REVIEW

DOI: 10.62838/ASMJ.2025.1.02

Data about application of chlorhexidine as a periodontal irrigant – Systematic Review.

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Abstract

Introduction. The most commonly used lavage solution for periodontal irrigation are diluted antiseptic solutions, the most important of them, is chlorhexidine solution. The ability of chlorhexidine to be fixed for periods of time of 8 hours on the surface of the tooth is among the main characteristics of the mechanism of action of this solution. Aim of the study. The aim of this study is to reveal the latest news about the indications for the application of chlorhexidine in cases of periodontal pathologies. Material and Methods. The electronic search to complete the purpose of the study was carried out on PubMed website for the latest area period, using the selected key words. Results. Based on the analysis of 32 articles extracted from the literature, from the combination of the key words chlorhexidine and endodontics and periodontics, not antibiotics, not probiotics, it was noticed that only 1 article was not included in the scope of our study. Conclusions. For chlorhexidine as a periodontal solution, the effects are known mainly in the control of bacterial plaque, but it is believed that new ways or different systems of its release should be found to express the periodontal effect. The side effects of chlorhexidine as a periodontal irrigating solution are better known, but in the processed data no concrete conclusions emerge as to which concentration of chlorhexidine would be the most indicated for specific periodontal diagnoses.

Keywords: antibiotics, probiotics, chlorhexidine, non-surgical treatment, indications, endodontic lavage solution, persistent apical periodontitis.

Introduction

Chlorhexidine, both as an endodontic lavage solution and as a periodontal disinfectant, has antiseptic values that, regardless of the field where it is applied, positive clinical results are regularly mentioned in articles published in the literature [1-3]. Depending on where it is performed in relation to the position of the gingival margin, periodontal irrigation is divided into supra and subgingival irrigation. Despite the fact that the solutions may be the same, these two types of procedures differ from the implementation technique, which is mainly based on the purpose of irrigation. Irrigation is also divided depending on where it is performed at home by the patient himself or at the dental unit [1-5]. Regardless of where it is performed, the principle of irrigation is the same: the high pressure of the exit of the lavage solution is used from a small exit of the syringe with which the solution is applied, with the aim of falling with great force on the surface of the tooth [2,6]. This exit is positioned on the surface of the tooth or on the surface of the gingiva, with the aim of either removing the bacterial plaque or massaging the gingiva on

which it falls with force [3,6]. If another solution is used instead of water as lavage solution, then it is expected that this solution will also have an antibacterial effect according to the specific mechanism of action of the selected solution. The possibility that the solution passes through the interproximal surfaces is higher than the possibility that these surfaces are cleaned by interdental brushing [6-9].

This fact increases the clinical value of periodontal irrigation application. This value is even higher in cases where the difficulty of cleaning different surfaces increases, such as in the case of fixed orthodontic appliances, or in cases of crowding of teeth, the presence of rough surfaces as a result of interproximal fillings, etc. Irrigation removes bacterial plaque and reduces gingival inflammation as a result of gingival massage, as a result when performed properly with appropriate techniques [1,10-12]. In continuation of this logic, the irrigating solution collides with force against the surface of the tooth and mainly against the entrance surface of the gingival sulcus; irrigation in this way turns into the best method of introducing the lavage solution into the interior of the sulcus, of the periodontal pocket [2,7,13-15]. The most commonly used lavage solutions for periodontal irrigation are diluted antiseptic solutions, the main one being chlorhexidine solution. The reduction of the creation of bacterial plaque is achieved up to 45%-61% of the possible amount of creation compared to other oily rinses, which achieve this effect up to 20%-35%, while the reduction in the appearance of gingivitis reaches up to 27%-67% in the case of chlorhexidine application and 25%-35% in the case of application of other oily rinses. The most commonly used preparation for rinsing is currently chlorhexidine digluconate 0.12%. The two side effects of prolonged or higher concentration chlorhexidine application are staining of the necks of the teeth, staining of resin or silicate fillings, and temporary deviations in the perception of taste [16-20].

The aim of this study is to reveal the latest news about the indications for the application of chlorhexidine in cases of periodontal pathologies.

Material and methods

The study is oriented around the collection of already published data on chlorhexidine as a solution applied for both endodontic and periodontal procedures of dental treatment and further on the ways of its application, the indicated percentages of the irrigating solution, the way of application as lavage solution or by means of membranes or retraction threads in the gingival sulcus. The aim of this study is to analyze how the chlorhexidine solution acts as a periodontal rinsing solution, which is the most indicated percentage of the solution based on periodontal diagnoses, etc. Focus is also given to the specificity of the lavage solution against the oral bacterial flora, or the main constituent element of this flora, and the sensitivity to chlorhexidine, depending or not on the concentration of the lavage solution used. The other field of application of chlorhexidine summarizes the periodontal reasons for application in both solution and gel form. In this regard, the purpose of analyzing the data is oriented around the fact whether

chlorhexidine is applied for reasons of controlling bacterial plaque or for reasons of healing existing periodontal pathologies.

The action of chlorhexidine in tissue healing in the periapex is another point of view that once again shows the mechanism of action in the periodontium in the periapex, which is not very different from the periodontium as a structure positioned at the neck of the tooth. The electronic search was performed on the PubMed website, using keywords according to the following electronic search steps:

Stage 1: application of keywords: chlorhexidine and endodontics and periodontics [1-32];

Stage 2: application of inclusion and noninclusion criteria of articles in further analysis with keywords: not antibiotics, not probiotics. The time interval of the search is 3 years. Articles published in PubMed about chlorhexidine and the reasons for its use in dental treatments, regardless of the areas of dental specialties.

The filters or the selected criteria are: abstract and full text, English language, and publications within the time interval of about 3 years. The time interval of the research is 3 years. Articles published in PubMed about chlorhexidine as a lavage solution closely related to its fields of application, without excluding the cases of articles where chlorhexidine is mentioned only for the side effects of oral application. The period was chosen due to the fact that the evolution of ideas on the application of this topical solution and the possible control or not that this solution achieves against the oral bacterial flora inside the gingival sulcus, or around the periapical areas of the infected roots of the teeth indicated for initial endodontic treatment, or for endodontic re-treatments, are in significant exploration and evolution for decades, presented in the already published literature.

From a total of 32 articles, through the second stage of selecting articles of interest in accordance with the purpose of our study, 1 article is left out [32]. Based on the analysis of 32 articles extracted from the literature on the combination of the keywords chlorhexidine and endodontics and periodontics, not antibiotics, not probiotics, it was noticed that only 1 article was not included in the scope of our study.

Reasons for exclusion:

1. Articles where other primary lavage solutions are mentioned and simple chlorhexidine is mentioned as a way of applying the lavage solution but not with concrete results—1 article [32].

The inclusion or not of the articles in the further study was not difficult, as the combination of keywords during the electronic search was very specific, and the articles included in the second stage of the electronic search were very specifically included, covering the scope of the study topic. The most frequent association of chlorhexidine as lavage solution with the prescription of antibiotics for the treatment of both endodontic and periodontal pathologies was eliminated by entering the exclusionary combination of keywords in the early stages of the electronic search.

In the selection of articles, two reviewers were involved, who were previously instructed on the way of selecting articles with the criteria of inclusion and exclusion in further analysis. The data collected by the two specialists were processed and checked by a third member of the team of specialists involved in order to minimally eliminate the same sources and to perform the initial control of the collected data. At figure 1, it is shown the way of selecting the article for further analysis according to the Prisma flow chart.



Figure 1. Prisma Flow Chart

Results

After analyzing the studies selected in this study, based on the selection criteria, data collection and processing are presented in the following tables. Table 1 shows the collected data depending on the type of article published and the dental specialty where chlorhexidine was applied as an antiseptic solution. The 3 year period of inclusion of the articles selected for this study was chosen to reflect the trend of scientific research on chlorhexidine as lavage solution, regardless of the dental specialty or dental treatments where it is indicated to be applied. This is because chlorhexidine has a wide field of application, even as an inhibitor of the degradation of the hybrid layer under fillings or dental restorations with composite.

Table 1. Data about the types of articles included in the study were presented depending on the dental specialty where it was applied and depending on whether it was taken for analysis as a single solution or as a comparative solution with other irrigating solutions.

Dental specialty	Endodontics	Periodontology	Total
СНХ	Karaoglan F et al. $2022^{(2)}$ Kichler V et al. $2021^{(6)}$ Rasaiah SR et al. $20219^{(7)}$ da Silva TA et al. $2023^{(9)}$ Minavi B et al. $2021^{(11)}$ Tandon J et al. $2022^{(12)}$ Eren SK et al. $2022^{(17)}$ Teixeira FFC et al. $2022^{(21)}$ Yao Y et al. $2021^{(23)}$ Hajihassani N et al. $2022^{(24)}$ Jose J et al. $2021^{(25)}$ Kurt SM et al. $2022^{(31)}$ 12 articles – 39%	Jaganath BM et al. 2023 ⁽⁴⁾ Kuo TY et al.2023 ⁽⁸⁾ Kumar A et al. 2023 ⁽¹⁴⁾ Li L et al. 2023 ⁽¹⁸⁾ Kuska-Kielbratowska A et al.2022 ⁽²⁰⁾ 5 articles – 16%	17 articles – 55%
CHX-other irrigators	Tonini R et al. 2022 ⁽¹⁾ Jeong JW et al. 2021 ⁽³⁾ Gabrielli ES et al.2022 ⁽¹⁰⁾ Corrazza BJM et al. 2021 ⁽¹⁶⁾ Teixeira FFC et al. 2022 ⁽²⁷⁾ Godoi-Jr EP et al. 2023 ⁽²⁸⁾ Martinho FC et al. 2023 ⁽³⁰⁾ 7 articles – 23%	Bahavikatti SK et al. $2021^{(5)}$ Radulescu V et al. $2022^{(13)}$ Zhou P et al. $2021^{(15)}$ Naghsh N et al. $2023^{(19)}$ Lang O et al. $2021^{(22)}$ YaghootiKhorasani MM et al. $2022^{(26)}$ Mathew M et al. $2022^{(29)}$ 7 articles – 23%	14 articles – 46%
Total	19 articles – 61%	12 articles – 39%	31articles – 100%

Table 2 shows those articles that have yielded values in the clinical success of the application of chlorhexidine for periodontal treatment reasons.

Table 3 shows data collected from the articles based on the percentage of application of chlorhexidine for periodontal reasons as an oral cavity rinse.

Type of study Diagnosis/Action	In Vivo	In Vitro	Total	
Therapy - composite restorations	-	Jaganath BM et al. 2023 ⁽⁴⁾ - 1 article (3%)	1 article- 3%	
Periodontology – control of bacterial plaque	Kumar A et al. 2023 ⁽¹⁴⁾ Li L et al. 2023 ⁽¹⁸⁾ Mathew M et al. 2022 ⁽²⁹⁾ 3 articles – (9%)	Bhavikatti SK et al. 2021 ⁽⁵⁾ Naghsh N et al. 2023 ⁽¹⁹⁾ YaghootiKhorasani MM et al. 2022 ⁽²⁶⁾ 3 articles (9%)	6 articles - 19%	
Chronic periodontitis - treatment	Kuo TY et al. 2023 ⁽⁸⁾ Radulescu V et al. 2022 ⁽¹³⁾ 2 articles (6%)	-	2 articles- 6%	
Periodontal surgery - wound healing	-	Zhou P et al. 2021 ⁽¹⁵⁾ Lang O et al. 2021 ⁽²²⁾ 2 articles – (6%)	2 articles – 6%	
Candidiasis – Oral medicine	_	Kuska-Kielbratowska A et al. 2022 ⁽²⁰⁾	1 article – 3%	
Total	5 articles – 16%	7 articles - 23% 12 articles - 39%		

Table 2. This table shows the data on the application of chlorhexidine for periodontal reasons and the impact it has as an oral cavity rinse according to the orientations of the specialties of dentistry.

Table 3. Concrete data about the effects of chlorhexidine based on the percentage of the solution applied for periodontal purposes.

Percentage of CHX Periodontal application	0.12%	2%	No % specified	Total
Therapy - composite restorations	-	-	1 article ⁽⁴⁾ - 3%	1-3%
Periodontology – control of bacterial plaque	4 articles ^(14,18,26,29) – 7%	-	2 articles $^{(5,19)} - 6\%$	6 - 13%
Chronic periodontitis - treatment	1 article ⁽¹³⁾ (3%)	-	1 article $^{(8)} - 3\%$	2-6%
Periodontal surgery - wound healing	-	-	2 articles ^(15,22) (6%)	2-6%
Candidiasis – Oral medicine	1 article ⁽²⁰⁾ – 3%	-		1-3%
Total	6 articles – 13%	0 - 0%	6 articles – 13%	12 - 26%

Discussions

From the data in Table 1, it can be seen that the trend of scientific research about chlorhexidine as an irrigating solution is more oriented around the specialty of endodontics with any concrete specificity of the effect of this solution on the periapical bacterial flora [7,11,12]. This trend is expressed in the values of 61% of the articles about the application of chlorhexidine in endodontics and 39% of the articles about the application of chlorhexidine in periodontology. Perhaps the effect of chlorhexidine as an irrigating solution in periodontology is already known and is only taken in cases of group-control studies where other irrigating solutions are compared for the antiseptic effect with that of chlorhexidine [1,3,10,26,29].

This logic supports again from data in Table 1, where it is shown that studies of the control group type where other lavage solutions are compared with chlorhexidine include about 46% of the articles, while the articles that reevaluate chlorhexidine for new properties or new applications in the field of dentistry are in about 55% of the articles included in this study. Also important is the fact that most of the studies about the effectiveness of chlorhexidine were carried out with "in vivo" types of studies. In almost 34% of the articles, this fact is mentioned.

From the data in Table 2, it can be seen that the highest percentage belongs to the articles related to the application of chlorhexidine as a controller of the bacterial plaque; this is said to be a fact mentioned in about 19% of the articles included in this study [5,14,18,19,26,29]. From Table 2, it seems that it is preferred to carry out in vitro research still on the control of the effect of chlorhexidine when applied as a periodontal lavage solution; this translates into a value of about 23% of the included articles in this study [4,5,15,19,20,22,26] against in vivo study type articles that occupy almost 16% of the selected articles [8,13,14,18,29]. Again, from Table 2, attention is drawn to the articles on wound healing after periodontal surgical interventions [15,22]. In these articles, it is emphasized that all periodontal lavage solutions that are indicated to be applied after periodontal surgical procedures have a negative effect on wound healing, but this influence mainly depends on the dosage of the irrigant, from the time between the intervals between oral rinses, and from the daily duration of application. To eliminate this fact, rinses of plant origin are needed, but as effective as chlorhexidine [15]. The negative effect that chlorhexidine has on the regeneration of the periodontal ligament is always emphasized [22].

Following this logic, compared to the studies carried out of the "in vitro" type that occupy almost 25%. From the data in Table 3, it is clear that the concentrations of chlorhexidine when used for periodontal reasons are more popular at 0.12% and 2% values. These solution percentages based on the selected items are applied in an almost 1:1 ratio, having no specific preferences or indications against certain chlorhexidine concentrations.

The strong points of this study include the selected viewpoint to analyze the periodontal lavage solution, bringing this viewpoint to the way of analyzing the collected data. The limits of this study are guided by the number of published articles that met the inclusion criteria in the analysis.

The most frequent reason for its application is for the control of bacterial plaque, which has two sub-divisions in the table with the values of 3% and 6%. So, in total, the indication as a controlling irrigator against the creation of bacterial plaque is in the values of 19% [5, 14,15,18,19,20,29].

Attention is drawn in this table to the application of chlorhexidine for anti-fungal [20] effect that is of the same sensitivity as ozonized water.

Conclusions

The clinical value of chlorhexidine as a periodontal lavage solution, the trend of scientific research is to prove the value of this solution also during endodontic applications where it fights against the same periodontal bacterial flora but which has canal access towards the periapex. For chlorhexidine as a periodontal solution, the effects are known mainly in the control of bacterial plaque, but it is believed that new ways or different systems of its release should be found to express the periodontal effect. The side effects of chlorhexidine as a periodontal irrigating solution are better known, but in the processed data no concrete conclusions emerge as to which concentration of chlorhexidine would be the most indicated for specific periodontal diagnoses.

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Conflict of Interest: None to declare.

Acknowledgments

Acknowledgments belong to our family. Henri and Hera are our motivation in the field of scientific research.

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Received: March 01, 2025 / Accepted: April 17, 2025