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Bacteriology in Diagnosing Oral Odontogenic Infections: A Scoping Review

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ABSTRACT

Background: Odontogenic infection is an invasion of pathogenic microbes that originate from the tooth or its supporting structures and can spread to the surrounding tissue. Bacteriological examination to support the diagnosis. **Objective:** This study aims to discuss the role of bacteriological examination in helping to diagnose odontogenic infections. **Method:** Scoping review research type. Search for research gaps using the PCC strategy. PubMed, Scopus, ScienceDirect and Google Scholar databases were used to search for articles by entering keywords using Boolean Operators. Reporting of scoping review results using PRISMA-ScR guidelines. Results: Oral Streptococcus species in caries samples included *S. mutans, S. salivarius, S. mitis* and *S. sanguis* with the dominant bacteria being S. mutans. **Results:** The highest bacterial prevalence of odontogenic infections was Staphylococcus bacteria with high sensitivity to penicillin antibiotics. Periodontal pocket samples showed the highest differences in bacterial prevalence from the three articles, including *Staphylococcus aureus, Fusobacterium nucleatum and Actinobacillus actinomycetemcomitans*. Enterococcus was the dominant bacteria in two articles with samples taken from root canals. Odontogenic abscess samples showed that Gram-positive bacteria were more dominant than Gram-negative bacteria, which were the most common in the culture results of abscess patients. The spread of odontogenic infections in the facial space shows that Methicillin resistant *Staphylococcus aureus* (MRSA) strains are the dominant bacteria found**. Conclusion:** Bacteriological examination should be carried out to show the dominant bacteria that cause odontogenic infections, so that it has benefits to support the diagnosis and treatment plan by the dentist

Keywords: Diagnosis, odontogenic infection, bacteriological laboratory examination

ABSTRAK

Pendahuluan: Infeksi odontogenik adalah invasi mikroba patogen yang berasal dari gigi atau struktur pendukungnya dan dapat menyebar ke jaringan sekitarnya. Pemeriksaan bakteriologi untuk menunjang diagnosis. **Tujuan:** Penelitian ini bertujuan membahas peran pemeriksaan bakteriologi dalam membantu menegakkan diagnosis infeksi odontogenik. **Metode**: Jenis penelitian scoping review. Pencarian research gap menggunakan strategi PCC. Database PubMed, Scopus, ScienceDirect dan Google Scholar digunakan untuk pencarian artikel dengan memasukkan kata kunci menggunakan Boolean Operators. Pelaporan hasil scoping review menggunakan panduan PRISMA-ScR. Hasil: Spesies Oral Streptococcus pada sampel karies diantaranya *S. mutans*, *S. salivarius*, *S. mitis* dan *S. sanguis* dengan bakteri dominan ialah *S. mutans*. **Hasil:** Prevalensi bakteri tertinggi infeksi odontogenik adalah bakteri Staphylococcus dengan hasil sensitivitas tinggi terhadap antibiotik penicilin. Sampel pocket periodontal menunjukkan perbedaan prevalensi bakteri tertinggi dari tiga artikel, diantaranya *Staphylococcus aureus*, *Fusobacterium nucleatum* dan *Actinobacillus actinomycetemcomitans*. Enterococcus merupakan bakteri dominan pada dua artikel dengan sampel yang diambil dari saluran akar. Sampel abses odontogenik menunjukkan bakteri Gram positif lebih dominan dibandingkan bakteri Gram negative yang paling banyak pada hasil kultur pasien abses. Penyebaran infeksi odontogenik pada spasia wajah menunjukkan bahwa Methicilin resistant strain Staphylococus aureus (MRSA) menjadi bakteri dominan yang ditemukan. **Kesimpulan:** Pemeriksaan bakteriologi sebaiknya dilakukan untuk menunjukan bakteri dominan penyebab infeksi odontogenik, sehingga memiliki manfaat untuk menunjang diagnosis dan rencana perawatan oleh dokter gigi.

Kata kunci: Diagnosis, infeksi odontogenik, pemeriksaan laboratorium bakteriologis

1. Introduction

The microbiological examination can assist dentists in establishing a definitive diagnosis, treatment plan, and determining decisions in the use of antimicrobial therapy but is still often ignored.[1] Research on the accuracy of clinical diagnosis of oral lesions by dentists is 76%.[2] Accurate diagnoses of the cause of infection are very important performed to provide the best care for the patient so that the patient can avoid further unnecessary invasive procedures.[3] Odontogenic infection is an invasion of pathogenic microbes originating from the teeth or supporting structures and can spread to the surrounding tissues.[4] Identifying pathogenic microbes that cause disease is necessary so that effective treatment can be determined by knowing the right antimicrobials or antibiotics.[3,5]

Previous studies have stated that only about 12% of dentists prescribe antibiotics adequately and correctly.[6] Inappropriate administrations of antibiotics or antimicrobials can cause patients to become resistant and not achieve the expected recovery.[7] Thus, misdiagnosis indirectly contributes to an increasing trend of antibiotic resistance worldwide. Treatment of odontogenic infections can include dental procedures, such as root canal treatment. Microorganisms living in the root canal system are important to remove during endodontic treatment. Elimination of bacteria that is not carried out effectively can cause interference with healing, so ensuring the sterility of the root canals with bacteriological examination is very helpful for the success of treatment.[8,9]

There have been many studies describing the causative bacteria of an odontogenic infection. However, the dominant bacteria found and antibacterial resistance in each patient are different and continue to grow. Evaluation needs to be done on bacteriological examination which should be done on some odontogenic infections because it has a good impact on supporting patient recovery. This study aims to determine the role of bacteriology laboratory examination in determining the diagnosis of odontogenic infections in the oral cavity which includes hard and soft tissues.

2. Material and Methods

The study was conducted using the scoping review method of articles regarding the bacteriological examination of odontogenic infections. Article searches were conducted through PubMed, Scopus, ScienceDirect, and Google Scholar until December 2022. The keywords used in the search for articles can be seen in Table 1 by searching for articles that match the research criteria specified in Table 2. Screening of articles was done by checking for duplication, reading titles and abstracts, and reading the contents of the entire text. The PRISMA-SCR method is used to identify and filter writings, as well as to report the results of systematic literature review research.

Table 1. Search strategy

Database	Search strategy
PubMed	*"(((microbiology) OR (bacteriology) AND ((odontogenic infections) OR (dental infections)) AND ((oral infections)))" **Filters**: Free full text, from 2017 – 2022, and artikel case report, clinical trial or randomized controlled trial.*
ScienceDirect	*Title, abstract or author-specified keywords: (((microbiology) OR (bacteriology)) AND ((odontogenic infections) OR (dental infections)) AND ((oral infections))) **Filters**: Open access & open archive, from 2017 – 2022*
Scopus	*TITLE-ABS-KEY (((microbiology OR microbiological OR bacteriology OR bacteriological) AND (oral AND infections) AND (odontogenic AND infections))) AND (LIMIT-TO (OA, "all")) AND (LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017)) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "english")) AND (LIMIT-TO (SRCTYPE , "j"))*
Google Scholar	*"Microbiology bacteriology odontogenic infections dental infections oral infections" **Filters**: English, 2017-2022*

3. Result and Discussion

The search results for articles according to the keywords: microbiology or bacteriology, oral infection, and odontogenic infection or dental infection found that 1,404 articles were identified through searches on PubMed, 30 articles on ScienceDirect, 27 articles on Scopus, and 2,310 articles on Google Scholar so that the total number of articles identified was 3,771. Duplication checks were carried out on articles that had been collected so 2,491 articles were obtained. The first screening was carried out by looking for articles that were relevant and by the inclusion criteria, namely 259 articles. The second screening was carried out by reading and reviewing the contents of the entire article, resulting in 26 articles. The results of the search and selection of studies in this review are described in Figure 1.

Table 2 shows the next stage of the study, namely presenting the results of the research and conclusions from each article that carried out bacteriological examinations for odontogenic infections or dental infections found in the database. Types of odontogenic infections found in this study include caries, periodontitis, endodontic infections, abscesses, and infections of the facial and neck spaces. The

search results obtained 5 articles discussing odontogenic infections, 6 articles discussing periodontal disease or periodontitis, 3 articles discussing endodontic infections or bacteriological examinations for endodontic purposes, 9 articles discussing abscesses in the oral cavity and face, and 3 articles discussing spatial infections.

Oral Streptococcus species found in caries samples included *S. mutans, S. salivarius, S. mitis,* and *S. sanguis* with the predominant bacteria being *S. mutans.*[10] The bacteria with the highest prevalence of odontogenic infections in the article written by Shekhar et al. [11] and Begum et al.[12] are *Staphylococcus* bacteria with high sensitivity to penicillin antibiotics. Samples from periodontal pockets in patients with periodontal infection showed the highest difference in the prevalence of bacteria found, including Staphylococcus aureus being the dominant bacteria in the studies of Sultana et al.[13] and Khozhiev[14], *Fusobacterium nucleatum* was the bacteria with the highest prevalence in the studies of Jepsen et al.[15] and *Actinobacillus actinomycetemcomitans* is the dominant bacteria isolated in the study of Al-Haddad et al.[16]

Enterococcus was the dominant bacteria found in two articles with samples taken from the root canals. [17,18] Samples of odontogenic abscess patients in the articles reviewed showed that Gram-positive bacteria were more dominant than Gram-negative bacteria.[19,20] Streptococcus bacteria were the most common bacteria found. on the culture results of abscess patients.[21–24] *Methicilin-resistant strain Staphylococus aureus* (MRSA) in spatial infections spreading odontogenic infection is the dominant bacteria found.[25]

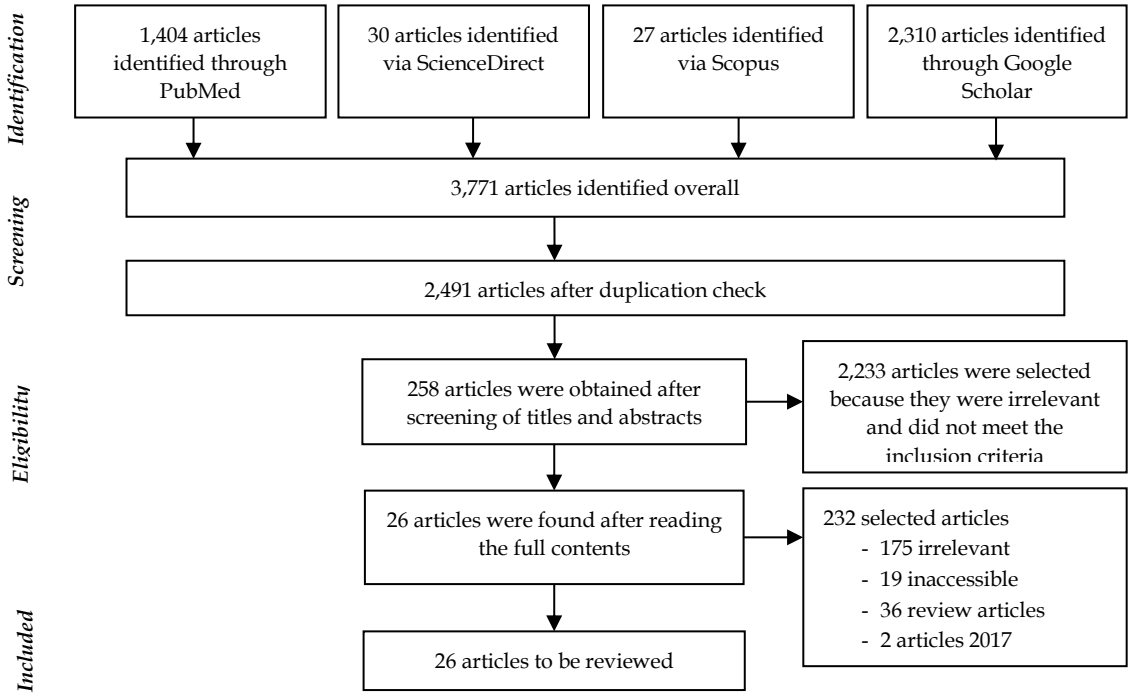

Figure 1. Flowchart of searching articles using PRISMA-Scr

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
				Method	Result	
Ngwu J, Uzoeto H, Emaimo J	2022	*Antibiogram of Biofilm Forming Oral Streptococci Species Isolated from Dental Caries Patients Visiting Federal College of Dental Technology and Therapy, Enugu Nigeria*	*Dental Caries*	A sterile swab is inserted and pressed gently against the tooth cavity. Then the swab sample was transferred aseptically to 5 mL Brain-heart infusion broth (BHI) which was sterilized with 20 µL bacitracin and 20% sucrose and incubated anaerobically at 37°C for 24 hours. After overnight incubation, the cultures were inoculated on blood agar and Mitis/salivarius agar at 37°C for 37–72 hours.	1. A total of 317 (70.4%) Oral Streptococci species were isolated, consisting of *S. mutans* 167 (37.1%), S. *salivarius* 61 (13.5%), *S. mitis* 56 (12.5%)) and *S. sanguis* 33 (7.3%). 2. Oral Streptococcus species were dominant in 167 samples of dental caries, 104 samples of dental plaque, and 46 samples of saliva. 3. Most oral Streptococcus species were found at the age of 21-35 years in 162 samples (36.0%). 4. Amoxicillin as a β-lactam antibiotic is effective against biofilm formation for *S. mutans* 96.3%, *S. salivarius* 97.1%, and 100% for *S. mitis* and *S. sanguis.* 5. Gentamicin with 100% sensitivity on: *S. salivarius, S. mitis, S. mutans, S. sanguis* 6. Ciprofloxacin with sensitivity: *S. salivarius* (85.7%), *S. mitis* (90%), *S. mutans* (100%), and *S. sanguis* (87.5%).	1. High prevalence of Oral Streptococci species in patients with dental caries 2. The need for good oral hygiene to minimize the occurrence of plaque which mediates biofilm formation. 3. Oral Streptococcus is resistant to antibiotics: Ceftriaxone, Tetracycline, Penicillin, Trimethoprim-Sulfamethoxazole, chloramphenicol, and Ampicillin. 4. Amoxicillin, Gentamicin, and Ciprofloxacin are very effective against Oral Streptococcus, so they require proper application in dental treatment. 5. Further antibiotic therapy of the patient should depend on appropriate screening for the selection of antimicrobial therapy.
Shekhar V, Abdul M, Gulia S et al.	2020	*Microflora in odontogenic infections*	*Odontogenic Infections*	In aerobic culture, samples were inoculated on MacConkey's agar, blood agar, and nutrient broth and then identified by Gram stain and biochemical assays. For Gram-positive coccus bacteria, a catalase test, bacitracin sensitivity, optochin sensitivity, coagulase test, and growth in 6.5% sodium chloride were carried out. On Gram-negative bacillus bacteria, oxidase test, catalase test, indole test, urease test, citrate test, and triple sugar iron were carried out. In anaerobic culture, samples were inoculated on blood agar, Kanamycin and Vancomycin blood agar, and bile esculin agar which were incubated under anaerobic conditions for 48-72 hours. Colonies were identified by Gram stain, hemolysis,	1. In microbiological flora in odontogenic infections, there are aerobic and anaerobic bacteria with *Staphylococcus aureus* being the most dominant microbe (41.1%), followed by Enterococcus species (21.1%). 2. The aerobic microbial strains isolated in this study were most sensitive to Co-Amoxiclav and Azithromycin. 3. The isolated anaerobic microbial strains are sensitive to: Metronidazole and Clindamycin.	1. *Staphylococcus* (41.1%) was the most frequently isolated microorganism in this study. 2. Penicillin remains the drug of choice in patients undergoing tooth extraction. 3. The causes of odontogenic infections involve both aerobic and anaerobic bacteria. Aerobic and anaerobic cultures are needed to determine the dominant bacteria.

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
				Method	Result	
				fluorescence, and antibiotic sensitivity to Penicillin, Vancomycin, Kanamycin, and sodium polyethanol sulfonate.		
Begum I, Javed S, Salman S et al.	2022	*Common Microorganisms and Drug Sensitivity in Odontogenic Infection*	*Odontogenic Infection*	Samples were taken from 200 patients with odontogenic infections. After the pus samples were collected, they were inoculated on agar plates and then incubated at 37°C for 24-48 hours for aerobic culture and for anaerobic culture media, maintained under anaerobic conditions at 37°C for 72 hours. Then the plates were tested for antibiotic sensitivity in Muller Hilton agar using the Kirby-Bauer disk diffusion method.	1. The microorganisms found were *Staphylococcus* 24.5%, *Streptococcus* 22.0%, *Pseudomonas aeruginosa* 16.0%, *Eubacterium* 13.5%, *Porphyromonas* 10.5%, *Prevotella* 6.5%, and *Fusobacterium* 7.0%. 2. The results of drug sensitivity include: Ampicillin 33.5%, Amikacin 24.5%, Gentamicin 17.0%, Cefotaxime 14.5%, and Ceftazidime 10.5%.	1. The bacteria *staphylococcus, streptococcus, Pseudomonas aeruginosa, eubacterium, Porphyromonas Prevotella*, and *Fusobacterium* are observed as organisms causing odontogenic infections. 2. Ampicillin is the most sensitive antibiotic followed by Amikacin, Gentamicin, Cefotaxime, and Ceftazidime. 3. Cultures of odontogenic infections are necessary to isolate all pathogens and determine the success of treatment.
Meinen A, Reuss A, Willrich N et al.	2021	*Antimicrobial Resistance and the Spectrum of Pathogens in Dental and Oral-Maxillofacial Infections in Hospitals and Dental Practices in Germany*	*Dental and Oral-Maxillofacial Infections*	Samples were taken from swabs on abscesses, surgeries, wounds, and tongue as well as biopsies from tissues and abscesses.	1. Analyzing data from 20,645 patients with odontogenic infections in two settings, namely hospitals and dental practices. The most dominant microorganism found was *Streptococcus spp*. (33 and 36%, respectively) and *Staphylococcus spp*. (21 and 12%, respectively). 2. Isolate *Streptococcus spp*. from the hospital, the proportion of penicillin resistance (8.0%) and aminopenicillin (6.9%). 3. The proportions of penicillin (2.6%) and aminopenicillin (2.1%) resistance were much lower in the dental practice sample. 4. *Staphylococcus aureus* isolates from hospital patients, the proportion of Methicillin resistance was 12.0%, higher than isolates from dentist practice, 5.8%. 5. The proportion of Clindamycin and Macrolide resistance was high	Dental and oral-maxillofacial infections in Germany are associated with a variety of different pathogens and it is known that *Streptococcus (especially alpha-hemolytic Streptococcus)* and *Staphylococcus* (mainly *S. aureus*) are the most frequently identified pathogens in hospitals and dental practices.

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
				Method	Result	
					(>17%) in *Streptococcus spp*. and *Staphylococcus aureus* isolates. 6. Resistance of *Klebsiella spp*. on Carbapenem, which is <1%.	
Delbet-Dupas C, Devoize L, Depeyre A	2019	*Are routine microbiological samplings in acute dental infections justified? Our 10-year real-life experience*	*Acute Dental Infections*	Samples were subjected to Gram staining and culture aerobically and anaerobically using Columbia blood agar with colistin and nalidixic acid (CNA) and chocolate agar with polyvitex which were incubated at 37°C. Samples that have been cultured are subjected to a sensitivity test.	1. A total of 535 patients were swabbed during surgery, 118 patients were not used for examination because they did not meet the criteria, and 58 patients on Gram staining found no microorganisms. 2. A total of 100 of 477 patients showed positive results. For the remaining 377 no dominant bacteria were isolated. 3. Analysis of the swab samples showed that 107 patients (55.7%) had aerobic flora, 79 (37.7%) anaerobic flora, and 14 (6.6%) mixed aerobic-anaerobic flora. 4. Gram-positive cocci were isolated in 103 (19.2%) cultures. 5. The dominant bacteria found were *Streptococcus group F, a-hemolytic Streptococcus,* and *Streptococcus constellatus.* 6. 6. Results of sensitivity to antibiotics: 23% resistant bacteria or intermediate sensitivity to Amoxicillin-clavulanic acid, 78% resistance to Gentamycin, 36% to Clindamycin, and 2% to Pristinamycin.	Bacteriological analysis has an impact on changes in patient recovery of approximately 5%.
Sultana S, Parvin R, Parvin M et al.	2022	*Prevalence of Methicillin and β−Lactamase Resistant Pathogens Associated with Oral and Periodontal Disease of Children in Mymensingh, Bangladesh*	*Oral and Periodontal Disease*	Bacteria were isolated from 131 pediatric patients aged 4-10 years. Samples were inoculated in nutrient broth and incubated overnight at 37°C. Then each culture was inoculated on Mittis Salivarius agar, Mannitol Salt agar, and De Man Rogosa Sharpe or Lactobacillus agar for isolation of target pathogens *Streptococcus sp., S. aureus* and *L. fermentum*. All colonies were tested for biochemical properties (catalase test, sugar fermentation test, methyl red test, Voges-Proskauer test,	1. Five pathogens were identified, among which *Staphylococcus aureus* (49%), *S. salivarius* (46%), *S. mutans* (16.8%), *S. sobrinus* (0.8%) and *L. fermentum* (13.7%). 2. Most of the isolates were resistant to 5 of 8 antibiotics. 3. Bacteria S. Aureus, *Streptococcus spp*., and *Lactobacillus spp*. showed resistance to: Metronidazole and β−lactam antibiotics (Cephradine, Amoxicillin), Cefixime, and Cefuroxime. 4. More than 50% of bacteria are sensitive to: Ciprofloxacin, Tetracycline,	1. *S. aureus* and *S. salivarius* are the main OPD pathogens in patients treated at Mymensingh Medical College Hospital of Bangladesh. 2. About 90% of the bacteria found are multidrug-resistant.

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
				Method	Result	
				indole test) and Gram staining. All cultures were tested for antimicrobial sensitivity using the Kirby–Bauer disk diffusion method.	Chloramphenicol, and Moxifloxacin.	
Jepsen K, Falk W, Brune F et al.	2021	*Prevalence and antibiotic susceptibility trends of periodontal pathogens in the subgingival microbiota of German periodontitis patients: A retrospective surveillance study*	*Periodontitis*	Using paper points inserted in the periodontal pockets of 7,804 patients placed on AMIES transport media. Paper points were transferred to 2 ml of thioglycolate suspension, and 10-fold serial dilutions were made of this suspension and 100 µl of the bacterial suspension was inoculated on special media for aerobic and anaerobic cultures. Then inoculated on Columbia sheep blood agar, China lactose blue agar, and Kimmig agar which were incubated for 24 hours at 37°C under aerobic conditions. For anaerobic microorganisms using Wilkins-Chalgren agar with 5% horse blood containing 5 µg Haemin and 0.5 mg Vitamin K1, trypticase soy-bacitracin-vancomycin (TSBV) agar and on Schaedler agar with 5% sheep blood supplemented with haemin, Vitamin K1, Kanamycin, and Vancomycin were incubated at 37°C for 3-5 days under anaerobic conditions. The culture was tested for antimicrobial sensitivity.	1. The prevalence of bacteria found was 95.9% *Fusobacterium nucleatum*, 88.0% *Tannerella forsythia*, 76.4% *Treponema denticola*, 76.5% *Campylobacter rectus*, 76.0% *Eikenella corrodens*, 75.0% *Capnocytophaga spp.*, 68.2% *Porphyromonas gingivalis*, 57.7% *Prevotella intermedia*, 30.4% *Eubacterium nodatum* and 21.5% *Aggregatibacter actinomycetemcomitan*. 2. *A. actinomycetemcomitans* is not sensitive to Metronidazole but is sensitive to all other antibiotics. 3. Resistance to Amoxicillin was low in P. gingivalis (0.4%) and T. forsythia (1.4%) and higher in P. intermedia (7.4%) and F. nucleatum (9.5%). 4. All isolates from *P. gingivalis, T, forsythia,* and *P. intermedia* were sensitive to Ampicillin-sulbactam and Amoxicillin-clavulanate. 5. The resistance level of Ciprofloxacin in P. gingivalis (8%), Clindamycin (3%), and Azithromycin (2%) in P. intermedia.	There is a high prevalence of periodontal pathogens in periodontitis patients with increasing resistance to several second-choice antibiotics, but there is no relevant change in sensitivity to Amoxicillin and Metronidazole, which are often used when additional antibiotic therapy is required in periodontitis patients.
Al-Deen S, Res A	2021	*Porphyromonas gingivalis: biofilm formation, antimicrobial susceptibility of isolates from cases of Localized Aggressive Periodontitis (LAP)*	*Localized Aggressive Periodontitis (LAP)*	A study involving 30 clinically diagnosed patients. Bacterial samples were collected from the periodontal pocket using a sterile probe placed in a 2 ml container containing thioglycolate. Culture media using Tryptic Soy Agar (TSA) with blood (5%) and MacConkey agar plates which were incubated at 35°C under 5% CO2 and left for 24-48 hours and used Brucella agar	1. *P. gangivilis* isolated was subjected to biofilm detection using the TCP method, 7 samples (23.3%) showed high biofilm-forming capacity, 6 samples (20%) showed moderate biofilm-forming capacity, while 17 samples (56.7%) showed a weak biofilm-forming capacity. 2. The sensitivity test results for Cefotaxime, Ceftriaxone, and Moxifloxacin showed very good	1. The pattern of high sensitivity for *P. gingivalis* strains, but some antibiotic resistance was found. 2. Patterns of antibiotic resistance are constantly changing, making it important to test for antibiotic sensitivity and to obtain careful selection of initial antibiotic therapy, as an adjunct to endodontic therapy. Resistance cannot be prevented, but efforts

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				Method	Result	
				enriched with Vitamin K1 blood agar and CDC+ amikacin which were incubated at 35°C anaerobically in a Gaspak jar. Biofilms were detected by the tissue culture method/microtiter plate method (TCA). P. gingivalis isolate was inoculated from fresh agar plates in 2 mL of Brain Heart Infusion (BHI) broth and incubated for 24 hours at 37°C anaerobically. Then the culture was diluted 1:40 with fresh medium in a microtitration plate and incubated for a further 24 hours at 37°C anaerobically. Each plate was tested against 12 antibiotics using the disc diffusion method.	activity at 100% sensitivity, Amoxiclav (90%), Tetracycline (83.3%), Cefuroxime (80%), Cefazolin (73.3%) and Azithromycin (63.3%). 3. Bacterial strains show poor sensitivity to Clindamycin, Doxycycline, Metronidazole, and Amoxicillin.	need to be made to limit the use of antibiotics.
Khozhiev K	2021	*Estimation of The Effectiveness of Application of The Combined Method of Treatment of Chronic Uppercular Periodontitis*	*Chronic Apical Periodontitis*	A bacteriological examination was carried out before and after endodontic treatment using sterile paper inserted in the root canal. Cultures were performed under anaerobic conditions using 5% hemagar with Difco Brain-Heart Infusion with the addition of hemin (5 mg/l) and menadione (0.1 mg/l). Biochemical identification using API and Roche test systems. To test the antibacterial effect that will be used on staphylococcus, streptococcus, and clostridia bacteria using 5% blood agar, for *E. coli* using mesopatamia agar, and for *Candida krusei* using Sabouraud's medium.	1. The dominant bacteria found were *Streptococcus* and *Staphylococcus* with 52% *Streptococcus sanguis*, 68% *Streptococcus mutans*, 52% *Streptococcus salivarius,* and 41% *Staphylococcus epidermidis.* 2. In some of the patient's root canals found 12% *Clostridium spp*. and 14% *Candida albicans*	The results of the study confirmed the antibacterial efficacy of a new method of treating copper-calcium hydroxide depophoresis and silver-copper conductor apexphoresis with a combination of fluctorization methods with facultative anaerobic microbes. This combination method is good for periodontitis patients and has significant resistance to antimicrobial effects.
Ciobanu L, Băncescu G, Didilescu A et al.	2018	*Investigation of antibiotic susceptibility of the bacterial isolates and local flora changes after complex therapy in chronic*	*Chronic periodontitis and periimplantitis*	Samples were taken from the deepest periodontal pocket and around the implant. Samples were inoculated on 5% sheep blood agar, chocolate with PolyViteX, Schedler agar with 5% sheep blood, hemin, and vitamin K3 and selective	1. The results of the culture before therapy of bacteria found in periodontal pockets are *P. Intermedia, Capnocytophaga spp., S. Constellatus, S. mitis, S. sanguinis*, and *A. Viscosus.* 2. The bacteria found in the culture after treatment of the periodontal pocket	1. Antibiogram showed that Amoxicillin-Clavulanate was active against all isolates, including beta-lactamase producers, except for some oral Streptococcus isolates. 2. *Capnocytophaga spp*. being one of

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
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		periodontitis and periimplantitis		Schaedler agar with Neomycin and Vancomycin. The cultures were incubated at 35°C and the smears were subjected to Gram staining. Sensitivity tests were carried out on several antibiotics and antibiograms were performed on Brucella blood agar for Capnocytophaga spp. and anaerobic bacteria, such as Actinomyces isolates. Müller-Hinton agar with 5% sheep blood for Streptococcus and Neisseria isolates, and Haemophilus test medium.	samples were *P. Intermedia, P. Buccae, S. Anginosus (F group)*, and *S. Oralis.* 3. Around the bacterial implants found before treatment *Capnocytophaga spp., P. oralis, S. intermedius, S. gordonii, H. Parainfluenzaee*, and *Veillonella spp.* 4. Around the implant after therapy, the bacteria found were *P. buccae, S. constellatus (C group), S. mitis,* and *N. mucosa.* 5. In the isolates tested for beta-lactamase production, only *P. intermedia* and *H. parainfluenzaes* strains showed positive results and were reported to be resistant to Ampicillin and Penicillin G. 6. *Mucosal N. strains* are sensitive to beta-lactam antibiotics, but highly resistant to Clindamycin. 7. All isolates are sensitive to Tetracycline except for *S. sanguinis, Streptococcus anginosus,* and *N. mucosa.* 8. Metronidazole is fully sensitive to anaerobic isolates other than *A. viscosus.*	the main bacteria causing periodontitis and periimplantitis, therefore incubation of anaerobic microorganisms is also necessary. 3. An antibiogram is considered a useful method when antibiotics are required for the treatment of periodontitis and periimplantitis.
Al-Haddad K, Al-Najhi M	2021	*Clinical features, age and sex distributions, risk factors, and the type of bacteria isolated in periodontitis patients in Sana'a, Yemen*	*Periodontitis*	Using sterile paper points to take samples of periodontal pockets in 49 periodontitis patients. Samples were cultured using Tryptic Soy Agar (TSA) with blood (5%) and MacConkey agar plates which were incubated at 35°C with 5% CO2 and left for 24-48 hours, as well as using Brucella agar with Vitamin K1 and CDC+ amikacin for blood. at 35°C under anaerobic conditions in a Gaspak jar. Cultures examined for 48-96 hours.	The most dominant bacteria isolated were *Actinobacillus actinomycetemcomitans* (79.6%), *Streptococcus pyogens* (73.5%), *Staphylococcus aureus* (53.1%), *Bacteroides* (20.4%), *Streptococcus mutans* (16.3%) *Anaerobic lactobacillus* (4%), and *Candida albicans* were isolated in 4 cases (10.2%).	1. The clinical features of periodontitis in Yemen and its risk factors are similar to those reported in other literature, but the bacteria isolated differ in frequency from those reported in other studies, because several upper respiratory tract pathogens such as *Streptococcus pyogens* were predominately isolated in this study. 2. Knowledge of the clinical picture, causative bacteria, and risk factors is the key to success in periodontal therapy.
Medina-Palacios S, Vitales-Noyola M,	2021	*Root canal microorganisms and their antibiotic susceptibility in*	*Endodontic infections*	Samples were taken from 15 patients with persistent apical periodontitis or secondary periodontitis who required repeat	1. A total of 26 microorganisms were identified, the most dominant bacteria being *Enterococcus* (26.8%), *Streptococcus* (19.22%), *Aerococcus* (19.1%), and	This study showed that the most dominant microorganism detected in secondary infections was the genus *Enterococcus* and showed high

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
				Method	Result	
López-González E et al.		*patients with persistent endodontic infections, with and without clinical symptoms*		endodontic therapy. Samples were taken from the root canal and incubated in thioglycollate under anaerobic conditions. The culture medium used is anaerobic CDC agar and identification of microorganisms using the API system.	*Clostridium* (11.4%). 2. As many as 48% of the bacteria were found to be sensitive to Amoxicillin and 28% to be resistant. 3. For clavulanic acid-amoxicillin, the sensitivity is 32% and the resistance is 28%. 4. Clindamycin sensitivity is 40% and resistance is 52%.	resistance to the antibiotics studied.
Zargar N, Amin Marashi M, Ashraf H et al.	2019	*Identification of microorganisms in persistent/secondary endodontic infections with respect to clinical and radiographic findings: bacterial culture and molecular detection*	*Endodontic infections*	Samples were taken from 30 patients, 15 male and 15 female. This sample was divided into two groups of 15 patients based on the size of the periapical lesions on radiographs. Sampling from the root canal was performed using sterile Headstrom files and sterile paper points, then transferred to the microbiology laboratory in a thioglycolic transport medium and two aerobic-anaerobic cultures were performed.	1. The bacteria found were *E. faecalis* and *Prevotella pallens* having the highest prevalence with a total of 63.33% and 6.66%. 2. The results of this study, *Atopobium parvulum* was first found in a dental canal with persistent/secondary endodontic infection.	1. The number of *E. faecalis* bacteria found in Iranian people with a percentage (63.3%), this bacterium is the most common microorganism found in teeth with secondary infections. 2. In this study, the type and prevalence of bacteria effective in persistent endodontic infections were found in Iranian patient samples. So a systemic treatment protocol is needed that can be applied according to the microflora that exists in the region in Iran.
Kranz S, Guellmar A, Braeutigam F et al.	2021	*Antibacterial Effect of Endodontic Disinfections on Enterococcus Faecalis in Dental Root Canals – An In-Vitro Model Study*	*Endodontic Infection*	The in vitro study was carried out using E. faecalis bacteria which were cultured under anaerobic conditions in Schaedler's fluid medium and then inoculated on extracted and irrigated teeth. After 48 hours the bacterial colonization of the dentinal tubules was observed by electron microscopy. Root canal samples that had been divided into several groups were disinfected with chloramine-T, CaOH, and NaOH using paper points. After disinfection, the root canal was swabbed again and then the sample was serially diluted and then cultured on Schaedler agar plus 6% sheep blood and 0.1% vitamin K under anaerobic	1. Using electron microscopy of dentinal tubule samples, it was observed that *E. faecalis* invaded the dentinal tubules to a distance of at least 300 µm. 2. Among all the tested disinfectants, filling the root canal with crystalline chloramine-T (chloramine-T CP) for 24 hours was the most efficient in suppressing *E. faecalis*. There was no significant difference in the results obtained for the chloramine-T group when compared to the CaOH control. 3. Irrigation with 1.3% NaOCl is also efficient in suppressing E. Faecalis. 4. Treatment for 20 seconds resulted in total suppression of bacteria in the root canal walls but failed to suppress species in the dentinal tubules completely.	1. The results of this study proved that of all the tested antiseptics, chloramine-T showed the strongest antibacterial activity. Unlike the treatment with NaOCl and CaOH, the application of chloramine-T crystals is also efficient in killing bacteria that have penetrated deep into the dentinal tubules. With chloramine-T, disinfection is estimated to be up to 300 µm. 2. In conclusion, chloramine-T exhibits promising characteristics and may be a beneficial alternative to antimicrobials commonly used in endodontic antiseptic therapy.

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
				Method	Result	
				conditions for 48 hours.		
Kang S, Kim M	2019	*Antibiotic sensitivity and resistance of bacteria from odontogenic maxillofacial abscesses*	*Odontogenic maxillofacial abscesses*	Sample of 1772 patients with maxillofacial abscess. Bacterial culture was performed using Amies sterile culture transport swabs. Each specimen was collected from the area where pus was present, using a sterile swab culture. The cultured bacteria were divided into G+, G–, and anaerobic bacteria, and the prevalence was sorted in each group and an antibiotic sensitivity test was carried out.	1. Bacterial cultures were performed on abscess pus samples from 1,772 patients and 2,489 bacterial strains were detected, including 2,101 G+ and 388 G – bacteria. 2. In anaerobic G+ bacteria, there are 15 types of Streptococcus and 6 types of Staphylococcus. G+ bacilli were detected including: *Enterococcus faecalis, Gemella morbillorum, Gemella haemolysans, Gemella sp., Lactobacil-lus sp.*, and *Leuconostoc mesenteroides subsp. cremoris.* 3. G+ aerobic bacteria that were detected included: *Bacillus sp., Diphtheroid sp., Ko-curia (Micrococcus) kristinae*, and *Micrococcus sp.* In the G+ Streptococcus group, the dominant strain was *Streptococcus viridans* (80.4%). 4. There were 6 types of G-anaerobic bacteria, namely: *Enterobacter, Aeromonas sp., Citrobacter braakii, Citrobacter freundii, Escherichia coli, Klebsiella oxytoca, K. pneumoniae subsp. pneumoniae, Leclercia (Esch.) adecar-boxylata, Morganella morganii subsp. sibonii, Morganella morganii subsp. morganii, Pantoea sp., Prevotella melaninogenica,* and *Shewanella algae.* 5. The G-aerobic bacteria detected were *Acinetobacter baumannii, A. baumannii (anitratus), Acinetobacter sp., Pseudomonas aeruginosa, Stenotroph-omonas maltophilia, Neisseria sp., Neisseria nonpathogenic*, and dominantly *Neisseria spp.* 6. *Klebsiella pneumoniae* subsp. was G-anaerobic which was most commonly detected (14.7%), while *Neisseria sp*. was the most commonly detected G-aerobic (56.2%). 7. Penicillin G sensitivity test, 2 out of 31	1. In the treatment of odontogenic maxillofacial abscess, it is appropriate to use antibiotics other than Penicillin G and Ampicillin as the first choice of treatment. 2. Based on the data in this study, it is recommended to choose broad-spectrum antibiotics with low resistance, such as second and third-generation cephalosporins, clindamycin, or quinolones.

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				Method	Result	
					Staphylococcus aureus tested showed sensitivity and 29 showed resistance. 8. Ampicillin sensitivity test, all tested *S. aureus* strains showed resistance, and Ampicillin sensitivity test on 46 out of 50 *Klebsiella pneumoniae* subsp showed resistance.	
Ghada A, Dominique C, Jacques M	2018	*Evaluation of sensitivity and resistance of bacteria associated with dental abscesses in Labanese population*	*Dental abscesses*	Samples were taken from the pus of 127 patients with dental abscesses and samples from the root canals using endodontic sterile K-files. Microbiological analysis used the standard culture method and biochemical system from the API system, as well as antibiograms using the Kirby-Bauer disc diffusion method.	1. The identified bacteria are facultative anaerobes and obligate anaerobes, such as: *Aerococcus viridans, Enterococcus faecalis, Gmella haemolysans, Streptococcus*, and *Actinomyces meyeri*. 2. Among facultative anaerobic bacteria, Gram-positive cocci have the highest number. 3. Gram-positive bacteria show the highest antibiotic resistance. Penicillin has the highest level of sensitivity. 4. The overall resistance of antibiotics in bacteria was found, namely 28.87% for Erythromicin, 20.43% for Clindamycin, and 9.85% for Penicillin.	1. The role of the dentist in making the correct diagnosis is necessary given the presence of virulent bacteria, such as *Staphylococcus aureus, Proteus mirabilis, Listeria grayi* which were identified in this study. 2. Development of bacteria that are resistant to several antibiotics, such as *Streptococcus viridans, Enterococci* and *Gemella*. 3. Penicillin is the first choice of antibiotic when needed in the treatment of tooth abscesses.
Plum A, Mortelliti A, Walsh R	2018	*Microbial flora and antibiotic resistance in odontogenic abscesses in Upstate New York*	*Odontogenic abscesses*	Culture specimens were taken from 131 abscess pockets, the specimens were placed in the BBL CultureSwab Plus transport medium. Cultures were cultured using blood, chocolate, magnesium, and Columbia agar for 3 days and an antibiotic sensitivity test was performed.	1. The dominant pathogens found were *Streptococcus alpha-hemolytic* (33.6%), *Streptococcus milleri* (32.1), *Prevotella spp.* (16.8%), and *Staphylococcus spp*. (14.5%). 2. Clindamycin and Erythromycin are the most common antibiotics for resistance. 3. *Stomatococcus, Staphylococcus, Corynebacterium, alpha-hemolytic Streptococcus, Lactobacillus,* and *Streptococcus milleri* showed resistance to Clindamycin. 4. *Stomatococcus* and *Lactobacillus spp* are resistant to Penicillin. 5. *Staphylococcus, Cornybacterium, alpha-hemolytic Streptococcus*, and *Streptococcus milleri* are resistant to erythromycin. 6. *Streptococcus milleri* is resistant to tetracycline. 7. *Staphylococcus* shows resistance to Methicilin.	The dominant antibiotics that most often experience resistance are Clindamycin and Erythromycin which doctors must consider when prescribing initial antibiotics, especially in elderly patients because in this study they experienced higher levels of antibiotic resistance.

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				Method	Result	
					8. *M. morganiii* is resistant to Ampicillin and Cefazolin.	
Regmi S, Chaudhary S, Gurung G et al.	2019	*Bacteriology of Periapical Abscess and Antibiotic Susceptibility Pattern of the Facultative Anaerobes Isolated at Gandaki Medical College*	*Periapical abscesses*	Samples were taken from 87 patients with periapical abscesses, using culture media in the form of nutrient agar, Mueller Hinton agar, Mannitol salt agar, and sensitivity tests were carried out to antibiotics Metronidazole, Cefoxitin, Penicillin-G, Amoxicillin, Gentamicin, and Vancomycin. The culture was carried out by incubating the microorganisms at 37°C for 48-72 hours then the growing microorganisms were subjected to Gram staining and biochemical tests were carried out on selected selective microorganisms and cultured on mannitol salt agar and blood agar at 37°C.	1. A total of 87 samples were studied and among them found *Streptococcus spp.* (67.37%) and *Staphylococcus spp.* (35.63%). 2. Vancomycin was found to be the most effective antibiotic with a sensitivity of 91.95%, Gentamicin (90.80%), Amoxicillin (87.35%), and Penicillin (68.96%). 3. Metronidazole was found to be the least sensitive, with a sensitivity of 36.78%.	Early diagnosis and selection of the right treatment in the management of periapical abscesses can eliminate other diseases that may occur. The involvement of facultative anaerobes causing periapical abscesses and current empiric therapy is still sensitive to first-line β-lactam agents.
Rusinovci S, Sejdini M, Salihu S	2018	*Bacteria That Cause Dentoalveolar Abscesses after Failed Endodontic Treatments: A Pilot Study*	*Dentoalveolar abscesses*	Samples were taken from 50 pus of patients with dental abscesses and 50 samples of healthy individuals. Cultures were carried out using blood media, brown agar for aerobic growth, and blood agar for anaerobic growth. The inoculated anaerobic plates were incubated anaerobically (5% CO2, 10% H2, and 85% N2) for 2 days at 37°C using the Anoxomat System™, if there is no bacterial growth after 2 days, the incubation period is extended to one Sunday.	1. Positive bacterial strains were identified in 42 out of 50 dental abscess patients. A total of 16 different microorganisms from 100 subjects (patients with dentoalveolar abscesses and healthy samples) were isolated. 2. In 18 of 50 samples of abscess patients (36.0%) there was only aerobic flora, 10 of 50 (20.0%) only obligate anaerobic flora, and 22 of 50 (44.0%) mixed abscesses of anaerobic-aerobic flora were isolated. 3. The dominant bacteria found were *Enterococcus spp*. 20 of 50 samples. 4. The microorganisms found in healthy oral samples were almost the same, except for *Streptococcus mitis, Streptococcus mutans, Polymicrobial infection, Fusobacterium nucleatum,* and *Prevotella spp.* not found.	1. The oral microorganism isolated in this study did not differ significantly from the oral microflora in healthy samples, so it can be concluded that the commensal microbiota is the main cause of tooth abscess. 2. Cultures and culture tests can take several days to produce results and modern methods of microbial identification are expensive. Most of the oral microflora cannot be cultured, so modern identification methods are needed, especially in polymicrobial infections.
Tsai Y, Liu Y	2018	*Bacteriology of peritonsillar abscess:*	*Peritonsillar abscess*	A total of 415 patients with peritonsillar abscesses underwent	1. A total of 168 patients were confirmed positive for pathogen isolation.	1. The most dominant pathogen

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
				Method	Result	
		the changing trend and predisposing factors		culture.	2. *Streptococcus viridans* (28.57%) and *Klebsiella pneumoniae* (23.21%) were the most dominant microorganisms identified by pus culture. 3. The anaerobic isolation rate increased to 49.35% in the last 6 years. 4. The dominant anaerobic bacteria are *Prevotella* and *Fusobacterium spp.* 5. Identification of *K. pneumoniae* is increased in elderly patients.	identified by pus culture was *S. viridans*, followed by *K. pneumoniae*. 2. The identification of anaerobes has been shown to increase in recent years. 3. The initial antibiotic selection should be effective against both aerobic and anaerobic bacteria.
Böttger S, Zechel-Gran S, Schmermund D et al.	2021	*Clinical relevance of the microbiome in odontogenic abscesses*	*Odontogenic abscesses*	Samples were taken by swab and aerobic and anaerobic cultures were performed using Columbia blood agar, brown blood agar, McConkey agar, Sabouard glucose agar, Schaedler/Schaedler KV agar (biplate), and Thioglycolate broth. Media were incubated at 37°C and examined after 24 and 48 hours, except for Schaedler/Schaedler KV agar plates, which were incubated for 48 hours. Additional Schaedler/Schaedler KV agar plates were incubated for 5 days before reading. Antibiotic sensitivity test was performed on 3 bacteria, namely Streptococcus, Staphylococcus, and Prevotella.	1. Culture detection could only be found in 41 of 48 patients. The bacteria found showed polymicrobial infection in 46 cases (95.83%), whereas a single infection only occurred twice (4.17%). 2. The results of the dominant bacterial culture found were anaerobic bacteria, with the dominant bacteria being *Streptococcus* (33.3%), *Staphylococcus*, and *Prevotella spp* (16.6%). 3. Analysis of the 16S rRNA gene detects a greater number of bacteria than conventional culture methods, even in samples that show negative cultures. 4. *Prevotella* showed resistance to penicillin in 79% of cases and to Clindamycin in 43% of cases. 5. *Streptococcus* showed a good overall sensitivity	1. Diagnostic of pathogens microbiologically by conducting bacterial cultures faces limitations. 2. A holistic approach, combining biomolecular pathogen diagnostics with 16S rRNA gene analysis and bioinformatics with culture pathogen diagnostics should be implemented in clinical trials as soon as possible. Only in this way can the contents and origin of abscesses in the mouth and maxillofacial area be known completely and reliably. 3. Molecular methods can become the gold standard in medical microbiology diagnostics, especially for polymicrobial infections with a predominance of anaerobic bacteria.
Rôças I, Siqueira J	2018	*Frequency and levels of candidate endodontic pathogens in acute apical abscesses as compared to asymptomatic apical periodontitis*	*Acute apical abscesses* dan *Periodontitis*	Samples were taken from 73 root canals in patients with asymptomatic apical periodontitis using sterile paper points and then placed in a buffered TE tube with a temperature of -20°C. Then the sample was melted to 7°C for 10 minutes. DNA extraction using the QIAamp DNA Mini Kit. Another 55 samples were taken from purulent aspiration in acute abscess patients.	1. Bacterial DNA was detected in all cases. 2. In abscesses, the most common types of bacteria found are *Fusobacterium nucleatum* (60%), *Porphyromonas endodontalis* (53%), *Parvimonas micra* (51%), and *Streptococcus species* (45%). 3. The most common types of bacteria detected in asymptomatic teeth were *P. endodontalis* (63%), *Dialister invisus* (58%), *Olsenellauli* (56%), and *F.*	1. There are no definite target species associated with abscesses in terms of frequency. However, several types of bacteria were found in higher numbers in the abscess. This helps explain previous non-quantitative findings and currently shows no significant association between specific bacterial strains and the appearance of symptoms.

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
				Method	Result	
					nucleatum (51%).	2. *P. endodontalis, P. baroniae, Streptococcus species,* and *T. Denticola* were found in abscesses and asymptomatic teeth with the same prevalence. 3. The presence of high levels of potentially virulent pathogenic bacteria can increase the virulence of the entire community and affect the appearance of symptoms of endodontic infection.
Fukushima S, Hagiya H, Mizuta Y et al.	2020	*Multiple deep-seated dentofacial abscesses caused by multidrug-resistant viridans group streptococci*	*Dentofacial abscesses*	Laboratory tests were carried out and cultures and antibiotic sensitivity tests were carried out.	1. Bacterial cultures from purulent samples detected were *Streptococcus oralis, Candida albicans,* and *Actinomyces naeslundii.* 2. *S. Oralis* antimicrobial sensitivity test showed resistance to several antimicrobials, such as: Penicillin G, Ampicillin, Ampicillin/Sulbactam, Cefotaxime, and Clarithromycin.	1. A case report found that multiple dentofacial abscesses were caused by multidrug-resistant S. oralis. 2. Odontogenic infections have the potential to become complications that can cause death, especially in patients with compromised immune systems. 3. Early diagnosis followed by a combination of surgical and antimicrobial treatment is essential for successful patient care.
Sulaiman N, Issa S, Razzak N	2020	*Orofacial space infections, etiology, microbiological susceptibility and surgical management*	*Orofacial space infections*	Incision and drainage of the abscess using the Hilton method is carried out for 3 days according to the facial space involved then samples are taken using a stick swab. Antibiotic sensitivity and culture were performed.	1. The predominant isolated microorganisms were *Streptococcus pyogenes* (59%), which occurred in 30 of 45 cases, *Klebsiella spp* in 10% of cases, and *Haemophilus spp* and *Enterococcus faecalis* (8%). 2. The fewest bacteria found were *Pseudomonas spp*. and *Escherichia coli* were isolated from only one case (2%) each. 3. Antibiotics isolated from bacteria showing the greatest sensitivity were Netilmicin, Cefoperazone, and Rifampicin (91%). 4. The highest bacterial resistance to antibiotics Gentamicin and Co-trimoxazole (33%).	1. Examination of 45 patients with orofacial infections, most of the infections were of odontogenic origin (62%), the most commonly involved facial space was submandibular (65%), the most common isolated microorganism was *Streptococcus pyogenes* (59%), and most In of the patients were treated using an extra-oral surgical approach (78%). 2. Orofacial infections are more common in women aged 30-40 years. Pain and trismus decreased for two weeks after treatment.

Author	Year of Publication	Research Title	Type of Infection	Bacteriological Examination		Simpulan Penelitian
				Method	Result	
Priyamvada S, Motwani G	2019	*A Study on Deep Neck Space Infections*	*Deep Neck Space Infections*	Initial aspiration with a needle in patients with deep neck space infections who have received initial therapy using Amoxicillin, Clavulanate, and Metronidazole followed by incision and drainage, then pus is cultured.	1. Samples were collected from 40 patients, 27 patients (67.5%) showed positive culture. 2. The most dominant organism culture results were methicillin resistant strain *Staphylococcus aureus (MRSA)* (22.5%), *Steptococcus* (20%), *Polymicrobials* (10%), *Pseudomonas* (5%), *Anaerobes* (5%), *E. coli* (2.5%), and *Proteus* (2.5%). 3. No bacterial growth was found in 13 patients (32.5%).	1. The most common causes of deep neck space infections from the results of this study are odontogenic and tonsillopharyngitis. 2. The most common site involved is the submandibular space followed by the peritonsillar space. 3. Recommend that all patients should receive antibiotics according to culture and sensitivity results but previously allowed to use empiric antibiotics. 4. Prevention of DNSI can be done by making the public aware of dental and oral hygiene and encouraging regular consultations for parents.
Umeshappa H, Shetty A, Kavatagi K	2021	*Microbiological profile of aerobic and anaerobic bacteria and its clinical significance in antibiotic sensitivity of odontogenic space infection: A prospective study of 5 years*	*Odontogenic Space Infection*	Pus that has been aspirated is immediately taken to the microbiology laboratory within 10 minutes. Pus was inoculated into brain heart infusion broth (BHI broth) for aerobic organisms for 18–24 hours at 37°C and for anaerobes it was inoculated in thioglycollate medium at 37°C for 48–72 hours. Pus samples were subjected to Gram staining, aerobic and anaerobic cultures, and antimicrobial susceptibility test.	1. In a study of 100 patients with odontogenic space infection, the pathogen was found in 92 cases and 8 cases were negative because they had previously received antibiotic therapy. 2. The most dominant microorganism isolated from anaerobic and facultative anaerobic bacteria is *Staphylococcus aureus.* 3. *Staphylococcus viridans* (50.43%) and *Peptostreptococcus* (23.75%) predominate among obligate anaerobes followed by *Bacteroides spp.* and *Prevotella spp.* 4. The overall resistance of obligate anaerobic bacteria to Penicillin is 41.5%. 5. The combination of Amoxicillin and Clavulanic acid has 100% effectiveness and 25.67% of bacteria show sensitivity to Erythromycin. 6. Cefotaxime and Ciprofloxacin are highly effective with a sensitivity of 83%.	1. The results of this study indicate that there is a change in the pattern of anaerobic bacteria that dominate the bacterial population found. 2. Gram-positive bacteria are much more common. Aerobic bacteria and facultative anaerobes were found in only Gram-positive cocci, while the anaerobic population consisted of Gram-positive cocci, Gram-positive bacilli, and Gram-negative bacilli. 3. The successful management of odontogenic space infection lies in decompression, elimination of etiological factors, and also in selecting the appropriate antimicrobial therapy on the isolated microbial flora, aiming for more effective patient recovery and preventing

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					7. *Bacteroides spp*, resistant to Erythromycin and Gentamicin. 8. Metronidazole is only effective against obligate anaerobes. 9. Clindamycin is preferred as a second-line option in penicillin-resistant patients.	complications associated with fascial space infection.

Bacterial diagnostics in odontogenic infections

Odontogenic infections are polymicrobial, which are caused by several different types of bacteria. Odontogenic infection begins with damage to the tooth structure called dental caries which can extend to the root canals and periodontal tissues. [10] The application of bacteriological examination in odontogenic infections can help identify the main causative bacteria of an infection, the sterility of the root canals, the effectiveness of the endodontic medicaments used, and bacterial sensitivity to definitive antibiotics that will be used as substitutes for empiric antibiotics. [11,25,26]

The bacteriological examination methods found in this literature study were dominated by the culture method. [10–34] The study of Bottger et al. [24] showed differences in bacteria found in the culture method and molecular techniques in abscess samples. This difference could be because culture analysis can only detect certain bacterial species from the tested sample according to the growth medium used. The use of blood agar media is the most frequently used culture medium because many microorganisms can grow. Meanwhile, the use of selective media can prevent the growth of certain bacterial species and can encourage the growth of other bacteria.[35] Thus, the use of culture methods to determine the complete pathogenic bacteria that cause infection requires a variety of growth media or can use molecular methods. Molecular methods can be the gold standard in upholding diagnostic bacteriology.[24] Therefore, if the therapy that has been given to an odontogenic infection does not provide a cure, the dentist should carry out a bacteriological investigation procedure to look for bacteria that are the cause of the failure of the treatment to do a sensitivity test to medication or antibiotics needed.

Bacteriological examination in periodontal disease

The samples of periodontal infection found in the review of this article were predominantly performed using a sterile probe or paper point in the periodontal pocket. The culture media used is solid media in the form of agar with various types which are cultured aerobically and anaerobically.[29] Pathogenic bacteria that cause periodontal disease such as periodontitis were found to include *Porphyromonas gingivalis, Treponema denticola, Tannerella forsythia, Fusobacterium nucleatum, Prevotella spp.*, and *Aggregatibacter actinomycetemcomitans*.[15,29] This is in line with a previous study conducted by Claesson et al. [1] which stated the type of the same bacteria that cause periodontitis. However, other articles in his research found different dominant bacteria in periodontal disease, including *Staphylococcus aureus*, *Streptococcus mutans, Capnocytophaga*, and *Actinobacillus actinomyctemcomitans*.[13,16,30]

Accurate sampling needs to be considered because there are different types of bacteria found in the depth of the gum gap. In samples taken close to the tooth surface, the dominant Gram-positive bacteria were found, whereas on the surface of the gingival sulcus the organisms were found to be predominantly Gram-negative. Decreased oxygen levels in the gingival sulcus with periodontal pockets also cause an increase in gingival crevicular fluid, this protein-rich fluid encourages the growth of anaerobic bacteria. Thus, sampling fluid in the gingival sulcus and periodontal pocket will find different organisms.[35] The sample taken is then transferred to a suitable transport medium, generally using thioglycollate, and sent immediately to the laboratory.[15,29]

Therefore, the differences in bacteria found indicate the need for bacterial screening in periodontitis patients to establish a diagnosis and provide appropriate therapy. If the expected healing is not achieved in patients who have been given periodontal treatment, dentists should carry out bacteriological supporting examination procedures to look for bacteria that cause treatment failure to carry out sensitivity tests to the drugs or antibiotics needed.

Persistent endodontic infections are caused by microorganisms originating from primary or secondary infections, which are resistant to chemo-mechanical debridement procedures and remain in the treated root canals. [36] anaerobic culture.[17,26] However, a study conducted by Zargar et al.[18] culture was carried out aerobically and anaerobically to determine the microorganism present in the root canals after disinfection or after the use of antimicrobials. A bacterial examination carried out found the same bacteria as the previous study by Alghamdi et al. [8] in root canal

samples and showed that *Enterococcus faecalis* experienced high resistance to several of the antimicrobials studied.[17,18]

Teeth undergoing root canal treatment must be sterilized from contaminating microorganisms before root canal filling and restoration. To ensure a sterile root canal, ideally a sample should be taken, and a culture analysis performed. Root canals that are not sterile can cause treatment failure due to secondary infection.[9,36] Confirmation of root canal sterility can guarantee the success of endodontic treatment. Therefore, microbiological diagnostics can prevent secondary infection of the root canal.

Enterococcus faecalis bacteria can invade dentinal tubules and can survive in the tubules by attaching to type-I collagen fibers.[37,38] *Enterococcus faecalis* which is known to be less sensitive to many of the disinfectants commonly used during antiseptic root canal treatment, such as chlorhexidine, sodium hypochlorite, and calcium hydroxide. In this review, it was shown that of all the tested disinfectants, chloramine-T crystals exhibited the strongest antibacterial activity and were even able to completely suppress bacteria that had penetrated deep into the dentinal tubules. Irrigation using NaOCl can clean all the bacteria that are on the root canal walls but cannot completely remove *E. faecalis* bacteria in the dentinal tubules. However, the antibacterial efficiency of other disinfectants may increase if higher concentrations are applied, but stronger concentrations will also lead to increased toxicity which can lead to irritation. [26]

The dominant bacteria found in odontogenic abscesses because of a review of three articles were Streptococcus.[19–21] This is in line with the abscess-causing bacteria described in previous studies by Claesson et al. [1] and Shweta et al.[39] including *Actinomyces israelii, Parvimonas micra, Staphylococcus aureus, Streptococcus anginosus, Streptococcus viridans,* and *Enterococcus faecalis*. Abscesses originating from odontogenic infections can extend to orofacial tissues, bacteria found in pus samples from patients with abscesses cultured show that the bacteria present are polymicrobial, namely aerobic and anaerobic bacteria.[20,24] Odontogenic abscesses can also extend to the peritonsillar area by the predominant pathogen found was *S. viridans*, followed by *K. pneumoniae*. [23] However, the study conducted by Rôças et al.[40] concluded that no specific species could be ascertained in terms of the frequency or predominance of bacteria found in patients with abscesses.

A Bacteriological examination and testing for sensitivity are very important to do because the choice of the right drug is very dependent on the nature of the infecting organism and its pattern of sensitivity. However, in emergency cases, such as Sepsis and Ludwig's Angina, empirical antimicrobial administration should be given immediately after sampling. Re-evaluation needs to be done after the results of laboratory tests regarding the results of samples and sensitivity tests come out to determine the effectiveness of the drugs that have been given.[35]

The use of antibiotics other than Penicillin G and Ampicillin is recommended in the treatment of abscesses, such as the use of second and third-generation cephalosporin antibiotics, Clindamycin, or Quinolone. [19] However, studies conducted by Ghada et al.[20] and Regmi et al.[22] showed the use of β-lactam antibiotics., Penicillin is still the first choice of antibiotic or is still sensitive in the treatment of odontogenic abscesses. The differences in the results of this sensitivity examination in the cultures of patients with odontogenic abscesses show different bacterial resistance in each patient. Giving antibiotics to patients with abscesses can be appropriate and appropriate if a sensitivity test is carried out on the culture of the abscess sample in the patient. [32]

Staphylococcus aureus is a bacterium with a high level of resistance to β-lactam class antibiotics.[13,21,25,27,34] Bacteria can produce β-lactamase enzymes which can break down β-lactam rings to inactivate antibiotics. This enzyme is commonly found in plasmids capable of destroying the β-lactam ring which is responsible for the antibacterial activity of the β-lactam group, especially penicillin derivatives. At the beginning of the discovery of the antibiotic methicilin, *S.aureus* was very sensitive to this antibacterial. However, *S. aureus* now appears widely worldwide as *methicillin-resistant S. aureus (MRSA)* strains.[35]

Other antibiotic choices, especially the combination of Amoxicillin and potassium clavulanate (Co-Amoxiclav) in the reviewed articles showed excellent sensitivity in several

articles.[11,34] This combination is effective against β-lactam bacteria because amoxicillin is broken down by β-lactamases to become penicilloic acid. This can be prevented by combining amoxicillin with potassium clavulanate.[35] Meanwhile, for *Streptococcus* bacteria, the Co-Amoxiclav combination does not show as high a sensitivity as *S. aureus*.[17,28] The different sensitivity test results for each bacterium in the patient culture results show different bacterial resistance in each patient. Early diagnosis followed by a combination of surgical treatment and appropriate selection of antimicrobials is critical to successful patient care.[32]

4. Conclusion

Based on the 26 articles reviewed in this study, it was found that the results of a comparison of all articles indicated that bacteriological examination should be carried out to show the dominant bacteria causing odontogenic infections so that it can have benefits to support the diagnosis and treatment plan carried out by dentists. The results of bacteriological examinations help determine specific antimicrobials, help select definitive antibiotics after conducting culture and sensitivity tests, ensure sterility or the absence of microorganisms in the root canals before root canal filling, and determine sensitivity to antimicrobials or root canal irrigation materials used.

5. References

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Authors Contribution

Contribution	Hazhiyyah NG	Dewi W	Balafif FF.
Concepts or ideas	√	√	√
Design	√	√	√
Definition of intellectual content	√		
Literature search	√	√	√
Experimental studies	√		
Data acquisition	√	√	
Data analysis	√	√	
Statistical analysis	√		√
Manuscript preparation	√	√	√
Manuscript editing	√	√	√
Manuscript review	√	√	√

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