

SYSTEMATIC REVIEW

Comparison of remineralization potential of enamel lesions by chewing gum containing various agents - A Systematic Review

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ABSTRACT

Background: Lesions on enamel causes demineralization to occur and numerous methods have been performed among which is chewing gums.

Aim: To assess the remineralization potential of enamel after chewing gums containing various agents.

Methods: This search was performed using PubMed, Science Direct, Cochrane Central Register Of Controlled Trials, Medline, Ovid Medicine using Mesh terms- Remineralization, Enamel lesions and Chewing gum. Out of 319 screened articles, 12 full text articles were assessed for eligibility and four were selected for qualitative analysis. This review was reported according to the PRISMA guidelines. In addition, four randomised controlled trials were included in the review process.

Results: The studies that were conducted showed that various agents incorporated in chewing gums enhanced the demineralization process and also aid in acid resistance.

Conclusion: Various agents incorporated in chewing gums enhanced remineralization of enamel lesions among which adding fluoride can speed up the process.

Keywords: Remineralization, Enamel lesions and Chewing gum.

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INTRODUCTION

Many years of research on tooth remineralization has many technologies that promote enamel remineralization and decrease enamel demineralization have been introduced as a result.. Tooth remineralization is a reparative process and helps in preventing cavities. It is a process that repairs lost enamel and reverse tooth damage The number of teeth remineralizing agents has steadily

increased due to the importance of oral health for patients. [1]. It is a process of enriching tooth with minerals, the remineralized crystals are less acid soluble than the original ones. Fluoride is a very effective agent in preventing caries and promoting remineralization [2].

Remineralisation has proven to be an effective process to prevent enamel lesion progression [3].

The surface layer of enamel lesion is one of the

obstacle to remineralization[4]. Enamel lesions occur by demineralization under the surface of enamel causing esthetic problems in patients. They are caused by acid producing cariogenic bacteria. The wide use of various agents in dentistry to repair lost tooth structure has gained immense popularity. Lesions may vary depending on their extent. If clinically observed initial enamel caries lesions are recognised as white opaque spots and are more soft than adjacent healthy enamel [5].

Chewing gum is available in various forms and they play a great role in the process of remineralization. Chewing gum has the tendency to increase salivary flow. They are safe and can be used for oral care at home by incorporating various non-cavity causing sweeteners like aspartame, sorbitol, xylitol etc. They reduce acid production, increase the strength of teeth and thereby reduce formation of tooth decay. Currently, it serves as a delivery system for chemicals including calcium, fluoride, and xylitol.[6]. Chewing gum used for a period of about 10 minutes will result in returning of plaque ph back to resting levels [7].

Calcium is a mineral that plays an important role in strengthening the tooth enamel. It is a component that combines with phosphate as hydroxyapatite crystals to form the hard tooth structure during tooth development. Disturbed calcium transport of enamel can lead to various developmental defects like enamel hypoplasia etc [8]. Calcium deficiency can lead to irritated gingiva, brittle teeth and cavities which in turn can cause periodontal diseases.

Fluoride is a naturally occurring mineral that reduces the prevalence of tooth decay. Fluoride ions encourage remineralization and forms fluorapatite [9]. It helps in caries prevention by means of fluoridation process which is incorporation of small amounts of fluoride in public water supplies, fluoridated mouth rinse or fluoride containing chewing gums and improve dental health by inducing arrested enamel lesions where the lesion is halted in progression [10].

A natural sugar alcohol, xylitol is the most potent one available. Long-term eating of gum containing xylitol has decreased the amount of mutant Streptococcus in saliva, thereby playing an important role in caries prevention. The frequency of its use has more importance than its amount [11]. Most of the oral bacteria cannot ferment it and it is a non-cariogenic sweetener [12]. Xylitol are found in fruits and vegetables. They help to reverse caries process and replace the tooth minerals.

Sugar free gums were found to remarkably decrease caries increment [13]. SFG can also as an addition to brushing teeth resulting in minimum plaque score reduction [14]. They are free of sugar and contain sweeteners for taste. Due to the absence of sugar in it

they are unlikely to cause caries lesions. Individuals with braces are not recommended to use them. They have a significant effect on caries reduction [15]. Sugar free chewing gums have anticariogenic property and have been assessed in many clinical trials [16].

OBJECTIVE:

The purpose of the study is to evaluate and compare the ability of chewing gum with various treatments to remineralize enamel lesions.

MATERIALS AND METHODS:

In the study randomised control trials were taken

INCLUSION CRITERIA

- Original articles related to the study
- Articles highlighting the remineralization potential of chewing gums
- Randomised control trials
- In situ studies

EXCLUSION CRITERIA

- Studies like Pilot, Cohort
- Studies without involving chewing gum usage in treating enamel lesions

SEARCH STRATEGY:

To find articles on the possibility of chewing gum to heal enamel lesions containing different agents following databases like PubMed, Science Direct, Scopus, Cochrane, Medline, Ovid Medicine were considered. Mesh terms were used to obtain the articles from each database.

Results:

369 articles were yielded from several databases. Among the eligible articles, 4 were independently assessed.

The flow chart of the report is shown in Figure 1 and shows how each step was carried out: identification, screening, eligibility assessment, exclusion, and inclusion for review.

Table 1 shows the review of articles on the remineralization potential of chewing gum incorporated with various agents. It shows the characteristics of the 4 articles included. The studies were done by randomised control trials. Agents like xylitol, calcium, fluoride were added in the chewing gum for assessing remineralisation potential of enamel lesions and were compared.

Table 2 shows the results of the studies included.

Table 3 shows the bias analysis classified as high risk, low risk and unclear risk of bias.

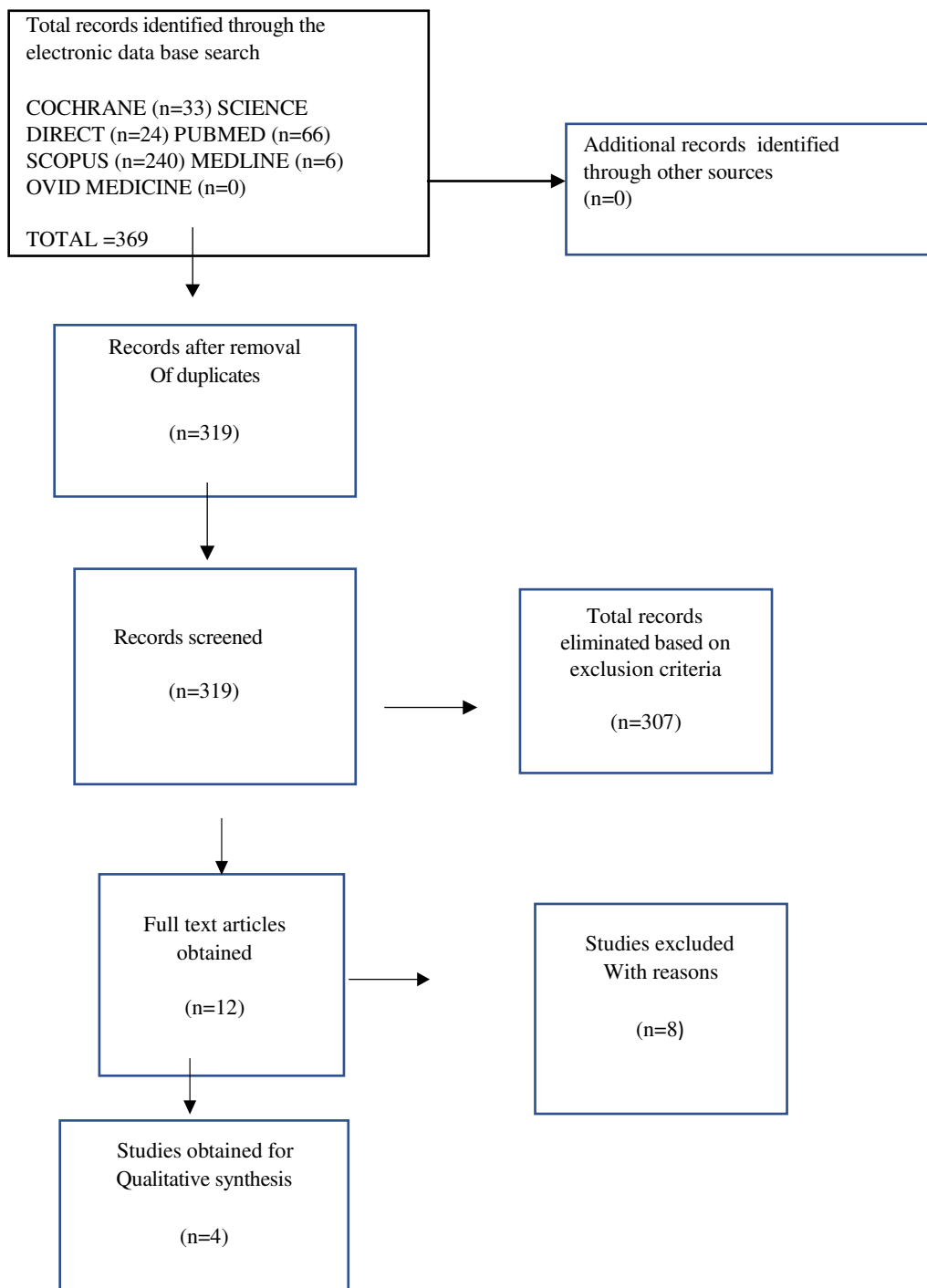


FIGURE 1: FLOW DIAGRAM DEPICTING THE AMOUNT OF STUDIES IDENTIFIED, SCREENED, ELIGIBILITY EVALUATED, EXCLUDED, AND INCLUDED IN SYSTEMATIC REVIEW.

TABLE 1: CHARACTERISTICS OF INTERVENTIONS IN THE STUDY

Author Name	Year	Patient Selection	Duration	Preparation	Intervention
E Suyama, T, Tamura, T, Ozawa, A, Suzuki, Y, Iijima, T Saito, [17]	2011	45 adults of age 23- 55 years (20 males, 25 females) <ul style="list-style-type: none"> • 21 university students of age 23-35 years (10 males, 11 females) 24 general public of age 32-55 years (10 males, 14 females) 	4 weeks	Sugar free maltitol coated chewing gum with 1.17% (w/w) green tea extract, “Camellia Extract MJ” (25 µg fluoride /piece) and sugar free maltitol coated placebo gum	Remineralization Acid resistance Score was assessed
Yuichi Kitasako ^{a1} , Miyuki Tanaka ^{a1} , Alireza Sadr ^b , Hidenori Hamba ^{ab} , Masaomi Ikeda ^c , Junji Tagami ^{ab} , [18]	2011	36 adults of age 20- 31 years (18 males, 18 females)	14 days	phosphoryl oligosaccharides of calcium (POs-Ca), fluoride- infused POs-Ca gum, and placebo gum	Remineralization score was assessed
Ying Dong, Wei Yin , Deyu Hu Ximu, Zhang, Lily Xu, W J Dodds, Minmin Tian, [20]	2014	177 school students of age 8-13 years	12 weeks	Two pieces of sugar-free chewing gum instead of gum chew for 20 minutes three times day and 12 minutes five times daily. Used was the QLF approach.	Remineralization scored was assessed
Supatra Watthanasaeen ^a , Anwar T Merchant ^b , Somkiat Luengpailin ^c , Nusara Chansamak ^d , Araya Pisek ^e , Waranuch Pitiphat ^f , [21]	2017	<ul style="list-style-type: none"> • 174 students with disabilities of age 7-18 years (93 intervention group, 81 control group) 	1 year	100% Xylitol chewing gum combined with oral health instruction versus oral health instruction only	Remineralization score was assessed

TABLE 2: RESULTS AND CHARACTERISTICS OF OUTCOME

AUTHOR NAME	YEAR	PRIMARY OUTCOME	RESULT	P-VALUE
E Suyama, T, Tamura, T, Ozawa, A, Suzuki, Y, Iijima, T Saito, [17]	2011	In comparison to placebo gums, fluoride chewing gums demonstrated higher levels of remineralization and acid resistance.	Fluoride chewing gums produced a better remineralization level and acid resistance than placebo gums	< 0.05
YuichiKitasako ^{a1} , MiyukiTanaka ^{a1} , AlirezaSadr ^b , HidenoriHamba ^{ab} , MasaomiIkeda ^c , JunjiTagami ^{ab} , [18]	2011	When fluoride is added to POs-Ca in chewing gum, the remineralization process is enhanced.	Fluoride incorporated to POs-Ca in chewing gum increased the remineralization progress	< 0.05
Ying Dong, Wei Yin , Deyu Hu Ximu, Zhang, Lily Xu, W J Dodds, MinminTian, [20]	2014	Daily chewing of sugar-free gum has a larger effect on remineralization.	Sugar free chewing gum has a significant impact on remineralization of enamel lesions	< 0.05
Supatra Watthanasae ⁿ ^a , Anwar T Merchant ^b , Somkiat Luengpailin ^c , Nusara Chansamak ^d , Araya Pisek ^e , Waranuch Pitiphat ^f , [21]	2017	Xylitol chewing gum reduced the prevalence of caries and enhanced remineralization in deciduous dentition	Chewing gum with xylitol promoted remineralization and improved overall oral health in children	< 0.01

TABLE 3: ASSESSMENT OF BIAS IN STUDIES INCLUDED FOR REVIEW

Author (year)	Random sequence generation	Allocation concealment	Selective reporting	Incomplete outcome data	Blinding of outcome assessment	Blinding of participants and personals
E Suyama, T, Tamura, T, Ozawa, A, Suzuki, Y, Iijima, T Saito, [17] 2011	+	+	+	+	+	+
YuichiKitasako ^{a1} , MiyukiTanaka ^{a1} , AlirezaSadr ^b , HidenoriHamba ^{ab} , MasaomiIkeda ^c , JunjiTagami ^{ab} , [18] 2011	+	+	+	+	+	+
Ying Dong, Wei Yin , Deyu Hu Ximu, Zhang, Lily Xu, W J Dodds, MinminTian, [20] 2014	-	+	+	+	+	?
Supatra Watthanasae ⁿ ^a , Anwar T Merchant ^b , Somkiat Luengpailin ^c , Nusara Chansamak ^d , Araya Pisek ^e , Waranuch Pitiphat ^f , [21] 2017	+	+	+	+	+	-

+ Low risk of bias ; - High risk of bias ;

? unclear risk of bias

DISCUSSION:

The review was focused to compare the potential of chewing gum incorporated with various agents to promote remineralization of enamel lesions.

E Suyama (2011) [17] reported that fluoride chewing gum (FCG) has higher resistance to acid compared to placebo gums. Fluoride content in saliva increased as a result of using two pieces of FCG continuously for 20 minutes twice a day for four weeks. This promoted remineralization of enamel lesions. According to this study, FCG has superior acid resistance and remineralization capacity than placebo gums.

Yuichi Kitasako (2011) [18, 19] reported that phosphoryl oligosaccharides of calcium (POs-Ca) gums contributed more to remineralization and recrystallisation of enamel lesions than placebo gums. The study concluded that fluoride incorporated in Pos-Ca gum yielded a superior remineralization result. Miho Sugiura (2016) concluded that addition of fluoride to POs-Ca can speed up the process of remineralization.

Ying Dong et al. (2014) [20] reported that chewing sugar free gum regularly aid to arrest as well as reverse early enamel caries lesions. This resulted after 4, 8 and 12 weeks. Greater frequency of chewing can increase remineralization. In this study, White spot enamel lesions (WSL) were evaluated using quantitative light- induced fluorescence at the baseline.

Supatra Watthanasoen et al. (2017) [21] reported that among the students with disabilities, regular use of xylitol gum decreased caries incidence in primary dentition and elevated the progress of remineralization. Overall there was improvement in the oral hygiene of the students with disabilities.

Xylitol can protect about 33% of deciduous tooth surfaces with caries. However, xylitol has been proven to have greater effect in caries prevention during the 2nd year of habitual chewing than the first year. The study also showed that there was no side effects other than the swallowing of gum by a student with visual impairment who had to withdraw for safety reasons by the research team and teachers. Suda R (2006) [12] concluded that xylitol along with calcium lactate had better remineralization potential than chewing gum with xylitol alone. Shen et al. (2001) found that the addition of casein phosphopeptide- amorphous calcium phosphate (CPP-ACP) to xylitol or sorbitol-based chewing gum increased the rate at which enamel lesions remineralized. [22].

Enamel lesions like dental caries are formed when sugar ferments into acid by acid-forming bacteria. Salivary flow increase when sugar free gums are chewed. This leads to an increase in the oral clearance rates of carbohydrates that can be fermented, buffering of plaque pH and remineralization enhancement. Demineralized enamel has reduced intensity of fluorescence [20].

CONCLUSION:

The study has come to a conclusion that sugar free chewing gum alone is sufficient to promote significant remineralization. Although incorporating agents like Pos-Ca, Xylitol, Fluoride, CPP-ACP etc can enhance the process. Adding fluoride to various other agents itself can speed up the demineralization process and also help in acid resistance. Xylitol chewing gum has been proven to promote remineralization and improve oral health in children with disabilities. These chewing gums have enhanced remineralization in both primary and permanent tooth lesions. Longer duration and frequency of chewing gum has produced in better results.

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