

Resistance to Antibiotics used in Treating Gum infections: A Cross-Sectional Study based on Gum Disease Patients in Syria in the Period of Covid 19

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Abstract:- Since the mouth is the ideal habitat for the development of all types of organisms, the gums are likely to be exposed to many diseases caused by certain types of bacteria. Therefore, it is necessary to constantly search for suitable types of effective antibiotics that can eliminate gum infections.

A paper research includes a set of questions. The paper research questionnaire was distributed to one hundred dentists with an average experience of no less than 9 years. The research form addressed eight antibiotics recommended for use in treating Gum infections. In a statistical analysis of doctors' answers about the most common antibiotics they use to treat gum infections, metronidazole ranked first, followed by amoxicillin and valdoxycycline. While clindamycin and ciprofloxacin ranked last. Doctors must currently commit not to prescribe antibiotics when there is a possibility of a patient's spontaneous recovery, for fear of incorrect use of antibiotics, which leads to an increase in the spread of bacterial resistance.

Keywords:- Gum Infections – Antibiotics - Bacterial Resistance

I. INTRODUCTION

A. Gum Structure:

It is a layer of soft connective tissue and mucous that covers the alveolar bone of the upper and lower jaw inside the mouth¹. The gum is transparent and its red color is due to its rich blood supply. The gums are attached both to the underlying alveolar bone and to the walls of the teeth by what are called gingival fibres². The gums are also one of the four components of the periodontal support tissue, which consists of the gums, the alveolar bone, the cementum and the dentoalveolar ligament². Gum health and disease can affect overall health. Gum inflammation and recession can lead to tooth loss³.

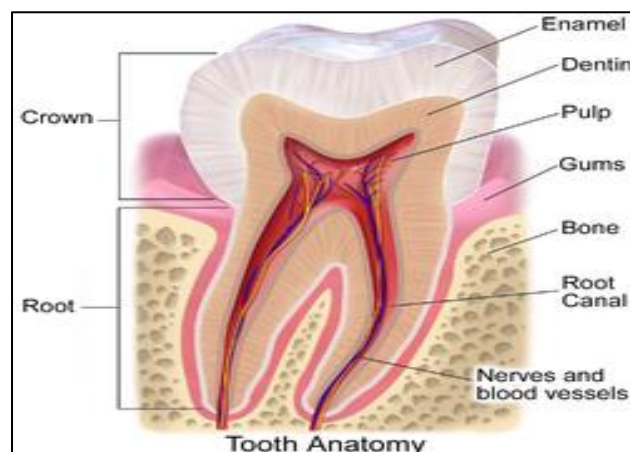


Fig 1. Tooth Anatomy¹

The gums can be anatomically into free, attached and interdental gums. Classically, it is the oral mucosa covering the inner cheeks and floor of the mouth as part of the gums³.

Floor of the mouth as part of the gums, but this common confusion lacks accuracy.

- Marginal gum: the free gingival margin that surrounds the neck of the tooth. In 50% of cases, it is separated from the attached part of the gum by a shallow depression called the gingival fissure. The traditional width is about 1 mm, and it forms the soft wall of the dental-gingival sulcus.
- Attached gum: It has a rubbery texture and adheres firmly to the periosteum covering the alveolar bone. It is characterised by a lack of attachment to the underlying anatomical structures.
- Interdental gums (gingival papillae): These gums occupy the interdental spaces, i.e. the spaces between the teeth below the points of contact.⁴

B. Characteristics of Healthy Gums:

The color of healthy gums is often described as bright pink. Other colors indicate disease, such as bright red in acute gingivitis and dark red to bluish red in long-term gingivitis. Too much melanin can cause dark spots or patches on the gums (hyperpigmentation). Smoking or drug use (such as "methamphetamine") can also cause discoloration⁵.

Thickness of the gums, the degree of keratinization of the epithelium, the degree of blood flow to the gums, the percentage of healthy skin pigmentation and also the presence of organic diseases describe the difference in the degree of healthy gum color from one person to another.⁶

C. *Gingivitis and Periodontitis:*

Gingivitis occurs when bacteria, plaque and tartar build up on the teeth and cause infection. Untreated periodontitis causes erosion of the bone that supports the teeth⁷.

D. *Oral Bacteria:*

The mouth is an ideal habitat for the development of all types of microorganisms. Because of the ideal conditions of moisture and oxygen. Microorganisms take advantage of food particles left on the teeth, gums, tongue and other surfaces⁷.

Streptococcus mutans is usually responsible for plaque¹². Alpha-hemolytic streptococci are among the most common isolates. The classification of this group is still controversial. Other bacteria present in the oral commensal flora include coagulase-negative staphylococci, gram-negative cocci of the Neisseriaceae and Veillonellaceae families, lactobacilli, spirochaetes, corynebacteria and mycobacteria. Pathogenic bacteria sometimes found in the oral cavity include *Staphylococcus aureus*, *Enterococcus faecalis*, *Streptococcus pneumoniae*, *Streptococcus pyogenes*, *Neisseria meningitidis*, members of the *Enterococcus* family, *Haemophilus influenzae* and *Actinomyces*^{8,9}. As long as the growth of these types of bacteria is controlled by good oral hygiene, proper nutrition and the protective action of the human body's immune system, their presence should not be harmful. The presence of these bacteria in the mouth is normal. They are part of what is known as the 'oral bacterial flora, as long as the body's natural defenses can control their massive spread¹⁰. The normal activity of bacteria is to secrete acids that attack tooth enamel, causing serious damage to the gums and oral mucosa over time.

➤ *Antibiotics Resistance:*

Antimicrobial resistance results mainly from the overuse and misuse of antimicrobial agents. As a result, microbes either develop a cover against the drugs used to treat them, or certain strains of microbes with natural antimicrobial resistance become more common than those that are easily overcome by drugs. Antimicrobial resistance can be acquired from other microbes by swapping genes in a process called horizontal gene transfer¹¹. This means that once an antibiotic resistance gene appears in a microbial community, it can spread to other microbes in the community, potentially moving from a non-pathogenic microbe to a disease-causing microbe. This process is largely driven by "natural selection" processes that occur during the use or misuse of antibiotics¹².

➤ *Reasons Why Antibiotics do not affect Bacterial Infections of the Gums:*

Bacterial infections in the mouth cause abscesses, which are small pockets of pus and dead tissue in the mouth. This usually happens near the base of the tooth, where the roots are. At this stage, most people think that antibiotics are needed, but because of the anatomy of the tooth, bacteria become trapped in the roots¹³. Without proper cleaning, such as a root canal, the infection will remain and may spread to the jaw or even the brain. There are many reasons why antibiotics alone may not therapy an infection. For example, the blood vessels that supply the inside of the tooth with the body's antibacterial defenses have been destroyed. So the antibiotics cannot get inside the tooth to treat the infection^{14,15}.

➤ *Risk Factors*¹⁶

- Poor oral health care habits.
- Smoking or chewing tobacco.
- Advanced stages of life.
- Malnutrition, including vitamin C deficiency.
- Immunity Inhibiting, such as leukemia, human immunodeficiency virus (HIV)/AIDS, or cancer treatment.
- Certain medications, such as phenytoin (Dilantin, Phenytec) for seizures and some calcium channel blockers.
- Hormonal changes (, such as in pregnancy, the menstrual cycle).
- Genetic factors and smoking.
- Medical conditions such as viral or fungal infections.

➤ *Antibiotics Used to Treat Gum Disease*

- Tetracycline antibiotics,^{17,18}: Tetracyclines inhibit bacterial growth by inhibiting translation. They bind to the 30S ribosomal subunit and prevent amino-acyl tRNA from binding to the A site of the ribosome.

Antibiotics including tetracycline hydrochloride, doxycycline, and minocycline are the primary medications used in periodontal treatment.

- Macrolide Antibiotics: Macrolides work by inhibiting bacterial protein synthesis. The mechanism of action of macrolides is based on their ability to bind the bacterial 50S ribosomal subunit, which causes bacterial protein synthesis to stop.
- Metronidazole: Metronidazole circulates in the organism, inhibits protein synthesis through interaction with DNA, and causes loss of DNA helical structure and strand breakage.

This antibiotic is preferably used in combination with amoxicillin or tetracycline to combat inflammation and bacterial growth in acute or chronic periodontitis.

- Penicillins: Penicillin attach the beta-lactam ring to the DD-trans-peptidase, preventing the new cell wall bacterial formation.
- Quinolones: Quinolone drugs are active against type II isomerase enzymes and work by preventing DNA replication and inhibiting cell synthesis and division.

Ciprofloxacin is used to specifically target *A. actinomycetemcomitans*, a slow-growing but harmful bacteria that contributes to gum disease.

Proline derivatives Lincosamide antibiotics. They work by binding to the 50s subunit of bacterial ribosomes to inhibit bacterial protein synthesis.

- Topical gel and strips, 19,20: Doxycycline gel conforms to the contours of the gum surfaces and freezes over them. Slide into the gum pocket after the root planning procedure. Chlorhexidines slowly release Strips containing tetracycline hydrochloride. Floss is placed temporarily between the tooth and gum to kill bacteria and reduce the depth of the pocket. Several sutures are sometimes applied for about 10 days to enhance the effect of the antibiotic. Metronidazole can be formulated as gel or strips too.

II. AIM OF THE RESEARCH

- To investigate resistance to antibiotics used to treat bacterial infections of the gums.
- To study the treatment plans used by a sample of dentists in cases of gingivitis.
- To study the effectiveness of the antibiotics commonly used by a sample of dentists and the extent to which resistance to these antibiotics is developing.

III. METHODS AND MATERIALS

We prepared a paper research questionnaire entitled (Resistance to antibiotics used to treat bacterial infections of the gums), which included a series of questions on the following topics.

- Risk factors for gum disease.
- Patients' behavior when gum disease is suspected.
- Treatment protocol for gum disease.
- Resistance to antibiotics.
- Antibiotics used for gum infections.

The paper research questionnaire was distributed to one hundred dentists with an average experience of at least 9 years.

IV. RESULTS AND DISCUSSION

➤ Patients' Behavior when they Suspect Gum Disease.

70% of the dentists confirm that: most of the patients who visit their clinic are at an advanced stage of disease progression, while 30% of the dentists confirm that the disease progression stage is moderate when they visit their clinic.

All doctors denied the presence of minor cases among the patients attending their clinics.

The answers showed that 65% of patients were taking antibiotics without consulting a dentist.

The results showed that 90% of patients fully adhered to the prescribed course of antibiotics.

This increase indicates that patients believe in the effectiveness of the medication they are prescribed, especially since most of them suffer from an advanced stage of disease progression and lose hope of recovery without fully adhering to the prescribed treatment.

➤ The Treatment Protocol Followed for Gum Disease

Scaling is the removal of plaque and bacterial deposits, and it is a very common procedure used by most dentists to combat gum disease due to its simplicity and effectiveness.

Root planning (smoothing the root surfaces) is rarely the procedure of choice in treating gum disease.

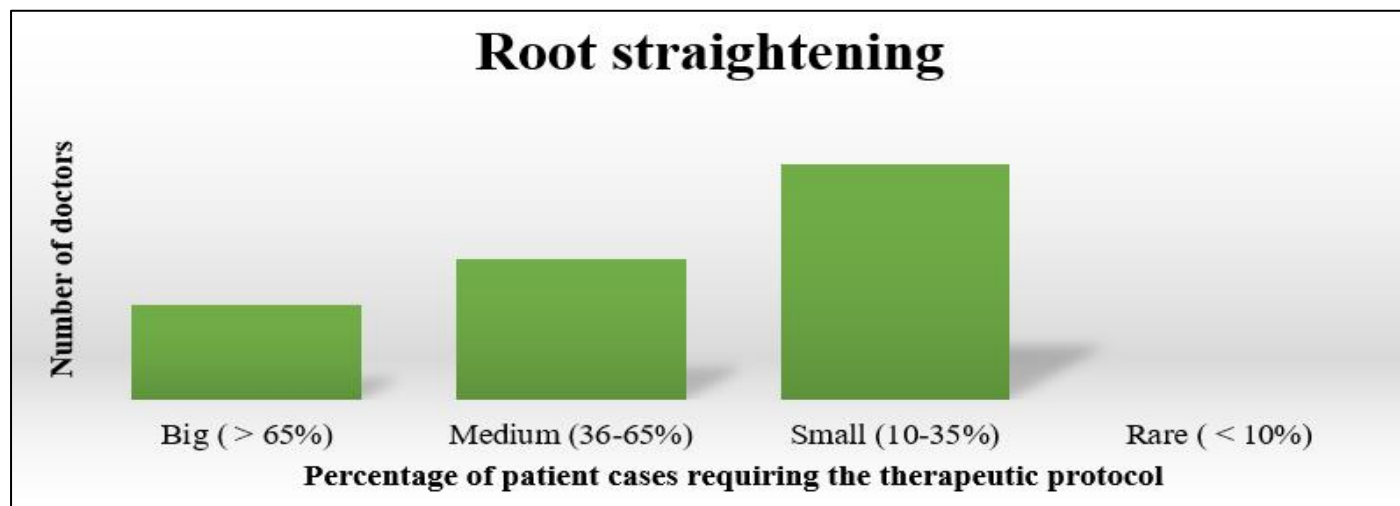


Fig 2: Root Straightening7

When we asked dentists about the use of antibiotics in treatment gum diseases, we noticed a diversity of answers, with a tendency to use them among most doctors. 30 percent use them frequently in such cases, preferring them to other procedures, while four doctors use them moderately.

The tendency to use antibiotics is due to their high effectiveness in most cases and their ease of use.

The discrepancy in answers reflects the lack of a unified medical protocol among doctors and sheds light on the influence of the doctor’s individuality on the treatment chosen for the patient.

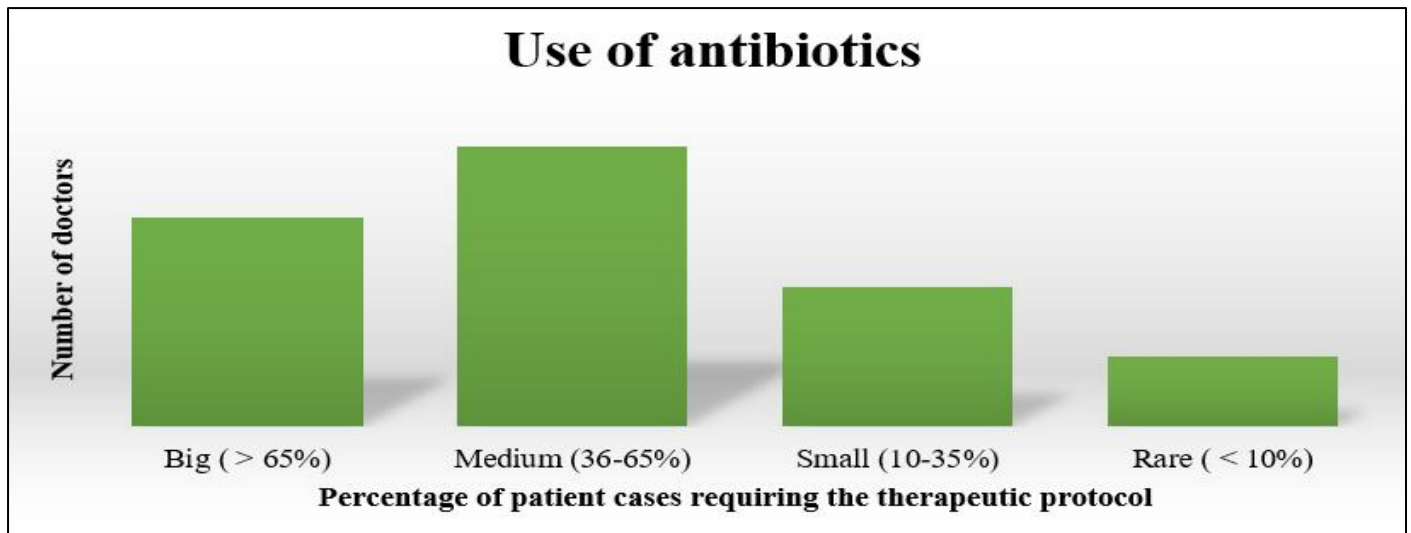


Fig 3: Use of Antibiotics

There are many surgical procedures available to treat gum disease, including pocket reduction surgery, soft tissue implants, and bone grafting.

Most doctors do not prefer surgery for gum diseases and consider it a last line of treatment due to the possibility of serious complications and lack of patients acceptance.

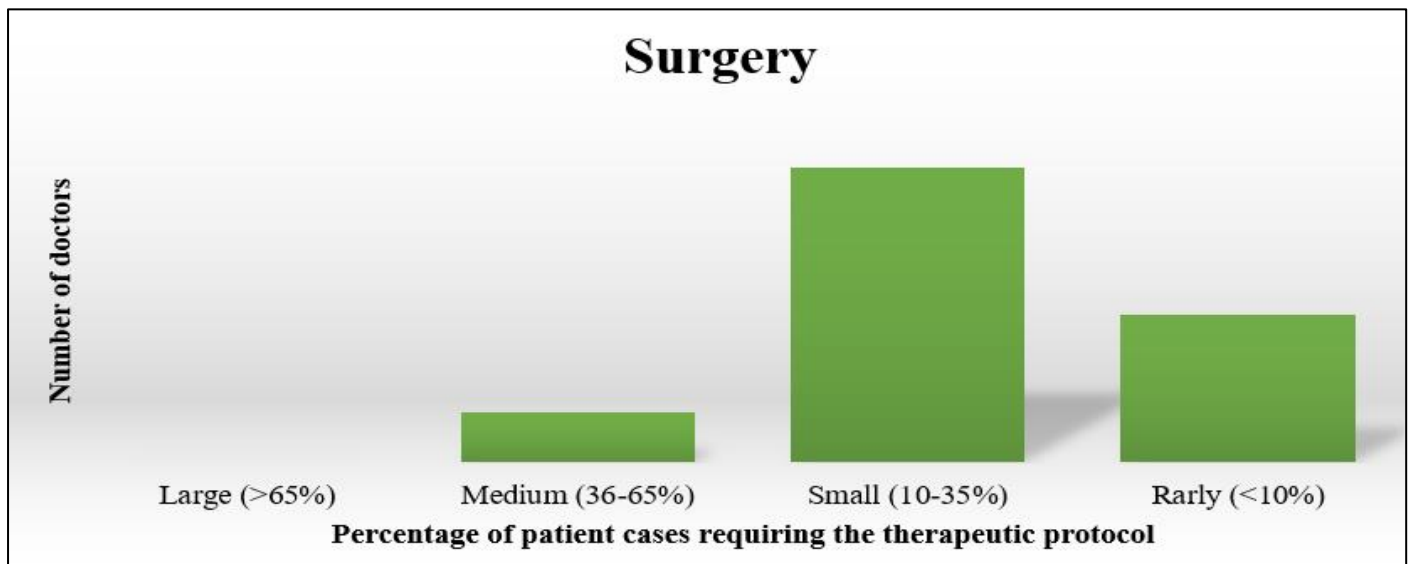


Fig 4: Treating by Surgery

➤ *Antibiotic Resistance*

All the doctors who helped us in the questionnaire prescribe systemic antibiotics, not topical ones. In explaining their answers, their answers varied as follows:

- The concentration in the gingival trough is maximum.
- Some antibiotics, such as spiramycin and tetracyclines, spread in the gingival fluid.
- Longer durability and higher efficacy.

- Greater efficiency.
- Covers all types of bacteria.

Most doctors do not perform bacterial culture and antibiotic susceptibility testing before starting treatment, nor even after drug resistance to the antibiotic used in treatment occurs. This may be due to the high cost of bacterial culture and antibiotic susceptibility testing and the long time required to obtain results.

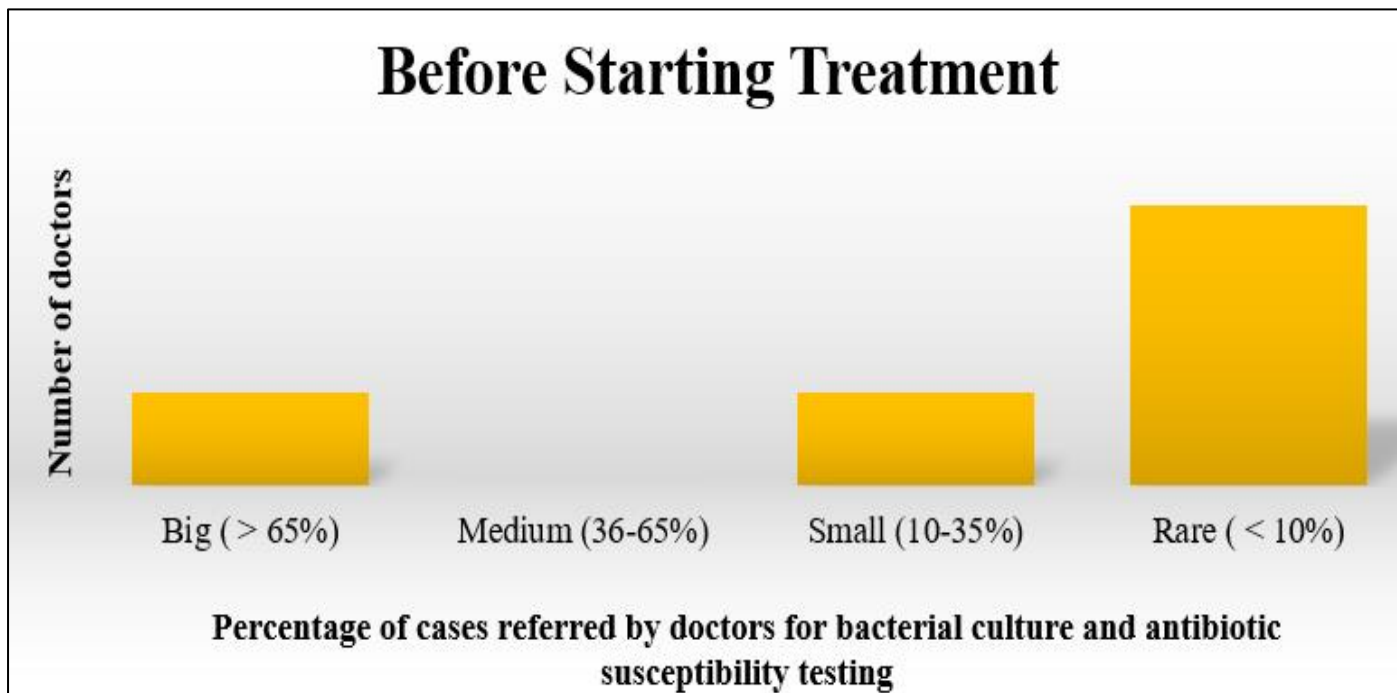


Fig 5: Percentage of Cases Referred by Doctors for Bacterial Culture and Antibiotic Susceptibility Testing before Drug Resistance to Antibiotic Susceptibility Testing

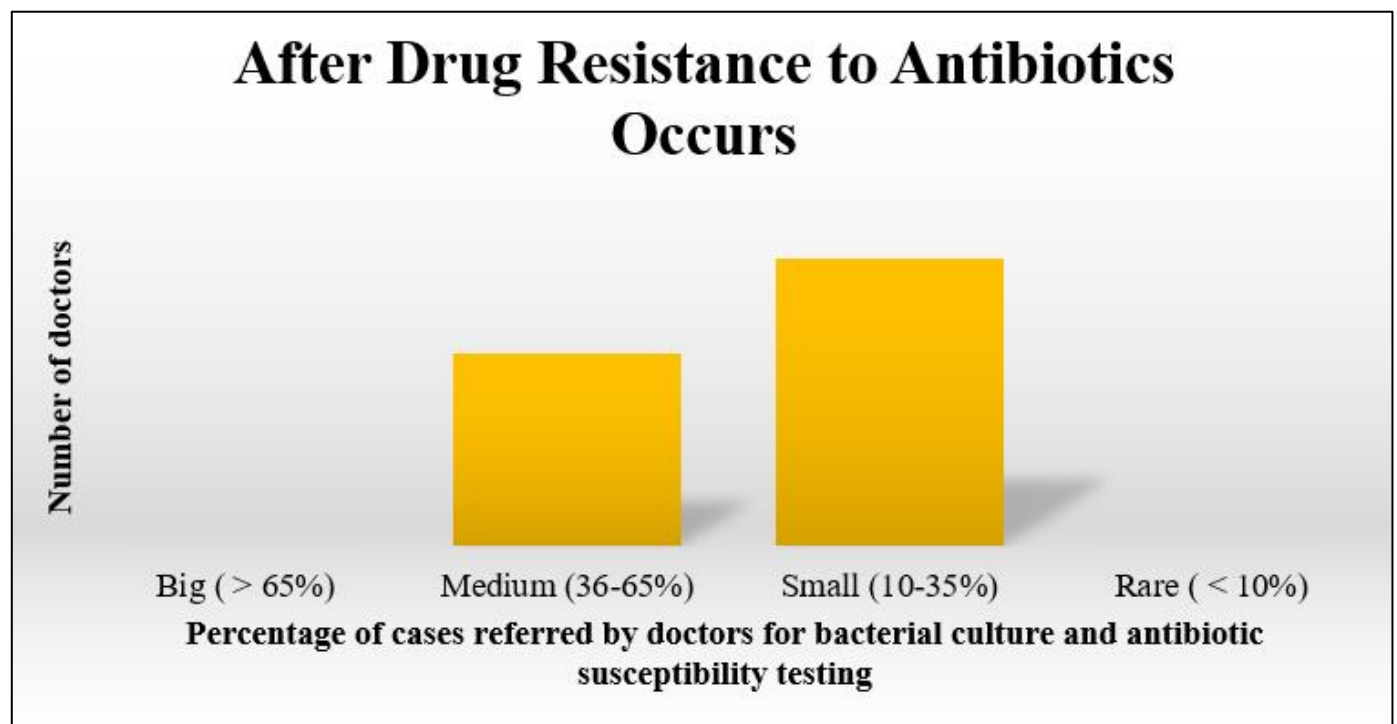


Fig 6: Percentage of Cases Referred by Doctors for Bacterial Culture and Antibiotic Susceptibility Testing after Drug Resistance to Antibiotic Susceptibility Testing

The research questionnaire covered eight antibiotics recommended for use in treating gum infections: tetracycline hydrochloride, doxycycline, minocycline, azithromycin, metronidazole, amoxicillin, spirofloxacin, and clindamycin. Some doctors also added Spiramycin as an important and commonly used antibiotic that has very good effectiveness in

treating gum infections. In a statistical analysis of doctors' answers about the most common antibiotics they use to treat gum infections, metronidazole ranked first, followed by amoxicillin and valdoxycycline. While clindamycin and spirofloxacin ranked last.

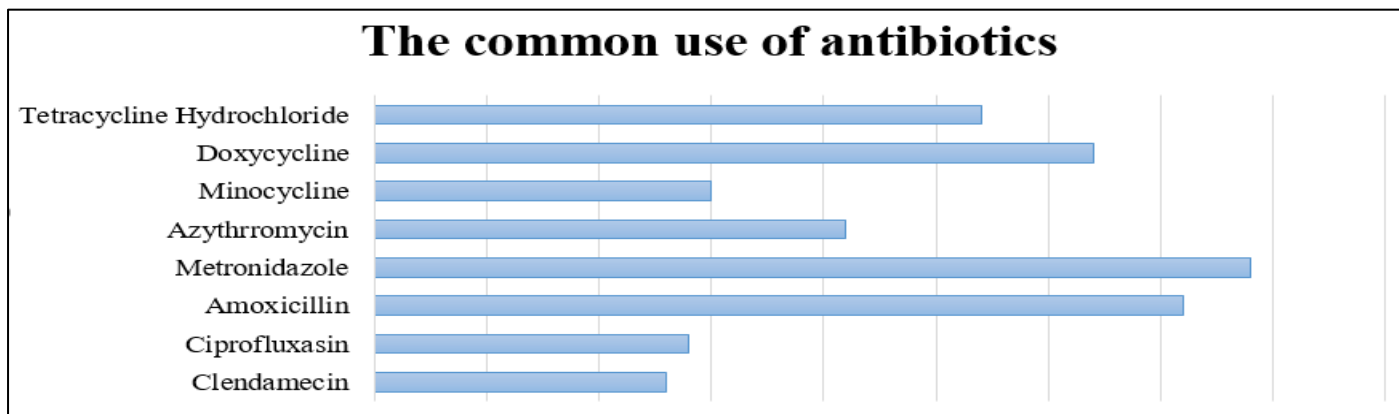


Fig 7: Common use of Antibiotics

We note that there is agreement between the effectiveness of antibiotics and their common use.

Amoxicillin was the most effective antibiotic, followed by metronidazole and doxycycline.

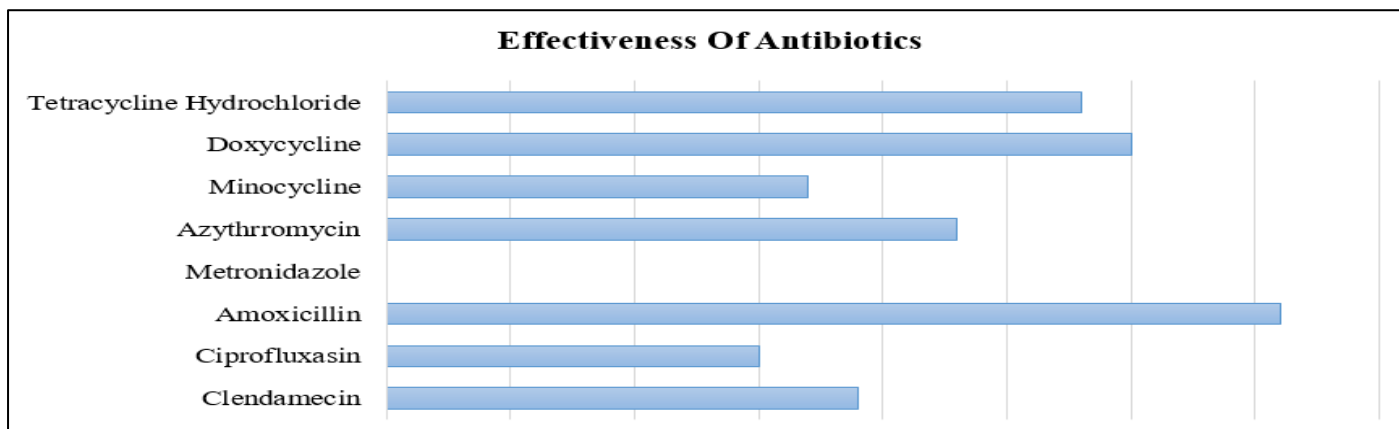


Fig 8: Effectiveness of Antibiotics

When doctors were asked about the prevalence of resistance development to each of the previous antibiotics, the results were similar for all antibiotics, although tetracycline

hydrochloride ranked first, as the answers were distributed as follows:

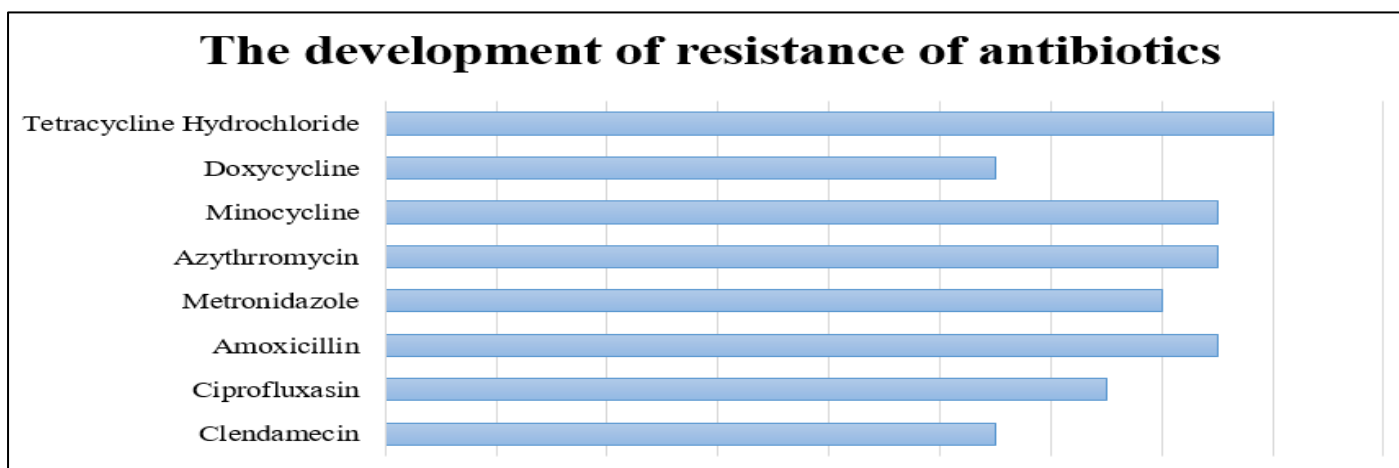


Fig 9: The Development of Resistance of Antibiotics

Given the widespread phenomenon of taking antibiotics without consulting a doctor, we asked doctors about the most common antibiotics involved in this, and amoxicillin and metronidazole ranked first and second, respectively.

This behavior of patients is due to their high effectiveness and widespread use by doctors.

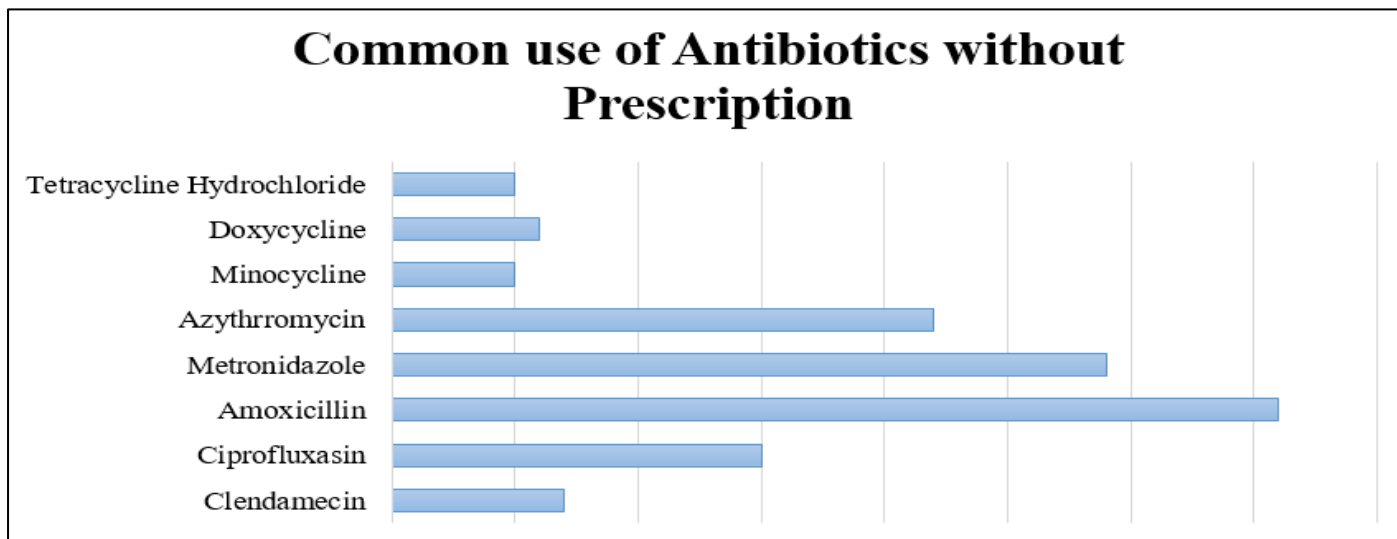


Fig 10: Common use of Antibiotics without Prescription

We asked dentists about antibiotics or the procedure to be followed in the event of antibiotic resistance developing. We noticed the rarity of requesting a bacterial culture, and we

also found that the most commonly used procedure was the combination of metronidazole with amoxicillin.

Table 1: The answers were distributed as follows (arranged in order of decreasing answer frequency):

Antibiotic	Antibiotic or the procedure to be followed if resistance develops
Tetracycline Hydrochloride	Metronidazole, Metronidazole + Amoxicillin , penicillin
Doxycycline	Metronidazole, Metronidazole + Amoxicillin , penicillin
Minocycline	Metronidazole, Amoxicillin, Metronidazole + Amoxicillin , penicillin
Azythromycin	Metronidazole, Amoxicillin, Metronidazole + Amoxicillin , Penicillin
Metronidazole	Clendamecin, Azythromycin, Spiramycin Augmantin, Doxycycline
Amoxicillin	Clendamecin, Azythromycin, Augmantin Doxycycline, Metronidazole
Ciproflaxasin	Amoxicillin, Penicillin, Metronidazole + Amoxicillin, Azythromycin, Doxycycline, Metronidazole
Clendamecin	Metronidazole + Amoxicillin, Penicillin

RECOMMENDATIONS

Given the widespread use of antibiotics, whether by patients without medical advice or by dentists prescription, and also the lack of bacterial culture and antibiotic susceptibility testing, it is the responsibility of health care worker, pharmacists, doctors and others, to promote awareness and medical education in the medical community and among others. General information on the following points:

- Prevent infection in the first place.
- Only intake antibiotics if they are really needed and prescribed by a doctor.
- Commitment to taking antibiotics at the dose and for the duration specified in the prescription.
- Doctors currently advise not to prescribe antibiotics if there is a possibility of a patient’s spontaneous recovery and to follow prevention and hygiene instructions.

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