

# MISUSE OF ANTIBIOTICS IN ENDODONTIC PRACTICE- IS IT LEADING TO ANTIBIOTIC RESISTANCE?

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## Abstract

Antibiotics have revolutionized the entire health care system including both medicine and dentistry. Dental Infections continue to pose a challenge and can be successfully treated by either removal of the nidus of infection such as by drainage of the associated abscess, removal of the infected pulpal tissue or by extraction of the tooth. During a dental procedure in case of an infection the antibiotics can be given either systemically or locally. Systemic Antibiotics should be prescribed or used for dental infections on the basis of certain defined symptoms. Supplemental use of antibiotics are advised as the basic principle of management of infections. Evidently, an appropriate use of antibiotics leads to complete resolution of the infection, prevention of the spread of disease and minimization of serious complications of disease. Unfortunately in dental practice there is a trend to prescribe or misuse the antibiotics. In spite of all its myriad advantages, the irony remains that antibiotics constitute the single most abused group of drugs in health care today. This has led to an alarming increase in the rate of microbial resistance to antibiotics. With a focus on antibiotics used in the management of infection control, the goal of this study was to summarize the pertinent use of antibiotics and to avoid development of antibiotic resistant infections due to misuse of antibiotics.

**Keywords:** Antibiosis, Microorganisms, Odontogenic infections, Root Canal Treatment.

## Introduction

Endodontics is largely concerned with the treatment of infections originating in the root canal system. Antibiotics have been used extensively for the management of Odontogenic infections since their discovery early in the past century.[<sup>1</sup>]The Oral cavity is home to over 700 species of micro-organism. Micro-organisms play a tremendous role in pulpal and periapical disease. The bacteria associated with primary endodontic infection are mixed, but are predominantly gram negative anaerobic rods, whereas the bacteria concomitant with secondary infection comprise only one or few bacterial species – most important of which is *E. Faecalis*. [<sup>2</sup>]Antimicrobial drugs have caused a

dramatic change in management of infectious diseases but infections with drug resistant organisms remain an important problem in clinical practice that is difficult to solve.[<sup>3</sup>]

### Historical background:

The term antibiosis was first described by Louis Pasteur and Robert Koch. Antibiotics have revolutionized the entire health-care system, since the discovery of penicillin in 1928 by Alexander Fleming. [<sup>4</sup>]The term antibiotic was coined by Waksman in 1942 and was defined as a substance produced by micro-organisms, or a synthetic derivative of a naturally occurring substance, that inhibits the growth or causes death of other micro-organisms. [<sup>5</sup>] Penicillin came into clinical use in the 1940's and it marked the beginning of the era of antimicrobial chemotherapy by saving the lives of many wounded soldiers during World War II. [<sup>6</sup>]

### Role of Antibiotics in Endodontics:

Micro-organisms and their by-products are the main etiologic factors causing progression and persistence of infection in the root canal and the surrounding peri-apical tissues. Elimination of these micro-organisms from the complex inaccessible anatomy of the root canal system is often difficult by mechanical instrumentation alone. Hence, systemic antibiotics are needed to be prescribed in adult and pediatric patients in various conditions including acute and chronic odontogenic infections as prophylactic measure to control bacteremia and chances of reinfection.[<sup>7</sup>]

Antibiotics not only help in reducing the infection but will also target to eliminate or destroy any remaining viable bacteria in the root canal system that have not been destroyed by the chemo-mechanical preparation processes (i.e., instrumentation and irrigation), reduce periradicular inflammation and hence reduce pain. It also will help to eliminate apical exudate and prevent or arrest inflammatory root resorption where present and prevent re-infection of the root canal system by acting as both a chemical and a physical barrier if the temporary or interim restoration breaks down. [<sup>8</sup>]

### Local and Systemic use of Antibiotics for Endodontics

Grossman - Father of Endodontics was the first person who used the applications of local antibiotics in endodontics. He proposed poly antibiotic paste combination (PBSC) of penicillin, bacitracin, streptomycin and caprylate sodium suspended in silicon vehicle in 1951. Later Food and Drug Administration banned PBSC for endodontic use in 1975, due to the risk of sensitization and allergic reactions. [<sup>3,9</sup>]

### Some of the locally used antibiotics according to their use:

Uses	Locally used Antibiotics
Intracanal Medicaments	Triple Antibiotic Paste , Ledermix Paste, Septomixine Forte
Irrigant	MTAD, Tetraclean
Regenerative Endodontics	Triple Antibiotic Paste
Pulp Capping	Ledermix paste, Pulpomixine
Obturation	Medicated guttapercha

- Triple Antibiotic Paste- (Metronidazole, Ciprofloxacin, Minocyclin)
- Ledermix Paste- ( Demeclocycline hydrochloride , triamcinalone acetonide)
- Septomixine Forte- (Polymixine B Sulphate)
- MTAD- (Citric acid, Doxycycline, a Tween detergent)
- Pulpomixine- (Dexamethasone acetate, polymyxine B Sulphate and Framycetin sulphate)
- Medicated Guttpercha- (Gutta, Albin, fluavil, tannin, salts, saccharine)

### Application of systemic antibiotics:

- Incision for drainage is important to remove purulent material consisting of bacteria, bacterial by-products, disintegrated inflammatory cells, enzymes and other inflammatory mediators. Drainage improves circulation to the infected tissues and improves delivery of a minimum inhibitory concentration of the antibiotic to the area. Because endodontic infections are polymicrobial, no single antibiotic is to be effective against all the strains of infecting bacteria.<sup>[10]</sup> However, it is likely that if an antibiotic is effective against several of the strains of bacteria, it will disrupt the microbial ecosystem. Some patients, especially immune- compromised patients, are at high risk for infections, and a culture of the infecting organisms with susceptibility testing may be indicated.<sup>[11]</sup>
- In patients presenting with acute apical abscess with systemic involvement, in immune-compromised patients and in conditions such as cellulitis and space infection systemic antibiotic administration is a must along with local debridement of the root canal. Patients who have only apical abscess do not require administration of systemic antibiotics and can be treated by local debridement of root canal and placement of an intracanal medicament alone.
- Studies have shown that the beta-lactam antibiotics are the drug of choice for acting against the endodontic pathogens and bacterial resistance to amoxicillin with clavulanic acid is negligible. For penicillin allergic patient drugs such as azithromycin or moxifloxacin should be considered as primary antibiotic of choice.<sup>[12]</sup>

### Antibiotic prophylaxis:

The scientific logic for Antibiotic prophylaxis in dentistry was to eradicate or reduce transient bacteraemia caused by invasive dental procedures. Periodontal Scaling, Periodontal Surgery and Dental Extraction considered as Invasive dental treatment in which bacteremia is more likely to occur. These procedures requires the use of antibiotic coverage with specific conditions, such as prosthetic heart valves and a history of endocarditis.

Despite a long history of use and multiple guidelines for prophylaxis, there remains uncertainty about its effectiveness. In the last 10 years, there have been significant changes to the guidelines for antibiotic prophylaxis. In 2007, the American Heart Association (AHA) released its newly revised guidelines for the prevention of Infective Endocarditis (IE) and reducing the risk for producing resistant strains of bacteria.<sup>[13]</sup> Dental practitioners should consider prophylactic measures to minimize the risk of IE in patients with cardiac conditions (such as Congenital Heart Disease, Unrepaired Cyanotic CHD),<sup>[14]</sup> Patients with compromised immunity(such as Human immunodeficiency virus (HIV), Severe combined immunodeficiency (SCIDS)).<sup>[15-16]</sup>Some dental procedures are at low risk of Bacteremia such as Restorative procedures, Intracanal endodontic treatment and post placement and core, Placement of rubber dam, removable partial dentures, Orthodontic appliance adjustments, taking oral impressions, oral radiographs, and fluoride gels application. <sup>[17]</sup>

## Antibiotic Resistance:

It was recognized that with introduction of every fresh antibiotic, bacteria showed insensitivity and resistance to them. Therefore, problem of antibiotic resistance (AR) is an ever-increasing threat to mankind (Petri, 2011). [18] Inappropriate use of antibiotics at all levels of health care delivery; poor sanitation and lack of awareness of seriousness of the antibiotic resistance are increasingly realized as variable factors.[19] Bacteria are quick to evolve resistance to antibiotics. This can occur through spontaneous mutations, the result of mistakes when bacteria copy their DNA as they divide. Mutations that allow bacteria to survive where others do not are beneficial and are passed on to successive generations; antibiotic resistance is a prime example. Bacteria can also develop resistance by taking up genetic material containing antibiotic resistance genes from their surroundings. To reduce antibiotic resistance it is important that patients finish a course of antibiotics once they have started it. This is the only way to ensure that as many bacteria as possible that are causing the infection are wiped out so that none are left to start a resistant bacterial population.[20]

## Alternatives to Antibiotics:

Scientists are exploring the possibility of developing drugs that can treat serious illnesses without the use of antibiotics. The development of new antibiotics has been accelerated by the efforts of international and national authorities. During the year 2014-15, five new drugs were approved for clinical use.

Various alternative approaches are being explored to treat infections, such as the development of nanoparticles and drugs that target the specific genes involved in the infection.

Biofilm formation is a major challenge for treating bacterial infections, and various strategies are being studied to prevent it. One of these is through the use of light treatment. In addition, the cholesterol degradation pathway provides nutrients for the bacteria that cause M. Tuberculosis.

Through the use of chip technology, researchers have been able to identify promising compounds that can be used to treat infections. One of these is Teixobactin, which was discovered in 2015. Another promising strategy involves starving the bacteria to reduce their harmful effects. [21]

## Conclusion:

Safe use of antibiotics has modernized the treatment of a number of diseases. Use of antibiotics, both systemic and topical, is common in the dental treatment, particularly for patients with pain or swelling. The use of antibiotic containing dental agents should be carefully justified, in order to avoid a bacterial resistance. The dental profession has an obligation to limit the use of antibiotics to those situations that actually require them and to situation where patients will benefit from their use. Antibiotics will not help to resolve pulpitis, they will not prevent post-operative pain or flare-ups. Doctors and patients should be meticulous and educated about the repercussions leading from the ongoing inappropriate use of antibiotics to treat endodontic infections.

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