

The Effects of Chewing Gum on the Formation of Plaque on the Smooth Teeth Surface

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Abstract

Background and Aim: Gingivitis is the most common gingival inflammatory disease. Plaque control methods play a major role in the prevention of periodontal disease and dental caries, which include mechanical and chemical technique. The present study was conducted to investigate the effect of chewing gum on dental plaque on smooth teeth surface.

Materials and Methods: A cross-over clinical trial was conducted on 18 subjects. The study was conducted in two 2-day duration with a 4-day wash out period. At the beginning of the study, subjects received professional prophylaxis. During the study period, they refused to brush and floss. Volunteers in the test group were instructed to chew one pellet four times a day for 20 min. On the third day, O'Leary and the Bleeding Point Index were measured. In the second stage, two groups were displaced. Finally, the data were subjected to statistical analysis by paired t-test and Wilcoxon.

Results: There was no significant reduction in plaque and bleeding index in test group ($P = 0.187$) compared to control group.

Conclusion: In the absence of oral health procedure, chewing gum has no significant effect on plaque reduction in the smooth teeth surface.

Key Words: Chewing gum, plaque Index, Gingivitis

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Introduction

Gingivitis is the most common form of gingival inflammatory disease, which the etiologic factor of it is bacterial plaque that accumulates around the teeth due to poor oral hygiene.[1,2] Various methods have been proposed to control dental plaque, which the best of it is mechanical plaque control such as tooth brushing and dental flossing.[3] The use of chemical control of plaque is recommended as a complementary method for complete

removal of plaque, one of which is the use of xylitol products such as xylitol chewing.[4] Xylitol is a sugar from the polyphenol family that has a bacteriostatic effect on *Streptococcus mutans*. [5] This dietary sugar is used in various industries such as food, pharmacy and dentistry as well as in the manufacture of products such as candy, beverages and chewing gum.[6] In a study in Finland, Turku et al. showed that replacing diet sugar with xylitol reduced caries. Xylitol prevents the

proliferation of bacteria as well as their growth and accumulation and reduces the adhesion of plaque to the teeth. Long-term use of xylitol controls the growth and activity of streptococci and prevents caries.[7]

Various studies have shown the effect of chewing gum containing xylitol in reducing dental plaque,[4,7,8] while Keukenmeester et al. in 2014 demonstrated chewing gum has not been effect in circumstance of regularly oral hygiene practice but in the absence of brushing will have a significant inhibitory effect on gingival inflammation,[9] Kakodkar et al in 2012 claimed after meal, gum chewing had no effect on established buccal and lingual dental plaques.[10] Therefore, the aim of this study was to evaluate the effect of chewing gum on dental plaque on smooth tooth surfaces.

Materials and Methods

The present study is a clinical trial that was registered under IRCT20171015036782N4 and was approved by the ethics committee of Shahid Sadoughi University of Medical Sciences in Yazd ir.ssu.rec.1396.69. Participants in this study were patients referred to the Department of Dentistry and middle school students in Ashkzar (Near Yazd, central Iran) who had good oral hygiene and no progressive caries and no orthodontic brackets and severe crowding. In this cross-over study, eighteen participants aged 14 to 30 years who met the inclusion criteria were randomly selected. Individuals with complete oral and dental health, without systemic disease, no rapidly progressing caries, as well as people without orthodontic brackets and severe dental irregularities are among the inclusion criteria. In this study, subjects were first randomly and equally divided into case and control groups. Then, explained sufficiently in oral and verbal to all volunteer subjects to participate in the study and written consent was assigned by the patients. This study was performed during two periods of 2 days with a wash out 4

days.[11,12] In the first period, group A participants, which included 9 patients, were asked to chew 4 chewing gums [BIODENT made in Alborz, Iran] daily for 20 minutes after the three meals and one after the evening snack, and in the second group was not given any chewing gum.[11] The ingredients of Biodent chewing gum, according to the company, included sweeteners such as sorbitol, xylitol, mannitol, maltitol, flavorings, stabilizers including sulfamic acid, aspartame, chewing gum base, antioxidants and no sucrose. At the beginning of the course, participants were asked to establish oral hygiene with a toothbrush and dental floss, then brushing and polishing was done, to reduce the plaque to zero and they were asked them avoiding hygienic devices during the study period, such as brushing, flossing and any other chewing gum. On the third day, buccal, lingual and proximal plaque levels were measured by using a disclosing tablet. Then index the O'Leary Index was used for smooth surfaces, in which the tooth is divided into four parts: mesial, distal, buccal and lingual. If a painted plaque in any of the four parts was seen, it was recorded in the relevant chart. Then the ratio of stained surfaces to total dental surfaces was calculated and expressed as a percentage. Another indicator used in this study was the Bleeding point Index, which shows bleeding during probing and we have to wait 30 to 60 seconds after probe to check it. In this index, the tooth is divided into four parts: mesial, distal, buccal and lingual, and if bleeding is observed during probing in each of these four parts, the relevant chart was indicated and calculated in relation to the total dental surfaces and as a percentage. In the second stage, the two groups were exchanged and the procedure was repeated, so that the people who chewed gum in the first stage did not use it in this stage and the participants who did not use it in the first stage chewed gum in this stage. Between the two stages, individuals

were returned to normal oral hygiene for 4 days, and at the beginning of the second stage, the plaque was reduced to zero again.[7,13] After finalizing, scaling and polishing were performed for all participants. It is worth mentioning that during this period, patients were contacted by phone to ensure the use of chewing gum. Finally, after collecting, data were analyzed by SPSS 17 software and paired t-test and Wilcoxon.

Results

Eighteen volunteer patients were randomly but equally divided into case (using chewing gum) and control (not using chewing gum) groups. In this cross over study the groups were exchanged after 4 days.

Using Kolmogorov-Smirnov test, the normality of the data was checked and the PI variables of the case and control groups had both normal distributions. Only the BI variable of the case group did not have a normal distribution but the control group had a normal distribution. Wilcoxon Signed-Rank Test was used for BI variables.

According to Wilcoxon test, the mean of BI index in the experimental group was 22.44 with a mid-quarter range of 13 and in the control group the mean of BI index was 21.78 with a mid-quarter range of 13.75. The mean BI index in the case group was slightly higher than the control group, which this difference is not statistically significant with respect to P-value = 0.962.

According to the paired t-test, the mean PI index in the experimental group was 66.83 with a standard deviation of 24.33 and in the control group the mean PI index was 72.56 with a standard deviation of 16.99. The mean PI in the case group (using chewing gum) decreased compared to the control group (not using chewing gum) but this difference was not statistically significant (P-value = 0.187). Chewing gum has been able to change PI and

reduce it, but this reduction is not statistically significant.

Discussion

Periodontal disease is a group of common inflammatory diseases that are caused by microbial plaque on the teeth. Prevention, early diagnosis and treatment are necessary to prevent the progression of these diseases.[14]

In the discussion of caries prevention, technologists have suggested strategies such as diet control, removal of plaque with a toothbrush, and strengthening tooth structure with fluoride.[15] In this regard, in recent decades, compounds called sugar substitutes such as xylitol and sorbitol have been introduced to reduce the consumption of sucrose and subsequent tooth decay.[8] Therefore, in recent years, these substances have been widely used in chewing gum, candy, toothpaste and saliva substitutes. This is probably due to the mechanical cleansing properties of chewing gum or increased salivation.[16] Various studies on the hypothesis of chewing gum consumption to reduce plaque accumulation on smooth surfaces can be divided into two groups: The first groups are studies that are done with zero plaque at the beginning of the study. (Like the present study), which actually examines the preventive effect of chewing gum on plaque formation, and the second groups are studies which are done with the amount of stabilized plaque and examine the therapeutic effect of chewing gum. Studies examining the effect of xylitol with zero plaque at the beginning of the study are short-lived because other oral hygiene methods are omitted during the study period.[7]

Makinen and colleagues showed that although the intrinsic anti-plaque activity of xylitol-containing chewing gum is lower than other plaque control agents, it can have a positive effect on plaque reduction.[15] In the present

study, the O'Leary plaque Index was lower in the case group than in the control group, indicating the effect of chewing gum consumption on the reduction of plaque at smooth levels, although this difference was not statistically significant. Also, Bleeding Index was compared in the case and control groups. The results showed that the Bleeding Index in the case group was higher than the control group and chewing gum cause the increase of BOP in participants and this shows that chewing gum did not reduce inflammation and did not have a positive effect on plaque accumulation, which could be due to the short period of study design. Although omitted of oral hygienic practices within 48 hours causes the initial signs of inflammation, but bleeding after probing may require more time,[17] while the results of Poursalami et al. study on the evaluation of the effects of two kinds of chewing gums containing xylitol and sucrose on the accumulation of bacterial plaque showed that the amount of plaque was significantly lower in the xylitol chewing gum group compared to the sucrose chewing gum group.[8] Evaluation of both chemical and mechanical effects of chewing gum on plaque reduction and more samples size in Poursalami study than the present study were the power of their study. In the study of Borhan Mojabi et al., the O'Leary plaque index was used to investigate the effect of chewing xylitol gum on plaque formation on smooth and occlusal surfaces of teeth similar to the present study. The results of Borhan Mojabi study showed that chewing xylitol gum can significantly reduce plaque accumulation at the occlusal, buccal and lingual levels but has no significant effect on proximal surfaces, which can be due to Minimal contact of chewing gum with proximal surfaces. In this study, unlike the present study, the occlusal surface was also examined and according to the results of their study, the lowest plaque accumulation was observed on the occlusal surface, which is quite

reasonable considering the maximum contact of chewing gum with the occlusal surface.[7] The results of Hanham et al.'s study on 11 oral health students showed that the changes in plaque formation at smooth surfaces were not statistically significant, [13] which is consistent with the results of the present study, which could be due to differences in the number of samples in the study. Although in Hanham's study, unlike the present study, proximal levels were not examined but plaque accumulation at the occlusal surface was evaluated and demonstrated significantly less plaque accumulation on this surface in gum chewing. Also, in the study of Pizzo et al. the results showed that chewing sucrose-free gum containing lactoperoxidase or silicon dioxide or zinc gluconate had no inhibitory effect on plaque accumulation on smooth surfaces.[11] In a study, Zhan et al. examined the effect of xylitol-containing wipes on cariogenic bacteria and caries in children. In this study, 44 mothers with children aged 6 to 35 months with active caries were randomly divided into two groups: using xylitol-containing wipes and placebo-containing wipes. In this study, the rate of dental caries in children at the beginning and after one year and the amount of *Streptococcus mutans* and *Lactobacillus* in saliva were evaluated. The results of this study showed that the use of wipes containing xylitol reduces the incidence of caries in children and xylitol can be considered as a useful supplement to control caries [18]. This study, unlike the present study, examines only the chemical effect of chewing gum and one of its strengths is the study of bacteria involved in caries and the duration of the study. Also in a study that Aluckal et al. examined the effect of xylitol-containing chewing gum on salivary *streptococcus mutans*, they showed that these chewing gums could be used as an adjunct to regular home care preventive procedures in caries prevention.[19] In the present study, the O'Leary plaque index

was used to measure the amount of plaque, while in the Isotupa study, the plaque collection method and the dry weight of plaque were used.[20] This method can be a good way to measure the amount of plaque. The disadvantages of this method are that it does not specify the amount of plaque in different dental parts separately and also requires more conditions and facilities than the O'Leary index, which was not possible in the present study.

In addition to the mechanical effects of chewing gum, Keukenmeester et al. investigated the chemical effect of chewing gum. The two indices evaluated in this study, like the present study, were related to gingivitis and plaque levels. One of the strengths of this study is the longer duration of this study (3 weeks) and the larger number of samples (220 people). In this study, gingivitis was treated under both hygienic and not hygienic methods circumstance, so that participants did not brush their mandibular teeth during the study, but maintained maxillary oral health. The results of this study showed that chewing gum has no effect on BI and PI if oral hygienic practices are taken regularly, but in the absence of hygienic practices, chewing gum will have an inhibitory effect on gingival inflammation.[9] Barnes considered chewing gum as an effective oral hygiene device in the absence of brushing and it was effective in adjunct to brushing for increasing oral health. [21] In another study, the results showed that chewing gum containing sucrose along with oral hygiene methods can reduce dental plaque accumulation by 40%, while in the same condition, sugar-free gum reduces by 51%. [22] In the absence of oral health methods, these values were changed to 47 and 67%. [5] These results emphasize the greater effect of chewing on the removal of dental plaque, especially on the use of chewing gum, and in particular in situations where for some reason it is not possible to perform effective oral

hygiene practices. Also, these results show that in the absence of routine oral hygiene practices compared to performing normal oral hygiene practices, chewing sugar-free gum is superior to sucrose-containing gum in reduction of dental plaque accumulation due to the inherent properties of substitute sugars such as reducing mutans streptococci of saliva and plaque, reduced salivary and plaque acid production.[23] One of the ways to prevent caries in chewing gum is to increase the saliva secretion caused by chewing gum. A study by Stookey et al. Showed that increased saliva secretion from chewing gum after a meal was more effective in preventing caries than its compounds which can be recommended for subjects with low levels of saliva secretion, such as patients undergoing radiotherapy.[24] In a study, Cosyn and Verelst stated that chewing gum significantly reduces dental plaque in the palatal and lingual areas, but has no effect on buccal aspect of tooth plaque,[25] which may be due to more contact of the chewing gum during chewing with Palatal and lingual surfaces, which indicate the mechanical effect of chewing gum on dental plaque reduction.

One of the limitations of this study is the lack of microbial examination and measurement of other indices involved in inflammation. One of the confounding factors of this study was the type of nutrition and cooperation of participants in the implementation of the project, which could affect the outcome of the study. It is noteworthy it was observed plaque formation on the participant's teeth due to not brushing for a few days during the study period after the completion of the polishing project was done for them and also some patients dissatisfied the taste of the disclosing tablet when measuring PI.

Conclusion

According to the results, chewing gum in the absence of other hygienic practices has little

effect on plaque reduction in smooth tooth surfaces. Also, it is suggested that future research be conducted with a larger number of specimens and examination of patients over a longer period of time, as well as examination of bacteria in the salivary specimen.

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Conflict of interests

The authors declare that they have no conflict of interests.

References

- Godlewska U, Brzoza P, Sroka A, Majewski P, Jentsch H, Eckert M, Eick S, Potempa J, Zabel BA, Cichy J. Antimicrobial and Attractant Roles for Chemerin in the Oral Cavity during Inflammatory Gum Disease. *Front Immunol.* 2017 Mar 29;8:353.
- Seyed Hashemi M, Hashempur MH, Lotfi MH, Hemat H, Mousavi Z, Emtiazy M, et al. The efficacy of asafoetida (*Ferula assa-foetida* oleo-gum resin) versus chlorhexidine gluconate mouthwash on dental plaque and gingivitis: A randomized double-blind controlled trial. *European Journal of Integrative Medicine.* 2019;29:100929.
- Figuero E, Nóbrega DF, García-Gargallo M, Tenuta LM, Herrera D, Carvalho JC. Mechanical and chemical plaque control in the simultaneous management of gingivitis and caries: a systematic review. *J Clin Periodontol.* 2017 Mar;44 Suppl 18:S116-34.
- Saheer PA, Parmar P, Majid SA, Bashyam M, Kousalya PS, Marriette TM. Effect of sugar-free chewing gum on plaque and gingivitis among 14-15-year-old school children: A randomized controlled trial. *Indian J Dent Res.* 2019 Jan-Feb; 30(1):61-6.
- KaramiNogourani M, Esfahanian V, Soltani M. The effect of chewing gums on plaque index in the lack of oral hygiene measures. *J Mash Dent Sch* 2009; 33(3): 247-54.
- Salehi G. Optimization of nitrogen source and dissolved oxygen concentration to enhance co-production of ethanol and xylitol in a co-culture system of two *Saccharomyces cerevisiae* and *Candida tropicalis* strains. *Cellular and Molecular Research (Iranian Journal of Biology)* 2015; 28(2): 237-49.
- Borhan Mojabi K, Mozaffari A, Latifi B, Vahid A. Effect of chewing xylitol gum on plaque accumulation on teeth surfaces. *J Res Dent Sci* 2012;8(4):180-5.
- Pooreslami HR, Farrokhgisoor E, Rad FA. A comparative study on the effects of two kinds of chewing gums containing xylitol and sucrose on the accumulation of bacterial plaque among a group of dentistry students in Kerman. *Majallah i Dandanpizishki Journal of Islamic Dental Association of Iran* 16(Special issue) 2004: 28-33.
- Keukenmeester RS, Slot DE, Rosema NA, Van Loveren C, Van der Weijden GA. Effects of sugar-free chewing gum sweetened with xylitol or maltitol on the development of gingivitis and plaque: a randomized clinical trial. *Int J Dent Hyg.* 2014 Nov;12(4):238-44.
- Kakodkar P, Mulay S. Effect of sugar-free gum in addition to tooth brushing on dental plaque and interdental debris. *Dent Res J (Isfahan).* 2010 Summer;7(2):64-9.
- Pizzo G, Licata ME, La Cara M, Pizzo I, Guiglia R, Melilli D. The effects of sugar-free chewing gums on dental plaque regrowth: a comparative study. *J Dent.* 2007 Jun;35(6):503-8.
- Salah R, Abdulbaqi RH, Mohammed AN, Abdulkareem AA. Four-day randomized controlled crossover trial evaluating the antiplaque effect of a combination of green tea and *Salvadora persica* L. mouthwash. *Journal of Herbal Medicine.* 2020; 23:100357.
- Hanham A, Addy M. The effect of chewing sugar-free gum on plaque regrowth at smooth and occlusal surfaces. *J Clin Periodontol.* 2001 Mar;28(3):255-7.
- Kawar N, Alranyes S. Periodontitis in pregnancy: the risk of preterm labor and low birth weight. *Dis Mon.* 2011 Apr; 57(4):192-202.
- Mäkinen KK, Hujoel PP, Bennett CA, Isotupa KP, Mäkinen PL, Allen P. Polyol chewing gums and caries rates in primary dentition: a 24-month cohort study. *Caries Res.* 1996; 30(6): 408-17.
- Beiswanger BB, Boneta AE, Mau MS, Katz BP, Proskin HM, Stookey GK. The effect of chewing sugar-free gum after meals on clinical caries incidence. *J Am Dent Assoc.* 1998

Nov;129(11):1623-6.

17. Hofer D, Sahrman P, Attin T, Schmidlin PR. Comparison of marginal bleeding using a periodontal probe or an interdental brush as indicators of gingivitis. *Int J Dent Hyg.* 2011 Aug;9(3):211-5.

18. Zhan L, Cheng J, Chang P, Ngo M, Denbesten PK, Hoover CI, Featherstone JD. Effects of xylitol wipes on cariogenic bacteria and caries in young children. *J Dent Res.* 2012 Jul; 91(7 Suppl):85S-90S.

19. Aluckal E, Ankola AV. Effectiveness of xylitol and polyol chewing gum on salivary streptococcus mutans in children: A randomized controlled trial. *Indian J Dent Res.* 2018 Jul-Aug;29(4):445-9.

20. Isotupa KP, Gunn S, Chen CY, Lopatin D, Mäkinen KK. Effect of polyol gums on dental plaque in orthodontic patients. *Am J Orthod Dentofacial Orthop.* 1995 May; 107(5): 497-504.

21. Barnes VM, Santarpia P, Richter R, Curtis J, Xu T. Clinical evaluation of the anti-plaque effect of a commercial chewing gum. *J Clin Dent.* 2005;16(1):1-5

22. Karami Nogourani M, Banihashemi M. The effect of chewing gum on dental plaque accumulation [doctoral thesis]. Isfahan: Iran Islamic Azad University khorasgan branch; 2007. 200 p.

23. Zero DT. Are sugar substitutes also anticariogenic? *J Am Dent Assoc.* 2008 May;139 Suppl:9S-10S.

24. Stookey GK. The effect of saliva on dental caries. *J Am Dent Assoc.* 2008 May;139 Suppl:11S-17S.

25. Cosyn J, Verelst K. An efficacy and safety analysis of a chlorhexidine chewing gum in young orthodontic patients. *J Clin Periodontol.* 2006 Dec;33(12):894-9.