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Full Length Research Paper

Rinsing with Tap Water: A Comparative Study with Tooth Brushing and Sugar-Free Chewing Gum for Oral Hygiene

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Among all oral diseases, tooth decay still imposes the greatest burden on health care systems. While patients prefer less complicated and time consuming preventive methods, the effectiveness of rinsing mouth with water has remained in the shadow. A great number of people, whether professional or not, believe that water rinse can be helpful where tooth-brush is not available. This study aimed to investigate that belief. In this study in three different attempts the basal saliva pH of 60 participants and their saliva pH after introducing to sugar solution, brushing teeth, chewing xylitol gum, and rinsing mouth with water were recorded. Data analysis showed that tap water may not be of any help in correcting oral pH after an acidic attack.

Key words: Saliva pH, sugar-free chewing gum, mouth rinse, tap water, tooth brushing, xylitol.

INTRODUCTION

"I drink iced tea a lot and when I am at work, I usually do not have a toothbrush. Does rinsing with water from the sink help at all?"

"Yes it will help. Rinsing should be done within the first half hour after exposure to sugar or acid, the sooner the better."

This dialogue, a seemingly true answer to a common place question, is copied and pasted from an on-line discussion (Yahoo Answers, 2009).

As people try to be competent to live a modern life, they need to be synchronized with the fast pace of modernization. Thus, easily accessible sources of high-energy food products, which may satiate hunger in a minimum of time, seem to be the fittest dietary options for today's lives. According to the bulletin of WHO in September 2005, socio-economical changes in many developing countries have significantly influenced diet and nutrition with a meaningful subsequent rise in consumption of sugary products. Consequently, the incidence of dental caries has increased in those countries (Watt, 2005).

Historically, the major burden of human oral health problems has been attributed to dental and periodontal diseases (Petersen et al., 2005). Unfortunately, tooth

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caries is still a significant oral health problem all over the world (Khan et al., 2013; Koposova et al., 2013; Marcenes et al., 2013). Nowadays, the chain of events which leads to caries is known and the preventive mea-sures target the key points of that chain in order to defy the noxious process. Among all oral health programs that nations has carried out to reduce the incidence of tooth caries, passive programs have been shown to be more effective than those requiring the active individual contribution. While water fluoridation, topical fluoride, and fissure sealant reduced dental decays between 14 and 86%, oral health education induced just short-term improvements. It can be inferred that people tend to implore oral care measures that take less time and effort (Watt, 2005).

The opening dialogue of this section is not uncommon for dental health practitioners. Patients frequently ask if rinsing their mouths with water after having meals or drinking sweetened beverages can reduce the risk of dental caries, or can substitute tooth brushing while they are at work or school. Since no study has responded to this concern yet, the present study aimed to find a reliable answer to the aforementioned question.

MATERIALS AND METHODS

This research was approved by the Ethic Committee of Shahid Sadoughi University of Medical Sciences (SSU), Iran, and informed consent was obtained from all participants. The study was registered by the clinical trial code of IRCT2012121711791N1.

Students from Dentistry School of Shahid Sadoughi University of Medical Sciences with an age range of 20 to 25 years volunteered to take part in the study. All volunteers were verified regarding to their unstimulated saliva pH in case of any unusually high or low records. Among those with normal oral pH (6.2 to 7.4), none had active dental or periodontal diseases and/or wore fixed orthodontics appliances. They all were generally healthy without any sign or symptoms of oral dryness. Finally, 60 students met the eligibility criteria of the study.

In the first attempt, after taking unstimulated saliva samples, all participants were asked to swish and swift a 50% sugar solution for 1 min. A minute later, a saliva sample was obtained from each participant. Immediately, they rinsed their mouth with tap water for 1 min. A third saliva sample was taken after another 1 min. In the second attempt, on the next day, the subjects repeated the first two steps. Then they were asked to brush their teeth (GUM® Soft brush, Sunstar Americas' Inc. Chicago, IL) instead of rinsing their mouth with tap water. The third sample was collected 1 min after brushing. The third attempt followed the same steps except for chewing sugar-free mint-flavored gum (Orbit®, Wrigley Company,Poznan, Poland) for 5 min instead of tooth brushing.

Each attempt was carried out between 9 a.m. to 12 p.m. and produced three saliva samples that their acidities were measured twice for each sample by electrical pH-meter (AZ-8686 Digital Pen Type, pH range: 0.00-14.00 ±0.0.5, Shenzhen Youfu tools Co., Ltd).

The data were submitted to statistical analysis using the SPSS software, version 17.0 for Windows (SPSS Inc.; Chicago, IL, USA) and the statistical tests applied in this regard were analysis of variance (ANOVA) and Paired *t*-test. For every attempt, mean acidities of saliva samples were compared to the baseline value of the same day. Thereafter, the records of each attempt were compared to their corresponding values from the other attempts.

RESULTS

The data for different attempts basal saliva pH and pH after introducing to sugar solution, brushing teeth, chewing xylitol gum, and rinsing mouth with water are shown in Table 1.

The mean resting saliva pH of subjects was 6.9±0.11; after introducing 50% sugar solution to the mouth, in every attempts, it dropped below the baseline records ($p<0.001$). Three consecutive records of the mean pH after the induced acidic attacks were 6.58±0.12, 6.6±0.08, and 6.54±0.11 which showed no statistical difference between the attempts ($p=0.13$).

In the first attempt, despite rinsing the mouth with tap water saliva pH meaningfully continued to decrease which resulted in a mean pH of 6.49±0.13 ($p<0.001$). In the second attempt, recorded pH after brushing teeth raised to 6.86±0.91, and in the third one it reached the score of 6.96±0.11 after chewing sugar-free gum ($p<0.001$). In comparison, chewing sugar-free gum could increase saliva pH better than brushing teeth ($p<0.001$).

DISCUSSION

One of the most common infectious diseases of oral cavity is dental caries. Research on tooth caries since 1960s has revealed that various factors such as saliva composition, time, level of education, and nutrition and diet play influential roles in caries formation (Touger-Decker and van Loveren, 2003). The end-result of all those contributing factors is demineralization of teeth. While demineralization occurs at pH of 5.5 or lower, dental structures can be re-mineralized in higher pHs, in the presence of saliva saturated with calcium and phosphorous (Bradshaw and Lynch, 2013; Davies and Blinkhorn, 2013; Elkassas and Arafa, 2014; Shetty et al., 2014).

People's daily lives and well-being are highly affected by damaged teeth. Moreover, dental treatments are expensive and impose economic burden on countries, especially in low-income countries that may exceed their total health care budget (Petersen et al., 2005; Watt, 2005). Therefore, preventive strategies are reasonably considered as top priority in oral health programs. Based on available evidence, interventions that require people to spend minimum time and make minor effort, like water supply fluoridation and/or topical fluoride therapy, dramatically have improved public oral health condition (Januszko et al., 1977; Watt, 2005; Cobiac and Vos, 2012; Rugg-Gunn and Do, 2012). On the contrary, inter-ventions which need active participation of people were shown to be less successful in making a steady decline in caries incidence. Related studies revealed that mass media campaigns or school-based tooth brushing campaigns had minor influence on caries prevention, as compared to fluoride therapy or fissure sealant therapy

Table 1. Mean values of saliva pH.

Parameter	Baseline	After sugar solution	After intervention	Within group P value
Attempt 1 (Water rinsing)	6.87±0.11	6.58±0.12	6.49±0.13	(p<0.001)
Attempt 2 (Tooth brushing)	6.9±0.11	6.6±0.08	6.86±0.91	(p<0.001)
Attempt 3 (Gum chewing)	6.93±0.11	6.54±0.11	6.96±0.11	(p<0.001)
Between attempts P values	p=0.08	p=0.13	p<0.001	-

(Brown, 1994; Kay and Locker, 1996, 1998; Watt, 2005).The aforemention evidence implies that people have an inclination for easy ways to improve their oral health status.

Modern lifestyle mandates short break times and quick meals for most of those who have outdoor occupations. The oral health professional usually advise brushing teeth after eating. However, when it is not feasible, some believe that rinsing mouth with tap water may reduce the risk of caries development, as it is posted on the website of MYO CLINIC "If you cannot brush after eating, at least try to rinse your mouth with water" (MYO CINIC, 2011). Since water rinsing can wash some large food particles or dilute oral contents, it looks like a logical emergency substitute for brushing teeth. Although not being based on any reliable data, some clinicians may also encourage their patients to swish and swift water, whenever tooth brushing is not possible. Lack of any supporting evidence for such claim led us to carry out the present study, which compares the efficacy of water rinse with gum chewing and tooth brushing in improving oral pH after an acidic surge.

In 1970s research on chewing-gum, as an oral health care aid, brought sugar-free gums into attention for the first time (Ribelles Llop et al., 2010). Further research highlighted xylitol chewing-gums as to be helpful in maintaining dental health, especially for its anti-caries effect (Tanzer, 1995; Imfeld, 1999; Kovari et al., 2003; Ly et al., 2008; Al-Haboubi et al., 2012; Dodds, 2013). Sugar-free chewing-gums can exert their anti-decay effect via four main routes. Firstly, they enhance tooth cleansing by provoking saliva secretion via chewing process as well as chemical stimulation of taste buds. Secondly, chewing-gums improve oral pH by inducing the temporary rise in saliva secretion which in turn bolsters the buffering capacity of oral fluid (Polland et al., 2003). The third advantage of gum chewing is related to its po-tential to facilitate re-mineralization of incipient caries. A recent double-blind randomized cross-over *in situ* study on sugar-free gums, with or without casein phospho-peptide amorphous calcium phosphate, indicated that they have meaningful re-mineralizing effect on enamel (Cochrane et al., 2012). The last anti-decay property of chewing-gums containing xylitol as sweetener is their anti-bacterial quality. Xylitol is a poly-alcohol which inter-feres with cell wall production in *Streptococcus mutans* (Aksoy et al., 2007; Ribelles Llop et al., 2010; Hanno et al., 2012). In long-term, xylitol negatively affects the synthesis of extracellular polysaccharides by *S. mutans*, which may reduce the size and growth rate of their colonies and change their morphology as well (Lee et al., 2009).

In the present study, mint-flavored xylitol gum (Orbit^{TM}) was used, as a proved preventive adjunct to tooth brushing (Karami-Nogourani et al., 2011). Our data showed that chewing xylitol gum not only elevated saliva pH beyond the resting pH value (6.96±0.11), but also exceeded the score obtained from tooth-brushing group (6.86±0.91), and the difference was statistically significant (p<0.001). Such discrepancy in pH records between gum-chewing and tooth-brushing can be attributed to the immediate drop in saliva flow rate after eliminating the sweet stimulus by brushing teeth (Gjorstrup, 1980; Gambon et al., 2006).

In contrast to both positive control groups, mean saliva pH continued to plunge down in case group even after vigorous rinsing of mouth with tap water. This finding can seriously challenge the mediocre belief that immediate water rinse after having sweetened beverages and/or food stuffs prevents or at least delays caries develop-ment. Actually, water dilutes the oral fluids, while it has almost no documented cleansing effect on dental plaque. Continued fermentation of sugars trapped in dental plaque in conjunction with attenuated oral buffering capa-city of diluted saliva seems to explain why tap water did not enhance oral pH in this trial. It is worthy to note that chewing sugar-free gums removes dental plaque from occlusal surfaces of teeth (Hanham and Addy, 2001).

This study suggests that in contrary to sugar-free gum, tap water may be beneficial neither as an interim oral hygiene measure nor as an anti-caries adjunct to tooth brushing.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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