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Effectiveness Of Hydrogen Peroxide Gel Application As An Adjunct To Scaling And Root Planning As Compared To Scaling And Root Planing Alone For Pocket Reduction In Patients With Moderate To Severe Periodontitis – A Systematic Review

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Abstract:
Background*: Hydrogen peroxide is an effective chemotherapeutic agent which helps to reduce level of micro-organisms further reducing inflammation in tissues .The objective of this systemic review was to evaluate the efficacy of hydrogen peroxide gel as an adjunct to scaling and root planing as compared to scaling and root planing alone in treating moderate to severe chronic periodontitis.*
Materials and Methods*: An electronic search was made in PubMed, Google Scholar and EMBASE databases. The search strategy provided a total of 2354 studies but only 4 studies which met the inclusion criteria were included as a part of this systematic review and tabulated in a data extraction sheet .*
Results*: Four studies were included in quantitative analysis after screening by two reviewers .Randomized controlled trials have indicated a significant higher pocket reduction and bleeding index after application of hydrogen peroxide gel as an adjunct to Scaling and root planning as compared to scaling and root planning alone.*
Conclusion: *Customized tray application of hydrogen peroxide gel as an adjunct to scaling and root planning is beneficial to treat patients with moderate to severe chronic periodontitis.*
Key Word*: - peroxide gel, scaling and root planning, randomized controlled trial ,systematic review, customized tray.*

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I. Introduction

Periodontitis is an inflammatory disease caused by pathogenic microorganisms present in dental plaque (microbial biofilm), resulting in periodontal pocket formation, loss of periodontal attachment and alveolar bone around the tooth(1,2,3).Thus, the periodontal treatment with mechanical instrumentation like debridement, scaling and root planing (SRP) has been performed to reduce the microbial load or disrupt microbial biofilm(4).The traditional approach for removal of sub and supragingival plaque is a non-surgical mechanical debridement, i.e. scaling and root planing(5-7) along with surgical procedures if required(8).The bacteria which remain after a SRP procedure regenerate, and bacteria are again introduced into the oral cavity, resulting in a new biofilm formation,(9-12) , so it is required to repeat a SRP procedure in a span of at least every 3 months for periodontal maintenance. All patients with compromised immune system ,systemic disease or with limited finances would benefit from adjunctive therapeutics which may reduce progression of periodontal disease and will help to improve the oral health(13,14) . These reasons have increased the use of systemic or time-release local drug delivery agents (LDDs) which provide chemotherapeutic or antimicrobial activity as an adjunct to SRP for treatment of moderate to severe chronic periodontitis patients(15-18) .Topical applications of peroxide help to reduce plaque and gingival inflammation,(19-22) effectively and safely. The aqueous hydrogen peroxide(H_2O_2) which is present at low concentrations (i.e., 3%) has a history with long-term and high safety record(23-27) and is used as topical application in mouth rinses, dentifrices, and antiseptic gels and as an oral debriding agent and wound cleanser(28) .An antimicrobial technique, in which hydroxyl radicals are generated by H_2O_2 photolysis act as the active ingredient helping as an excellent LDD system(29) . Hydroxyl radicals when in contact with microorganisms are powerful oxidizing agents, which cause lethal oxidative damage there by helping to reduce their

number(30,31).Also ,a customized prescription-tray delivery approach to deliver peroxide (and other medications) into periodontal pockets of all depths is an advantage since the patients can use it daily at home or between office visits,(32)hence allowing the patient an adjunctive care at early stages of disease(33) . The present systematic review aims to evaluate the use of hydrogen peroxide gel as an adjunct to SRP in comparison with SRP alone in treatment of moderate to severe chronic periodontitis patients.

Rationale : Hydrogen peroxide gel is an effective chemotherapeutic agent which decreases the microbial level, thus reducing inflammation. Therefore, this systemic review was done to evaluate efficacy of hydrogen peroxide gel as an adjunct to SRP in the patients with chronic periodontitis.

Focused question : The focused question adopted the Population ,Intervention ,Comparison ,and Outcome(PICO) criteria (34) . The focused question for the present systematic review is : " Is hydrogen peroxide gel application effective as an adjunct to scaling and root planning as compared to scaling and root planning alone for pocket reduction in patients with moderate to severe chronic periodontitis ?"

Primary objective : To assess effects of hydrogen peroxide gel as an adjunct to SRP as compared to SRP alone in treatment of subjects with chronic periodontitis with respect to probing pocket depth (PPD) and bleeding index(BI).

Secondary objective : To assess the effective concentration level of hydrogen peroxide gel for the treatment of chronic periodontitis when used as an adjunct with SRP.

II. Material And Methods

Protocol And Registration: This systematic review was conducted in accordance with the Preferred Reporting Items of Systematic Review (PRISMA) (35) with registration number - CRD42023406616

Study Design : This is a systematic review of randomized controlled trials which aimed to evaluate the effect of hydrogen peroxide gel for the treatment of moderate to severe chronic periodontitis .

Information Sources and Search Strategies: An electronic search was made in MEDLINE/PubMed, EBSCO, Google Scholar from 10 February 2012 to 10 March 2022 for articles addressing the focused question .
The selection strategy was based on a combination of types, studies AND disease AND therapy using different combination of Medical Subject Headline (MeSH) terms and free text words .
MeSH terms adopted for the electronic database search were :- Hydrogen peroxide gel AND periodontitis Hydrogen peroxide gel OR Scaling and root planning Hydrogen peroxide gel AND chronic periodontitis

Types Of Studies:- randomized controlled trial OR randomized controlled clinical trial OR randomized clinical trial

Disease: moderate to severe chronic periodontitis

Therapy : hydrogen peroxide gel as an adjunct to SRP ,SRP

Inclusion criteria:
1.Randomized controlled trials interventional study.
2. Full text articles.
3.Studies published in English language only from 10 February 2012 to 10 February 2022.
4.Patients with moderate to severe chronic periodontitis.

Exclusion criteria:
Review papers, in-vitro studies, animal studies ,case reports , commentaries, interviews, updates.

Selection Process: Titles and abstracts of all identified reports were independently screened by two reviewers based on inclusion /exclusion criteria. Any disagreement was resolved by discussion from the relevant articles . Selected studies were identified and analyzed for data extraction by the two reviewers.

Data Management and Collection Process: From the selected studies the 2 reviewers collected and grouped the data into the following :-
1.Study characteristics (author ,year of publication ,design ,follow-up period)
2.Patient characteristics (no. of subjects ,age ,gender country)
3.Treatment (type ,assessed ,test and control group)
4.The collected data was then transferred into evidence-based tables to provide an overview of the included studies and data available .

Outcome And Prioritization:
The primary outcome variable was change in PPD and BI .
Secondary outcome was the concentration of hydrogen peroxide gel effective for treating the subjects of chronic periodontitis .
1. Probing pocket depth (PPD)
2. Bleeding Index (BI)

Statistical analysis

The included studies were assessed independently by two reviewers for risk of bias in each study ,by using the recommended approach for assessing risk of bias in studies in Cochrane Reviews, Rev man software5.4.1 (Higgins 2011)(36).The bias was assessed as low risk of bias ,unclear and high risk of bias .

III. Result

Titles and abstracts of all identified repots were independently screened by two reviewers based upon the inclusion /exclusion criteria. The studies identified from the electronic data base resulted in 2354 full text articles and were assessed independently. Duplicate for studies appearing to meet the inclusion criteria or with insufficient information in the title or abstract were confirmed in eligibility for the exclusion. Any disagreement was resolved by discussion among the 2 reviewers . Figure 1 is the flowchart that summarizes the article selection process .Finally 4 studies were selected for full text assessment and for data quantitative analysis as shown in Table no 1.

Figure no 1 : Shows flowchart that summarizes the article selection process

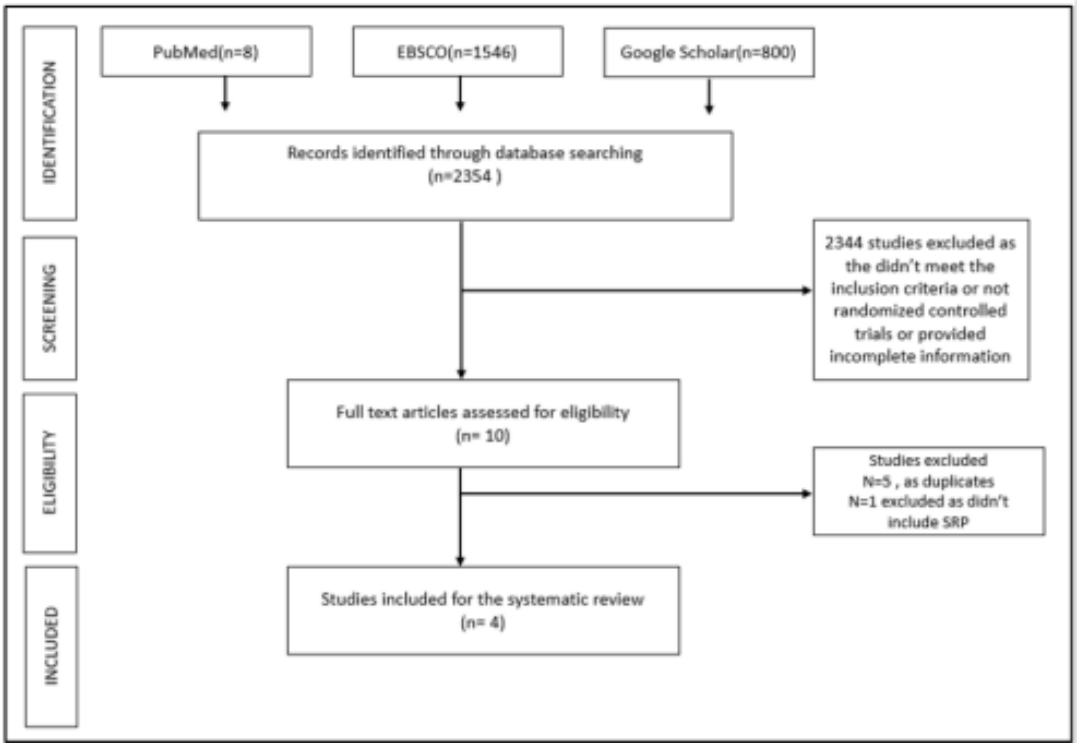


Table no 1 : Summary of included studies

First author, year of publication	Taro Kanno 2017[37]	Mark S. Putt 2014[38]	Mark S. Putt 2013[39]	Mark S. Putt 2012[40]
Study design	Randomized controlled trial	Randomized, controlled, examiner blinded, parallel-group design	Randomized, controlled, examiner blinded, parallel-group design	Randomized, controlled, examiner blinded, parallel-group design
Population characteristics (no. of subjects ,age)	53 patients, 55.5 mean years	61 patients , 18-70 years 31 patients	31 patients , 30-70 years	31 patients , 30-70 years
Periodontal diagnosis	Chronic periodontitis	Chronic periodontitis	Chronic periodontitis	Chronic periodontitis
Interventions	Group 1: Root Debridement + H_2O_2 photolysis. Group 2 :Root Debridement + minocycline chloride gel. Group 3= Root Debridement	1.SRP+ prescription tray(Perio Tray®) application of 1.7% H_2O_2 gel (Perio Gel) and, for the first 2 weeks, doxycycline. 2.SRP+prescription tray application of peroxide gel 3.SRP alone	1.SRP alone. 2.SRP+prescription custom-tray application (Perio Tray®) of 1.7% H_2O_2 gel (Perio Gel ®) for a period of 3 months, then extended to 6 months	1.SRP alone . 2.SRP+prescription custom-tray application (Perio Tray®) of 1.7% H_2O_2 gel (Perio Gel ®) for 3 months
Dosage form and concentration	3% H_2O_2 Gel	Gel, 1.7% H_2O_2	Gel, 1.7% H_2O_2	Gel, 1.7% H_2O_2
Periodontal parameters assessed	PPD ,BI	Oral soft tissue health,PPD,BI	Oral soft tissue health,PPD,BI	Oral soft tissue health,PPD,BI
Conclusion	a)PPD reduced after SRP+ Gel, 1.7% H_2O_2 gel photolysis. b)3% Gel, 1.7% H_2O_2 gel was effective for reducing PPD	a)Clinical improvement seen in PPD and BI in group b)1.7% Gel, 1.7% H_2O_2 gel was effective for reducing PPD and BI	a)Clinical improvements in PPD was maintained till 6 months after SRP with adjunctive Gel, 1.7% H_2O_2 gel b)1.7% Gel, 1.7% H_2O_2 gel was effective for reducing PPD and BI	a)Clinical improvement was seen in reducing PPD and BI in Gel, 1.7% H_2O_2 group b)1.7% Gel, 1.7% H_2O_2 gel was effective for reducing PPD and BI

Risk of Bias: The risk of bias is shown in a color-coded graphical representation where green represented low risk , yellow represented unclear risk and red represented high risk of bias. Risk of bias for included study is presented as a bar graph in Figure 2. Figure 3 indicates the risk of bias summary including risk of bias item for each included study.

Figure no .2:Risk of bias of included studies

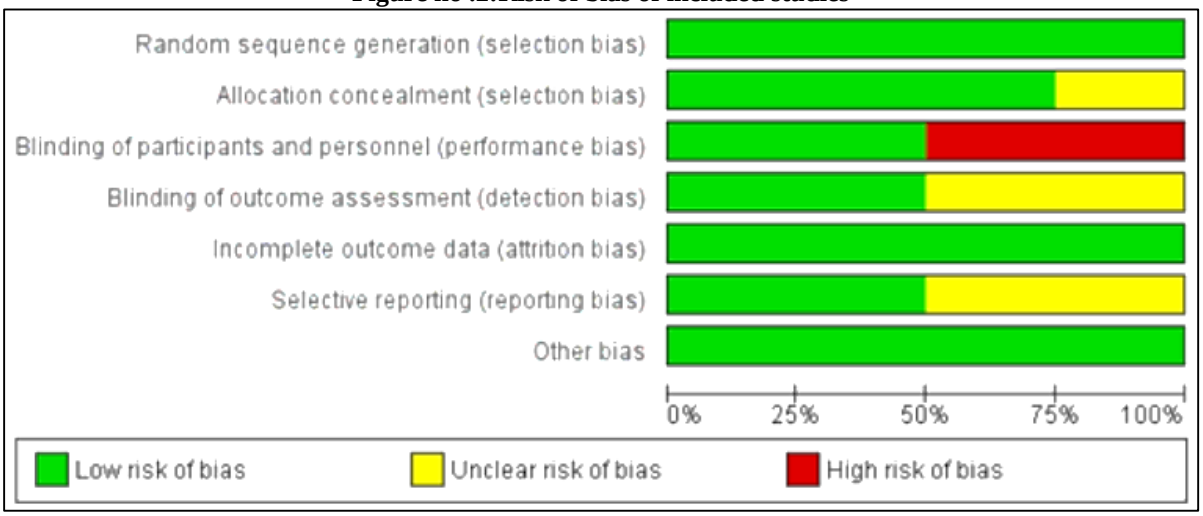
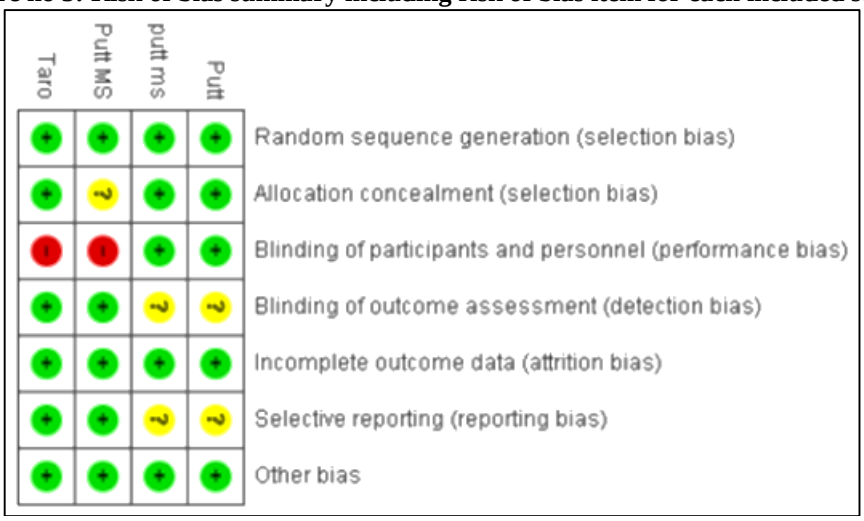


Figure no 3: Risk of bias summary including risk of bias item for each included study



IV. Discussion

The present systematic review ,aimed to evaluate the use of Gel, 1.7% H_2O_2 gel as an adjunct to SRP in comparison with SRP alone in chronic periodontitis patients. In this systematic review 4 studies were selected on the basis of inclusion criteria out of total 2354 studies . The study by Taro Kanno et al in the year 2017 (37) was a randomized controlled trial which evaluated effect of non-surgical therapy for moderate to severe periodontitis, including root debridement with antimicrobial chemotherapy based on Gel, 1.7% H_2O_2 photolysis by using newly developed RP-14 device. His final outcome of the study suggested that Gel, 1.7% H_2O_2 photolysis treatment was beneficial when used as an adjunctive antimicrobial chemotherapy during a non-surgical periodontal treatment which led to achievement of shallow pockets at the end of the treatment. He also conducted a microbial examination which revealed , treatment modalities have decreased the bacterial and P. gingivalis load in periodontal pockets. The study by Mark S. Putt in the year 2014 (38)was a randomized controlled, examinerblinded, parallel-group design study which evaluated the clinical effect of SRP alone or in combined with local administration of Gel, 1.7% H_2O_2 gel (with or without inclusion of doxycycline for 2 weeks) in customized prescription trays for the treatment chronic periodontitis. His results concluded that the adjunctive use over 6 months of 1.7% Gel, 1.7% H_2O_2 gel (with or without inclusion of doxycycline for 2 weeks) when locally administered using the prescription or customized trays, for treatment of subjects with moderate to advanced periodontitis, resulted in significant clinical improvement in PPD and BI . He also concluded that the tooth whiteness improved at each visit for both tray/peroxide treatment groups. The study by Mark S. Putt in the year 2013 (39) was a randomized controlled, examiner blinded, parallel-group design study which evaluated clinical effects of SRP procedure alone or in combination with local administered Gel, 1.7% H_2O_2 gel using customized trays for the treatment of patients with chronic periodontitis over a period of six months. His results suggested that peroxide gel-prescription tray treatment regimen with SRP was more effective than SRP therapy alone for reducing PPD and BI. It also reduced disease severity in both shallow (≤ 5 mm) and deep (> 5 mm) pockets, decreasing PPD in the latter by 1.50 mm versus 0.55 mm for SRP after 23 weeks. The study by Mark S. Putt in the year 2012 (40) was a randomized controlled, examinerblinded, parallel-group design study which compared the effectiveness of SRP to daily treatment with 1.7% Gel, 1.7% H_2O_2 gel using the prescription, custom-fabricated dental trays as an adjunct to SRP alone. There was an effective reduction in disease severity in both shallow (≤ 5 mm) and deep (> 5 mm) pockets, significantly decreasing PPD in the latter by 1.57 mm versus 0.58 mm for SRP alone after 10 weeks. In all the 3 studies by Mark S. Putt concentration percentage effective in treating moderate to severe chronic periodontitis is 1.7% of Gel, 1.7% H_2O_2 gel in customized fabricated trays as well as 3% in the study of Tarro which used a photolysis method .

V. Conclusion

Within the limitations of this study, the current systematic review states the potential of hydrogen peroxide gel as an adjunct to SRP brings effective results in reduction of PPD and BI . Concentration percentage effective in treating chronic periodontitis is 1.7% of Gel, 1.7% H_2O_2 gel as well as 3% and no adverse events were reported in any of the included articles in this systematic review for using Gel, 1.7% H_2O_2. Gel, 1.7% H_2O_2 as an adjunct to SRP can be used as a part of maintenance phase in the treatment plan. Efficacy of 3 % and 1.7% Gel, 1.7% H_2O_2gel can be studied and compared with other drugs for treating chronic periodontitis .Further

,randomized controlled trials can be performed with longer follow up periods for evaluating the effectiveness and effect of Gel, 1.7% H_2O_2 gel including subjects with chronic periodontitis presenting systemic conditions .

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