Dental Erosion and Its Risk Factors in 12-year-old School Children in Mashhad

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ABSTRACT

Statement of Problem: The dental hard tissues might be destroyed by different factors. One is dental erosion defined as the progressive loss of hard dental tissues by a chemical process not involving bacterial action.

Purpose: The purpose of this study was to determine the prevalence of dental erosion and its risk factors in 12-year-old school children.

Materials and Methods: This cross-sectional study was carried out on 483 12-year-old school children in Mashhad, 2007. Dental erosion was recorded for the labial and palatal surfaces of the upper incisors. For measurement purposes, the O'sullivan's index was adopted, and the results were statistically analyzed by T-student and Chi-Square tests.

Results: The prevalence of dental erosion was 38.1%, with no significant sex difference. Dental erosion was significantly higher in private school children ($P<0.001$) and in underprivileged areas ($P=0.005$). Matt appearance of the enamel was the most prevalent type of dental erosion (21.2% central incisors, 5.2% lateral incisors). In most of the involved cases, more than half of their surfaces were diagnosed as affected by erosion (24.4% central incisors, 5.2% lateral incisors). The frequency consumption of carbonated beverages and night drinks illustrated a significant relation with dental erosion ($P=0.01$, $P=0.023$). Children who swam professionally in swimming pools had significantly higher dental erosion ($P<0.001$).

Conclusion: Based on the findings of this study, individually tailored preventive programs may be recommended to patients and a comprehensive case history should be taken so that all risk factors can be revealed.

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Introduction

Tooth erosion is the chemical dissolution of the dental tissues without bacterial involvement. The underlying etiology of erosion is believed to be a source of acidic action on a susceptible tooth. It may be caused by exposure of the teeth to frequent consumption of acidic drinks or foods, environmental exposure to acids, or reflux of gastric acid into the mouth. Symptoms of dental erosion range from sensitivity to severe pain associated with pulp exposure, altered occlusion and poor aesthetics [1]. Erosion is recognized as an important cause of loss of the tooth tissue for adults, children and adolescents [1-5]. To prevent further progression, it is important to detect this condition as early as possible [2].

Clinical appearance is the most important feature for dental professionals to diagnose early forms or more advanced stages [3]. General health, diet, habits and assessment of saliva flow rates should be accompanied by clinical examination [2]. Life style and behavior differences must also be considered as having an important role in formation of dental erosion. For example, soft drink consumption in the USA increased by 300% in 20 years [4]. High erosion was associated with the method of drinking specially when it was kept for a long time [5].

The beverages and also the method of drinking play an important role in dental erosion on facial and occlusal surfaces. Severe palatal erosions were scarce and highly associated with chronic vomiting. The cause of this vomiting varies according to the patient's age [6]. High consumption of carbonated drink increased the odds of erosion being present at 12 years by 252 % [7]. High intake of herbal tea and fruit juice, using a straw while placing it past the anterior teeth may have an exceeding erosive potential [8].

The progression of erosion has been examined at the age of 12 years and 2 years later in UK. In this study, 4.9% of the subjects at baseline and 13.1% about 2 years later had deep-enamel or dentin lesions [9]. The risk groups are swimmers exercising in water with low PH and athletes consuming erosive sport drinks. Early diagnosis of dental erosion and accurate detection of possible risk factors are two most important steps. There are different dominant predisposing factors and etiologies which are highly effective on the erosive condition. The interplay of chemical, biological and behavioral factors plays a critical role in explaining why some people exhibit more erosion than others, even when exposed to the same situation [1]. The purpose of this study was to investigate the prevalence of dental erosion and its risk factors in 12-year-old school children in Mashhad.

Materials and Methods

This cross-sectional study was carried out on 483 healthy 12-year-old school children (168 boys and 315 girls) in Mashhad. The samples were selected through a cluster-stratified method. A written consent was obtained from each parent. A letter was sent to the parents stating the objectives and importance of the study, and asking for their participation. An examiner carried out clinical examinations supported by a scribe. Before commencing, the examiner was trained by an experienced dentist, who was regarded as the gold standard. Arrangement of different levels of dental erosion was used in the calibration exercise, which was based on the diagnosis of photographic images. Reliability was assessed through the Kappa test.

Children were clinically examined at their schools under standard artificial illumination using plane mouth mirrors and sterilized gauze to remove gross debris. The four upper incisors were examined. Each examination for erosion lasted 30 seconds on average. Intra-examiner reliability during the filed work was checked with publicate examinations of every tenth subjects. The Kappa statistic was calculated on a tooth basis.

Classification

The dental literature provides useful clinical indices for the epidemiological recording of dental erosion [10]. In this study, O'sullivan Index was used for the measurement of erosion in the four upper incisors [11].

1) Erosion site on each tooth:

a.   Code A: Labial or buccal only

b.   Code B: Lingual or palatal only

c.   Code C: Occlusal or incisal only

d.   Code D: Labial and incisal /occlusal

e.   Code F: Multi surface

2) Grade of severity (worst score recorded for an individual tooth):

a.   Code 0: Normal enamel

b.   Code 1: Matte appearance of the enamel surface with no loss of contour

c.   Code 2: Loss of enamel only (loss of surface contour)

d.   Code 3: Loss of enamel with exposure of dentine (dentinoenamel junction visible)

e.   Code 4: Loss of enamel and dentine beyond dentinoenamel junction

f.   Code 5: Loss of enamel and dentine with exposure of the pulp

g. Code 6: Unable to assess (e.g. tooth crowned or large restoration)

3) Surface area, affected by erosion:

a. Code +: less than half of surface affected.

b. Code -: more than half of surface affected.

For the purpose of differential diagnosis, all detectable disorders of the dental hard tissue were recorded as follows:

1) Developmental defects of the enamel

2) Dental fluorosis community index F (the fluorosis index described by Dean using natural light; the teeth were examined moist)

3) Post-eruptive disturbances of the dental hard tissue, such as coronal damage from injury, or facts on incisal and occlusal surfaces of the teeth resulting from attrition.

Questionnaire

A questionnaire was prepared to elicit the following information:

1) Personal demographic details.

2) Dental (caries, orthodontic treatments, etc.) and medical history (asthma, gastric disease, etc.).

3) Habits of consuming carbonated beverages, fruits (type and frequency).

4) Time (at meal, between meals, before bed, irregular) and type (oral, straw, slowly, quickly) of consumption.

5) Swimming habits (regularly, professionally, summer, all year).

Data analysis

The data were entered onto a computer using SPSS 10.0. The descriptive-analytical tests were used. The results were statistically analyzed by Chi-Square test. Statistical significance was established at the 5% level.

Table 1 Distribution of the grade of erosion severity according to O'sullivan's Index

Tooth Frequency Grade of severity	Central incisor		Lateral incisor	
	Number	%	Number	%
Code 0	623	64.5	898	92.80
Code 1	205	21.2	51	5.20
Code 2	106	11	14	1.30
Code 3	26	2.70	3	0.70
Code 4	4	0.4	0	0
Code 5	2	0.20	0	0
Total	966	100	966	100

Results

- There was no significant difference in the prevalence of dental erosion between girls (37.5%) and boys (39.3%).

- The highest frequency of erosion was observed in the maxillary central incisors (35.5%) and the lowest was in the maxillary lateral incisors (7.05%).

- Matt appearance of the enamel (code 1) was the most prevalent type of dental erosion (21.2% for central incisors and 5.2% for lateral incisors) (Table 1).

- In most cases, more than half of the anterior teeth surfaces were involved by erosion (24.4% for central incisors and 5.6% for lateral incisors) (Table 2).

- There was a significant relationship between the fruit juice consumption, carbonated beverage per day ($P<0.001$), time of beverage consumption ($X2=7.541$, $P=0.023$) and dental erosion (Table 4). No relationship was found between duration of beverage consumption and dental erosion ($P=0.35$).

- The most erosion site was on the labial surface (code A) of the affected teeth (14.5% for central incisors and 2.9% for lateral incisors) and no tooth was found with E and F codes (Table 3).

- 62.5% of children who swam professionally in chlorinated swimming pools had dental erosion ($P<0.001$) (Table 5).

- Dental erosion was significantly higher in private schoolchildren compared with privileged ones ($X^2=18.45$, P=0.005).

- It was also illustrated that dental erosion is not related to the individuals' medical history (Gastro esophageal disorders, Asthma, Medicine use).

Table 2 Distribution of the surface areas affected by erosion according to O'sullivan's index

Tooth Frequency Surface affected	Central incisor		Lateral incisor	
	Number	%	Number	%
Code +	107	11.05	14	1.43
Code -	236	24.4	54	5.60

Table 3 Distribution of erosion site on maxillary permanent incisors according to O'sullivan's index

Tooth Frequency	Central incisor		Lateral incisor	
Erosion site	Number	%	Number	%
A	140	14.5	28	2.9
B	80	8.3	26	2.7
C	119	12.3	11	11.15
D	4	0.4	3	0.3
E	0	0.0	0	0.0
F	0	0.0	0	0.0
Total	343	35.5	68	7.0

Table 4 Distribution of dental erosion according to consumed beverages per day

Consumed beverages	Erosion	Total	Number	%	P-Value
Water	No	64	44	68.8	$\chi^2 = 29.3$
	Yes	419	140	33.4	$P<0.001$
Carbonated beverage	No	384	112	29.2	$\chi^2 = 63.6$
	Yes	99	72	72.7	$P<0.001$
Fruit juice	No	366	106	29.0	$\chi^2 = 57$
	Yes	114	78	68.4	$P<0.001$

Discussion

A wide-range prevalence of dental erosion has been reported in primary and permanent dentition. This may be due to the relatively small number of subjects in the majority of studies and the use of different criteria for diagnosis [12].

The use of upper incisors, when investigating dental erosion in 12-year-old children, is appropriate since at this age, these teeth have been exposed in the mouth for a considerable length of time when comparing to the other teeth. Other studies have included the molars since these teeth have also been shown to be susceptible to erosion. However, confining examination of incisors in large societies has proved to be an easier task [13]. In this study the prevalence of dental erosion among 12-year-old

school children was found to be 38.1%. This prevalence is similar to that published by Deery et al [14] and Al-Majed et al [15]. On the other hand, the prevalence found in this study was higher than those reported by Calgar et al. [10] and Peres et al. [13]. The differences observed between the results of this study and those of other investigations may be explained by several factors. First of all, the different criteria used in various studies could be one of the reasons for this discrepancy. It is difficult to compare the results of different prevalence studies when different teeth are included in the measurement methods. Finally, the permanent dentition analyzed in different studies shows erosion at any ages ranging from 12 to 14 years, which may also influence the results through differences in time of exposure to risk factors [13].

Table 5 Distribution of dental erosion according to swimming in the pool

Swimming	Erosion Frequency	No		Yes		Total	
		Number	%	Number	%	Number	%
Regularly		18	37.5	30	62.5	48	100.0
Summer school		82	59.0	57	41.0	139	100.0
Irregularly		87	59.2	60	40.8	147	100.0
No time		112	74.8	37	25.2	149	100.0
Total		297	61.7	184	38.3	483	100.0
Result				$X^2 = 23.45$	$P<0.001$		

The predominance of erosion sites on the labial surfaces recorded in this study is in agreement with the data reported by Peres et al [13], but different from those reported by Al-Majed et al. [15] and caglar et al. [10]. In most cases of this study, the grade of erosion severity (code 1) was similar to what Peres et al. [13] and Al-Majed et al. [15] have observed but lower than what was measured by caglar et al. [10].

The surface area affected by erosion (code -) in the present study was greater than that of Peres et al.'s study (Code +) [13]. This may be due to more risk factors or long duration exposure. The prevalence of all dental erosions was 38.1% with no significant difference between sexes. The absence of significant differences in the prevalence of dental erosion between boys and girls in this study may be explained by a similar pattern of exposure to risk

factors in the population. This finding is similar to the results of studies conducted by caglar *et al*. [10], peres *et al*. [13] and Deery *et al*. [14]. However, Al-Dlaigan [16] noted that boys had a higher prevalence of dental erosion than girls. In this research, the prevalence of erosion was significantly higher in private schools than among underprivileged ones. One hypothesis that could explain the findings of this study is related to dietary habit, especially the consumption of acidic beverages. These risk factors are more prevalent among higher income social groups, such as children enrolled in private schools. While exploring the influence of socioeconomic status on the prevalence of dental erosion, studies have shown contra- indicatory results. Millward *et al*. and Williams *et al*. found a lower prevalence of dental erosion among underprivileged children [13]. In contrast, Al-Dlaigan *et al*. [16] and Peres *et al*. [13] reported a significantly higher prevalence of erosion in teenagers of the lowest socioeconomic groups. As lifestyles have changed through decades, behavioral factors play a dominant role in dental erosion in different countries [10,13,15,16].

A significant relationship between fruit juice, carbonated beverage consumption and dental erosion was seen in our study. Similar findings have been reported as shown in studies by Mathew *et al*. [10] and Al-Dlaigan *et al*. [16]. Also, the frequency of carbonated beverages consumption and night drinks illustrated significant relations with dental erosion (0.023). 62.5% of children who swam professionally in chlorinated pools had dental erosion. The recommend PH for swimming pools is between 7.2 and 8.0. Swimming activities in PH-adjusted pools do not harm the teeth. However, erosion among competitive swimmers was found in 39% of swim-team members who were trained in a pool with a PH of 2.7 [2].

While evaluating dental erosion, biological and behavioral factors must always be taken into consideration. It makes sense that a diet composed of foods or beverages with a low PH value would have erosive effects on human teeth. PH alone, however, is not a good indicator for any substance's erosive potential [10]. The interplay of chemicals, biological and behavioral factors is crucial to exhibit dental erosion [2]. It is important to learn more about the etiology of erosive lesions before they can be accurately diagnosed. In these cases, prevention has a higher priority over treatment. Personal interviews may give better information about dietary habits. Preventive advice to children, teenagers, parents, and health care providers should include a warning about dangers of erosive sources to the teeth.

Conclusion

It might be concluded that the prevalence of dental erosion in this study should be noticed. Early diagnosis of dental erosion and accurate detection of possible risk factors are too vital tasks. It should be noticed that adopting preventing measures plays an important role in prevention of dental erosion.

Acknowledgment

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