Drug sensitivity pattern of bacteria from dental extraction

ABSTRACT:

Teeth are hard, resistant structures found on the jaws within the mouth and pharynx regions of vertebrates, primarily used for catching and masticating food, defense, and other specialized purposes Bacterial infections are the predominant cause of purulent soft tissue inflammations in the head and neck area, facilitated by a diverse oral microbiota and lesions in dental tissues and the periodontium. This study highlights the need for antibacterial mouth rinses and systemic antibiotics to control and prevent such situations. However, the inappropriate and overuse of antibiotics have led to the emergence of resistant bacteria, reducing the efficacy of some antibiotics.

Materials

Equipment Used: Weighing balance, Petri dishes, Autoclave, Wire loop, Bunsen burner, Incubator, Beakers, Conical flask, Measuring cylinders, Pipettes, Test tubes, Glass slides

Collection of Specimens: Specimens were collected using sterile commercial swab sticks from 10 areas of extracted teeth from different patients. The swabs were properly labeled and transported to the Microbiology Laboratory of Abia State University, Uturu (ABSU) within 2-3 hours of collection.

Reagents and Antibiotics Used - Antibiotics included: Gentamycin (10 mcg), Ofloxacin (5 mcg), Erythromycin (15 mcg), Vancomycin (30 mcg), Ciprofloxacin (5 mcg), Amoxicillin (10 mcg). Reagents included: Kovac's reagent, normal saline, dye tetramethyl-p-phenylenedamine, bromothymol blue, and hydrogen peroxide.

Sterilization of Materials: All glassware (pipettes, test tubes, beakers, conical flasks, Petri dishes) was sterilized at 121°C for 15 minutes in an autoclave.

Method

Preparation of Media

Nutrient Agar: Dissolve 8.4g in 300ml distilled water, sterilize, pour into plates, and incubate for sterility check.

MacConkey Agar: Dissolve 15.6g in 300ml distilled water, sterilize, pour into plates, and incubate for sterility check.

Peptone Water: Dissolve 4g in 250ml distilled water, sterilize, and dispense into test tubes.

Inoculation of Samples: Swab sticks were used to inoculate the organisms into the media, which were then incubated at 37°C for 24 hours.

Purification of Isolates: Isolates were subcultured onto nutrient agar plates and incubated. Discrete colonies were gram-stained for confirmation and preserved as stock cultures for biochemical tests.

Identification of Bacterial Isolates: Isolates were identified based on colony appearance, microscopic examination, and biochemical tests including catalase, citrate, oxidase, indole, coagulase, and gram staining.

Gram Staining: Gram staining involved applying crystal violet, iodine, acetone, and safranin to the smears and observing under an oil immersion lens.

Biochemical Tests: Catalase Test: Detection of bubbles indicates a positive result, Citrate Test: Blue coloration indicates citrate utilization, Oxidase Test: Purple color within 3-5 seconds indicates a positive result, Indole Test: Red color after adding Kovac's reagent indicates a positive result, Coagulase Test: Clumping indicates a positive result.

Antibiotic Susceptibility Testing: Using the Kirby-Bauer disc diffusion method, antibiotics were tested against isolates, and inhibition zones were measured and interpreted using NCCLS criteria.

Result

Physical and Biochemical Observations: Isolates from 10 patients included Staphylococcus aureus, Lactobacillus spp., and Streptococcus spp. Biochemical tests confirmed their characteristics.

Antibiotic Susceptibility Patterns: Results showed varying sensitivity, intermediate, and resistance patterns among the isolates for different antibiotics.

Efficacy Index Ratio: Calculated for each antibiotic, indicating their effectiveness. Ciprofloxacin, Ofloxacin, and Gentamycin showed high efficacy.

Discussion

The study identified common bacteria in dental caries and their resistance patterns, revealing high resistance to Vancomycin and Amoxicillin and high sensitivity to Ciprofloxacin, Ofloxacin, and Gentamycin. These findings align with global trends of increasing antibiotic resistance and underscore the need for targeted antibiotic therapy based on susceptibility testing.

Conclusion

Staphylococcus aureus, Lactobacillus spp., and Streptococcus spp. were the primary bacteria isolated from dental caries. The resistance to Vancomycin and Amoxicillin is concerning, while Ciprofloxacin, Ofloxacin, and Gentamycin were effective. These results highlight the importance of proper antibiotic stewardship and routine susceptibility testing to manage dental infections effectively.

Key Words: Dr*ug Sensitivity, Dental Extraction, Bacterial Infections, Antibiotic Susceptibility*

1.0 INTRODUCTION

Teeth is a hard, resistant structure occurring on the jaws in or around the mouth and pharynx areas of vertebrates used for catching and masticating food, for defense, and for other specialized purposes (Munojatkhon, 2023). The human oral cavity as a biological system contains many species of microorganisms. When these microorganisms penetrate into deeper tissues or in case of compromised host resistance and bacterial infections they manifest as diseases (Mahalle, A. et al. 2014).

Bacterial infections are the most common cause of purulent soft tissue inflammations in the head and neck area (Burczyńska A., et. al., 2017). Their occurrence is favoured by a large variety of oral microbiota and lesions of dental tissues and the periodontium (Vengerfeldt V., Špilka K., Saag M. et al., 2014 and Kilian M., Chapple I. L. C., Hannig M. et al., 2016). The causes of infections are divided into odontogenic and nonodontogenic, with 70–90% of cases belonging to the first group. The most common odontogenic causes are gangrenous teeth, complicated third molar eruption, infected dental cysts, residual tooth roots, and complications after endodontic treatment (Bogacz, M, et. al., 2019, Al-Ahmad A., Ameen H., Pelz K. et al., 2014 andGhom, A., &Ghom, S. , 2014).

Germs such as Streptococcus mutans and Streptococcus sobrinus are the most frequent bacteria found in tooth cavities (Faustova, M. O., et al., 2018). When bacteria get access to deeper tissues, they will cause odontogenic infections, in the state of sufficient pathogenic bacteria and a weak body condition, infections may spread to various spaces in the oral cavity (Santosh, A. N. et al., 2014 and Olurotimi et al., 2014). In order for this situation to be controlled and prevented, antibacterial mouth rinses and systemic antibiotics can be prescribed (Buonavogliaet al., 2021). Early diagnosis, identification of microorganisms through culture and antibiotic sensitivity, prompt antibiotic treatment together with early removal of cause should prevent most complications and resulting in early recovery, therefore management of these infections involves both surgical and supportive therapy (Lakshmi, U. V. et al., 2019).

According to recent studies, the prevalence of transient bacteria after tooth extraction varies between 30 and 60% in adults and 33 and 80% in children (Navarro et al., 2017 &Tubiana et al., 2017). In order for this situation to be controlled and prevented, antibacterial mouth rinses and systemic antibiotics can be prescribed (Benítez-Páez A., 2014). The fundamental approach in treating infection is to choose a high-efficacy antibiotic (Benítez-Páez A., 2014). Unfortunately, inappropriate and over-use of antibiotics have led to the elimination of sensitive microorganisms, which offers an environment for resistant bacteria to survive leading to reduced efficacy of some antibiotics.

Human beings and their ancestors have always been afflicted by diseases. The advent of modern or allopathic medicine turned attention of scientists increasingly from plant sources to synthetic preparations as the basis for modern drugs. However, the deleterious side-effects of many modern drugs along with the development of drug-resistant organisms have brought back into focus ethnomedicinal studies.

2.0 MATERIALS

2.1 Equipment Used

Weighing balance, Petri dishes, autoclave, wire loop, Bunsen burner, incubator, beakers, conical flask, measuring cylinders, pipettes, test tubes and glass slides.

2.2 Collection of Specimens

The specimens were collected using sterile commercial swab sticks, properly labeled accordingly by swabbing the 10 areas of extracted teeth of different patients and the swab sticks were carefully placed back into the swab jacket. The specimens were transported to the Microbiology Laboratory of Benue State University, Makurdi for the analysis within 2- 3h of collection.

2.3 Reagents and Antibiotics Used

The antibiotics used include; Gentamycin (10mcg), Ofloxacin Erythromycin (15mcg), Vancomycin (30mcg), Ciprofloxacin (5mcg), Amoxicillin (10mcg). The reagents used include; Kovac's reagent, normal saline, dye tetramethyl-p-phenylenedamine, bromothymol blue and hydrogen peroxide.

3.0 METHODOLOGY

3.1 Sterilization of Materials

All the glass wares via pipettes, test tubes, beakers, conical flasks, petri dishes etc, were properly foiled and sterilized at 121°c for 15 minutes in the autoclave.

3.1.2 Preparation of Nutrients Agar

The nutrient agar was prepared by dissolving 8.4g into 300mls of distilled water. The conical flask containing the medium was adequately labeled and properly shaken for it to dissolve completely. The medium was sterilized in the autoclave for 15 minutes at 121°c. It was allowed to solidify and plates were then labeled properly. The plates were incubated for 18-24 hrs for sterility of plates.

3.1.3 Preparation of Macconkey Agar

The MacConkey agar was prepared by dissolving 15.6g of the powder in 300mls of distilled water. The conical ask containing the medium was shaken for the agar to dissolve properly. The conical flask was plugged with cotton wool and then sterilized in the autoclave for IDENTIFICATION15 minutes at 1219 It was allowed to cool to a temperature of 45° c - 50°c and was dispensed into sterile petri dishes which were labeled appropriately after solidification. The plates were incubated for 15-24hrs for sterility of plates.

3.1.4 Preparation of Peptone Water

The peptone water was prepared by dissolving 4g of peptone powder in 250mls of distilled water. The conical flask containing the medium was adequately labeled and properly shaken for it to dissolve completely. The flask was then plugged with cotton wool and then sterilized in the autoclave for 15minutes at 121°C. It was allowed to cool to a temperature of 45°C-50°C and then poured into test tubes. The test tubes were covered with foil.

3.2 INOCULATION OF SAMPLE / SPECIMENS

Swab sticks were used to make a smear that is inoculating the organisms into the media and then incubated at 37°C for 24 hours.

3.2.1 Purification of Isolates

Each of the isolates was aseptically subculture from the plates and inoculated by streaking into a freshly prepared sterile nutrient agar plates and then incubated at 37°C for 24 hours. After the duration of incubation period, discrete lonies were picked using a sterile wire loop and gram stained to confirm their purity. Isolates were either gram positive or gram negative and was preserved as stock cultures for biochemical tests.

3.2.2 Identification Of Bacteria Isolates

The pure isolates were identified using their colonies appearance, microscopic examinations and biochemical test. The biochemical test includes catalase test, citrate test, oxidase test, indole test coagulase test, and gram stain.

3.2.3 Gram Staining

Smears of the isolates were prepared on clean grease free slides. The smear was allowed to air dry, heat fixed by passing the slide over flame. The slide was placed on a staining rack and flooded with crystal violet (the primary dye) for 1 minute, it was rinsed with water. The smear was flooded with lugol's iodine (mordant) left for 1minute and then rinsed off immediately with water. The smear was flooded with acetone and rinsed off immediately with The smear was flooded with safranin for 1minute, rinsed with water and then allowed for 1minute, rinsed with water and then allowed to dry. It was examined under an oil immersion lens 200 Organisms that retained the colour of the primary dye purple) were gram positive while those that retained secondary our (pink)were gram negative (Onyeagba, 2004).

3.2.4 Catalase Test

The enzyme catalase catalyzes the degradation of hydrogen peroxides to water and molecular oxygen (H_2O_2 H_2O + O_2). Catalase positive organisms rapidly produce bubbles when exposed a solution containing hydrogen peroxide

A drop of 3% hydrogen peroxide diluted with 7ml of water was placed on a clean grease free slide using a Pasteur pipette. A colony of test organism was collected using an inoculating wire loop and placed on the slide with hydrogen peroxide. The reaction observed was gas bubbles confirmed the presence of catalase positive while catalase negative organisms do not produce gas bubbles.

3.2.5 Citrate Test

This test is based on the ability of an organism to utilize citrate as the only source of carbon. The organism was cultured to medium containing sodium citrate ammonium salt and an indicator (Bromothymol blue) which changes to blue if the organism is positive.

The method involves using a sterile wire loop to collect a clony of the test organisms and stab into the Simon's citrate agar slant. This was incubated for 24hours at 37°C. A blue colouration indicates that citrate has been utilized.

3.2.6 Oxidase Test

The oxidase reagent which contains dye tetramethyl-p- phenylenediamine was prepared by dissolving 0.1g in 100mls of distilled water. For each organism, a drop of the reagent was placed on the top of the drop.

Purple colour developed between 3-5 seconds for oxidase positive organisms. This is due to the possession of the cytochrome oxides and no colour change for oxidase negative organisms.

3.2.7 Indole Test

This test demonstrates the ability of certain bacteria to decompose the amino acids, tryptophan to indole which accumulates the medium. For each isolate, peptone water was prepared; 5ml were dispensed into test tubes and autoclave at 121°C for 15 minutes. A sterile wire loop charged with the test organism inoculated into the medium and incubated for 7 days at 37°C. Then 0.5ml of kovac's reagent was added to each test tube

A deep red colour was observed in the reagent layer indicates positive result and no color indicates negative result colour indicates

3.2.8 Coagulase Test

The enzyme coagulase causes plasma to clot converting fibrogen to fabrin. It was done by dropping a normal saline to emulsify colonies of the test organism to form a smooth emulsion. Two drops of human plasma was placed on it and the slide was rocked for one minute. A clumping of the indicates presence of a coagulase organism.

3.3 ANTIBIOTIC SUSCEPTIBILITY TESTING

The antibiotics susceptibility tests were performed using the Kirby Bauer method (disc diffusion techniques). The antibiotics disc was designed and contained appropriate centration of the antibiotics, which include: Gentamycin (10mcg), Ofloxacin (5mcg), Erythromycin (15mcg), Vancomycin (30mvg), Ampicillin (10mcg), amoxillin (10mcg), Ciprofloxacine (5mcg).

3.4 PREPARATION OF MCFARLAND TURBIDITY

1% v/v solution of sulphuric acid was prepared by adding 1ml of concentrated suphuric acid to 99ml of water. The 1% w/v solution of barium chloride was also prepared by dissolving 0.5g of dehydrate barium chloride into 50ml distilled water. 0.5ml of the barium chloride solution was added into 99.5ml of sulphuric acid solution. Then 10ml of the turbid solution was transferred into a capped test tube.

For each isolate, 5ml of distilled water was pipette into test tubes and autoclave at 121°C for 15 minutes. A sterile wire loop charged with test organisms were inoculated into the tubes marking it with McFarland turbidity standard of 0.5 concentrations.

Muller Hinton agar was prepared, poured into Petri dishes and sterility test carried out. The test organisms were innocullated from the test tubes using the spread technique. The sensitivity discs containing the antibiotics were placed aseptically into plates using a sterile forceps. A sterile forceps was used to gently lap each disc to ensure even contact with the agar surfaces the plates were incubated at 37°C for 18-24 hours.

The different inhibition zones sizes were measured and recorded in millimeter (mm). Then the zone size interpretation criteria or the National Committee for Clinical Laboratory Standards (NCCLs) were used to interpret the zone sizes (chessbrough, 2000).

4.0 RESULT

4.1 Physical and Biochemical Observation:

A total of 10 (TEN) swab specimen from extracted teeth examined. The most probable organisms (bacteria) isolated from 10 patients with dental cars Staphylococus aureus, Lactobacillus spp. and Streptococcus spp. Also biochemical test such as catalase, indole oxidase, coagulase citrate were done to characterize the isolate

Table 1: Cell morphology, Gram Reaction, Biochemistry Characteristics and Identification of Bacteria.

S/No.	Colonial Characteristics	Grams Characteristics	Catalyst Test	Oxidase Test	Citrate Test	Coagulase Test	Indole Test	Motility Test	Glucose Test	Most portable Organisms
1.	Golden yellow pigment smooth, entire, raised and convex elevation on nutrients ager.	Gram positive cocci in clusters.	+	-	+	+	-	+	A	Staphylococcus aureus
2.	Colonies are pontiform convex with an entire	Gram positive rods (bacilli)	+	-	+	-	-	+	A	Lactobacillus spp.

	margin.									
3.	Colonies are pontiform,Grey and smooth on nutrient ager pontiform, Entire and convex lactose fermenting colonies (Pinkish MacConkey ager).	Gram positive cocci in chains	+	-	+	+	-	+	A	Staphylococcus spp.

KEY:

+ Positive

- Negative

A Acid only

4.2 Antibiotics Susceptibility of Bacteria Isolated:

The antibiotics susceptibility of bacteria isolated were listed in table 2 and were also grouped into sensitive (S), intermediate (I) and resistant (R).

Table 2. Antibiotics susceptibility of bacteria isolate

Plate No.	Ery	Amp	Van	Amx	Cpr	Ofl	Gen	Portable Organisms
1	S	S	R	R	S	S	S	Staphylococcus spp.
2	R	R	R	R	S	S	S	Staphylococcus aureus
3	I	R	R	R	S	S	S	Staphylococcus aureus

4	S	R	R	R	S	S	S	Staphylococcus aureus
5	S	T	R	R	S	S	S	Lactobacillus spp.
6	S	S	R	R	S	S	S	Staphylococcus spp.
7	I	R	R	R	S	S	S	Staphylococcus aureus
8	S	I	R	R	S	S	S	Staphylococcus spp.
9	I	S	R	R	S	S	S	Staphylococcus spp.
10	R	R	R	R	A	S	S	Staphylococcus aureus

KEY:

S = Sensitive $\geq$ **16mm**

R = Resistance $\leq$ **12mm**

I = Intermediate 12 - 15mm

Erythromycin (Ery) =15mcg

Gentamycin (Gen) =10mcg

Ofloxacin (Ofl) =5mcg

Vancomycin (Van) =30mcg

Ciprofloxacin (Cpr) =5mcg

Amoxycillin (Amx) =10mcg

Ampicillin (Amp) =30mcg

4.3 Antibiotics Susceptibility Pattern of Bacteria Isolation

The frequency of Antibiotics susceptibility pattern of bacteria isolated were in table 3 from Dental School and Dental Clinic Enugu State.

Table 3. Frequency of Antibiotics susceptibility pattern of bacteria isolate

S/No.	Antibiotics (Conc.)	Sensitivity (%)	Intermediate (%)	Resistance (%)
1.	Erythromycin (15mcg)	5 (50.00)	3 (30)	2 (20)
2.	Ampicillin (30mcg)	8 (30.00)	1(10)	6 (60)
3.	Vancomycin (30mcg)	0 (0)	0 (0)	10 (100)
4.	Amoxycillin (10mcg)	0 (0)	0 (0)	10 (100)
5.	Ciprofloxacin(5mcg)	10 (100)	0 (0)	0 (0)
6.	Ofloxacin(5mcg)	10 (100)	0 (0)	0 (0)
7.	Gentamycin(10mcg)	10 (100)	0 (0)	0 (0)

4.4 Efficacy Index Ratio of Antibiotics Susceptibility

The efficiency index ratio of antibiotics susceptibility pattern of isolates shown in (table 4)

Table 4: Index ratio of antibiotics susceptibility pattern of isolates

S/No.	Antibiotics (Conc.)	Index
1.	Erythromycin (15mcg)	1.00
2.	Ampicillin (30mcg)	0.50
3.	Vancomycin (30mcg)	0.09
4.	Amoxycillin (10mcg)	0.09
5.	Ciprofloxacin(5mcg)	11.00
6.	Ofloxacin(5mcg)	11.00
7.	Gentamycin(10mcg)	11.00

KEY:

Formula= S + 1 ÷ Rn + 1 = n

Where:. S = Sensitivity

Rn = Resistance + Intermediate

n = Index Ratio

Note:. Value ≥ 1 is significant

≤ 1 is not significant

5.0 DISCUSSION

The study examined swab specimens from extracted teeth of ten patients with dental caries to identify the bacterial isolates and their antibiotic susceptibility patterns. The organisms identified included Staphylococcus aureus, Lactobacillus spp., and Streptococcus spp..

Morphological and Biochemical Characterization

Staphylococcus aureus:

- ★ Colonial characteristics: Golden yellow pigment, smooth, entire, raised, and convex elevation.
- ★ Gram characteristics: Gram-positive cocci in clusters.
- ★ Biochemical tests: Catalase positive, oxidase negative, citrate positive, coagulase positive, indole negative, motility positive, glucose fermentation positive (acid only).

Lactobacillus spp.:

- ★ Colonial characteristics: Pontiform convex colonies with an entire margin.
- ★ Gram characteristics: Gram-positive rods (bacilli).
- ★ Biochemical tests: Catalase positive, oxidase negative, citrate positive, coagulase negative, indole negative, motility positive, glucose fermentation positive (acid only).

Streptococcus spp. (listed as Staphylococcus spp. in some entries):

- ★ Colonial characteristics: Grey, smooth colonies on nutrient agar, lactose fermenting colonies (pinkish on MacConkey agar).
- ★ Gram characteristics: Gram-positive cocci in chains.
- ★ Biochemical tests: Catalase positive, oxidase negative, citrate positive, coagulase positive, indole negative, motility positive, glucose fermentation positive (acid only).

These identifications are consistent with known characteristics of these organisms. Staphylococcus aureus and other Staphylococcus spp. are common in dental infections due to their presence in the oral cavity and their ability to form biofilms (Sasaki et al., 2018 and Acet Ö, et. al., 2021) Lactobacillusspp. are also frequently found in carious lesions because of their role in acid production and enamel demineralization (Zheng et al., 2019).

Antibiotic Susceptibility Patterns

The study tested various antibiotics against the bacterial isolates, with results categorized as sensitive (S), intermediate (I), and resistant (R).

Erythromycin (15 mcg):

- 50% sensitivity, 30% intermediate, 20% resistance.

Ampicillin (30 mcg):

- 30% sensitivity, 10% intermediate, 60% resistance.

Vancomycin (30 mcg):

- 0% sensitivity, 0% intermediate, 100% resistance.

Amoxicillin (10 mcg):

- 0% sensitivity, 0% intermediate, 100% resistance.

Ciprofloxacin (5 mcg):

- 100% sensitivity, 0% intermediate, 0% resistance.

Ofloxacin (5 mcg):

- 100% sensitivity, 0% intermediate, 0% resistance.

Gentamycin (10 mcg):

- 100% sensitivity, 0% intermediate, 0% resistance.

These results indicate a worrying level of resistance to some commonly used antibiotics such as Vancomycin and Amoxicillin, with complete resistance noted for all tested isolates which is in control to Nasreena Bashir A., et. al., 2023. In contrast, Ciprofloxacin, Ofloxacin, and Gentamycin exhibited 100% sensitivity, making them highly effective against the tested isolates.

Efficacy Index Ratio

The efficacy index ratio calculated for each antibiotic indicates their effectiveness:

- ★ Ciprofloxacin, Ofloxacin, and Gentamycin had an index of 11.00, indicating high efficacy.
- ★ Erythromycin had an index of 1.00, which is marginally significant.
- ★ Ampicillin had an index of 0.50, indicating low efficacy.
- ★ Vancomycin and Amoxicillin had indices of 0.09, indicating poor efficacy.

Antibiotics with an index value ≥ 1 are considered significant. Thus, Ciprofloxacin, Ofloxacin, and Gentamycin show significant efficacy against the isolated bacteria, making them preferred choices for treatment (Broussou D.C.,2014).

INTERPRETATION

The study's results provide insight into the antibiotic resistance patterns among dental caries pathogens. The high resistance observed for Vancomycin and Amoxicillin is concerning, as these antibiotics are commonly used to treat infections (Sebastian A, et. al., 2019). The high resistance rates to Vancomycin and Amoxicillin are concerning, given the widespread use of these antibiotics in clinical practice. The 100% sensitivity to Ciprofloxacin, Ofloxacin, and Gentamycin suggests these antibiotics should be considered for treating dental infections, especially in cases where resistance to other antibiotics is observed (Aref Shariati, 2014).

Ciprofloxacin, Ofloxacin, and Gentamycin show promising efficacy, with all isolates being sensitive to these antibiotics. This suggests that these antibiotics may be effective choices for treating dental caries infections caused by the identified bacteria.

The resistance pattern observed aligns with broader concerns about antibiotic resistance in microbial populations, particularly in oral pathogens which can exchange resistance genes easily within the biofilm environment. This underscores the importance of routine susceptibility testing and cautious antibiotic use to mitigate the development and spread of resistant strains.

The data presented in the study highlight the importance of ongoing surveillance and tailored antibiotic therapy based on susceptibility patterns. The results also emphasize the necessity for proper dental hygiene and preventive measures to reduce the incidence of bacterial infections leading to dental caries.

6.0 CONCLUSION

The findings on Staphylococcus aureus, precisely its resistance characteristics, align with data from other studies conducted in clinical settings regarding the MRSA situation. This indicates that fluoroquinolones, such as Ciprofloxacin, Ofloxacin, and aminoglycosides, particularly Gentamycin, are potentially viable treatment options. This study underscores the importance of regular antibiotic susceptibility tests in managing dental caries. The high resistance of the pathogenic bacterial strains to commonly used antibiotics like Vancomycin and Amoxicillin calls for innovative and appropriate therapeutic regimens and more conscientious use of antibiotics in clinical practice. The demonstrated sensitivity of Ciprofloxacin, Ofloxacin, and Gentamycin against the isolates supports their use as first-line medications for dental infections. Ongoing surveillance of antibiotic resistance and the implementation of stringent antibiotic stewardship measures are essential to improve patient outcomes.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of manuscripts.

REFERENCE

Acet Ö, Erdönmez D., Acet B., Odabaşı M. (2021). N-acyl homoserine lactone molecules assisted quorum sensing: Effects consequences and monitoring of bacteria talking in real life. Arch. Microbiol. DOI: 10.1007/s00203-021-02381-9

Al-Ahmad A., Ameen H., Pelz K. et al., Antibiotic resistance and capacity for biofilm formation of different bacteria isolated from endodontic infections associated with root-filled teeth, Journal of Endodontics. (2014) 40, no. 2, 223–230, https://doi.org/10.1016/j.joen.2013.07.023, 2-s2.0-84893000508.

Aref Sharia , 1 , † Maniya Arshadi, 2 , 3 , † Mohammad Ali Khosrojerdi, 4 Mostafa Abedinzadeh, 4 Mahsa Ganjalishahi, 4 Abbas Maleki, 5 Mohsen Heidary,corresponding author 6 , 7 , * and Saeed Khoshnoodcorresponding author 5 , 8. The resistance mechanisms of bacteria against ciprofloxacin and new approaches for enhancing the efficacy of this antibiotic. Front Public Health. 2022; 10: 1025633. Published online 2022 Dec 21. doi: 10.3389/fpubh.2022.1025633

Bogacz, M., Morawiec, T., Śmieszek-Wilczewska, J., Janowska-Bogacz, K., Bubiłek-Bogacz, A., Rój, R., ... &Mertas, A. (2019). Evaluation of drug susceptibility of microorganisms in odontogenic inflammations and dental surgery procedures performed on an outpatient basis. *BioMed Research International*, *2019*(1), 2010453. DOI: 10.1155/2019/2010453

Brook, I. (2017). "The role of bacteria in oral infections." Journal of Clinical Microbiology, 55(7), 1902-1910.

Broussou D.C., Toutain P.L., Woehrlé F., El Garch F., Bousquet-Melou A., Ferran A.A. Comparison of in vitro static and dynamic assays to evaluate the efficacy of an antimicrobial drug combination against Staphylococcus aureus. PLoS One. 2019;14(1) doi: 10.1371/journal.pone.0211214

Buonavoglia, A., Leone, P., Solimando, A. G., Fasano, R., Malerba, E., Prete, M., ... & Racanelli, V. (2021). Antibiotics or no antibiotics, that is the question: an update on efficient and effective use of antibiotics in dental practice. *Antibiotics*, *10*(5), 550. DOI: 10.3390/antibiotics10050550

Burczyńska A., Strużycka I., Dziewit Ł., and Wróblewska M., Periapical abscess—etiology, pathogenesis and epidemiology, PrzegladEpidemiologiczny. (2017) 71, no. 3, 417–428.

Faustova, M. O., Ananieva, M. M., Basarab, Y. O., Dobrobolska, O. V., Vovk, I. M., & Loban, G. A. (2018). Bacterial factors of cariogenicity (literature review).

Ghom, A., &Ghom, S. (2014). Infections of Oral Cavity. *Textbook of Oral Medicine*, 409.

Kilian M., Chapple I. L. C., Hannig M. et al., The oral microbiome—an update for oral healthcare professionals, British Dental Journal. (2016) 221, no. 10, 657–666, https://doi.org/10.1038/sj.bdj.2016.865, 2-s2.0-84996538908.

Koyuncuoglu, C. Z., Aydin, M., Kirmizi, N. I., Aydin, V., Yilmaz, N., Aksoy, M., & Cilli, F. (2017). Rational use of medicine in dentistry: do dentists prescribe antibiotics in appropriate indications? European Journal of Clinical Pharmacology, 73(8), 1027-1032. DOI: 10.1007/s00228-017-2258-7

Lakshmi UV, Rayalu KP, Moturi K, et al. Bacteriology of orofacial space infections-A retrospective study. J NTR Univ Health Sci. 2019;8(3):198–205. DOI: 10.4103/JDRNTRUHS.JDRNTRUHS_9_18

Mahalle A, Deshmukh R, Mahalle A. Evaluating the antibiotic susceptibility of bacteria isolated from the pyogenic abscess of dental origin. Journal of Dental Research and Scientific Development. 2014;1(1):6–10. DOI: 10.4103/2348-3407.126132

Munojatkhon, K. (2023, December). ORAL ANOTOMIC STRUCTURE. In *Ethiopian International Multidisciplinary Research Conferences* (Vol. 1, No. 2, pp. 21-24).

Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2020). Medical Microbiology. Elsevier Health Sciences.

Bashir, N., Dablool, A. S., Khan, M. I., Almalki, M. G., Ahmed, A., Mir, M. A., ... & Ayaz, M. (2023). Antibiotics resistance as a major public health concern: A pharmaco-epidemiological study to evaluate prevalence and antibiotics susceptibility-resistance pattern of bacterial isolates from multiple teaching hospitals. *Journal of Infection and Public Health*, *16*, 61-68.Navarro, B. G., Salas, E. J., Devesa, A. E., López, J. L., & Viñas, M. (2017). Bacteremia associated with oral surgery: a review. *Journal of Evidence Based Dental Practice*, *17*(3), 190-204. DOI: 10.1016/j.jiph.2023.09.019

Olurotimi, A. O., Gbotolorun, O. M., Ibikunle, A. A., Emeka, C. I., Arotiba, G. T., & Akinwande, J. A. (2014). A comparative clinical evaluation of the effect of preoperative and postoperative antimicrobial therapy on postoperative sequelae after impacted mandibular third molar extraction. *Journal of oral & maxillofacial research*, *5*(2). DOI: 10.5037/jomr.2014.5202

Santosh AN, Viresh AN, Sharmada BK. Microbiology and antibiotic sensitivity of odontogenic space infection. IJMDS. 2014;3(1):303–313. DOI: 10.2323/jgam.2017.11.005

Sasaki M., Kodama Y., Shimoyama Y., Ishikawa T., Kimura S. (2018). Aciduricity and acid tolerance mechanisms of Streptococcus anginosus. J. Gen. Appl. Microbiol. 64 174–179. 10.2323/jgam.2017.11.005

Sebastian A, Antony PG, Jose M, Babu A, Sebastian J, Kunnilathu A. Institutional microbial analysis of odontogenic infections and their empirical antibiotic sensitivity. J Oral Biol Craniofac Res. 2019;9:133–8.DOI: 10.1016/j.jobcr.2019.02.003

Sweeney, L. C., Dave, J., Chambers, P. A., & Heritage, J. (2004). "Antibiotic resistance in general dental practice - a cause for concern?" Journal of Antimicrobial Chemotherapy, 53(4), 567-576.doi: 10.2147/tcrm.s9736

Tubiana, S., Blotière, P. O., Hoen, B., Lesclous, P., Millot, S., Rudant, J., ... & Duval, X. (2017). Dental procedures, antibiotic prophylaxis, and endocarditis among people with prosthetic heart valves: nationwide population based cohort and a case crossover study. *Bmj*, *358*. doi: https://doi.org/10.1136/bmj.j3776

Vengerfeldt V., Špilka K., Saag M. et al., Highly diverse microbiota in dental root canals in cases of apical periodontitis (data of Illumina sequencing), Journal of Endodontics. (2014) 40, no. 11, 1778–1783, https://doi.org/10.1016/j.joen.2014.06.017, 2-s2.0-84908299552.

Zheng J., Wu Z., Niu K., Xie Y., Hu X., Fu J., et al. (2019). Microbiome of deep dentinal caries from reversible pulpitis to irreversible pulpitis. J. Endod. 45 302–309.e1.DoI: 10.1016/j.joen.2018.11.017