection, dosage and duration of antibiotic treatment results in the best clinical outcome for the prevention or treatment of infection, with minimal toxicity to the patient and minimal impact on subsequent resistance. There are 4 D's of antimicrobial therapy: Right Drug, Right Dose, Right Duration of therapy and De-escalation to pathogen-directed therapy (1).

### Antibiotics used in Dental Diseases

1) Cellulitis and Abscess: The primary phase of infection is termed as cellulitis while the secondary phase is known as abscess. The antibiotic used for treatment of cellulitis is penicillin which prevents

progression to the second phase of cellulitis – the abscess. The pathogens usually associated with dental abscesses are *Streptococcus viridans* spp. or Gram-negative organisms. The acute dentoalveolar abscess and periodontal abscess usually require antibiotic therapy, in case of systemic involvement or in spreading infection. The ideal choice of treatment for periodontal abscess includes the drainage and irrigation of the abscess with 0.2% Chlorhexidine like antiseptic mouthwash. Endodontic therapy or extraction of the causative tooth and surgical drainage of any areas of pus accumulation are the treatment of choice for the dentoalveolar abscess. The duration of treatment depends on the severity of the infection, clinical response and should not be unduly prolonged due to the risk of development of resistance. The appropriate 5-day regimen (7):

**Amoxicillin Capsules:** 500 mg, 1 capsule three times daily

For children: 250 mg or Oral Suspension: 125 mg/5 ml or 250 mg/5 ml  
OR

**Phenoxymethylpenicillin Tablets:** 250 mg, 2 tablets four times daily  
For children: 250 mg or Oral Solution: 125 mg/5 ml or 250 mg/5 ml

For patients allergic to penicillin

**Metronidazole Tablets:** 200 mg, 1 tablet three times daily

For children: 200 mg or Oral Suspension: 200 mg/5 ml

If patients does not respond to first-line drug or in cases of severe infection with spreading cellulitis, 5-day regimen is:

**Clindamycin Capsules:** 150 mg, 1 capsule four times daily

For children: 12-17 years (as for adults)

OR

An appropriate 7-day regimen is:

**Co-amoxiclav Tablets:** 250/125 mg, 1 tablet three times daily

For children: 12-17 years (as for adults)

OR

**Clarithromycin Tablets:** 250 mg, 1 tablet two times daily

For children: 250 mg or Oral Suspension: 125 mg/5ml or 250 mg/5 ml

**2) Pericoronitis:** It is the inflammation of a flap (operculum) of the gingival tissue that overlies a partially impacted tooth, usually molar (5). The microorganisms responsible for the pericoronitis are anaerobic bacteria. Debridement followed by irrigation is the sufficient therapy for pericoronitis without requirement of use of antibiotics. However, if the patient has persistent swelling with fever and trismus, then a three-day course of metronidazole can be prescribed. Metronidazole is a useful addition to an antibiotic regimen (amoxicillin) when coverage of anaerobic bacteria is needed.

**An appropriate 3-day regimen (7)**

**Metronidazole Tablets: 200 mg, 1 tablet three times daily**

**3) Sinusitis:** It is the inflammation of lining membrane in any of the hollow areas (sinuses) of the skull around the nose. Sinusitis must be treated immediately to prevent complications of contiguous spread of infection into the infratemporal space or orbital cavity and osteomyelitis of the surrounding structures such as maxilla and paranasals. The clinical signs of infection are headache, regional pain, inflammation of the oral buccal mucosa and rhinorrhea or

unilateral nasal discharge. Amoxicillin or doxycycline is the usually administered antibiotics.

An appropriate 7-day regimen (7):

**Amoxicillin Capsules:** 500 mg, 1 capsule three times daily

For children: 250 mg or Oral Suspension: 125 mg/5 ml or 250 mg/5 ml

OR

**Doxycycline Capsules:** 100 mg 2 capsules on the first day, followed by 1 capsule daily.

For <12 years: Not recommended, as deposited on growing bone and teeth (by binding to calcium) and causes intrinsic staining of developing teeth and occasionally dental hypoplasia.

For ≥12 years: As for adults

For severe infection in adults and children aged 12 years and over: 2 capsules daily.

**4) Necrotizing Ulcerative Gingivitis:** It is characterized by the rapid onset of painful gingivitis with interproximal and marginal necrosis, ulceration associated with anaerobic fuso-spirochaetal bacteria and *Prevotella intermedia*. In mild cases of NUG, local measures like oral hygiene instructions and removal of supragingival and sub-gingival deposits are sufficient while due to pain associated with NUG, the patient may only be able to tolerate limited debridement in the acute phase. But more severe cases require treatment with antibiotics, metronidazole being the drug of first choice.

**Metronidazole Tablets (8):**

For Adolescents and adults: 250 mg every 6-8 hours for 10 days in combination with amoxicillin

For children: 200 mg or Oral Suspension: 200 mg/5 ml

OR

**Amoxicillin Capsules (7):** 500 mg, 1 capsule three times daily

For children: 250 mg or Oral Suspension: 125 mg/5 ml or 250 mg/5 ml

OR

**Doxycycline (8):**

For Children >8 years who weigh <45 kg: 2.2 mg/kg every 12 hours on day 1, then 2.2 mg/kg once/day; for severe infections, 2.2 mg/kg every 12 hours until infection resolves.

For Children >8 years who weigh >45 kg and adults: 100 mg every 12 hours on day 1, then 100 mg once/day; for severe infections, 100 mg every 12 hours until infection resolves.

**5) Actinomycosis:** It is a chronic, suppurative granulomatous infection, seen in the clinical context of a grossly carious tooth or a tooth with previous root canal therapy. It can also be associated with an impacted tooth, periodontitis, or periimplantitis. It is most often localized to the mandible in angle region. The majority of cases are asymptomatic. The microorganisms that have been isolated are anaerobic gram-positive bacteria such as *Actinomyces israelii*, *Actinomyces odontolyticus*, *Actinomyces naeslundii*, *Actinomyces gerencseriae* and *Actinomyces viscosus*. The pathognomonic for actinomycosis is abscesses, draining sinus or gingival parulis with a yellow purulent exudate (sulfur granules). There may be a presence of asymptomatic cervicofacial slow-growing hard swelling along with trismus. The condition is diagnosed via culturing the exudate and isolation of the microorganism or by biopsy. Management includes prolonged antibiotic regimens (penicillin, doxycycline, clindamycin, erythromycin and tetracycline), as well as surgical debridement and management of the original source of infection (9).

6) **Dental trauma:** Tooth trauma is a risk factor for oral infection especially in the presence of direct pulp exposure and / or alteration of the periodontal space. The possibilities of infection increases when trauma to the dental hard or supporting tissues is associated with open skin or mucosal membrane wounds. In case of avulsion, local application of an antibiotic to the root surface of an avulsed tooth with an open apex and less than 60 minutes extraoral dry time has been recommended, to inhibit external resorption and aid in pulpal revascularization (5). Systemic antibiotics have been recommended as adjunctive therapy for avulsed permanent incisors with an open or closed apex. Tetracycline (doxycycline twice daily for 7 days) is the drug of choice, but the age of child must be considered for the systemic use of tetracycline due to the risk of developing discoloration in the permanent dentition. Penicillin V or amoxicillin can be given as an alternative in patients under 12 years of age. For luxation injuries in the primary dentition, antibiotics are not indicated (6).

**Role of triple antibiotic paste in dental infections:** The infection of the root canal system is polymicrobial consisting of both aerobic and anaerobic bacteria. The single antibiotic could not be effective in the sterilization of root canal infection due to the complexity of the root canal system. Hence, a combination would be needed to address the diverse flora encountered. The combination that appears to be most promising consists of Metronidazole, Ciprofloxacin and Minocycline. This triple antibiotic regimen was first tested by Sato et al. in 1996. In recent years, the Cariology Research Unit of the Niigata University has developed the concept of "Lesion sterilization and tissue repair (LSTR)" therapy that employs the use of a combination of antibacterial drugs, Metronidazole 500 mg, Ciprofloxacin 200 mg and Minocycline 100 mg (3 mix used in 1:1:1 ratio) for the disinfection of oral infectious lesions, including dentinal, pulpal and peri radicular lesions. A carrier of equal amounts of macrogol ointment and propylene glycol (MP) are mixed together resulting in an opaque mix (MP used in a 1:1 ratio). Either a 1:5 MP: 3mix (creamy consistency) or 1:7 MP: 3mix (standard mix) can be prepared. The antibiotic paste is left in the tooth for a period of 4 weeks to allow complete disinfection of any necrotic tissue. After this period the tooth is re-entered for further treatment (4).

#### Use of triple antibiotic paste (4)

- A) Regenerative endodontic treatments
- B) In healing of large peri radicular lesions
- C) Killing of common endodontic pathogens from necrotic/infected root canals in vitro.
- D) In order to sterilize the infected root dentine, especially the deep layers
- E) Traumatized immature tooth with a periapical lesion.

#### Conclusion

The timing of administration of antimicrobial agents and the decision to start the therapy pretreatment or post treatment is important. The most significant use of antibiotics is to control oral infection and to prevent a bacteremia precipitated by dental manipulations that causes severe systemic sequelae. Therefore, a dentist should have a complete knowledge about the mechanism of action, benefits, adverse effects and interaction with other drugs of any given antibiotics. The appropriate and prudent use of antibiotics is essential for the successful results that ensure the effective, safe treatment and prevents microbial resistance.

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#### Abbreviations

NUG: Necrotizing Ulcerative Gingivitis

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