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Review Article

Dentistry Section

The Clinical Effectiveness of Post-Brushing Rinsing in Reducing Plaque and Gingivitis: A Systematic Review

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ABSTRACT

Introduction: Dental plaque is the major etiological factor associated with the development of gingivitis. Hence, maintenance of oral hygiene is very essential.

Aim:-To systematically review the literature on the effects of a post toothbrushing rinsing on plaque and parameters of gingival inflammation.

Materials and Methods: A literature review was performed in PubMed Central and Cochrane library, embase, google scholar were searched up to February 2015 to identify appropriate studies. The primary outcome measure was plaque and gingival inflammation reduction.

Results: Out of the total 56 titles appeared, 08articles fulfilled the criteria and were selected for the review. One article which was hand searched and one article which was through e-mail was included. A statistically significant reduction in overall plaque and gingivitis was noted when different mouth rinses were compared to the control ($p<0.05$). It was seen that chlorhexidine is the best antiplaque and antigingivitis agent but due to its side effects after continuous use, was not indicated for long term use. Probiotic was superior to chlorhexidine in terms of reduction of gingival inflammation.

Conclusion: There are relatively few studies evaluating the association between post toothbrushing rinsing and gingivitis. A clear effect was observed, indicating that different mouthrinses (chlorhexidine, probiotic, herbal, essential oil mouthrinse) when used as an adjunct to mechanical means of oral hygiene, provides an additional benefit with regard to plaque and gingivitis reduction as compared to a placebo or control.

Keywords: Dental plaque, Gingival diseases, Mouthwashes, Toothbrushing

INTRODUCTION

Periodontal diseases are commonly present throughout the world. The role of dental plaque is well-recognized as many of the epidemiological studies have demonstrated that there is direct correlation between severity of gingival as well as periodontal diseases and dental plaque mass. Thus, maintenance of oral hygiene is very essential [1,2]. It has been seen that improving oral hygiene and gingival health helps in reduction of the periodontal disease. Therefore, plaque control is the main factor in primary and secondary prevention of periodontal diseases [3]. There are mechanical and chemical approaches for controlling the plaque where the former is more common and cost-effective but because of its dependence on dexterity and thoroughness of the individuals as well as their compliance; it cannot be reliable all the time [4]. Thus according to the researchers when chemotherapeutic agents is combined with mechanical regimen lead to control of plaque and gingivitis with greater efficacy, which is the earliest form of periodontal disease [5,6]. Therefore the efforts to obtain maximal results from mechanical cleaning have provided the basis for implementing preventive concepts but, at the same time, also suggest the need for developing adjunctive agents for chemical plaque control [7].

Description of the Disease Condition

Dental plaque is a complex biofilm on the surface of the teeth, produced by initial colonizing bacteria in the salivary film of the enamel, followed by secondary colonization through the inter-bacterial adhesion which further lead to oral infectious diseases, such as periodontal inflammation, caries and gingivitis [8,9].

An imbalance among the matrix metalloproteinase produced by host cells on stimulation from dental plaque microorganisms and tissue inhibitors of matrix metalloproteinase (TIMP) may lead to collagen breakdown and periodontal tissue destruction [10-12].

Description of the Intervention

For plaque control antimicrobial mouthrinse in addition to mechanical methods is used as it is difficult sometimes for individuals to maintain the adequate amount of plaque control by using only mechanical methods [13,14]. It was also supported by International Association for Dental Research (IADR) in 2002 at California in USA [15]. Among these mouthrinses, chlorhexidine and essential oil-containing mouthrinses have been proved to be most suitable mouthrinses who provide long term plaque as well as gingivitis control [16].

It has been said through various studies that CHX digluconate is safe, stable and effective in preventing and controlling the plaque formation thus inhibiting the development of gingivitis [15,17]. However, the side-effects of chlorhexidine mouthwash were taste alteration, excess formation of supragingival calculus, soft-tissue lesions in young patients, allergic responses, and staining of teeth and soft tissues, which arises the question on its efficacy for long term use [17,18].

Whereas patient's motivation is also required in mouthrinse containing essential oils as they meet the long-term preventive objectives and an alcohol-free oral rinse product with antimicrobial ingredient cetylpyridinium chloride (CPC) which acts by penetrating the bacterial cell membrane that causes leakage of cell components, disruption of bacterial metabolism, inhibition of cell growth, and finally cell death [19]. Probiotic technology is also a step forward for maintaining the oral health as it uses natural beneficial bacterial which was commonly found in healthy mouths [20]. Penetration of plaque biofilms is the main mechanism of action of antimicrobial mouthrinse [21].

Why is It Important to This Review

Periodontal disease and caries are the most prevalent infectious oral diseases in humans where both are associated with dental plaque. Removal of plaque is the main key of prevention and the first step in treatment of periodontal disease [22]. Proper oral hygiene cleaning cannot be achieved by toothbrushing alone especially in inaccessible areas like proximal embrasures, which require the use of supplements like proximal cleaning aid and mouthrinses and their efficacy in reducing interproximal gingivitis has been proved through few studies [23]. Only two mouthrinse formulations: an essential oil or EO–containing mouthrinse and 0.12 percent chlorhexidine mouthrinse—have been awarded the ADA's Council on Scientific Affairs Seal of Acceptance as adjuncts for the prevention and reduction of gingivitis and plaque [24].

Thus systematic review will be of help to the clinicians in knowing the most effective mouthrinse for the reduction of plaque and gingival inflammation.

AIM

Research Question: To compare the effect of different types of mouth rinses used post brushing, on plaque and gingiva in the subjects. To assess the clinical effectiveness of different types of mouth rinses and their use in reducing the plaque and gingival inflammation.

MATERIALS AND METHODS

(i) Eligibility Criteria: The articles which were published in English, dated from the year 1990 to February 2015 were included in this review. The search terms for articles were the terms either in the title or abstract. Full text original research articles were taken. Unpublished articles in press and personal communications, etc were screened and excluded. Our focus was to be broad in scope to include as much relevant existing data as reasonably possible.

Inclusion criteria

1. Original research articles.
2. Invivo studies (Randomized Control Trials).
3. The articles emphasizing on the efficacy of post tooth brushing rinsing on plaque and gingival inflammation.

Exclusion criteria

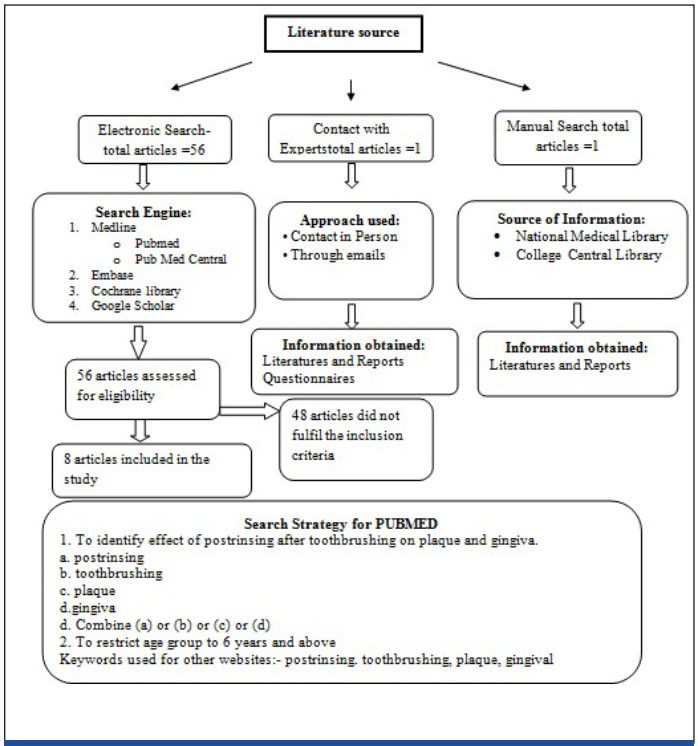
1. Narrative Review articles.
2. Studies reporting pre-tooth brushing rinsing.

Types of outcome measures: Plaque and gingival inflammation reduction as measured by change from baseline in the Plaque Index (Silness and Loe 1964 [25]; Turesky modification of Quigley-Hein Plaque Index 1970 [26]) and gingival index (Loe and Sillness 1963 [27]) is the primary outcome measure as measured. The following secondary outcomes were considered relevant: bleeding on probing in both the permanent and the deciduous dentitions; stains, presence of calculus.

Search Method for Identification of Studies: For the identification of the studies included in this review, we devised the search strategy for each database. The search stratergy used a combination of controlled vocabulary and free text terms. The main database was PubMed, PubMed Central, Cochrane Review, Embase and Google Scholar [Table/Fig-1].

Electronic Searches

1. PubMed (1990-2015).
2. PubMed Central (1990-2015).
3. Cochrane Review (1990-2015).
4. Embase (1990-2015).
5. Google Scholar (1990-2015).



[Table/Fig-1]: Search strategy.

Other Sources: The search also included the hand search of the journals fulfilling the inclusion criterion for the review.

Thus, a total of 10 full text articles were retrieved for the review [Table/Fig-2]. Reported data was analysed and represented in the form of figures and tables for the current review.

RESULTS

The included results were evaluated for the study design, blinding and evaluation period [Table/Fig-3]. The summary of the results has been provided in [Table/Fig-2].

Risk of bias in included studies: Based on ten studies, the four studies conducted were at high risk for incomplete outcome data [2,7,24,28], three studies conducted were at low risk [7,23,29] and two studies were at high risk for random sequence generation [2,15]; the five studies conducted were at low risk for allocation concealment [2,7,20,22,23]; the seven studies conducted were at low risk for blinding of outcome assessment [2,7,15,20,23,24,29]; the five studies conducted were at low risk [3,20,23,29] and the nine studies were at low risk for selective outcome reporting [2,7,15,20,22-24,28,29] [Table/Fig-4a&b].

Study Outcomes: Differences between baseline and end-of-trial scores for parameters of interest are shown in [Table/Fig-5-9].

Within Groups: The studies conducted by Turkoglu O et al., Jhingta P et al., Kiszely AA et al., Arora V et al., Najafi MH et al., Mythri H et al., Sharma N et al., Pilloni A et al., Pedrazzi V et al., presented baseline data and end of trial scores with respect to changes in time within each group [Table/Fig-5-9] [2,3,7,15,22-24,28,29]. From studies that did provide data, the general trend was that, different mouthrinse showed significant change between baseline and end of trial score for all evaluated parameters.

DISCUSSION

Bulk of the plaque is reduced mechanically but thin dental plaque is still left afterwards which can be easily reduced by chemical means. Thus the present review describes the combination of chemical and mechanical oral hygiene method which further offers the greatest efficacy of plaque control [15].

It has been seen that the chlorhexidine has the greatest success and hence considered as a gold standard against other potential antiplaque agents. However, the local side effects of chlorhexidine,

Study and year	Title	Sample size	Patient characteristic	Duration of treatment	Study design	Dose	Blinding	Results/ summary
1. Turkoglu O et al., in 2014 [2]	The effect of adjunctive chlorhexidine mouthrinse on GCF MMP-8 and TIMP-1 levels in gingivitis: a randomized placebo-controlled study	50	50 individuals aged 18–45 years of age, male or female patients with gingivitis associated with dental plaque, clinical attachment level <3 mm, a minimum of 20 teeth	28 days	2 groups:- Experimental:- (chlorhexidine mouthrinse) Control:- (placebo mouthrinse)	10 ml mouth rinse for 1 minute twice daily, 30 minutes after tooth brushing	Double blind	1.CHX group showed lower PI values than the placebo group at 4 weeks ($p < 0.05$) and the reductions in the PI from baseline were significantly greater in the CHX group ($p < 0.05$).
2. Jhingta P et al., in 2013 [3]	Effect of hydrogen peroxide mouthwash as an adjunct to chlorhexidine on stains and plaque	105 subjects	55 (57.75%) were females and 50 (52.5%) were males. The subjects included BDS and dental hygienist students of the college and the patients visiting the outpatient department of Periodontics	21 days (1 week, 2 week, 3 week)	3 treatment groups; each group comprises 35 subjects. Group I -0.2% CHX (Hexidine®) twice daily (60s) for 3 weeks after brushing. Group II -0.2% CHX (60 s) followed by 1.5% H_2O_2 (60 s) twice daily for 3 weeks after brushing. Group III - 1.5% H_2O_2 (60 s) followed by 0.2% CHX (60 seconds) twice daily for 3 weeks after brushing.	Rinsing twice daily after toothbrushing for 1 minute	Unclear	In all the three groups, there was a reduction in mean plaque score at the end of 2 weeks in comparison with scores at the end of 1 week and was significant in group I. At the end of 3 weeks also, there was further reduction in plaque scores in comparison with the scores at 2 weeks in all three groups. The reduction was significant in group I and group III. After the end of 3rd week, the mean stain area was significantly more than the scores at the end of 2nd week in group I and group II. There was less amount of plaque formed in group II than group I after the end of 1st, 2nd, and 3rd week and the difference was highly significant (p values: 000, 0.000, and 0.000, respectively. In comparison to group I, there was significantly less amount of plaque formed in group III after the end of first (p-value, 0.000) and second week (0.017). After the end of 3 weeks also, the plaque scores were less in group III than group I but it was not significant (p-value, 0.104).
3. Albert-Kiszely A et al., in 2007 [7]	Comparison of the effects of cetylpyridinium chloride with an essential oil mouth rinse on dental plaque and gingivitis – a six-month randomized controlled clinical trial.	151	151 subjects aged 18-65 yrs with good general health and minimum of 18 natural teeth(40 men and 111 women)	90 days and 180 days	2 groups:- Test group- cetylpyridinium mouthrinse Control group- essential oil mouthrinse.	rinse twice daily with 20 ml of rinse for 30 s after 1 min. of regular toothbrushing.	Double blind	There were no significant differences between the experimental and the positive control mouthrinse treatment groups for overall gingivitis status and plaque accumulation. A significant greater reduction in bleeding sites was observed for the CPC rinse versus the EO rinse. ($p<0.05$)
4. Arora V et al., in 2014 [15]	Efficacy of Dental Floss and Chlorhexidine Mouth rinse as an adjunct to Toothbrushing in removing Plaque and Gingival Inflammation – A Three Way Cross Over Trial	45	Forty five dental students in the age group of 19-25yr.	21 days	3 groups:- (n=15). Group A– Toothbrushing with Dental floss (TB+DF), Group B– Toothbrushing with 0.12% Chlorhexidine Gluconate Mouthrinse (TB+CHX-MR) and Group C– Toothbrushing alone (TB Alone)	15 ml mouth rinse for 30 seconds twice daily, 30 minutes after tooth brushing	Double blind	Group B showed more reduction in plaque and gingival scores in comparison to Group A and Group C which was found to be statistically significant ($p<0.001$). While comparing between group A and group C at second and third follow-up, no significant difference were observed.
5. Harini PM. Anegundi RT. In 2010 [20]	Efficacy of a probiotic and chlorhexidine mouth rinses: A short-term clinical study	45	45 children aged 6-8 years.	14 days	3 groups [Group A, B, and C] with 15 children in each group as follows: Group A: Control group (mint water) Group B: Probiotic group Group C: Chlorhexidine group	Rinse once daily about 30 min after tooth brushing with 15 mL of the solution (1:1 dilution for chlorhexidine) for 60 s	Double blind	There was a significant decrease in the mean PI and mean GI scores of Probiotic and Chlorhexidine groups when compared with that of the Control group. No significant differences in the mean plaque accumulations between the Probiotic and Chlorhexidine groups but there was significant difference in GI between probiotic nad chlorhexidine group (probiotic being better than chlorhexidine mean=0.2300 and 0.6805 respectively)

6. Najafi M H et al., in 2012 [22]	Comparative study of 0.2% and 0.12% digluconate chlorhexidine mouth rinses on the level of dental staining and gingival indices	60	60 patients aged 17–56 years having gingivitis and bleeding on probing but no attachment loss or bone loss.	14 days	3 groups: Experimental group- 0.2% chlorhexidine and 0.12% chlorhexidine mouthrinse Control group: Placebo	Rinsing twice daily after toothbrushing	Double blinding	Significant reduction of plaque and gingival bleeding in chlorhexidine group than placebo group. Gingival bleeding was significantly reduced in 0.2% chlorhexidine in comparison to 0.12% chlorhexidine. Dental staining was significantly more in 0.2% chlorhexidine in comparison to 0.12% chlorhexidine and placebo(more in comparison group than placebo).
7. Mythri H et al., in 2011 [23]	The efficacy of antiseptic mouth rinses in comparison with dental floss in controlling interproximal gingivitis	160	160 subjects with four index age groups 12, 15 ,35-44 and 65-74(40 in each group) were included.	3 and 6 month	4 study groups were: Group I – Brushing only (control) Group II – Brushing and flossing (Pick-n-floss dental floss holder) Group III – Brushing and rinsing with essential oil mouth rinse (Cool mint Listerine, Pfizer Company Ltd, Mumbai, India) Group IV– Brushing and rinsing with Chlorhexidine mouth rinse (0.2% Chlorhexidine gluconate)	20 ml mouth rinse for 30 seconds twice daily, 30 minutes after tooth brushing	Single blind	group I and group II showed reduction in PI, MGI and BI from baseline to 3- and 6-month evaluation, not statistically significant in comparison to group III and group IV which showed statistically significant reduction. ($p<0.05$) Comparisons between group III and group IV showed group IV to be more effective than group III.
8. Sharma N et al., in 2004 [24]	Adjunctive benefit of an essential oil–containing mouthrinse in reducing plaque and gingivitis in patients who brush and floss regularly A six-month study	246	246 patients with mild to moderate gingivitis.	6 month	3 treatment groups: group I:- brushing and rinsing with a control mouthrinse, Group II:-brushing, flossing and rinsing with a control mouthrinse, Group III:-brushing, flossing and rinsing with an EO–containing mouthrinse.	brush twice daily with an ADA-Accepted toothbrush and dentifrice as well as to rinse twice daily with a 5 percent hydroalcohol control mouthrinse.	Investigator blind	The subjects using the BFEO regimen had statistically and clinically significant lower mean Modified Gingival Index, or MGI, scores and Plaque Index, or PI, scores than did subjects in the BC and BFC group . Subjects in the BFC group had statistically significantly lower mean MGI and PI scores than did subjects in the BC group. ($p<0.001$)
9. Pilloni A et al., in 2010 [28]	Perceived and measurable performance of daily brushing and rinsing with an essential oil mouthrinse	766	766 generally healthy Italian subjects aged 19-66 years, with mild to moderate levels of gingivitis, no pockets of more than 4 mm, and at least 20 scorable teeth.	3 month	-	Brushed twice daily, immediately followed by rinsing for 30 sec with 20 ml of an essential oil mouthrinse (Listerine®).	Unclear	There was statistically significant reduction in plaque(51.9% reduction) and gingivitis(45.7% reduction). ($p<0.001$)
10. Pedrazzi V et al., in 2015 [29]	Herbal Mouthwash Containing Extracts of *Baccharis dracunculfolia* Agent for the Control of Biofilm: Clinical Evaluation in Humans	12	12 healthy individuals were taken	7 days	4 groups: Experimental:- 1. Plax 2. B. *dracunculifolia* extract and essential oil 3. Listerine Control group	Rinsing after toothbrushing for 1 minute	Triple blinding	Significant reduction of plaque in experimental group in comparison to control group. Test formulation with active B. dracunculifolia reduced the rate of plaque (biofilm) after one weekof use, in the same level as chloride triclosan, Gantrez, and essential oils. ($p<0.001$)

[Table/Fig-2]: Summary of the results.

particularly extrinsic staining and taste aberrations, have limit its long-term use [3]. The use of CPC-containing mouth rinses as an adjunct to toothbrushing have efficacy in reduction of dental plaque and gingival inflammation in both long term as well as intermediate term use [7].

A significant inhibitory effect on plaque accumulation and gingival inflammation by using probiotic mouth rinse has also been observed through this study and significant difference in the mean PI and mean GI between the Control, Chlorhexidine, and Probiotic mouth rinses groups after 14 days compared with the baseline were seen. It was seen that there were no significant differences in the PI between the Probiotic and Chlorhexidine groups on the 14th day examination whereas significant difference was observed in the GI between the Probiotic and the Chlorhexidine groups ($p = 0.009$), probiotic being better than chlorhexidine [20].

The adjunctive use of cool mint listerine antiseptic provides a clinically significant and meaningful benefit in patients with gingival inflammation which was apparent 21% incremental reduction in

Randomized clinical trial	Parallel design	Cross-over Design	Single blind	Double blind	Triple blind	No mention of blinding	Baseline evaluation
Turkoglu O et al., [2]	✓	-	-	✓	-	-	✓
Jhingta P et al., [3]	✓	-	-	-	-	✓	-
Albert-Kiszely A et al., [7]	✓	-	-	✓	-	-	✓
Arora V et al., [15]	-	✓	-	✓		-	✓
Harini PM et al., [20]	✓	-	-	✓		-	✓
Najafi MH et al., [22]	✓	-	-	✓		-	✓
Mythri H et al., [23]	✓	-	✓	-	-	-	✓
Sharma N et al., [24]	✓	-	✓	-	-	-	✓
Pilloni A et al., [28]	-	✓	-	-	-	✓	✓
Pedrazzi V et al., [29]	✓	-	-	-	✓	-	✓

[Table/Fig-3]: Study design, blinding and evaluation period.

Reference	Random sequence generation	Allocation concealment	Blinding of outcome assessment	Incomplete outcome data addressed	Selective outcome reporting
Turkoglu O et al., [2]	High risk	Low risk	Low risk	High risk	Low risk
Jhingta P et al., [3]	Unclear	Unclear	Unclear	Low risk	Low risk
Albert-Kiszely A et al., [7]	Low risk	Low risk	Low risk	High risk	Low risk
Arora V et al., [15]	High risk	Unclear	Low risk	Unclear	Low risk
Harini PM et al., [20]	Unclear	Low risk	Low risk	Low risk	Low risk
Najafi MH et al., [22]	Unclear	Low risk	Unclear	Unclear	Low risk
Mythri H et al., [23]	Low risk	Low risk	Low risk	Low risk	Low risk
Sharma N et al., [24]	Unclear	Unclear	Low risk	High risk	Low risk
Pilloni A et al., [28]	Unclear	Unclear	Unclear	High risk	Low risk
Pedrazzi V et al., [29]	Low risk	Unclear	Low risk	Low risk	Low risk

[Table/Fig-4a]: Risk of Bias.

Study	Index	Intervention/Groups	Baseline	Post Intervention scores	p-value
Turkoglu O et al., [2]	Plaque Index	I Chlorhexidine	4	2	p<0.05* -
		II Placebo	4	3	
Jhingta P. et al., [3]	Turesky modification Quigley hein Plaque Index	I Chlorhexidine	0.532± 0.214	.385± 0.15	p<0.05*
		II CHX+H202	0.252± 0.017	0.224± 0.131	
		III H2O2+ CHX	0.341± 0.208	0.325± 0.173	
Albert Kiszely A et al., [7]	Plaque Index	I 0.07% cetylpyridinium chloride mouthrinse	0.45± 0.229	0.31± 0.201	p<0.05*
		II Essential oil mouthrinse	0.41± 0.232	0.29± 0.192	
Arora V et al., [15]	Plaque Index	I Toothbrush+dental floss	0.68± 0.05	0.40± 0.16	p<0.001*
		II TB + Chlorhexidine	0.67± 0.07	0.21± 0.03	
		III TB alone	0.68± 0.05	0.40± 0.06	
Mythri H et al., [23]	Plaque Index	I Control	2.25± 0.36	2.15± 0.34	p>0.05$ (I&II)
		II Flossing	2.31± 0.50	2.21± 0.49	
		III Listerine	2.33± 0.50	2.05± 0.41	p<0.000* (III&IV)
		IV Chlorhexidine	2.35± 0.48	1.81± 0.47	
Sharma N et al., [24]	Plaque index	I BC	2.77± 0.27	2.61± 0.27	p>0.05$ (I)
		II BFC	2.78± 0.30	2.37± 0.38	
		III BFEO	2.75± 0.34	1.13± 0.60	p<0.001* (II&III)

[Table/Fig-5]: Effects on the Plaque Index (mean ± SD).
*= significant , $ = non significant

Criteria	Random sequence generation	Allocation concealment	Blinding of outcome assessment	Incomplete outcome data addressed	Selective outcome reporting
Low risk	Referring to a random number table; Using computer random number generator	Participants and investigators enrolling participants could not foresee assignment because one of the following, or an equivalent method, was used to conceal allocation: Central allocation (including telephone, web-based and pharmacy-controlled randomization); Sequentially numbered drug containers of identical appearance; Sequentially numbered, opaque, sealed envelopes.	Blinding of participants and key study personnel ensured, and unlikely that the blinding could have been broken.	No missing outcome data; Reasons for missing outcome data unlikely to be related to true outcome (for survival data, censoring unlikely to be introducing bias); Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups.	The study protocol is available and all of the study's pre-specified (primary and secondary) outcomes that are of interest in the review have been reported in the pre-specified way; The study protocol is not available but it is clear that the published reports include all expected outcomes, including those that were pre-specified (convincing text of this nature may be uncommon).
High risk	Allocation by judgement of the clinician; Allocation by preference of the participant	Using an open random allocation schedule (e.g. a list of random numbers); Assignment envelopes were used without appropriate safeguards (e.g. if envelopes were unsealed or non-opaque or not sequentially numbered); Alternation or rotation; Date of birth; Case record number; Any other explicitly unconcealed procedure	No blinding or incomplete blinding, and the outcome is likely to be influenced by lack of blinding; Blinding of key study participants and personnel attempted, but likely that the blinding could have been broken, and the outcome is likely to be influenced by lack of blinding.	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups;	Not all of the study's pre-specified primary outcomes have been reported; One or more primary outcomes is reported using measurements, analysis methods or subsets of the data (e.g. subscales) that were not pre-specified; One or more reported primary outcomes were not pre-specified (unless clear justification for their reporting is provided, such as an unexpected adverse effect);
Unclear	Insufficient information about the sequence generation process to permit judgement of 'Low risk' or 'High risk'.				

[Table/Fig-4b]: Criteria for risk of bias table.

Study	Index	Intervention/Groups	Baseline	Post Intervention scores	p-value
Kiszely AA et al., [7]	Gingival Index	I 0.07% cetylpyridinium chloride mouthrinse	0.80±0.198	0.56±0.213	p<0.05*
		II Essential oil mouthrinse	0.77±0.242	0.56±0.236	
Arora V et al., [15]	Gingival Index	I Toothbrush+dental floss	0.65±0.03	0.29±0.02	p<0.001**
		II TB + Chlorhexidine	0.63±0.03	0.18±0.01	
		III TB alone	0.64±0.03	0.32±0.04	
Mythri H et al., [23]	Modified Gingival Index	I.Control	2.24±0.37	2.21±0.37	p<0.000*
		II. Flossing	2.20±0.52	2.11±0.50	
		III. Listerine	2.18±0.49	1.57±0.36	
		IV. Chlorhexidine	2.23±0.49	1.56±0.43	
Sharma N et al., [24]	Mean Modified Gingival index	I.BC	2.11±0.09	2.04±0.17	p<0.000*
		II. BFC	2.10±0.08	1.81±0.21	
		III. BFEO	2.11±0.11	1.44±0.28	
Pilloni A et al., [28]	Gingival Index	Essential oil mouthrinse	1.95±0.73	1.06±0.80	p<0.001**

[Table/Fig-6]: Effects on the Gingival Index (mean ± SD).
* = significant, $ = non significant **Highly significant

Study	Index	Intervention/ Groups	Baseline	Post Intervention scores	p-value
Turkoglu O et al., [2]	Pappilary Bleeding Index	I.Chlorhexidine	2	1	p>0.05$ (I &II) -
		II.Placebo	2	1	
Mythri H et al., [23]	Bleeding Index	I.Control	16.87±4.71	8.97±3.23	p<0.000* (III&IV)
		II.Flossing	17.60±4.87	9.56±4.00	
		III.Listerine	18.67±6.63	4.43±4.04	
		IV.Chlorhexidine	18.12±4.83	2.80±2.74	

[Table/Fig-7]: Effects on the Bleeding Index (mean).
* = significant, $ = non significant.

Study	Index	Intervention/ Groups	1st week	3rd week	p-value
Jhingta P. et al., [3]	Lobene Index modified by Koertge and Gunsolley (GMSI)	I.Chlorhexidine	0.037±0.045	0.175±0.113	p<0.000* (I,II,III)
		II.CHX+H_2O_2	0.007±0.036	0.084±0.110	
		III.H_2O_2+ CHX	0.054±0.151	0.117±0.154	

[Table/Fig-8]: Effects on the Stain Index (mean ± SD).
* = significant, $ = non significant

Study	Index	Intervention/ Groups	Baseline	Post Intervention scores	p-value
Turkoglu O et al., [2]	Calculus Index	I.Chlorhexidine	2	2	p>0.05$ (I &II)
		II.Placebo	2	2	

[Table/Fig-9]: Effects on the Calculus Index.
* = significant, $ = non significant

gingivitis. Furthermore, rinsing with the EO– containing mouthrinse provided an additional reduction in interproximal gingivitis of 15.8 % when added to the routine brushing and flossing. Thus, this mechanical/chemotherapeutic combination seemed to provide a synergistic effect rather than additive [24]. It has been evident through various studies that herbal mouthwashes have also been used and established in the market which further reduces the gingival inflammation and plaque formation [29]. Thus, further more research in this field is recommended which will be helpful in providing more data by studying the effects of post-rinsing toothbrushing on plaque and parameters of gingival inflammation.

CONCLUSION

The dental profession having thorough knowledge about the properties and adverse effects of different mouthrinse can ensure to maximize the effect of the agent. Clinician should note the difference of action against plaque between the concentrations of different mouthrinses.

The use of daily antiseptic mouth rinse as an adjunct to mechanical plaque control help in control of plaque and gingivitis with greater efficacy is supported by many studies. The most effective mouth rinse available today is chlorhexidine gluconate 0.12%, but its adverse effects is greater when compared to ADA approved essential oils, thus the latter is more effective in controlling gingival disease. Hence, health professionals should regularly review products and have complete knowledge about the products and their efficacy based on evidence before prescribing to the patients.

The quality of the trials included in this review is variable and few reports lacked methodological details. Head-to-head comparisons of mouthrinses and other preventive strategies may provide more useful information. It is important that future trials should include the assessment of other relevant outcomes such as potential side effects and those related to acceptability of treatment. The evaluation of possible differences in effect associated to mouthrinse application features such as frequency/concentration of application, should be based on trials that directly address the comparison of such features.

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