Clinical Research

Subgingival chlorhexidine irrigation for scaling and root planing adjunctive therapy in chronic periodontitis: a systematic review

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ABSTRACT

BACKGROUND Scaling and root planing (SRP) is a conventional treatment for chronic periodontitis; however, it has limitations in treating deep pockets. To enhance its efficacy, chlorhexidine (CHX) is proposed as adjunctive therapy with SRP due to its broad antimicrobial spectrum, low systemic toxic activity in humans, absence of oral microorganism resistance, and lack of teratogenic effects. This study aimed to know the efficacy of the adjunctive therapy of CHX.

METHODS A literature search was conducted using various databases including PubMed, LIVIVO, EBSCOhost, and Google Scholar, following the Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines within the last 10 years (2011–2021). Clinical parameters such as plaque index (PI), gingival index (GI), bleeding on probing (BOP), pocket depth (PD), and clinical attachment level (CAL) were recorded. The risk of bias in the selected studies was assessed using Cochrane Collaboration's Handbook version 5.2.0.

RESULTS Of 368 studies, 10 met the inclusion criteria, with 8 of them having a higher quality. Higher reduction of PI, GI, BI, PD, and CAL were observed in SRP with CHX irrigation compared with SRP alone.

CONCLUSIONS Overall, adding CHX to SRP appeared to have additional clinical benefits compared with SRP alone in the treatment of chronic periodontitis.

KEYWORDS chlorhexidine, periodontitis, root planing, therapeutic irrigation

Periodontal disease is a prevalent dental and oral health issue in Indonesia, with 74.1% of the population suffering from periodontitis. Periodontitis is an oral infection that leads to the loss of tooth-supporting tissue, resulting in loose and eventually missing teeth.[1] It can be caused by microorganisms such as *Porphyromonas gingivalis*, *Actinobacillus actinomycetemcomitans*, *Prevotella intermedia*, *Tannerella forsythia*, and *Fusobacterium nucleatum*, which cause inflammation in periodontal tissue and result in clinical attachment loss, alveolar bone loss, and periodontal pocket formation.[2,3] According to the American Academy of Periodontology, chronic periodontitis is common in adults and is characterized by attachment loss and bone resorption. The disease has a slow to moderate progression and is marked by the presence of subgingival calculus. Several studies have shown that chronic periodontitis affects patients' quality of life and negatively impacts their physical, functional, and psychological well-being and social activities.[4]

Treatments for chronic periodontitis can be divided into non-surgical and surgical procedures.[3] Surgical procedures are typically performed in a second phase (corrective) after evaluating the results of the first phase of non-surgical therapy.[5] Scaling and root planing (SRP) is a non-surgical treatment to eliminate infected tissues and subgingival microbiota in the inflamed pocket.[6,7] However, SRP has limitations in accessing deep pockets, furcation, and areas with altered root morphology, leading to plaque deposits and eventually recolonization of pathogenic bacteria in the treated area.[8] This also depends on the operator's skill and patient-related factors such as smoking status and systemic disease. As a result, adjunctive subgingival irrigation therapy is necessary to support SRP.[9,10]

Subgingival irrigation is a part of local antimicrobial therapy used in conjunction with other treatments to treat periodontal disease.[10] The irrigation fluid is applied directly into the periodontal pocket to enhance the effectiveness of mechanical treatment, prevent the recolonization of microorganisms, and improve the health of periodontal tissues.[10] The clinical parameters as indicators of treatment success include plaque index (PI) to evaluate the success of SRP, gingival index (GI) and bleeding on probing (BOP) to assess levels of gingival inflammation, pocket depth (PD) to measure the distance between the gingival margin and the pocket base, and clinical attachment level (CAL) to measure the distance between cementoenamel junction (CEJ) and the bottom of the pocket.

Chlorhexidine (CHX) is an antimicrobial utilized as adjunctive therapy to SRP and has shown significant clinical benefits compared with conventional mechanical root debridement alone. CHX has several advantages as an irrigating material, including its broad antimicrobial spectrum, low systemic toxicity to humans, no reported resistance among oral microorganisms, and lack of teratogenic effects.[11] However, long-term use of CHX may cause issues such as mucosal desquamation, tooth staining, and altered taste sensation.[11] This study aimed to compare the use of subgingival CHX irrigation as adjunctive therapy to SRP with SRP alone to treat chronic periodontitis.

METHODS

This systematic review was performed following the Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines, with PROSPERO registration number 387315. The review was limited to the population, intervention, comparison, and outcome research question, which focused on chronic periodontitis patients receiving SRP and subgingival irrigation with CHX as intervention, compared with SRP alone, with outcomes measured by CAL, PI, GI, BOP, and PD. The literature search was conducted using some electronic databases including PubMed, EBSCOhost, Google Scholar, and LIVIVO. Additionally, manual hand-searching of reference lists and snowball searches were carried. Keywords used in the electronic database searches included "((periodontitis) OR (chronic periodontitis)) AND ((scaling root planing) OR (non-surgical therapy)) AND ((subgingival irrigation) OR (chlorhexidine))", while "subgingival irrigation in chronic periodontitis" was used in Google Scholar and manual searches.

The inclusion criteria for this review included randomized controlled trials (RCTs) published in the last 10 years, used 0.12–0.2% CHX concentrate, and evaluated clinical parameters of periodontal tissue. Exclusion criteria included non-human studies, systematic review and meta-analysis studies, and studies on patients with chronic periodontitis but coexisting systemic diseases.

The quality of RCTs was evaluated by two reviewers (AG and YPP) using the revised risk of bias assesment tool from Cochrane Collaboration's Hanbook version 5.2.0 in the Review Manager software version 5.4 (UK Charity and a Limited Liability Company, United Kingdom), which evaluated domains such as random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective outcome reporting, and other biases.

PI was measured based on Silness and Loe and Turesky-Gilmore-Glickman's modification of the Quigley-Hein PI, with the aid of an explorer and mouth mirror.[11,12] The GI in several studies was assessed according to the Loe and Silness indices and evaluated the severity of gingival inflammation.[11,12] BOP or bleeding index (BI) or sulcus bleeding index using BI of Muhlemann was determined by the percentage of the area that bled after probing.[13,14] PD was the distance between the gingival margin and the bottom of the pocket using a probe.[14,15] CAL was measured as the loss of attachment from CEJ to the bottom of the pocket using a probe, both at baseline and follow-up.[11,12]

RESULTS

Of 368 studies obtained in the initial search, 10 met the inclusion criteria and were used in this study (Figure 1). Eight studies were RCTs, and two were RCT and split-mouth method.

Studies that did not meet all four criteria or had two high-risk values were considered low-quality studies, whereas high-quality studies were those that met four or more criteria. Based on the risk of bias assessment, most studies had a low risk of bias, and only two had a high risk of bias. The summary graph of the risk of bias is shown in Figure 2.

The results showed that the greatest decrease in PI was 75.6% in the SRP with CHX group after 30 days.[11] However, when comparing with the SRP group alone, only three[10,11,14] out of ten[10–19] articles demonstrated a significant decrease. The largest decrease in GI was 88.4%, which occurred after 1 month in the SRP with CHX group.[16] When comparing between groups, only four[11,12,14,17] out of eight[11,12,14–19] articles showed significant differences. The greatest decrease in BOP value was 82.6%, which was observed after 6 months in the SRP with CHX group.[15] When comparing between groups, only one[14] out of seven[10,12–14,16–18] articles revealed a significant reduction. The largest decrease in PD was 51.4%, which was seen after 1 month in the SRP with CHX group.[11] When comparing between groups, only four[11–13,18] out of nine[10–16,18,19] articles showed a significant decrease. The greatest decrease in CAL was 62.1%, which occurred after 1 month in the SRP with CHX group (Table 1). However, only one[11] out of eight[10–12,14,16–19] articles showed a significant decrease when comparing between groups.

DISCUSSION

Chronic periodontitis can be treated effectively by eliminating plaque and etiologic factors that cause inflammation in the periodontal tissues.[20] Petersilka

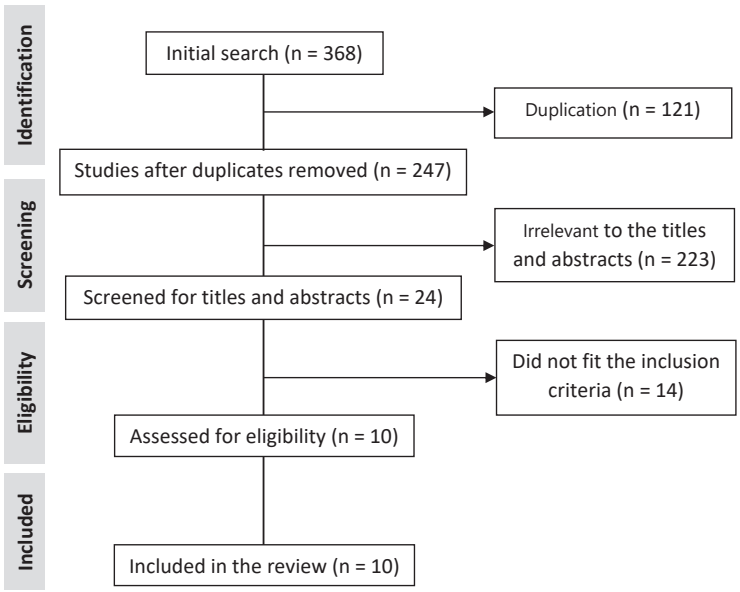

Figure 1. Flow diagram of the study selection

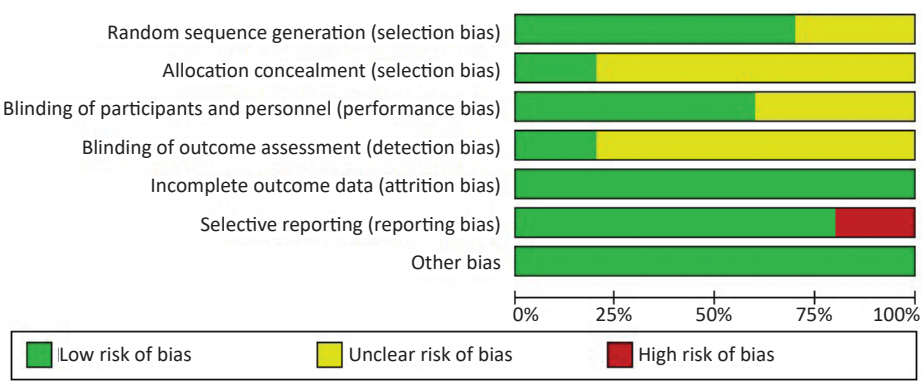

Figure 2. Risk of bias graph

Table 1. Result of data extraction

First author, year	Intervention, N	Control, N	Study duration	Reduction from baseline (%)															
				PI		GI		BI or BOP		CAL		PD		SBI		RAL		BANA	
				Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control
Ravindrareddy,[17] 2012	SRP + 0.12% CHX with WaterPik® device, 40 sites	No intervention, 40 sites	45 days	22.2	18	33.8	20.3	75.8	64.6	5.1	4.9	-	-	-	-	-	-	-	-
Vitt,[13] 2019	SRP + 0.2% CHX, 21 patients	SRP + distilled water, 19 patients	12 months	22	22	-	-	24	27	-	-	20.3	20.3	-	-	-	-	-	-
Tumer,[16] 2019	SRP + 0.2% CHX, 30 patients	SRP + distilled water, 30 patients	1 month	57.4	50	88.4	87.7	77.1	81.8	62.1	42	21.7	22.4	-	-	-	-	-	-
Tewari,[18] 2018	SRP + 0.2% CHX irrigation, 22 patients	SRP + NS irrigation, 22 patients	3 months	69.3	65	38.3	30.1	-	-	25	15.1	41.8	15	71	67	-	-	-	-
Nagarathna,[12] 2018	SRP + 0.2% CHX, 15 patients	SRP-only, 15 patients	40 days	47	38.2	48.6	41.4	-	-	20	26.3	34.5	24.1	-	-	-	-	-	-
Lecic,[10] 2016	SRP + 0.2% CHX, 20 pockets	SRP-only, 20 pockets	3 months	1	1	-	-	1.2	1	27	32.2	50	45	-	-	-	-	-	-
Vaish,[19] 2016	SRP + 0.2% CHX, 10 patients	SRP-only, 10 patients	3 months	33.3	21.7	15.7	5.3	-	-	-	-	8.1	6.5	-	-	6.9	3.3	-	-
Gottumukkala,[15] 2013	SRP + 0.2% CHX, 11 patients	SRP + NS, 11 patients	6 months	51.3	34	82.6	69.6	82.6	60.9	-	-	42.1	30.3	-	-	-	-	91.3	69.6
Sağlam ,[14] 2013	SRP + CHX irrigation, 15 patients	SRP + NS, 11 patients	3 months	48	42	46.1	40.4	72	67	29.4	31.1	23	25	-	-	-	-	-	-
Nandini,[11] 2012	SRP + 0.2% CHX, 10 patients	SRP + NS, 10 patients	30 days	75.6	49	71	27.3	-	-	-	-	51.4	28.2	-	-	34.5	8.6	-	-

BI=bleeding index; BOP=bleeding on probing; CAL=clinical attachment level; CHX=chlorhexidine; GI=gingival index; NS=normal saline; PD=pocket depth; PI=plaque index; RAL=relative attachment level; SBI=sulcus bleeding index; SRP=scaling and root planing; BANA= N-benzoyl-DL-arginine-2-naphthylamide

et al[21] have shown that up to 30% of the treated root surface can be recolonized by bacteria within 60 days of SRP-only treatment, leading to a recurrence of periodontal disease. Treatment strategies by combining SRP with antimicrobial agents have been developed to prevent early recolonization and improve clinical outcomes.[17] CHX, an antibacterial agent with a high substantivity and broad antimicrobial spectrum, has been widely used in dentistry for over 40 years and is considered an excellent antiplaque agent.[22]

Several methods for applying subgingival irrigation materials include using a syringe connected to a needle[11,13–15,18] or a mechanical irrigator (WaterPik®, USA) by placing the tip about 1–2 mm into the pocket for about 7–10 min.[12,16] The most effective method for CHX application was demonstrated by Gottumukkala et al,[15] who used a 24-gauge needle to apply 10 ml of CHX once a week for 1 month within 20 sec.

Based on the clinical parameter results, CHX had positive effects on GI and BOP due to its anti-inflammatory effect, which reduced the concentration of basal leukocytes and proinflammatory cytokine produced by *P. gingivalis.*[23] However, CHX had insignificant effects on CAL and PD due to its cytotoxic and inhibitory effect on fibroblasts during the repair stage, which delayed fibroblast binding and periodontium regeneration.[24] Meanwhile, SRP might be the reason for the significant decrease in PI.[19]

Subgingival CHX irrigation also had positive effects on microbiological parameters. Huth et al[25] found that CHX irrigation reduced periodontal pathogens, such as *P. gingivalis, Parvimonas micra,* and *T. forsythia,* compared with ozonated water on day 40. CHX was also better than ozone in preventing microbial regrowth. Lander et al[26] observed that one episode of CHX irrigation had its peak effect at 2 to 4 weeks, indicating that CHX had a sustained effect on microorganisms for up to day 40. At high concentrations (>0.1%), CHX had a bactericidal effect by promoting cell leakage.[27]

CHX has effectively reduced gingival inflammation, controlled subgingival plaque, and treated periodontitis.[27,28] Although CHX as subgingival irrigation reduced clinical parameters in the SRP with CHX irrigation and the control groups, the difference was not significant. This might be due to the short, uneven application duration, absence of an antibacterial effect, or insufficient liquid concentration.[13] The liquid form of the antimicrobial agent might also leak after being inserted into the pocket and become contaminated by blood or gingival crevicular fluid content, presenting a major obstacle to subgingival medication application.[16] Therefore, using CHX in chip or gel form might be an alternative.[27]

The limitations of this study included the short duration of CHX usage and the small number of samples, which did not allow the researchers to identify any side effects. Further research is needed to determine the long-term and short-term effects of CHX on clinical and microbiological parameters and to find the best equipment, time interval, and frequency of CHX application for significant clinical changes. Adding subgingival CHX irrigation as adjunctive therapy to SRP for chronic periodontitis can improve patient's quality of life. In conclusion, the addition of CHX in SRP has some additional clinical efficacy over SRP alone.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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REFERENCES

1. Li A, Chen L, Thomas RZ, van der Velden U, Amaliya A, van der Sluis LWM, et al. Periodontal breakdown inter-tooth relationships in estimating periodontitis-related tooth loss. J Dent. 2021;112:103755.
2. Caton JG, Armitage G, Berglundh T, Chapple ILC, Jepsen S, Kornman KS, et al. A new classification scheme for periodontal and peri-implant diseases and conditions - Introduction and key changes from the 1999 classification. J Clin Periodontol. 2018;45 Suppl 20:S1–8.
3. Heitz-Mayfield LJ, Trombelli L, Heitz F, Needleman I, Moles D. A systematic review of the effect of surgical debridement vs non-surgical debridement for the treatment of chronic periodontitis. J Clin Periodontol. 2002;29 Suppl 3:92–102; discussion 160–2.
4. Musurlieva N, Stoykova M. Evaluation of the impact of chronic periodontitis on individual's quality of life by a self-developed tool. Biotechnol Biotechnol Equip. 2015;29(5):991–5.
5. Wolf HF, Rateitschak EM, Rateitschak KH, Hassel TM. Color atlas of dental medicine: periodontology. 3rd ed. Rateitschak KH, Wolf HF, editors. Stuttgart: Thieme; 2004.
6. Komara I, Sopiatin S, Hendiani A, Rusminah N, Susanto A. Effect of carbonate apatite membrane as adjunctive therapy of scaling and root planing on gingival crevicular fluid matrix metalloproteinase-8 in chronic periodontitis patient. J Int Dent Med Res. 2021;14(4):1517–22.
7. Garcia Canas P, Khouly I, Sanz J, Loomer PM. Effectiveness of systemic antimicrobial therapy in combination with scaling and root planing in the treatment of periodontitis: a systematic review. J Am Dent Assoc. 2015;146(3):150–63.
8. Issac AV, Mathew JJ, Ambooken M, Kachappilly AJ, Pk A, Johny T, et al. Management of chronic periodontitis using subgingival irrigation of ozonized water: a clinical and microbiological study. J Clin Diagn Res. 2015;9(8):ZC29–33.

9. Ramanauskaite E, Machiulskiene V. Antiseptics as adjuncts to scaling and root planing in the treatment of periodontitis: a systematic literature review. BMC Oral Health. 2020;20(1):143.
10. Lecic J, Cakic S, Janjic Pavlovic O, Cicmil A, Vukotic O, Petrovic V, et al. Different methods for subgingival application of chlorhexidine in the treatment of patients with chronic periodontitis. Acta Odontol Scand. 2016;74(6):502–7.
11. Nandini N, Vidya D, Komal A. Comparative evaluation of 1 % curcumin solution and 0.2 % chlorhexidine irrigation as an adjunct to scaling and root planing in management of chronic periodontitis: a clinico-microbiological study. J Pharm Biomed Sci. 2012;14(03):1–7.
12. Nagarathna DV, Shastry A, Sabhachandani NR. Comparative evaluation of the efficacy of ozonated water and chlorhexidine irrigation along with scaling and root planing and scaling and root planing alone in chronic periodontitis patients a clinico-microbiological study. Int J Innov Sci Res Technol. 2018;4(5):889–96.
13. Vitt A, Gustafsson A, Ramberg P, Slizen V, Kazeko LA, Buhlin K. Polyhexamethylene guanidine phosphate irrigation as an adjunctive to scaling and root planing in the treatment of chronic periodontitis. Acta Odontol Scand. 2019;77(4):290–5.
14. Sağlam M, Arslan U, Buket Bozkurt Ş, Hakki SS. Boric acid irrigation as an adjunct to mechanical periodontal therapy in patients with chronic periodontitis: a randomized clinical trial. J Periodontol. 2013;84(9):1297–308.
15. Gottumukkala SN, Koneru S, Mannem S, Mandalapu N. Effectiveness of sub gingival irrigation of an indigenous 1% curcumin solution on clinical and microbiological parameters in chronic periodontitis patients: a pilot randomized clinical trial. Contemp Clin Dent. 2013;4(2):186–91.
16. Tumer H, Berberoglu A, Caygur A, Yilmaz HG. Clinical evaluation of chlorhexidine and essential oils' adjunctive effects in subgingival ultrasonic instrumentation on periodontal parameters and halitosis. J Essent Oil Bear Pl. 2019;22(1):169–75.
17. Ravindrareddy N, Madhubabu DS, Mahendraraju C, Himasilpa C, Kiran K. Clinical effects of professional antimicrobial subgingival pulsated jet irrigation [WaterPik®] in patients with chronic periodontitis: a comparative study. J NTR Univ Health Sci. 2012;1(1):38–45.
18. Tewari S, Grover S, Sharma RK, Singh G, Sharma A. *Emblica officinalis* irrigation as an adjunct to scaling and root planing: a randomized controlled clinical trial. J Dent Indones. 2018;25(1):15–23.
19. Vaish S, Dodwad V, Mahajan A, Gupta S. Evaluation of clinical efficacy of 0.2% chlorhexidine irrigation, 1.5% chlorhexidine gel and 2.5mg biodegradable chlorhexidine chip as an adjunct to scaling and root planing in the management of chronic periodontitis. J Dent Spec. 2016;4(2):142–6.
20. Newman MG, Takei HH, Klokkevold PR, Carranza FA. Clinical periodontology. 2015. 872 p.
21. Petersilka GJ, Ehmke B, Flemmig TF. Antimicrobial effects of mechanical debridement. Periodontol 2000. 2002;28:56–71.
22. Amaliya A, Ramadhanti R, Hadikrishna I, Maulina T. The effectiveness of 0.2% chlorhexidine gel on early wound healing after tooth extraction: a randomized controlled trial. Eur J Dent. 2022;16(3):688–94.
23. Houri-Haddad Y, Halabi A, Soskolne WA. Inflammatory response to chlorhexidine, minocycline HCl and doxycycline HCl in an in vivo mouse model. J Clin Periodontol. 2008;35(9):783–8.
24. Alleyn CD, O'Neal RB, Strong SL, Scheidt MJ, Van Dyke TE, McPherson JC. The effect of chlorhexidine treatment of root surfaces on the attachment of human gingival fibroblasts in vitro. J Periodontol. 1991;62(7):434–8.
25. Huth KC, Quirling M, Lenzke S, Paschos E, Kamereck K, Brand K, et al. Effectiveness of ozone against periodontal pathogenic microorganisms. Eur J Oral Sci. 2011;119(3):204–10.
26. Lander PE, Newcomb GM, Seymour GJ, Powell RN. The antimicrobial and clinical effects of a single subgingival irrigation of chlorhexidine in advanced periodontal lesions. J Clin Periodontol. 1986;13(1):74–80.
27. de Freitas CV, Galdez LP, Dias HL, Cirelli JA, Souza EM, da Silva VC. Effect of subgingival irrigation with different substances in the treatment of periodontal disease. a histometric study in rats. J Int Acad Periodontol. 2016;18(1):2–6.
28. Varoni E, Tarce M, Lodi G, Carrassi A. Chlorhexidine (CHX) in dentistry: state of the art. Minerva Stomatol. 2012;61(9):399–419.