

Erosion and the Effect of Saliva in Coping with It: A Review Article

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ABSTRACT

Introduction and Objective: Oral problems have increased with the spread of carbonated and flavored beverages, because these beverages are acidic and most of these foods contain sugars that cause tooth decay over time. Considering the importance of this issue, the present study was conducted to evaluate the effect of saliva on erosion.

Materials and Methods: First, the keywords related to the topic are collected based on MESH and searched in PUBMED databases. Then, the obtained articles are reviewed in terms of inclusion and exclusion criteria, and studies with the required criteria are carefully studied and the necessary information is extracted from them.

Findings: In order to decrease oral problems, it is emphasized that sugars should be consumed in one meal during the day and they should not be consumed gradually during the day. Proper nutrition is another important issue in oral health. There is a significant relationship between the degree and severity of tooth decay by acidic and carbonated drinks. Replacing carbonated drinks with non-carbonated drinks can decrease oral erosion problems. The use of sugar-free chewing gum as well as foods that are higher in fiber can cause more saliva secretion and ultimately less erosion. Saliva secretion is beneficial for oral health and prevents the decay of tooth surface by acids.

Conclusion: Consumption of carbonated drinks is associated with the severity of erosion and it is recommended to reduce consumption and change the diet.

Keywords: Erosion. Dental Care, Tooth. Saliva

INTRODUCTION

In recent years, with the improvement of oral health science, the issue of dental erosion has also received much attention. Dental erosion is the gradual loss of hard tooth tissue caused by chemical processes without bacterial involvement. It is a "silent" disease and is highly affected by personal habits and lifestyle. Erosion can be attributed to numerous factors, including the swallow of organic and mineral acids. Erosion is known as the loss of hard dental material. Loss of hard tooth tissue can occur in two ways, either by decay through etching or by non-

bacterial acids. The second way, later known as erosion, was first proposed in the early 19th century [1-4].

External factors affecting tooth erosion include diet, work environment, swimming pool water, and some medications. Endogenous acids during vomiting, gastroesophageal reflux disease (GERD) and bulimia nervosa and excessive saliva buffering are among the inherent and endogenous factors that lead to inherent erosion of teeth. Eating habits, lifestyle and oral hygiene also have a significant effect on dental health and erosion. In general, the chemical factors that lead to tooth decay can be classified as follows [5].

Table 1. Factors affecting dental erosion

Chemical factors	Biological factors	Behavioral factors
pH and buffer capacity of the product Acid type of values (pKa) Product adhesion to the tooth surface Properties of product degradation Calcium concentration Phosphate concentration Fluoride concentration	Saliva: Stimulation capacity, flow rate, composition, buffer capacity, pH Anatomy and strength of teeth Anatomy of the soft tissue of the mouth in relation to the teeth Physiological soft tissue movements ✓	Eating habits Healthy lifestyle: Diet containing acidic vegetables and fruits Excessive consumption of acidic foods and beverages Nightly bottle feeding with acidic drinks Intense exercise activities dieting Oral health measures

Saliva is one of the most important issues considered by researchers in decreasing oral caries. Saliva is involved in the protective and cleansing activities of the oral environment, maintenance of teeth and the entire mucosa, antibacterial and antiviral activities, and most importantly, taste and digestibility. Saliva also has a proven and irrefutable role in balancing oral pH as well as remineralization. Saliva also has the ability to neutralize acids in the mouth [6-10].

The critical pH of the mouth is 5.5, and any food that is more acidic has the potential to dissolve hydroxyapatite

in tooth crystals. An environment with a pH of less than 5.5 is very harmful to dental health and can damage tooth surfaces, including enamel and dentin. Enamel resorption by these existing acids softens the enamel and prepares it for decay, so that even a simple brushing can damage the enamel and cause erosion. Almost all beverages consumed by people during the day have a pH between 2 and 4. If we look at the subject scientifically, all of them have the capability of erosion and tooth surface decay [11].

Considering that most studies conducted in the world have studied only certain food groups in relation to tooth

decay and in Iran no similar review study has been conducted, the present study evaluates the destructive effect of beverages and foods in erosion as well as the positive effect of saliva in preventing it. Knowing this relationship can help design preventive programs in the field of health and decrease the prevalence and incidence of this disease.

MATERIALS AND METHODS

International databases such as Scopus, PubMed, Elsevier and domestic databases such as Google Scholar, IranDoc, SID, Magiran, Iranmedex, Direct, Ebsco, Biomarkers, Saliva, Periodontitis Dental caries were used to evaluate the role of saliva in dental erosion. The keywords used are quality of saliva, quantity of saliva, tooth erosion, and acidic beverages and acidic foods that in the papers published during 2000 to 2020, they were extracted and studied based on MESH method and applying restrictions on conducting studies. The OR, AND operators were used to find related articles. The studies were searched from February 5 to March 5, 2020. In order to increase the value of the article, an attempt was made to remove some old articles and replace the last ones that were updated as much as possible. An electronic search was conducted on a total of 150 articles, of which 47 articles were related in terms of content, topic and objective and were selected.

Inclusion and exclusion criteria: Inclusion criteria included qualitative, clinical, analytical studies, and articles published in English and Persian, articles related to erosion, acidic beverages, saliva, and diet. Editorial letters, case studies and descriptive studies were excluded. Also, articles with inadequate reports and a study whose full text was not available, in which erosion was not considered as the main factor, were excluded from the study.

Screening and data extraction: Two trained authors conducted search strategies. In the first stage, the titles and abstracts were reviewed for the selection of articles, in the next stage, the two authors independently reviewed the full texts of the articles. Differences in findings were resolved by considering the general conclusion of articles as the criterion and in this study, they were organized.

Qualitative evaluation: After preparing a list of titles and abstracts of the studies available in the databases, the STROBE standard checklist was used to determine the quality of the studies [12]. The STROBE checklist consists of 22 different sections that evaluate various aspects of methodology including sampling methods, statistical analysis, confounding factor adjustment, measurement of variables, validity and reliability of the tools used and the objectives of the study. Inclusion criteria met at least 15 out of the 22 sections of the STROBE checklist.

RESULTS

By studying the articles obtained by MESH method, the research fields were identified. These fields include: oral health and care, the effect of carbonated beverages on erosion, factors affecting erosion, the importance of the pellicle layer and its relationship with saliva, salivary flow rate and the ability to neutralize (Buffering Capacity), the role of saliva in dental regeneration and remineralization, the effect of nutrition on erosion and dry mouth or

xerostomia. Lifestyle, which is more common in advanced societies today, leads people to live healthier and more active sports as well as organic diets, but it should be borne in mind that in the same style of life, the consumption of fast food and carbonated beverages is also very common which is considered an important factor in dental erosion [5].

In general, a summary of the articles obtained in relation to the subject of the study is given in Table 2.

Two studies were obtained in the field of oral health and care status. Cetinkaya et al. in their research on alcoholic beverages and oral health showed that sugar-free non-alcoholic beverages affect oral health and are less likely to cause tooth decay and erosion. They stated that consuming non-alcoholic beverages and replacing them with non-alcoholic and non-carbonated beverages can be effective in reducing the erosion process. Another study was conducted in Iran that pointed to the role of daily milk consumption on oral health. The positive effect of nutrition with milk and reduction of sweetened drinks was important in this study and it was stated that the chance of tooth erosion for people who had never used sweetened soft beverages was 94%, lower than that in daily consumers [13, 14].

However, H Al-Dlaigan et al. in the field of the effect of carbonated beverages on erosion showed that there was a significant relationship between the rate and severity of tooth decay by acidic and carbonated beverages and dental erosion was associated with the consumption of soft drinks, carbonated beverages and fresh fruits in the study groups. Variables related to tooth decay were found at higher levels in the erosion and asthma groups. Comparison between the three groups did not show a significant difference in the amount of unstimulated and stimulated saliva flow or pH and buffer capacity. Children with asthma were more prevalent than the control group. Further research is needed on the factors affecting the increase in the prevalence of erosion in children with asthma [15].

Studies of Sanchez et al. also showed that the number of children and adolescents with erosions has greatly increased. The main cause of erosion in children is drinking natural juices such as orange juice and apple juice and carbonated beverages such as Coca-Cola and soda. Consuming these drinks with food causes far less damage to the teeth than consuming them alone. The habit of consuming these drinks during the day lowers the pH in the mouth and keeps the oral environment acidic during the day, which greatly increases the likelihood of erosion. Frequent consumption of drinks with low pH causes the teeth to be demineralized by the existing acid and the enamel to be destroyed, although this process is reversible and the saliva has the ability to regenerate and mineralize the crystals in the enamel, the risk of those who regularly consume beverages such as juices is 37 times higher than those who do not consume this amount of beverages [16]. It is important to pay attention to controlling the consumption of acidic beverages.

Research by Moazzez et al. has proven that the consumption of sugar-free chewing gum as well as foods high in fiber can cause more saliva secretion and ultimately help prevent erosion. It is also noted that foods that contain

fiber reduce appetite, which can help decrease the consumption of harmful foods and ultimately prevent erosion. As the findings indicate that citric acid, malic acid and phosphoric acid and carbonated beverages are the most harmful chemicals that affect oral health and it is

important to pay attention to reducing the consumption of these substances [8]. In general, it can be concluded that the consumption of fiber nutrition and reducing the consumption of carbonated beverages affect the reduction of erosion.

Table 2. Summary of the results of the reviewed articles

Name of author and year of article	Field	Results
Cetinkaya et al., 2020 [13]	Oral health and care status	Sugar-free non-alcoholic beverages affect oral health and are less likely to cause tooth decay and erosion. Consuming non-alcoholic beverages and replacing them with non-alcoholic and non-carbonated beverages can be effective in reducing the erosion process.
Hasheminejad et al., 2020 [14]	Oral health and care status	The chance of tooth erosion for people who had never used sweetened soft beverages was 94%, lower than that in daily consumers.
Al-Dlaigan et al., 2002 [15]	The effect of carbonated beverages on erosion	There was a significant relationship between the rate and severity of tooth decay and acidic and carbonated beverages and dental erosion was associated with the consumption of soft drinks, carbonated beverages and fresh fruits in the study groups.
Sanchez et al., 2003 [16]	The effect of carbonated beverages on erosion	The main cause of erosion in children is drinking natural juices such as orange juice and apple juice and carbonated beverages such as Coca-Cola and soda. Consuming these drinks with food causes far less damage to the teeth than consuming them alone.
Moazzez et al., 2003 [8]	The effect of carbonated beverages on erosion	Using sugar-free gum as well as eating foods that are higher in fiber can cause more saliva to be secreted and ultimately help prevent erosion.
Zwier et al., 2013 [17]	Factors affecting erosion	The rate of unstimulated flow was significantly lower in people with dental erosion. Chloride concentrations in unstimulated saliva were significantly higher in the erosion group.
Gibbons et al., 1991 [18]	Investigation of pellicle and role of saliva	Myosin helps to form a layer of pellicle and prevent direct contact of the tooth surface with acids in the environment.
Hannig et al., 2015 [19]	Investigation of pellicle and role of saliva	The pellicle layer can act as a wall against the penetration of acids into the permeable surface of the enamel and protect it.
Sullivan et al., 2000 [5]	Investigation of pellicle and role of saliva	The proteins in saliva play a significant role in the production of the pellicle layer on the hard surface of teeth. Pellicle is important since it plays a major role in mechanical defense against acids in the mouth and also prevents the demineralization of the teeth that causes erosion.
Dugmore et al., 2003 [20]	Investigating the amount or flow of saliva produced and its relationship to defense of tooth surface	Low saliva causes the acids in various foods to stay in the mouth for a long time and increases the chances of erosion.
Noble et al., 2011 [21]	Investigating the amount or flow of saliva produced and its relationship to defense of tooth surface	Sports dehydrate the body, which causes the body to lose a lot of water.
Dawes et al., 2010 [22]	The relationship between saliva and tooth remineralization	Increased production and secretion of saliva is very beneficial for oral health
Hicks J, Garcia-Godoy et al., 2003 [23]	The relationship between saliva and tooth remineralization	When enamel is softened by acids in the mouth and ready to be destroyed, it is saliva that is responsible for regenerating and repairing it. Calcium, phosphate and alkaline environment are the first conditions for tooth regeneration. Dry mouth or xerostomia can have a significant effect on a person's daily life, affecting speech and eating, and people do not get the taste properly when eating and suffer from a burning sensation in the mouth and tongue. According to statistics, this disease is more common in the elderly with a 20% increase

Another study in 2020 revealed that the highest consumed beverage in daily living was tea in both genders, followed by sweetened soft beverages, as well as milk and kefir/yogurt drink. The results of the DMFT index were also significantly different in participants that had never consumed milk compared with those who had used milk on a daily basis. Moreover, the DMFT index in participants who had never consumed sweetened soft beverages was 39% less than those who had had a daily intake of such beverages. Also, the chance of tooth erosion for participants who had never used sweetened soft beverages was 94%, lower than that in daily consumers. The findings mentioned the positive effect of nutrition with milk on oral erosion [14].

There are several studies in the field of evaluating the factors affecting erosion, including the study of Zwier et al. in 2013 with the aim of investigating the relationship between several parameters of saliva and erosion in

deciduous teeth. In this study, stimulated saliva was collected from 88 elderly people with erosion. Flow rate, pH and buffer capacity were determined immediately. Total protein content, carbonic anhydrase VI, amylase, albumin, cesium, phosphate, urea, sodium, chlorine, iodine and potassium were also measured. The unstimulated flow rate was significantly lower in people with dental erosion. Chloride concentrations in unstimulated saliva were significantly higher in the erosion group [17].

Other research in this field shows that various factors such as 1. Regular consumption of carbonated beverages 2. Regurgitation and unwanted vomiting due to digestive problems 3. Long-term use of acidic drugs such as vitamin C play a role in increasing oral acidity and that saliva has a proven and irrefutable role in balancing oral pH as well as remineralization. Saliva is referred to as buffering capacity, therefore, increasing the amount of saliva secreted in the mouth (flow rate) can significantly help protect oral health

[8]. Paying attention to the role of saliva and its study in reducing erosion can be important.

Studies have also been conducted on the study of pellicle and the role of saliva in their formation. Research by Gibbons et al. showed that myosin is the major organic component of saliva and is made up of large glycoproteins. The high degree of glycosylation and the tendency of these proteins to assimilate with water prevent the drying of the oral environment. Moreover, due to the high density of this substance, a viscous environment is created in the mouth. Various studies have proven the high value of myosin to help form the pellicle layer that helps prevent direct contact of the tooth surface with acids in the environment [18]. Studies of Hannig and Joiner also showed that the pellicle layer can act as a wall against the penetration of acids into the permeable surface of the enamel and protect it. In studies by Sullivan et al., the proteins in saliva have been thoroughly and completely reviewed and it was found that they play a significant role in the production of the pellicle layer on the hard surface of teeth. Pellicle is important since it plays a major role in mechanical defense against acids in the mouth and also prevents the demineralization of the teeth that causes erosion. Therefore, saliva not only directly plays a role in balancing the acidity of the mouth, but also indirectly plays a role in defending the teeth by helping to produce pellicle [5, 19].

Other studies were conducted to investigate the amount or flow of saliva produced and its relationship to tooth surface defense. Decreased saliva production is seen in various patients which can have several reasons. A study by Dugmore et al showed that the clearance and elimination of acids in the mouth depends entirely on the amount of saliva secreted in the mouth as well as the ability of saliva to clear. Low saliva causes the acids in various foods to stay in the mouth for a long time and increases the chances of erosion. Sports dehydrate the body, which causes the body to lose a lot of water. A direct relationship between erosion and sports has been proven in studies by Noble et al [20, 21].

While, Dawes and Hicks J, Garcia-Godoy studied the relationship between saliva and remineralization of teeth. The results of these studies showed that increased production and secretion of saliva is very beneficial for oral health because saliva helps remineralize teeth with calcium and phosphate, which prevents the destruction of tooth surface by acids. Saliva and fluoride are two important factors in tooth regeneration and remineralization. When enamel is softened by acids in the mouth and ready to be destroyed, it is saliva that is responsible for regenerating and repairing it. Calcium, phosphate and alkaline environment are the first conditions for tooth regeneration. High levels of calcium and phosphate in saliva play an important role in delaying the destruction of enamel and the presence of fluoride in the mouth accelerates the regeneration process [22, 23].

Regarding dry mouth, Hicks J, Garcia-Godoy et al. showed that the disease depends on the amount and quality of saliva secreted. However, this disease can also be seen and felt in people in whom saliva is secreted normally. Their study showed that dry mouth can be caused by various medications. Medications such as antidepressants, antihistamines as well as autoimmune

diseases such as Sjogren's syndrome. Patients with cancer who are undergoing chemotherapy and radiotherapy, or patients with hormonal disorders or severe infections may all develop dry mouth or their dry mouth may be aggravated by the above conditions. Dry mouth or xerostomia can significantly affect a person's daily life, affecting speech and eating, and people do not taste properly when they eat and experience a burning sensation in the mouth and tongue. According to the obtained statistics, this disease is more seen in the elderly with a 20% increase [23].

DISCUSSION

Different findings regarding the status of oral care have shown that the level of oral health in Iran is at a low level. The use of oral cavity filling treatments can be effective in reducing oral problems. It is also emphasized that sugars should be consumed in one meal during the day and they should not be consumed gradually during the day [12, 24]. Proper nutrition is another important issue in oral health [25]. Regarding the effect of carbonated beverages on erosion, there was a significant relationship between the amount and severity of tooth decay by acidic and carbonated beverages and tooth erosion was associated with the consumption of soft drinks, carbonated beverages and fresh fruits in the study groups. The reduction in the consumption of carbonated beverages on erosion is significant and its reduction should be taken into account [5, 15].

Another finding on this issue is that replacing carbonated beverages can decrease oral erosion problems. So that non-alcoholic beverages without sugar affect oral health and cause less oral caries and erosion. Consumption of soft drinks and alcoholic beverages has been associated with tooth loss, whether tooth decay or periodontal disease. Research has proven that the use of sugar-free chewing gum, as well as foods that are higher in fiber can cause more saliva secretion and ultimately decrease erosion [8].

Saliva contains proteins and compounds that help neutralize oral acidity. These salivary defense proteins disrupt the basic structure of microbes and prevent them from multiplying [18]. The proteins in saliva play a significant role in the production of the pellicle layer on the hard surface of teeth. Pellicle play a prominent role in mechanical defense against acids in the mouth and also prevent demineralization of teeth that cause erosion [5]. The amount or flow of saliva produced is directly related to its ability to defend the tooth surface and is considered as one of the effective factors [1]. Low saliva causes the acids in various foods to stay in the mouth for a long time and increases the chances of erosion. Studies by Dawes has shown that increased saliva production and secretion is very beneficial for oral health because saliva helps remineralize teeth with calcium and phosphate, which prevents the destruction of tooth surface by acids [20, 22].

The effect of nutrition on erosion is very important. The findings show that people who consumed carbonated beverages, soft drinks as well as acidic juices had much higher and more severe erosion than the other group. Also, the way they drank (with or without a straw) was also

effective on the results, diet drinks had less destructive effects on the teeth than regular drinks [5].

CONCLUSION

Saliva is the most important inhibitory factor that can prevent dental erosion. Knowing its ingredients as well as the structure of saliva can help us develop methods that can prevent erosion. Erosion can be seen at various ages, from adolescents to adults. Long-term contact with external or internal acids in the body can cause tooth decay and eventually damage the tooth structure. If not treated early, it can destroy a significant amount of tooth structure, affecting nutrition, speech and even the beauty of the patient. The most important stage of treatment is early diagnosis of this disease.

Improving oral health, brushing properly, and avoiding foods that are high in sugar and acid are important factors that should be considered. Based on all the research that has been carried out on this subject, it has been proven that carbonated and acidic beverages have very destructive effects on the teeth, so it is important to reduce the number of times and regulate their consumption.

The presence of existing acids causes the minerals in the teeth to decay, which makes the tooth surface very soft and ready to be vulnerable to any hard object that comes in contact with the teeth. It is suggested to use acid-reducing agents after consuming acidic substances.

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