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Review

Dental Erosion in Primary Teeth

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Abstract
Dental erosion is recognized as an increasingly common condition in pediatric dentistry with complications of tooth sensitivity, esthetic problems, eating difficulties and loss of occlusal vertical dimension. The dental erosion process is characterized by softening of the outer layer of enamel as well as a decrease in microhardness. In microhardness studies, it has been shown that primary tooth enamel is softer than the enamel of permanent teeth and the erosion process is faster in primary tooth enamel than permanent tooth enamel. Since the sizes of primary teeth are smaller than permanent teeth, the risk of dental erosion-related damage increases. The purpose of this article is to critically review dental erosion in children in terms of its prevalence, etiology, diagnosis, clinical presentation, and prevention.

Süt Dişlerinde Dental Erozyon

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Öz
Diş erozyonu, pediatrik diş hekimliğinde diş hassasiyeti, estetik sorunlar, yeme güçlükleri ve oklüzal dikey boyut kaybı gibi komplikasyonlarla birlikte giderek yaygınlaşan bir durum olarak kabul edilmektedir. Diş erozyonu süreci, diş minesinin dış tabakasının yumuşaması ve mikro sertliğin azalmasıyla karakterize edilir. Mikrosertlik çalışmalarında süt dişi minesinin daimi diş minesine göre daha yumuşak olduğu ve süt dişi minesindeki aşınma sürecinin daimi diş minesine göre daha hızlı olduğu gösterilmiştir. Ancak süt dişlerinin boyutları daimi dişlere göre daha küçük olduğundan diş erozyonuna bağlı hasar riski artar. Bu makalenin amacı çocuklarda diş erozyonunun prevalansı, etiyolojisi, tanısı, klinik görünümü ve önlenmesi açısından eleştirel olarak gözden geçirilmesidir.

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Introduction

Unlike dental caries, dental erosion is the process of hard tissue and mineral loss from dental tissues due to chemical reasons without microorganism factors and is defined as irreversible losses (1). While dental erosion is known as the loss of the outer layer of the tooth as a result of demineralization and exposure to acid, erosive tooth wear occurs under the influence of both chemical and mechanical factors (2). The dental erosion process is characterized by softening of the outer layer of enamel and also a decrease in microhardness (3,4). In microhardness studies, it has been shown that primary tooth enamel is softer than the enamel of permanent teeth and the erosion process is faster in primary tooth enamel than permanent tooth enamel. The most common erosion areas are occlusal surface of the molars and palatal and incisal surfaces of the incisors.

Dentin involvement of erosion in primary teeth is faster than permanent teeth, due to morphological differences and thinner enamel structure (5). Due to the smaller size of primary teeth compared to permanent teeth, the risk of dental erosion-related damage increases (6).

In primary dentition, restorative treatment of dental erosion lesions is not indicated if the child does not have any symptoms. In the case of tooth sensitivity, small areas of erosion observed can be covered with resin materials. Depending on the etiologic factors, severity and progressive pattern of disease, all patients with dental erosion should be checked regularly (5).

Epidemiology of Dental Erosion

Dental erosion, which causes changes in the external structure of the tooth, is mostly encountered in the occlusal, facial and lingual regions (7). S. mutans, the main microorganism of dental caries, cannot continue its life activities in the pH where erosion is seen. For this reason, erosion and caries lesions are generally not seen together. Microscopically and clinically, erosion is viewed differently from dental caries (8). In the case of erosion, it is not possible to talk about complete wear. Enamel weakened by acid causes other types of wear to occur more easily. The acid in the oral cavity weakens the enamel surface components. This outer layer is then separated from the surface and the relatively intact enamel surface emerges from the bottom. This solid enamel surface can also be damaged by possible subsequent acid attacks (9).

According to Linnett and Seow's study, the prevalence of dental erosion has increased, especially among children and adolescents (10). In children aged 2-7 years, the incidence of enamel erosion alone has been reported more than cases of erosion involving dentin. In studies conducted with children aged 12-14 years, the rate of erosion involving dentin has increased. The distribution of the eroded teeth in the jaws is not regular. It has been reported that the upper anterior teeth and first molars are affected more frequently in children and adolescents (6).

In studies conducted in England, the prevalence of dental erosion in the primary dentition was found to be between 8% and 65% (11) In Germany, dental erosion was seen at a rate of 71% in children aged 8-11 years (12). Zhang et al. found dental erosion lesions in 75% of 12-year-old Hong Kong children (13). The results obtained in studies conducted on adolescents show that the prevalence of erosion in permanent teeth varies between 10% and 90% (14).

The prevalence of dental erosion in studies conducted in our country; It was detected in 25% of children aged 6-12, 52% in children aged 13-15, and 25.9% in the 11-15 age group (15,16)

Pathogenesis of Dental Erosion

Regardless of the etiology of dental erosion, the major pathology that occurs is the demineralization of superficial hard tissues by the dissolution of hydroxyapatite crystallites. This situation can cause serious destruction of dental tissues due to acidic pH, the presence of chelating agents, low calcium-phosphorus concentration in saliva and frequency of erosive attacks (17).

Etiology of Dental Erosion

Demineralization and dissolution of tooth enamel occur when the pH of the oral environment is less than critical. There are 3 major reasons for this low pH in the oral cavity. These; are stomach acids that pass into the oral cavity caused by stomach ailments, acids produced by acidogenic bacteria, and exogenous acids taken with nutrition. Of these acids, acidogenic bacteria-induced ones cause dental caries, while others cause dental erosion (18).

The Effect of Nutrition on Dental Erosion

Nowadays, unfortunately, children are the first to be affected by the negative changes in society's lifestyle and eating habits due to the easier access to fast foods, the preference for snack foods due to time constraints, and the influence of the media. Erosion, one of the dental problems we encounter due to these changes, is the most common form of tooth wear in pediatric patients (5).

The most important external factor that causes dental erosion is shown to be excessive intake of acidic beverages (19). When beverages with this acid content come into contact with the teeth, the demineralization process begins (20). Acids that are common in nutrition and related to the erosion process; citric, phosphoric, malic and tartaric acids (21).

Vegetables, fruits and beverages consumed for diet mainly contain citric acid and then malic acid. Lemon and orange juice contain high levels of citric acid. Citric acid is also included in the content of many food products (cola, etc.) produced. The erosive potential of citric acid is very high. The reason for this high erosive potential is that its ability to bind calcium (Ca) in the enamel content continues despite the increase in pH value. Malic acid is present in apples, plums and peaches. Tartaric acid is included in the content of wine and grapes. While lactic acid is found in fermented foods, phosphoric acid is in the content of cola-derived beverages (22).

It is not correct to show any acid-containing food or drink as the main etiological agent causing erosion. Evidence from the research highly supports the contribution of soda and food intake in dental erosion. In clinical studies investigating the effects of low-pH foods on teeth, it is stated that these beverages cause some changes in the enamel of the teeth (21). Some researchers explain the difference in the responses of different subjects to erosion by different factors. To these factors; The way the liquid is taken into the oral environment, the tooth surfaces that the acidic liquid touches, the exposure time of the teeth to acid, lip-cheek movements, swallowing habits and salivary flow rate can be given as examples. In addition, the buffering ability of saliva, the morphology of the teeth, and the physical and chemical properties of enamel may cause differences in the erosion process (21,23).

Differences in the way drinks are taken affect erosion. Drinks swallowed by holding in the mouth cause the oral environment to be exposed to high concentrations of acidic beverages, while beverages consumed with a straw provide a minimal oral environment and tooth contact, reducing the spread of the beverage into the mouth. Using the straw by positioning it at the very back of the tongue reduces the erosive potential of the beverage (6).

Consumption of acidic beverages at times when the salivary flow rate is low (before going to bed at night, between sleep, after exercise, between meals, etc.), keeping them in the mouth, drinking with more contact with the teeth, and brushing the teeth immediately after consumption of beverages are factors that increase the formation of erosive lesions (8).

Mostly citrus fruits, fruits, vegetables, vinegar foods, snack foods, ketchup, tomato and cooking sauces are some of the foods with erosive potential. These foods have been proven to be associated with dental erosion in adults, children and adolescents. Compared to normal individuals, erosive lesions were observed 37 times more in people who consumed more than two citrus and citrus fruits a day (18).

Effect of Drugs on Dental Erosion

Frequent and long-term use of drugs with low pH can lead to erosion of dental hard tissues (24). These erosive lesions can occur mostly due to the acidity of drugs in syrup or effervescent form (25). The low production of stomach acid is called achlorhydria. Patients with this condition take oral hydrochloric acid for treatment. This treatment option has been reported for very severe erosive lesions (21).

Recently, the use of fortifying vitamin C has become popular. The pH of vitamin C supplements is quite low. It can be shown as a cause of erosion, especially when used for a long time and when drugs come into direct contact with tooth surfaces (21,24). Studies have been conducted to evaluate the pH and in vitro enamel demineralization potential of different vitamin C preparations. In these studies, it is reported that the pH is less than 5.5 and tooth erosion occurs after 100 hours of exposure. In a clinical study conducted in individuals with normal salivary flow, it was found that vitamin C preparations do not erosive affect tooth structures in cases where they are not in direct contact with the teeth (21). A meta-analysis of nutrients reveals that vitamin C is a risk factor for dental erosion (26,27).

Dental erosion, which is followed by the effect of acidic drugs that are used for a long time and taken orally, does not occur only by direct contact of the drugs with the teeth. It may also be caused by the use of drugs that indirectly cause vomiting. Vomiting is among the complications of many drugs (8). One of the most commonly used drugs worldwide is aspirin (Acetylsalicylic acid). In a study on children with juvenile rheumatoid arthritis, the presence of erosion on the chewing surfaces of patients using aspirin as a chewable tablet was reported, while the presence of erosion was not observed in patients who swallowed the tablet (28).

An important factor in the formation and acceleration of dental erosion is that the drugs used cause dry mouth as a side effect. Unstimulated salivary flow is important in detecting the pathogenesis of erosion (28). Long-term use and low pH value analgesics, antibiotics, gastrointestinal drugs, cardiovascular drugs, antipsychotics, potassium supplements, antiemetics, asthma drugs, etc. They have erosive potential due to their acidic nature (29–32).

According to the results of a laboratory study, guaifenesin, ferrous sulfate and salbutamol sulfate are commonly prescribed to children. The erosive potential of these ingredients in primary teeth has been investigated. Salbutamol sulfate reduced the microhardness of deciduous enamel from day 7, while other drugs significantly reduced it after day (28,33).

The Effect of Lifestyle and Habits on Erosion

Wrong eating habits gained from an early age are effective in the formation of erosion. Especially consuming acidic beverages using a bottle and going to bed at night with a bottle are more destructive due to the decreasing saliva flow rate at night. Cleaning the teeth with abrasive toothpaste frequently and using excessive force can make the teeth prone to erosion. Due to these abrasive applications, the outer part of the enamel with high mineral content has been removed and the pellicle thickness, which acts as a barrier to dental erosion, has decreased. In addition, athletes swimming in pool facilities without pH regulation were also exposed to dental erosion (18).

Tooth wear is mainly due to parafunctional habits such as teeth grinding. With the involvement of erosion factors affecting the teeth, the wear process accelerates. Dental occlusion plays a role in the etiology of non-carious cervical lesions caused by tooth flexion. Thus, the stress caused by eccentric chewing forces causes cracks in the cervical of the tooth. The presence of these cracks increases the susceptibility to acid erosion (21).

Endogenous acid sources have been cited as the cause of endogenous erosion in the oral cavity. Erosion may occur as a result of regurgitation, vomiting, gastroesophageal reflux (GER) and the pH value of stomach contents coming to the oral environment and dental structures with a pH value of 1-1.5. The severity of dental erosion varies from patient to patient, depending on the frequency of these disorders, the amount of saliva flow, and the structure of the teeth (34).

The pH of the stomach contents is around 1-1,5, which is well below the critical pH at which demineralization begins in dental hard tissues. For this reason, it is stated to be a strong corrosive factor (35). In the study of Jarvinien et al., it was determined that dental erosion is 4 times more common in patients who regurgitate once a week, and 18 times more in patients who vomit constantly (36). Dental erosion process; It may vary depending not only on the duration and frequency of vomiting, but also on the oral hygiene habits of individuals such as vigorous brushing after vomiting, the structure of dental hard tissues, the amount of mineralization, fluoride use, and the quality and quantity of saliva (36,37).

In the research, it was emphasized that the most affected area by the stomach acid contents reaching the oral cavity is the palatal parts of the maxillary incisors. Erosion lesions manifest themselves as the thinning of the enamel layer in the early stages, and the exposure of dentin and pulp in the later period (35).

Another deterioration that causes the fluid in the stomach to reach the oral cavity by backward movement is called regurgitation. Regurgitation is distinguished from vomiting by decreased abdominal diaphragmatic muscle contraction and less expulsion of gastric contents (34).

Effect of Tooth Composition, Structure and Type on the Erosion Process

The contents of the teeth are highly variable and diverse. Studies have shown that there are significant differences in the acid response of human teeth exposed to acidic foods and beverages. This biological change is explained by in vitro model systems using the natural surfaces of human teeth (21,38). Primary teeth are more prone to dental erosion than permanent teeth due to the differences in their structures. Due to the thinner enamel of primary teeth and morphological differences, dentin involvement occurs faster in primary teeth than in permanent dentition. In immature teeth with large pulps, dental erosion seems more likely to lead to pulp exposure and inflammation. At the same time, primary tooth enamel has a higher water content and is more permeable compared to permanent tooth enamel. This explains the relatively rapid occurrence of dental erosion in primary teeth (25,39).

There are different explanations for dental erosion susceptibility of primary and permanent teeth. In an in vitro study by Amaechi et al., it has been proven that erosion occurs 1.5 times faster in primary teeth compared to permanent teeth (40). Lussi et al., in their in vitro study, compared the erosive potentials of acidic liquids in permanent and deciduous teeth, and they stated that there was no significant difference between primary and permanent teeth in terms of erosion susceptibility (41).

Tooth contours, tooth shapes, drinking and swallowing patterns are defined as factors affecting the erosion process in the oral cavity. Enamel becomes more susceptible to attrition when exposed to acidic content. Therefore, occlusion plays an important role in erosion-induced tooth wear (21).

Clinical Appearance of Dental Erosion

Early-stage enamel erosion does not cause discoloration or softening of the surface. There is no pain and it is at a level that cannot be detected clinically. Erosive lesions at this level have an “orange peel” appearance (42). Tooth enamel is not shiny in cases of active erosion. On the contrary, eroded enamel has a brighter structure. When the abrasion descends to the dentin, it takes on a yellow-brown color. In these cases, the tooth is more sensitive to temperature changes. In the initial stage of dentin erosion, the superficial lesions show dentin characteristics. It has a more white and light yellow appearance. When the lesion is severe, dentin; It has a rounded, diffuse, diffuse shape and a distorted color. Thus, dark yellow-brown sclerotic dentin was formed (43).

Treatment of Dental Erosion

First of all, the causes of dental erosion should be eliminated. If lesions have begun to form, they can be treated with restorative methods. The main goal of erosive lesion treatments is to preserve the tooth structures at the maximum rate without the preparation of the teeth. However, low pH affects not only natural teeth but also

materials used for restoration. Myklebost et al. They examined this in a study in which gastric contents fluids were simulated. According to this study; it has been proven that Tetric Ceram composites, compomers, resin-modified glass ionomer cements, glass ionomer cement used for the posterior region and amalgam restorative materials significantly increase the surface roughness rates. For this reason, the polishing processes of restorative materials should be perfect and controls should be made at regular intervals (44).

If the erosion process has caused loss in the appearance and function of the tooth, it can be treated prosthetically. The purpose of prosthetic treatments; is to reduce the sensitivity of dentin, to obtain an aesthetic appearance, to change the decreasing vertical dimension due to abrasions and to prevent the progress of the process (45). Desensitizing toothpastes, gels and varnishes can also be used. It has been stated that the use of fluoride toothpastes containing potassium citrate (5.5%), and potassium nitrate (5%) can relieve tooth sensitivity as a result of the precipitation of calcium carbonate in the dentinal tubules (46). Patients' complaints of sensivity can be reduced for a while with HEMA and agents with glutaraldehyde, flouride varnish and ingredients with potassium oxalate (47). It has been proven that gels with a high fluorine content provide surface hardening in erosive lesions and protect the enamel against a second acid exposure thanks to the calcium fluoride layer (47,48).

Conclusions

Dental erosion in the primary dentition is commonly encountered in children. Its multifactorial aetiology and its associations with other dental conditions such as enamel hypoplasia and caries add complexity to the diagnosis, prevention and management of these conditions. The high prevalence of dental erosion reported in children calls for further research into its prevention, such as the use of protective additives to alleviate the erosive effects of acidic foods and beverages and medicaments.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Authors Contribution Statement

O.P. and R.A. contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. All authors read and approved the final manuscript.

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