

Comparison of the Effect of Xylitol Gum- and Mastic-chewing on the Remineralization Rate of Caries-like Lesions

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Abstract:

Objective: The use of sugar-free chewing gums has been reported to be highly effective in the prevention of dental caries. This study carried out to compare the effect of mastic gum and a xylitol chewing gum on remineralization of caries-like lesions.

Materials and Methods: In this cross-over, single blinded, in situ study, first, artificial caries-like lesions were created in six extracted human premolars. Then axial sections were cut from each tooth to the thickness of approximately 100 microns. Fifteen adult subjects participated in the study. Lower removable appliances with rectangular boxes in the lingual surfaces were fabricated for them. One tooth section was placed in each of these boxes. The appliances were worn for two separate periods of three weeks each. The subjects chewed five sticks of gum (mastic gum and or xylitol chewing gum) per day, each for 20 minutes. In the second period, the sections were replaced with new ones and the participants were instructed to change their gums. The sections were examined by polarized light microscope and the difference between the size of demineralized areas before and after intervention were recorded. Paired t-test and LSD test served for statistical analyses.

Results: The decrease in demineralized surfaces in both groups was statistically significant (mastic gum: $P=0.018$, xylitol gum: $P<0.001$). The difference of average decrease between the two groups, however, was not statistically significant ($P>0.05$).

Conclusion: Chewing both mastic gum and xylitol chewing gum improved the remineralization of caries-like lesions but their effects were similar.

Key Words: Tooth Remineralization; Tooth Demineralization; gum mastic; Xylitol; Chewing Gum;

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INTRODUCTION

The formation of dental caries is a process in which the mineral tissue of the teeth is dissolved by the acid produced by microbes. It is not merely a simple demineralization; rather it is considered as a dynamic process including demineralization by the organic acids originated from microorganisms and further remineralization by saliva components or drugs [1]. Current evidences suggest that as long as the

superficial layer of the enamel is intact, primary dental caries in enamel, which has not yet reached DEJ, is reversible and can be remineralized in an optimal situation [1,2]. Chewing sugar-free gum increases the saliva flow and enhances its buffering effect. These changes in saliva improve the process of remineralization of dental caries and prevent the process of demineralization [3-6]. Mastic gum is a natural substance derived out

of *Pistacia (atlantica kurdica)* tree's resin; native to western Iran. This resin is used for a wide range of industrial purposes including the manufacture of drugs, foods, chemical substances, and chewing gum. Many of the components of mastic gum show antimicrobial activity against a range of bacteria, and most likely they act synergistically [7]. Since mastic gum is compatible with gastrointestinal tract and possesses an antibacterial nature, it can subdue *Helicobacter Pylori* [8,9]. Mastic gum's advantage over all the other gum bases used in the gum industry is that it is natural while the rest are either oil-based or of chemical polymers.

It has also been shown that use of mastic gum significantly diminishes the oral bacteria count, decreases the plaque index, and abates gum inflammation [10]. Recent studies have demonstrated the ability of mastic gum to suppress the growth of cariogenic bacteria and to reduce the salivary streptococcus mutants count [11,12].

Leach et al [13] investigated the effect of sorbitol chewing gums on the rate of remineralization of caries-like lesions of enamel in an in situ study and they showed that remineralization ratio in the group using the sugar-free chewing gums was twice as this ratio in other group that did not use gums and this difference was statistically significant. Manning et al [14] carried out a similar study investigating the rate of remineralization of caries-like lesions in two groups of subjects: one chewing sorbitol and the other chewing xylitol gums. They concluded that in both groups, the average width of the demineralized lesion was reduced showing progress in the remineralization process but the difference between the two groups was not statistically significant [14]. Szöke et al [3] conducted a three-year study on 547 primary school students asking them to chew sorbitol chewing gums three times a day after meal courses. Comparison between the subjects using and those not using gums revealed

that after two years, dental caries were reduced by 38.7% in the group using sugar-free chewing gums [3]. Arfa and Bakhtiari [15] compared the rate of the secreted saliva and its pH after chewing xylitol-containing gum and mastic gum in case and control groups. The results indicated that both mastic gum and xylitol chewing gum increased the rate of secreted saliva and its pH [15]. To our knowledge, however, the possible remineralization effect of mastic gum has not been compared with that of other chewing gums.

The aim of the present study was to investigate the effect of mastic gum on the rate of remineralization of caries-like lesions in enamel and to compare it to that of xylitol-containing chewing gums.

MATERIALS AND METHODS

This study was approved by the Ethics Committee of Research Deputy of Shahid Beheshti Dental School.

In this cross-over, single blinded, in situ study, first, artificial caries-like lesions were created in six extracted human premolars according to the following protocol. The teeth were sterilized by means of 10% sodium hypochlorite solution. Then they were covered all over with nail varnish except for a window of exposed enamel, and were placed in acetic acid/sodium acetate buffer solution (pH=4.8) for two weeks.

Five axial 100 µm thick cuts were then made by means of Struers ground section device (Accutum 50, Denmark) on the buccal window of each tooth. After mounting the dental particles in acrylic resin, each particle was stored in a separate can marked by code; containing deionized distilled water. The particles were observed under a polarized light microscope (Olympus, U-25, Japan) and the demineralized area was measured in microns with Olsy I m3 software which is compatible with the microscope used.

The required number of samples in each

group, considering 10% as the acceptable difference, was determined to be 11, which was increased to 15 in order to compensate probable loss-to-follow up.

Fifteen 20-30 years of age healthy volunteers with no evidence of progressive periodontal disease and no untreated dental caries participated in the study. We completely explained the study aims and procedures to the participants, emphasizing that all of them were allowed to leave the study whenever they wanted, as was the case for four of the participants in the group chewing mastic gums. None of the participants was on antibiotics or any other interfering prescriptions with probable influence on salivary flow. For each subject we constructed mandibular removable appliances with an 8×20 mm² window on lingual area. One tooth slice was placed in each of these windows, and the windows were covered with a metal mesh allowing the tooth particles to be exposed to saliva.

Mastic gum samples collected from Kurdistan region, Iran in June 2005 were obtained from the grand bazaar of Tehran. Mastic gum was measured by means of a Sartorius scales (BL 150, Germany) and then it was divided into 1.46 gr pieces to be equal to the weight of xylitol chewing gum pieces.

In the first phase of the study, lasting for 3 weeks, participants were instructed to chew either Mastic gum or Orbit (Wrigley, Poland) xylitol chewing gums (1.46 gr, 1 stick, respectively) for 20 minutes after meals five times a day (breakfast, lunch, dinner, and two snacks). This stage was followed by a week off the study construction. Then the particles were replaced with new ones and the participants were instructed to change their gums. Then the second phase of the study was started with the same instructions as the first phase. Following the intra-oral phase, the demineralized area of each enamel slice was measured again.

The data was processed with SPSS 9.0 statistical software. Paired t-test and LSD test served

for statistical analyses. The significance level was set at 95% ($P < 0.05$).

RESULTS

The average decrease in the demineralized surfaces was 6.02% in the group chewing mastic gum and 8.86% in the group chewing xylitol-containing gum. The decrease in both groups was statistically significant (mastic gum: $P = 0.018$, xylitol gum: $P < 0.001$). Paired t-test also showed a significant difference between size of demineralized area before and after intervention in both groups ($P < 0.05$). The difference of average decrease between the two groups, however, was not statistically significant ($P > 0.05$).

DISCUSSION

The present study compared the effect of mastic gum (a sugar-free natural substance) and a sugar-free chewing gum containing xylitol in conversion of the process of demineralization. The results showed that chewing either mastic gum or xylitol chewing gum after meals and snacks was associated with significant as measured by lesion width. No significant difference existed between the remineralization effects of the two gums.

The result of the present study resembles the previous studies declaring positive effect of chewing sugar-free gums on the process of remineralization [13,16]. Short-term studies on the effect of sorbitol and xylitol chewing gums, such as Manning et al [14] and Edgar et al [17] have reported no significant difference between the two products. In contrast, long clinical trials such as Scheinin et al [18], Isokangas et al [19] and Mäkinen et al [20] have shown significant difference between efficiency of these products. One of the limitations of our study is its short duration.

Improvements in remineralization can be associated with increase in salivary flow and pH of the plaque. Salivary secretion is an influential factor on the process of remineralization. Arfa and Bakhtiari [15] demonstrated that the rate

of salivary secretion in case groups (mastic gum & xylitol chewing gum) had noticeably increased compared to the control group in which the subjects did not chew gums [15]. It is possible that the increase in the remineralization observed in this study is related to the enhancement of salivary secretion due to chewing mastic or xylitol gum.

Since this has been an *in situ* study, the results are totally dependent on the subjects' cooperation. The participants should have acted according to their given instruction, but there has not been a thorough supervision on their action and the study has sufficed merely in their reports. This is a limitation of all *in situ* studies. On the other hand, the main advantage of this study over similar *in vitro* studies was that the enamel slice had been placed in the dynamic situation of mouth to take into account all the intra-oral factors' affecting changes in the artificial lesions. The study was carried out as a crossover in order to omit the effect of interventional factors. The participants were instructed not to change their life style, food, and hygiene habits. They used fluoride-containing toothpastes during the study. Since chewing gum is known as a supplementary method to decrease dental caries and no evidence to show its independent efficiency exists, instructing to mere use of gums to prevent dental caries would face limitations according to research ethics.

Manning et al [14] investigating the possible interactive effect of gum and toothpaste's fluoride on the process of remineralization indicated that the salivary fluoride level was not affected by the induced salivary secretion level as a result of chewing gum. Moreover, no significant relationship was observed between the fluoride level and the percentage of remineralization [14]. However, in Creanor et al [16] study, a considerable remineralization occurred in the control group (using fluoride toothpaste, not chewing gum) possibly due to the toothpaste's fluoride. The rate of reminer-

alization, however, was much higher in the group using chewing gum as well [16].

We had no control group (not chewing gums) in our study due to the limitation of resources in preparing the enamel sections and time considerations. Therefore, it was not possible to compare the result in chewing gum group with that of the control group.

In the present study, the percentage of changes in the demineralized area after intervention in both groups was low (6.02% and 8.9% in mastic and xylitol gum groups, respectively). This finding is not in line with studies such as Leach et al [13] reporting 42.8% change in the demineralization in the group chewing xylitol gums. The results however resemble those of Manning et al [14] who compared groups chewing sorbitol and xylitol gums and reported low variations (8.7% and 12% in sorbitol and xylitol gum groups, respectively). One major reason for this discrepancy is the difference between the values of the primary demineralized area in different studies. The average thickness of the primary lesions had been 59.8 μ in Leach et al study [13], which would have resulted in high change percentages with very low modifications in the lesions' size; while the average thickness of the primary demineralized lesion in our study has been 386.7 μ . The primary lesion's thickness is dependent on various factors such as the kind of employed acid and the duration of storing the teeth in it. Moreover, using different techniques of study and difference in the quality of used gums may also be influential on the results. Consequently, absolute comparison between the numeric results of different studies would not be helpful.

CONCLUSION

The results of the present study support the concept that use of mastic gum and xylitol-containing chewing gum for 20 minutes after an acidogenic challenge can enhance the remineralizing potential of the mouth, proba-

bly by stimulating salivary flow. However, no significant difference existed between the effect of mastic gum and xylitol chewing gum on enhancing the rate of remineralization of caries-like lesions. Since this is the first study on the effect of chewing mastic gum on enhancing the remineralization process, it seems a necessity to investigate the effectiveness of this natural product through long-term clinical studies.

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