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# Effectiveness of systemic antibiotic therapy in reducing dry socket incidence after tooth extraction: A randomized controlled trial.

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**Abstract**

Alveolar osteitis, commonly known as dry socket, is one of the most frequent postoperative complications following tooth extraction and is associated with significant patient discomfort and delayed healing. Although several preventive strategies have been proposed, the role of systemic antibiotic therapy in reducing its incidence remains controversial due to concerns about effectiveness and antimicrobial resistance. This study aimed to evaluate the effectiveness of systemic antibiotic therapy in reducing the incidence of dry socket after tooth extraction in a primary healthcare center located in northern Peru. A quantitative, longitudinal, randomized controlled trial was conducted, including a total of 120 patients undergoing tooth extraction. Clinical evaluations were performed postoperatively, and data were recorded using a standardized data collection form. The results showed that the overall incidence of dry socket varied across demographic groups, with similar proportions observed between males (27.5%) and females (26.7%). Regarding age distribution, the highest frequency was observed in patients aged 46 years and older (25.0%), followed by younger age groups. Patients receiving systemic antibiotic therapy showed a lower occurrence of dry socket compared to those who did not receive antibiotics. These findings suggest that systemic antibiotic therapy may be effective in reducing the incidence of dry socket following tooth extraction. However, its use should be carefully considered in the context of clinical indications and antimicrobial stewardship.

**Keywords:** Alveolar Osteitis, Tooth Extraction, Anti-Bacterial Agents, Postoperative Complications, Randomized Controlled Trial.

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## Introduction

Alveolar osteitis, commonly known as dry socket, is one of the most frequent and painful postoperative complications after tooth extraction. It is generally characterized by the premature loss or disintegration of the intra-alveolar blood clot, exposure of the socket walls, intense postoperative pain, and delayed local healing. Although its pathophysiology is not fully resolved, contemporary evidence supports a multifactorial process involving fibrinolysis, local inflammation, bacterial colonization, and surgical trauma. Reported incidence varies according to the type of extraction and the diagnostic criteria used, but it is consistently higher after mandibular third molar surgery than after routine dental extractions. [1–5]

Previous literature has identified several factors associated with dry socket, including surgical difficulty, traumatic extraction, smoking, oral contraceptive use, and local or systemic conditions that may interfere with clot stability and wound healing. In particular, prospective and review-based evidence has highlighted surgical trauma and operator-related variables as important contributors, while hormonal exposure has also been associated with increased susceptibility in some patient groups. [6–9] At the same time, preventive strategies remain controversial. A randomized controlled trial by Millones and Huamaní reported outcomes supporting systemic antibiotic therapy in the reduction of dry socket frequency after simple extraction, whereas broader evidence syntheses have shown that, although prophylactic antibiotics may reduce the risk of dry socket in some extraction settings, the magnitude of benefit is modest and must be weighed against adverse events and antimicrobial stewardship concerns. [10–13]

This unresolved balance between possible benefit and prudent antibiotic use gives the topic clear clinical and public health relevance. In everyday dental practice, dry socket may lead to severe pain, repeated postoperative visits, additional medication use, and delayed recovery, thereby increasing the burden on both patients and primary care services. [4,14,15] However, routine administration of systemic antibiotics after extraction remains difficult to justify unless there is sound evidence supporting their indication in specific clinical contexts. Therefore, evaluating their effectiveness in real outpatient settings remains important, particularly in primary healthcare environments where decision-making must consider both patient outcomes and responsible antibiotic prescribing. [11–15]

The objective of this study was to evaluate the effectiveness of systemic antibiotic therapy in reducing the incidence of dry socket after tooth extraction in a primary healthcare center located in northern Peru. This research is justified by its contribution to the clinical and methodological understanding of postoperative dry socket prevention, with direct implications for evidence-based dental practice and rational antibiotic use in ambulatory oral surgery. [10–15]

## Methods

### *Study Design*

This study was designed as a two-arm, parallel-group randomized controlled trial conducted at a primary healthcare center located in northern Peru. The trial was prospectively carried out between October and November 2022 to evaluate the effectiveness of systemic antibiotic therapy in reducing the incidence of dry socket after simple tooth extraction. The study was reported in accordance with the CONSORT 2010 Statement for parallel-group randomized trials. [16]

### *Participants, sample size, and randomization*

The source population consisted of patients attending the dental service of the study center for simple tooth extraction during the study period. A total population of 192 potentially eligible patients was identified.

Participants were eligible if they were aged 18 years or older, agreed to participate, and had an indication for extraction of a single tooth for prosthetic,

orthodontic, or endodontic reasons, including chronic pulp necrosis with or without periapical involvement or irreversible pulpitis. Patients were excluded if they required odontosection or osteotomy, were receiving any concurrent pharmacological therapy, had undergone root canal treatment more than 6 months earlier in the tooth indicated for extraction, required third molar extraction, reported smoking, alcohol or illicit drug use, required intraligamentary anesthesia, had systemic disease, or had physical or mental conditions that could interfere with adherence to postoperative instructions.

The sample size was calculated for a finite population using an expected dry socket prevalence of 29%, a 95% confidence level, and a 5% margin of error, resulting in a required sample of 120 participants. This parameter was based on previous post-extraction alveolar osteitis data reported in the literature [17]. Eligible patients were selected through simple random sampling and then randomly allocated into two study groups: an intervention group receiving systemic antibiotic therapy and a control group not receiving antibiotics.

### *Intervention and clinical procedures*

All extractions were performed by the dentist in charge of the dental service under routine clinical conditions. Local anesthesia was administered using 2% lidocaine with epinephrine 1:80,000. Simple extraction was carried out using elevators, forceps, and alveolar curettes as required, followed by socket suturing with 3-0 black silk. All participants received postoperative instructions and analgesic therapy.

The intervention group received paracetamol 500 mg immediately after surgery, with an additional tablet only if pain occurred, plus systemic antibiotic therapy consisting of amoxicillin 500 mg every 8 hours for 5 days. In patients reporting penicillin allergy, clindamycin 300 mg orally every 6 hours for 5 days was prescribed instead. Participants in the intervention group also received daily telephone reminders to reinforce adherence to the prescribed antibiotic regimen. The control group received only paracetamol 500 mg after surgery, with one additional tablet if needed for pain.

### *Outcome assessment and data collection*

The primary outcome was the occurrence of dry socket after simple extraction. Outcome assessment was performed through postoperative clinical examination 7 days after extraction, or earlier if the patient reported symptoms suggestive of alveolar osteitis. Data were recorded using a structured clinical data collection form that included participant identification data, exposure to antibiotic therapy, and presence or absence of dry socket.

The study variables were defined as follows: the independent variable was systemic antibiotic therapy, categorized as “received” or “not received”; the dependent variable was dry socket, categorized as “present” or “absent.” Sex and age were recorded as covariates from the clinical history.

### *Measurement instrument*

Data were obtained through direct postoperative clinical examination and review of the clinical record using a structured data collection form specifically developed for this study. Because the instrument was used to record clinical and demographic information rather than latent constructs, formal psychometric validity and reliability testing were not applicable. Outcome determination was based on clinical assessment performed according to the study protocol.

### *Statistical Analysis*

Data were summarized using absolute and relative frequencies and presented in contingency tables. To evaluate the association between systemic antibiotic therapy and the occurrence of dry socket, the chi-square test ($\chi^2$) was applied. A significance level of 5% ($p < 0.05$) was established. All analyses were conducted using IBM SPSS Statistics software (version 26.0; IBM Corp., Armonk, NY, USA).

### *Ethical Considerations*

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and with the institutional ethical framework governing research involving human participants [18]. Written informed consent was obtained from all participants before enrollment. Confidentiality of personal and clinical information was preserved throughout the study, and the identity of the participating healthcare center is not disclosed in this manuscript for institutional privacy reasons. The protocol was reviewed and approved by the institutional ethics committee in accordance with its research ethics regulations in force at the time of the study.

## Results

A statistically significant association was found between systemic antibiotic therapy and the incidence of dry socket among patients undergoing tooth extraction ($\chi^2 = 78.076$, $p < 0.001$). Patients who received antibiotic therapy exhibited a lower prevalence of dry socket (25.0%) compared to those who did not receive antibiotics (29.2%) (Table 1).

**Table 1.** Effectiveness of systemic antibiotic therapy in reducing dry socket incidence after tooth extraction in a primary healthcare center in northern Peru, 2022.

| Antibiotic therapy | Dry socket (Present) | Dry socket (Absent) | Total | $\chi^2$ | p |
|---|---|---|---|---|---|
| | f (%) | f (%) | f (%) | | |
| **Received** | 30 (25.0) | 36 (30.0) | 66 (55.0) | | |
| **Not received** | 35 (29.2) | 19 (15.8) | 54 (45.0) | 78.076 | 0.000 |
| **Total** | 65 (54.2) | 55 (45.8) | 120 (100.0) | | |

Regarding sex distribution, dry socket occurred at similar rates in male (27.5%) and female patients (26.7%), with no substantial differences between groups (Table 2). In terms of age, a higher prevalence was observed in patients aged ≥46 years (25.0%), compared to those aged 25–35 years (15.8%) and 36–45 years (13.3%) (Table 3). These findings suggest that antibiotic therapy may be associated with a reduced incidence of dry socket, while increasing age appears to be linked to a higher frequency of this condition.

## Discussion

The present randomized controlled trial demonstrated that systemic antibiotic therapy was associated with a lower occurrence of dry socket following tooth extraction. This finding is clinically relevant considering that alveolar osteitis is a postoperative complication characterized by premature clot disintegration, intense pain, and delayed healing, as described by Blum [1] and Kolokythas et al. [2]. From a biological perspective, fibrinolysis and bacterial colonization play a central role in its pathogenesis, which supports the theoretical basis for antimicrobial prophylaxis.

The results of this study are consistent with the randomized clinical trial conducted by Millones and Huamani [10], who reported a reduction in dry socket frequency in patients receiving systemic antibiotics. Similarly, Ramos et al. [11] found in a meta-analysis that antibiotic use may reduce postoperative complications, including alveolar osteitis. This is further reinforced by the Cochrane review by Lodi et al. [12], which concluded that antibiotics can reduce the incidence of dry socket, although their indication must be carefully balanced due to antimicrobial resistance concerns. More recently, Camps-Font et al. [13] demonstrated through network meta-analysis that antibiotic prophylaxis may significantly decrease postoperative complications in third molar surgery.

**Table 2.** Prevalence of dry socket according to sex in patients undergoing tooth extraction in a primary healthcare center in northern Peru, 2022.

| Dry socket | Male<br>f (%) | Female<br>f (%) | Total<br>f (%) |
|---|---|---|---|
| **Present** | 33 (27.5) | 32 (26.7) | 65 (54.2) |
| **Absent** | 34 (28.3) | 21 (17.5) | 55 (45.8) |
| **Total** | 67 (55.8) | 53 (44.2) | 120 (100.0) |

**Table 3.** Prevalence of dry socket according to age group in patients undergoing tooth extraction in a primary healthcare center in northern Peru, 2022.

| Dry socket | 25–35 years<br>f (%) | 36–45 years<br>f (%) | ≥46 years<br>f (%) | Total<br>f (%) |
|---|---|---|---|---|
| **Present** | 19 (15.8) | 16 (13.3) | 30 (25.0) | 65 (54.2) |
| **Absent** | 15 (12.5) | 13 (10.8) | 27 (22.5) | 55 (45.8) |
| **Total** | 34 (28.3) | 29 (24.2) | 57 (47.5) | 120 (100.0) |

Nevertheless, the role of systemic antibiotics remains controversial. Garola et al. [14] emphasized that alveolar osteitis is a multifactorial condition in which surgical trauma, fibrinolytic activity, and patient-related factors play a significant role. In addition, recent evidence suggests that local preventive strategies may be equally or more relevant than systemic interventions. For instance, Bowe et al. [19] reported that chlorhexidine application significantly reduces dry socket incidence, highlighting the importance of local antimicrobial control. Similarly, Daly et al. [20] demonstrated that local antiseptic measures can be effective in preventing alveolar osteitis without exposing patients to systemic antibiotic risks.

Regarding demographic factors, the distribution of dry socket according to sex observed in this study is consistent with previous evidence suggesting that sex alone is not a definitive predictor. Parthasarathi et al. [6] and Rakhshan [7] reported that multiple variables influence its occurrence. However, hormonal factors may contribute to increased susceptibility in women, particularly those using oral contraceptives, as demonstrated by Almeida et al. [8] and confirmed by Tang et al. [9]. These findings indicate that patient-specific risk assessment remains essential in clinical decision-making.

In terms of age, a higher frequency of dry socket was observed in older patients in this study. This may be explained by delayed tissue repair and systemic conditions affecting healing. However, the literature shows variability, as Kostares et al. [5] reported that surgical difficulty and local factors are more strongly associated with dry socket than age alone. Furthermore, recent studies have emphasized that procedural variables such as surgical trauma, duration of extraction, and operator experience significantly influence outcomes, as described by Lago-Méndez et al. [21].

The strengths of this study include its randomized controlled design and standardized clinical protocol, which enhance internal validity. However, several limitations must be considered. The study was conducted in a single healthcare setting, limiting external generalizability. Additionally, potential confounding variables such as oral hygiene, surgical complexity, and operator variability were not fully controlled. Moreover, the absence of stratified analysis for different antibiotic regimens may limit the interpretation of the therapeutic effect.

Future research should focus on multicenter randomized trials with larger and more diverse populations. Comparative studies evaluating different antibiotic protocols, as well as alternative preventive approaches such as antiseptic agents or biological therapies, are needed. Recent evidence by Martín-Ares et al. [22] suggests that platelet-rich fibrin and other regenerative approaches may play a role in preventing dry socket, while systemic antibiotic stewardship remains a critical consideration in modern clinical practice.

## Conclusions

Systemic antibiotic therapy was associated with a reduced incidence of dry socket following tooth extraction in the studied population, with fewer cases observed among patients who received antibiotics compared to those who did not. These findings suggest that antibiotic therapy may contribute to the prevention of alveolar osteitis; however, considering the multifactorial nature this complication, its use should be clinically justified and integrated within a broader preventive approach that includes adequate surgical technique and postoperative care, in accordance with principles of antimicrobial stewardship.

## Author Contributions Statement (CRediT)

**EPCQ:** Formal analysis, Data curation, Validation, Visualization, Conceptualization, Methodology, Supervision, Writing – Original Draft, Writing – Review & Editing.

**EPCQ:** Investigation, Resources, Project administration, Writing – Review & Editing.

All authors critically reviewed the intellectual content and approved the final version of the manuscript for publication.

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## Conflict of Interest

The authors declare no financial, institutional, or personal conflicts of interest that could have influenced the conduct or publication of this study.

## Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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