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Original Article

A Comprehensive Review on the Efficacy of Amoxicillin, Amoxiclav, and Chlorhexidine as Prophylactic Measures Following Tooth Extraction

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ABSTRACT

This study conducts a systematic review of the literature in this field, focusing on the use of antibiotics and antiseptic agents in oral health research. Specifically, it examines the effectiveness of using amoxicillin, amoxiclav, and chlorhexidine as prophylactic treatments following tooth extraction. The research began with a thorough search of relevant studies in various medical databases such as Google Scholar, Medline, PubMed, and other trusted online sources. Both the methodologies and outcomes of the identified studies were assessed. A filtering process was applied to select the most pertinent and reliable articles, resulting in the inclusion of 1,750 articles. These studies were assessed against specific eligibility criteria to exclude irrelevant studies. Ultimately, 10 studies, primarily randomized control trials (RCTs) and clinical trials were selected for this review. These studies directly focused on the use of amoxicillin, amoxiclav, and chlorhexidine as prophylactic agents to prevent oral infections after tooth extractions. The review found that amoxicillin and chlorhexidine were the most commonly used prophylactics, with amoxicillin being particularly effective in reducing complications following tooth extraction. Although chlorhexidine was less effective than antibiotics, it remains an easy and low-risk addition to the procedure.

Keywords: Antibiotics, Tooth extraction, Amoxicillin, Amoxiclav, Chlorhexidine.

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Introduction

Amoxicillin, a penicillin-class beta-lactam antibiotic, is commonly used for treating both acute and chronic infections. It is known for its broad application in managing various infection types, whether mild or persistent [1]. This drug can work alone or be combined with other therapeutic agents, like clavulanate or gallium-based antibacterial compounds, to increase its effectiveness and simplify treatment [2, 3]. This synergistic approach boosts its ability to target a wide range of bacterial infections, making it a cornerstone of clinical care. Amoxicillin is recognized as one of the most frequently prescribed antibiotics in primary care [4]. The antibiotic is synthesized by adding an amino group to penicillin, which improves its resistance against certain bacterial strains. Both amoxicillin and amoxiclav are effective antibiotics, but they differ in composition. Amoxicillin is a standalone antibiotic, whereas amoxiclav combines amoxicillin with clavulanic acid, enhancing its ability to fight bacterial resistance by inhibiting enzymes that might neutralize amoxicillin [5]. This combination makes amoxiclav more potent against a broader spectrum of bacteria, including strains resistant to amoxicillin alone [6, 7]. Amoxiclav is used to treat infections across different body areas, such as the joints (e.g., septic

arthritis), lungs (e.g., pneumonia), and the oral cavity (e.g., dental infections). It is also effective in treating acute bacterial rhinosinusitis [8] and as a preventive measure in surgical settings to reduce the risk of infections. In dentistry, post-surgical infection prevention is crucial, and while antibiotics have traditionally been used for this purpose, recent studies have highlighted the effectiveness of an alternative method—the use of chlorhexidine [9]. Chlorhexidine is especially beneficial for treating gingivitis and other oral infections [10]. This systematic review will evaluate the roles and effectiveness of antibiotics in dental surgeries, with a focus on tooth extractions, comparing their ability to prevent bacterial infections and refining their efficacy based on existing research.

Materials and Methods

PICO statement

Population (P)

Patients undergoing tooth extraction procedures.

Intervention (I)

Prophylactic use of antibiotics (amoxicillin, amoxiclav) or antiseptic (chlorhexidine).

Comparison (C)

Comparative analysis of the effectiveness of different prophylactic measures (amoxicillin, amoxiclav, and chlorhexidine).

Outcome (O)

Assessment of the effectiveness in preventing post-operative infections, complications, and patient outcomes.

Search strategy

To guarantee the validity of the findings, particular terms and keywords were used throughout the review. The selection of studies was restricted to those published within the last decade, with a focus on English-language articles. The review concentrated on antibiotics and antiseptics in dental applications, particularly concerning tooth extraction procedures. This careful approach aimed to produce thorough and scientifically robust results, ensuring that the literature analyzed and synthesized was both pertinent and of high quality.

Eligibility criteria for study selection

In this systematic review, a thorough study selection process was implemented, based on established inclusion and exclusion guidelines to maintain scientific integrity and relevance. The eligibility criteria applied were as follows:

Inclusion criteria

Time frame

The focus was placed on research published within the past ten years, specifically from 2013 to 2024.

Relevance to dental procedures

Only studies directly related to dental procedures, particularly those concerning tooth extraction, were considered.

Full-text availability and valid abstract

Only studies offering accessible full-text versions and valid abstracts were included in the review.

Language requirement

Only studies published in English were included to maintain consistency in data analysis and presentation.

Prophylactic antibiotics and antiseptics

Studies involving prophylactic use of amoxicillin, amoxiclav, or chlorhexidine were eligible for inclusion.

Data clarity and processing

Eligible studies were expected to provide a clear, systematic method for data collection, processing, and analysis.

Randomized Control Trials (RCTs)

RCTs assessing the use of amoxiclav, amoxicillin, or chlorhexidine as prophylactic treatments in oral infections were prioritized.

Exclusion criteria

Author attribution

Studies without clearly identified authorship were excluded.

Publication date

Articles published before 2013 were excluded from the review.

Non-medical context

Studies outside a clinical or medical framework were not considered.

Unclear results

Studies lacking coherence or clarity in reporting key findings were excluded.

Study selection and data synthesis

To gain a comprehensive understanding of the topic, the research team conducted a thorough systematic review of the articles selected for inclusion. During this process, specific keywords were employed in the database search to filter out irrelevant studies, focusing only on relevant and up-to-date data. Author information was carefully reviewed according to the details provided by the original authors. In instances where the primary author's information was unavailable, the lead researcher took responsibility for verifying any discrepancies. Full-text articles were evaluated objectively by all team members to reach a consensus on their inclusion. The team adhered to a collaborative approach, ensuring each member contributed their findings and other relevant input with complete transparency. Any disagreements that arose during the review process were addressed by discussing different perspectives, ultimately resolving issues through mutual agreement.

Data analysis

In conducting our systematic review, we applied a rigorous data analysis methodology to assess the effectiveness and safety of prophylactic antibiotics in dental procedures. In addition to a structured narrative synthesis, we utilized tabulation to gather and examine key details from each study. The following criteria guided our data analysis:

Dosage assessment

The review included an analysis of the dosages prescribed for both the antibiotics and chlorhexidine used in the studies.

Infection persistence

Evaluation of the rates at which infections persisted after treatment.

Affected site evaluation

Examination of the condition of the affected regions before, during, and after treatment.

Diagnosis-based dosage variation

Analysis of different antibiotic dosage regimens according to specific diagnoses.

Bacterial count estimates

Quantification of bacterial levels before, during, and following treatment.

Therapeutic duration

Assessment of the duration needed for antibiotics to show effectiveness.

Patient health monitoring

Tracking patients' general physical condition before, throughout, and following treatment with each antibiotic.

Adverse effects assessment

Assessment of the adverse effects encountered by patients for each antibiotic. However, it is crucial to note that a meta-analysis could not be conducted due to insufficient variability in the available data. The lack of diversity in the data prevented a meaningful meta-analysis, highlighting the necessity for additional research in this field. These data analysis parameters enabled a thorough evaluation of the outcomes related to the use of prophylactic antibiotics in dental procedures, offering significant insights for clinical decision-making.

Risk of bias

The systematic review followed a series of pre-established steps aimed at minimizing potential bias. Initially, the inclusion and exclusion criteria were implemented to significantly reduce bias. Additionally, the use of randomization, blinded data processing, blinded study evaluation, and individual article screening contributed to progressively minimizing the risk of bias throughout the review. The overall bias was evaluated using the Cochrane Handbook's risk of bias tool [11]. The findings focused on factors such as sequence generation, blinding of participants, personnel, and outcome assessors, as well as selective reporting, incomplete data, allocation concealment, and other potential biases during the process. The results are displayed in **Figure 1**.

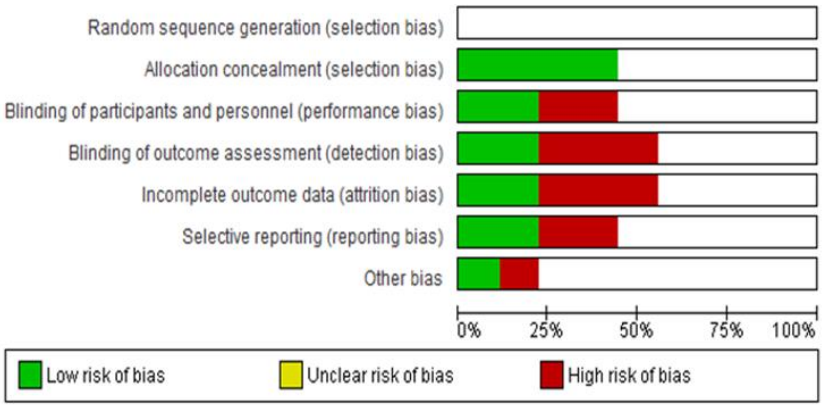

Figure 1. Risk of bias of the studies.

Search criteria

This systematic review concentrated on studies published between 2013 and 2024. A targeted search was conducted using specific keywords to ensure accuracy and relevance. The primary sources for the literature search included major medical databases such as Medline, PubMed, and Google Scholar as supplementary resources. The review adhered strictly to well-established protocols, including the PRISMA [12] guidelines (**Figure 2**) and the Cochrane methodology. These approaches were selected to maintain high standards of thoroughness and transparency throughout the review process.

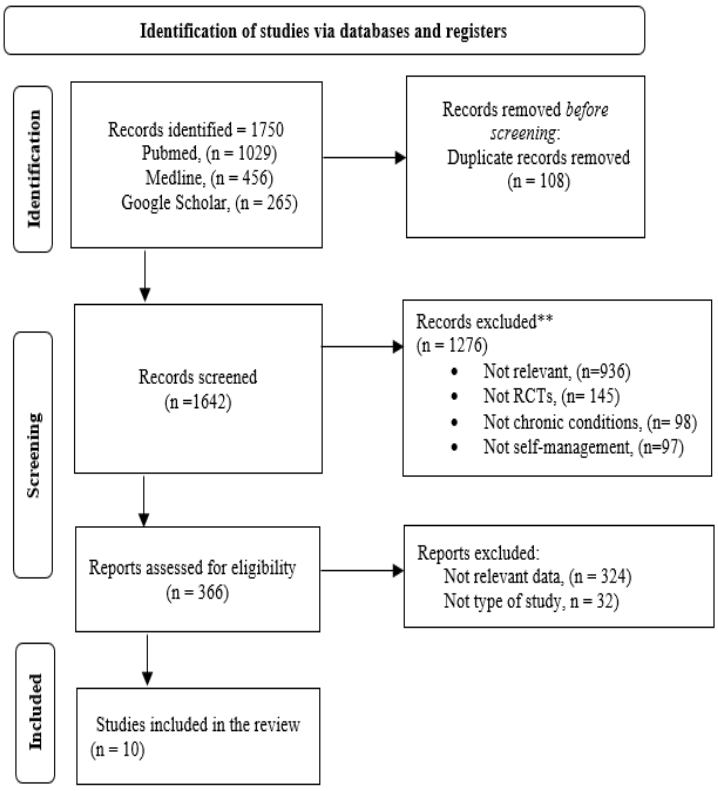

Figure 2. PRISMA flow diagram.

Results and Discussion

Literature search

The extensive literature search, utilizing both electronic and manual techniques, initially yielded 1750 articles (**Figure 2**). Through a detailed screening process, 108 duplicate records were identified and removed. The remaining 1642 articles underwent an in-depth review of their titles and abstracts. From this, 366 articles were selected for further scrutiny, leading to a comprehensive evaluation of their full texts.

After a careful assessment of eligibility, ten [9, 13-21] articles were ultimately included in this systematic review. These articles, published between 2013 and

2021, represent a wide array of research within the designated period (**Table 1**).

Study characteristics

Table 1. Characteristics of the included studies

Study	Study design	Population	Prophylactic substance used	The most frequent bacteria identified	Regimen	Outcome	Procedure
Khooharo *et al*. [13]	Random control trial	75	Amoxicillin (500 mg)	Didn't test	A 500 mg oral dose of amoxicillin was administered one hour before extraction.	5.33% of patients had dry socket	Extraction
Barbosa *et al*. [14]	Random control trial	52	Chlorhexidine (CHX) (0.2%)	Streptococcus Viridans	10 ml of CHX mouthwash was used for 1 minute before extraction.	71% of Streptococcus remained	Extraction
Barbosa *et al*. [14]	Random control trial	52	CHX (0.2%,1%)	Streptococcus Viridans	CHX–10 ml of 0.2% mouthwash for 1 minute / Subgingival irrigation with 1.8 ml of 1% CH for 1 minute.	79% of Streptococcus remained	Extraction
Barbosa *et al*. [14]	Random control trial	52	CHX (0.2%,1%)	Streptococcus Viridans	CHX – 0.2% mouthwash, 10 ml for 1 minute / 1% CHX supragingival irrigation, 10 ml for 1 minute.	69% of Streptococcus remained	Extraction
Limeres Posse *et al*. [15]	Random control trial	52	Amoxicilini/clavulanate 1000/ 200 mg	Streptococcus Spp.	Administered intravenously during the procedure.	No bacterial growth was observed 1 hour post-extraction	Extraction
Limeres Posse *et al*. [15]	Random control trial	50	Amoxicillin 2 g	Streptococcus Spp.	A 2 g oral dose, taken 1 to 2 hours before extraction.	4% of bacterial growth recorded 1 hour post-extraction	Extraction
Duvall *et al*. [16]	Random control trial	10	Amoxicillin/CHX 0.12% (mouth rinse)	Streptococcus Viridans	15 ml of CHX for 1 minute, along with a 2 g tablet taken pre-operatively.	40% incidence of bacteremia	Extraction
Duvall *et al*. [16]	Random control trial	10	CHX 0.12% (Mouth rinse)/Placebo.	Streptococcus Viridans	15 ml of CHX was used for 1 minute before the procedure.	60% incidence of bacteremia	Extraction
Marttila *et al*. [17]	Random control trial	10	Amoxicillin 2g	*Streptococcus*	A 2 g oral dose of amoxicillin.	No bacteremia was detected in blood samples 20 minutes post-extraction	Extraction

Edsor *et al*. [18]	Random control trial	80	Amoxicillin 2g	No aerobic bacterial was found	A 2 g oral dose of amoxicillin taken 1 hour before extraction	No aerobic bacteria were found 30 seconds after elevating the mucoperiosteal flap	Extraction
Gazal *et al*. [19]	Random control trial	46	Amoxicillin 625 mg	Didn't test	625 mg of amoxicillin taken 1 hour before the procedure	15% of patients developed dry socket	Extraction
Halabi *et al*. [20]	Random control trial	372	CHX 0.12% mouthwash	Didn't test	15 ml of solution for 30 seconds, used for 7 days starting 24 hours post-procedure	2.68% incidence of alveolar osteitis among patients	Extraction
Ugwumba *et al*. [21]	Random control trial	48	CHX 0.2% mouthwash	Staphylococcus aureus	0.2% CHX mouthwash for 1 minute before the procedure	27.1% of patients showed positive bacteremia	Extraction
Mohan *et al*. [9]	Random control trial	68	Amoxicillin 500 mg	Didn't test	Amoxicillin 500 mg tablet, taken three times daily	2.94% of patients experienced bacteremia	Extraction

Amoxicillin was utilized in six studies [9, 13, 15, 17-19]. In the study by Khooharo *et al.* [13], a single preoperative dose of 500mg amoxicillin was shown to be effective in reducing the risk of dry sockets. Limeres Posse *et al.* [15] administered 2 g of amoxicillin before the procedure and observed a 4% bacterial growth in blood samples collected one hour after extraction. Marttila's study, which also used 2 g of amoxicillin preoperatively, found no bacterial growth in blood samples 20 minutes post-extraction [17]. The Edsor study, which involved extractions of teeth with periodontal and periapical pathology, used 2 g of amoxicillin before the procedure and detected no aerobic bacteria in the blood samples [18]. Gazal et al. [19] used a 625 mg dose of amoxicillin one hour before the procedure, with 15% of patients developing dry socket symptoms (e.g., pain and bad breath) five days after the surgery. In Mohan et al.'s study [9], 500 mg of amoxicillin was administered preoperatively, and the infection rate was found to be 2.94%, with symptoms including severe pain, pus discharge, and trismus.

In another study by Limeres Posse *et al.* [15], intravenous amoxiclav (1000/200 mg) was used before surgery, and no bacterial growth was observed in blood samples taken one hour after the extraction.

Chlorhexidine was investigated in 4 studies [14, 16, 20, 21]. Barbosa's research examined three different prophylactic approaches using chlorhexidine: a 0.2% CHX mouthwash, a 0.2% CHX mouthwash combined with subgingival irrigation (1% CHX), and a 0.2% CHX mouthwash along with supragingival irrigation (1% CHX). No statistically significant differences were observed in blood samples regarding residual streptococcus among these methods [14]. In Duvall et al.'s study [16], a 0.12% CHX mouth rinse was administered, and post-extraction analysis revealed a 60% incidence of bacteremia in blood samples. Halabi *et al.* [20] also employed a 0.12% CHX mouthwash before the procedure, reporting that 2.68% of patients developed alveolar osteitis. Ugwumbaet administered a 0.2% CHX solution before extraction and collected blood samples 15 minutes later, finding that 27.1% of cases exhibited positive bacteremia [21].

Duvall *et al.*'s [16] study also incorporated a combination of 2g amoxicillin and a 0.12% CHX mouth rinse before extraction. Blood samples taken 10 minutes post-extraction indicated that 40% of patients had bacteremia levels exceeding baseline.

Discussion

This systematic review examines infections and related complications in the oral cavity, with a strong focus on antibiotics frequently prescribed before dental extractions. A significant portion of the research centers on the prophylactic use of amoxicillin and chlorhexidine, which are widely studied in this context [9, 13-21]. In contrast, amoxiclav appears to be less

commonly utilized as an antibiotic, as indicated by the limited number of studies addressing its use.

The reduction in postoperative infection rates observed with amoxicillin and amoxiclav is consistent with the well-documented antibacterial effects of beta-lactam antibiotics [22]. As members of the penicillin class, both medications have proven effective in managing and preventing odontogenic infections [23]. However, the comparable infection rates between amoxicillin and amoxiclav suggest that the inclusion of clavulanic acid in amoxiclav may not provide a significant advantage in post-extraction prophylaxis [15]. Additionally, variations in patient demographics, surgical techniques, and follow-up periods across studies should be considered, as they may influence the interpretation of these findings.

Chlorhexidine's slightly lower effectiveness compared to antibiotic regimens raises important considerations regarding its role as an independent prophylactic measure after tooth extraction. Recognized for its broad-spectrum antimicrobial properties, chlorhexidine effectively targets a range of microorganisms [24]. However, its ability to prevent infections following dental extractions appears somewhat less robust than that of antibiotic treatments [16]. This suggests that while chlorhexidine remains a potential option in certain cases, it may not be the most suitable choice when enhanced antimicrobial protection is required [20].

The safety profiles of prophylactic agents play a crucial role in clinical decision-making. Both amoxiclav and amoxicillin are well-tolerated, with minimal reports of adverse effects [25]. While Chlorhexidine has been associated with a higher incidence of mild local irritation, this aligns with previous findings and must be considered alongside its broad antimicrobial activity [26]. Selecting between antiseptics and antibiotics requires a careful evaluation of their effectiveness in preventing infections, potential side effects, and the broader implications of antimicrobial stewardship, including concerns about antibiotic resistance [27].

Amoxicillin stands out as the primary pharmaceutical agent, commonly administered in oral tablet form [9, 13, 15-19, 28]. Its use is largely postoperative, aimed at preventing infections in extraction sites or managing existing infections. Similarly, chlorhexidine is employed as a prophylactic agent, often in combination with other substances such as diacetate [14, 16, 20, 21]. The effectiveness of chlorhexidine in infection prevention is particularly noted at a 0.2% concentration in prophylactic solutions.

Conclusion

This systematic review highlighted the predominant use of amoxicillin and chlorhexidine Prophylaxis in comparison to amoxiclav. Administering amoxicillin preoperatively has proven to be an effective strategy for minimizing post-extraction complications. While chlorhexidine Prophylaxis does not match the efficacy of antibiotics, it remains a simple and low-risk addition to the procedure.

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