

Dental Erosion and its Associated Factors In 11-16-Year Old School Children

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*Dental erosion currently stands as a great challenge for the clinician, regarding the diagnosis, identification of the etiological factors, prevention and execution of an adequate treatment. **Aims:** To evaluate the prevalence, severity, and associated factors on dental erosion in 11-16-years old. **Study design:** A cross sectional study was conducted among 2000 school children who were randomly selected. A questionnaire was given to the children that included personal demographic details and habit of consuming acidic foods and drinks. An index specific for dental erosion given by O Sullivan was used to assess every affected tooth. The values were subjected to chi-square test and multivariate logistic regression analysis. **Results:** The prevalence of dental erosion was found to be 1.4%. Females (1.6%) were slightly more affected than males (1.3%). Public school children (2.1%) were found to be affected a little more than private children (0.7%). Chi square test showed significant association between type of school and erosion prevalence ($p = 0.015$). Most commonly affected teeth were lateral incisor (59.72%). **Conclusion:** The prevalence of dental erosion was found to be low when compared to various studies done all over the world.*

Key words: dental erosion, prevalence, school children, dietary habits.

INTRODUCTION

Significant changes in lifestyle and dietary habits have contributed to the awareness of dental professionals to another dental disorder tooth wear. It includes mechanical processes such as attrition, abrasion, abfraction and also a chemical process, which is dental erosion. In the present scenario dental erosion is a great challenge for the dental practitioner as far as diagnosing the condition, identifying the etiological factors, executing an adequate treatment, and instituting preventive measures is concerned.¹ The major challenge with respect to diagnosis is to distinguish dental erosion from other kinds of wear. As a matter of fact most of the dental practitioners do not seem to have sufficient knowledge about the diagnosis of different types of tooth wear.¹

Previous studies have reported the etiology of erosion and its association with clinical conditions (dental enamel hypoplasia and caries), behavioral (dietary habits and oral hygiene), gastroesophageal reflux disease (GERD), demographic, and socioeconomic factors and have concluded varied results with respect to the same.^{2,3,4,5}

A number of studies have been conducted in various parts of the world and the prevalence of dental erosion has been known to keep increasing globally in the previous years.^{6, 7, 8, 9} If dental erosion is undiagnosed or ignored by the dentist, the consequences could be severe and devastating to the tooth. These complications could be dental hypersensitivity, pain, altered occlusion, eating difficulties, pulp exposure, abscesses and poor esthetics.¹⁰ There is a lack of information, however, about the distribution of dental erosion of children in India with regard to their permanent dentition. No extensive studies have been conducted so far to report the distribution of dental erosion in India with respect to the same. As the prevalence

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of dental erosion is on increasing trend, this study provides empirical evidence to pediatricians about the need to carefully review the children using the index specific for dental erosion and not tooth wear. This age group selected gives a clear picture of prevalence of erosion at its base.

Therefore the aim of this study was to evaluate the prevalence of tooth erosion and other associated factors in a population based sample of schoolchildren in Davangere city.

MATERIALS AND METHOD

A cross sectional study was conducted among 2000 (1173 boys and 827 girls), 11-16-year old school going children who belonged to Davangere, a city in India. Estimated *population of Davangere* city is 435128 as per official census report of 2011. Prior to the study ethical clearance was obtained from the Institutional Review Board of College of Dental Sciences. Permission from Deputy Director of Public Instructions, Principals of respective schools and parents were sought prior to commencement of the study.

Sampling and training of examiner

All examinations were done by a single examiner who was calibrated to match a Benchmark. The clinical examinations for 30 subjects were comprehensively carried out by single examiner for two times within interval of one week to assess for the intra-examiner variability. The kappa statistics was found to be 0.95, which reflected a high degree of conformity in the examination. Two stage sampling procedure was adopted for selection of the sample. In the first stage, 6 government schools and 6 private schools were selected from the total number of schools (190) with the help of simple random sampling. In the second stage children were selected from the already selected schools with the help of proportionate stratified random sampling. A pilot study was conducted among 200 children with the objective of determining the sample size and feasibility of the study. Based on the same the sample size of 2000 was taken.

Questionnaire (table 5)

A close ended questionnaire was given to the students, which comprised of 11 questions. They included personal demographic details, oral hygiene habits and habits about consuming acidic foods and drinks (form and duration of consumption). Validity of the questionnaire was checked by face to face interview of 20 study participants (Cronbach α value 0.75)

Clinical examination

Clinical examination was conducted in a suitable classroom using a mouth mirror and probe under natural light (Type III examination). Cotton rolls were used to clean the teeth of food debris and to dry them. The teeth were examined for include loss of surface anatomy, increased incisal translucency, chipping of enamel edges and absence of enamel.¹⁰ It was kept in mind that as far as eroded surfaces were concerned the width of the lesion exceeded the depth in almost all cases. The depth of loss of tissue for each surface was examined according to the tooth erosion index given by O Sullivan¹¹ (Table 1). Fig number 1 denotes dental erosion along with their codes as shown below. Kindly note the cup or bowl shaped lesions seen. All the lesions had a width greater than the depth as mentioned previously. This should be kept in kind to distinguish erosion from the other kinds of tooth wear.

Statistical analysis

Descriptive summary statistics was obtained for all independent variables. Difference in proportion was tested using Chi-square test along with Odd's ratio wherever required. Multivariate logistic regression analysis was carried out in order to evaluate a relationship between dental erosion and various associated factors (age, gender, school type and dietary habits). Analysis was done using Statistical Package for Social Sciences 19 (SPSS, Chicago link). P value less than 0.05 was considered for statistical significance.

RESULTS

The overall prevalence of dental erosion was 1.4%. The numbers of children affected were 28. Table 2 gives a representation of the prevalence of dental erosion according to the variables studied. The total number of girls and boys examined were 827 girls and 1173 boys. Among them 13 (1.6%) and 15 (1.3%) were affected by dental erosion. P value was found to be 0.58 which was statistically not significant.

As far as age was concerned most of the children were affected between 15-16 years (1.7%). But the results were not significant. (p=0.35)

Significant difference was seen with respect to type of school with public school children being more affected (2.1%) than that of private children (0.7%) (p<0.01) (Table 2). The rest of the variables dietary factors like type of erosive foods taken, duration and frequency. But no results were found significant.

Since some of the variables revealed association with dental erosion in univariate analysis, a multivariate logistic regression model was evaluated to find out the interaction effect between independent variables and the dependent variable (presence or absence of dental erosion). All the variables were included in the model, but only the type of school was a risk factor for dental erosion. (p<0.05, 95% CI = 0.83- 3.95). Significance was seen with only one variable that is type of school (p = 0.015). (Table 3)

Table 1 : O'Sullivan (2000)¹¹ adapted and validated by Peres et al (2005)¹²

Site of erosion on each tooth represented by an alphabet

- Code A Labial only
- Code B Palatal only
- Code C Incisal/occlusal only
- Code D Labial and incisal/occlusal
- Code E Palatal and incisal/occlusal
- Code F Multi-surface

Grade of severity denoted by a number (worst score for any individual tooth recorded)

- Code 0 Normal enamel
- Code 1 Matt appearance of the enamel surface with no loss of contour
- Code 2 Loss of enamel only
- Code 3 Loss of enamel with exposure of dentin (ADJ visible)
- Code 4 Loss of enamel and dentin beyond ADJ
- Code 5 Loss of enamel and dentine with exposure of pulp
- Code 9 Unable to assess (e.g. tooth crowned or large restoration)

Area of surface affected by erosion (denoted by a +/- sign)

- Code - Less than half of the surface affected
- Code + More than half of the surface affected

Figure 1 : Erosion seen with respect to left upper lateral incisor and canine



The code for lateral incisor and canine is A2-

A (site of erosion – labial surface)

2 (loss of enamel only)

- (less than half of the surface affected)

Table 4 shows a description about the tooth wise prevalence, which was found to be 0.15%. Out of 48,000 teeth examined (excluding the second and third molars) 72 teeth showed dental erosion. Most commonly affected teeth were lateral incisors (59.72%) followed by central incisors (16.66%) and canine (15.27%). Most frequently affected surface was palatal surface followed by labial. (Table 4). When severity of dental erosion was taken into consideration, most (51.3%) of the teeth affected belonged to code 1, followed by code 2 (34.7%) and code 3 (13.8%) (Table 1).

DISCUSSION

This study is the first of its kind in India where the prevalence and associated factors to dental erosion has been investigated in detail using O Sullivan index. The major factors that affect the diagnosis of dental erosion and makes it difficult is the absence of a standardized index, type of teeth examined, sample size, age, socio-economic and geographic factors that could influence its outcome. Measuring dental erosion is difficult, and no single index has been universally accepted. O’Sullivan index was adopted in our study that was adapted and validated by Peres *et al.*¹² It is simple, easy to use and is sensitive to small changes. This index has the advantage of evaluating different criteria: site of erosion, severity and affected tooth surface area.² Other indices were excluded because most of them were common to all kinds of tooth wear and not specific for dental erosion.

It is well recognized that dental erosion has complex etiologies and further may be affected by environmental and host factors. There was another group of factors affecting the same called as genetic factors. They include tooth eruption and development, altered enamel bio-mineralization, salivary flow and salivary composition, dental morphology that includes surface topography, fissure depth and wall inclination.⁴

In the present study 1.4% prevalence of dental erosion was noted among 11-16 year old children. This was lower than the majority

of findings reported by various authors. Globally the prevalence noted ranged from 7.2% - 68% conducted between the years 2005 - 2012.^{2,3,5,6,7,8,9,13,14} The age groups among whom these studies were conducted ranged from 11-15 years. The reason for the wide variation and the increase in the prevalence could be attributed to the changing lifestyle and dietary patterns seen, which could also be the reason for children to be placed at a higher risk group with regard to the permanent dentition. Also the wide variation in prevalence noted among other studies could be because of absence of a standardized index, type of teeth examined, sample size, age, socioeconomic and demographic factors.²

Lussi *et al* in his study states that the prevalence of erosion is not homogenous and is subjected to change.¹⁵ The incidence of new tooth surfaces exhibiting erosion, in erosion-free children, decreased significantly with age. In children with tooth erosion the condition progressed steadily. On tooth level the incidence decreased significantly with age for upper incisors and lower first molars. There was a difference in influence of background variables on the incidence of tooth erosion between molars and upper incisors.¹⁶ Comparing prevalence data from cross-sectional national studies indicates that dental erosion increases between different age cohorts of young people over time.¹⁷

As far as gender distribution is concerned, the results obtained are contradictory again. Our study showed that females were slightly more affected than male although not significant ($p > 0.05$). This is in line with previous studies^{2,3,6,7} which showed no difference between girls and boys with respect to prevalence of dental erosion. Controversial results have been found with a few other studies who concluded that boys are affected more than girls owing to the differences in the strength of musculature and biting forces, and also to a higher consumption of acidic drinks among boys.^{9,18,19,20}

Table 2: Prevalence of dental erosion according to variables studied.

Variables	total (%)	erosion present	p value	OR	95% CI
AGE					
11-12 years	435 (21.7)	3 (0.7)			
13-14 years	1100 (55.0)	17 (1.5)	0.35		
15-16 years	465 (23.2)	8 (1.7)			
GENDER					
Male	1173 (58.65)	15 (1.3)	0.58	1.65	0.78-3.48
Female	827 (41.35)	13 (1.6)			
SCHOOL TYPE					
Private	1000 (50)	7 (0.7)	0.01	1.82	0.83-3.95
Public	1000 (50)	21 (2.1)			
DIETARY FACTORS					
FLAVOR OF FOOD					
Candy	1536 (76.8)	22 (1.4)	0.82	1.1	0.45-2.711
Jelly	464 (23.2)	6 (1.3)			
FREQUENCY OF INTAKE					
Daily	1018 (50.9)	10 (1.0)	0.11	1.61	0.75-3.46
Others	982 (49.1)	18 (1.8)			
METHOD OF INTAKE					
Sip	1661 (83)	26 (1.6)	0.16	2.65	0.63-11.12
Chew	339 (17)	2 (0.6)			
DRINKS					
appy fizz	82 (4.1)	1 (1.2)			
lemon soda	245 (12.2)	3 (1.2)			
Fanta	83 (4.1)	0	0.82		
Coke	283 (14.1)	5 (1.8)			
Mazza	1307 (65.3)	19 (1.5)			
TIME OF THE DAY					
Morning	73 (3.6)	0			
Afternoon	523 (26.1)	4 (0.8)	0.31		
Evening	1080 (54)	19 (1.8)			
Night	324 (16.2)	5 (1.5)			
FREQUENCY OF INTAKE					
Daily	103 (5.4)	2 (1.9)			
once a week	446 (22.3)	7 (1.6)	0.49		
twice a week	623 (31.1)	5 (0.8)			
Occasionally	828 (41.4)	14 (1.7)			
INTAKE OF FRUITS (orange, lemon or grapes)					
Yes	1998 (99.9)	28 (1.4)	0.86		
No	2 (0.1)	0			
FREQUENCY OF INTAKE					
Morning	338 (16.9)	8 (2.4)			
Afternoon	734 (36.7)	8 (1.1)	0.2		
Evening	326 (16.3)	2 (0.6)			
Night	602 (30.1)	10 (1.7)			
INTAKE OF NIGHT FOODS					
Yes	206 (10.3)	4 (1.9)	0.48	1.5	0.35-6.37
No	1794 (89.7)	24 (1.3)			

Table 3 : Multivariate logistic regression analysis between independent variables and the dependent variable (presence or absence of dental erosion).

Likelihood Ratio Tests				
Effect	Model Fitting Criteria		Likelihood Ratio Tests	
	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Intercept	199.9	0.00	0	.
Age	204.1	4.22	2	0.12
gender	200.3	0.37	1	0.54
type	205.9	5.97	1	0.015
Br freq	200.3	0.34	1	0.56
rinsing	201.5	1.57	1	0.21
Candy freq	201.7	1.77	1	0.18
way	201.4	1.52	1	0.22
drinks	203.3	3.39	4	0.50
time	204.2	4.33	3	0.23
Freq of drink	204	4.09	3	0.25
fruits	199.9	0.01	1	0.93
Fruits freq	203.1	3.17	3	0.37
Night food	201.2	1.28	1	0.26

Sig at P < 0.05

Table 4 : Characteristics of dental erosion in relation to the number of affected teeth

Teeth		11	21	31	41	12	22	32	42	13	23	33	43	14	16	Total
Surface	Labial only	0	2	1	1	4	3	2	1	2	0	0	1	1	2	20
	Paal only	1	0	0	3	8	6	2	6	1	1	1	0	0	1	30
	Incisal/occlusal	1	1	0	0	3	1	0	0	2	0	1	0	0	0	9
	Labial and incisal/occlusal	0	1	1	0	1	2	0	0	2	0	0	0	1	1	9
	Lingual and incisal/occlusal	0	0	0	0	1	3	0	0	0	0	0	0	0	0	4
	Matt appearance of the enamel surface with no loss of contour	0	2	0	2	5	4	1	2	3	0	0	1	1	3	24
Grade of Severity	Loss of enamel only	1	2	2	2	5	6	2	5	2	1	1	0	0	0	29
	Loss of enamel with exposure of dentin	1	0	0	0	7	5	1	0	2	0	1	0	1	1	19
Area Affected	Less than half	2	2	2	3	11	12	4	6	5	1	2	0	1	3	54
	More than half	0	1	0	1	6	3	0	1	2	0	0	1	1	2	18
Total		12						43		11				2 4		

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Table 5 : Questionnaire comprising of 12 questions

1. Demographic details (name, class, age)	
2. Frequency of brushing habit	Once a day, twice a day, thrice a day
3. Habit of rinsing mouth after meals	Yes, no
4. Consumed flavor of candy	Lemon, orange, kachcha mango, others
5. Frequency of consumption of the candy	Daily, once in a week, twice in a week, occasionally
6. Method of consumption of the candy	Retain it and sip, chew it straight away
7. Consumed drink among the following	Appy fizz, lemon soda, fanta, coca cola, mazza
8. Time of consumption of the drink in a day?	Morning, afternoon, evening, night
9. Frequency of consumption of the drink	Daily, once in a week, twice in a week, occasionally
10. Consumed fruits (Orange, lemon, grapes)	Yes, no
11. If yes, frequency of intake	Morning, afternoon, evening, night
12. Consumed foods at night (sweetened cereals, cream biscuits, cakes, toast, sweet sandwiches, soft drinks)	Yes, no

The reason behind deciding on a wide range of age in our study (11-16 years) was that all the permanent teeth would have erupted at this time and the incisors and first molars would be present in the mouth for a number of years. Hence they would be exposed to possible extrinsic and intrinsic etiological factors for sometime.² In this study, children of 15-16 years had the maximum prevalence of dental erosion (1.7%) followed by children who belonged to 13-14 years (1.5%). This was in agreement with a few other studies done by Ferreira *et al*², Dugmore *et al*¹⁷ and Mcguire *et al*¹⁸ where the result showed that oldest children more likely to have erosive lesions than younger ones, the reason being at 16 years of age the teeth are exposed to all possible intrinsic and extrinsic etiological factors for a number of years.²

When the type of school is taken into consideration it was again contradictory. Our study showed that children studying in public schools (2.1%) were affected a little more than private schools (0.7%). The regression analysis showed significant difference between type of school and erosion prevalence which was in contradiction to a number of studies,^{2,3,13} where there was no significant association between the type of school and dental erosion. Studies conducted by Manguiera⁹ and Peres¹² et al showed significant difference in private school children with respect to dental erosion when compared to public schools children. Both these studies were conducted among Brazilian children. The reason attributed was that the availability of processed foods was less in public schools when compared to the private schools. The reason for our result could be the large number of vendors present outside public schools than private schools.

When the severity was taken into consideration, most of the affected teeth belonged to the code 1 category followed by code 2 and finally code 3 (table 1). This is in accordance with another study done in Brazil by Ferreira² where the prevalence of erosion was found to be 7.2% and all the lesions were found to be in the enamel.

The tooth wise prevalence was found to be 0.15% (table 4). The teeth most commonly affected were the lateral incisors followed by central incisors and canines. The surface most affected was the palatal surface followed by the labial surface. This result was in consistent with other studies and the reason has been suggested that the abrasive effects of the tongue on softened, demineralized enamel may contribute to a greater loss of tooth surface palatally or poor saliva clearance of the upper anterior teeth.^{9,22} This was in contradiction to other studies that showed that the buccal surface was the most common surface affected which was explained by the pattern of exposure to specific factors.^{2,20} Majority of teeth with erosion showed less than half of the surface affected which was denoted by a negative sign. One suggested hypothesis is that these schoolchildren may have been exposed to risk factors of tooth erosion at low levels, or for a relatively short period of time.²

Dietary habits were not significantly associated with erosion in this study and this is in agreement with other studies.^{2,6,7} However some studies done by Majed⁵, Asmyhr²³ and Correa²⁴ concluded significant association between consumption of acidic foods and drinks and the occurrence of tooth erosion. Unfortunately, there is a lack of standardized questionnaire in epidemiological surveys related to tooth erosion and dietary habits and this might be attributed to contradictory results. The results could also be influenced by factors such as quantity and composition of saliva, tooth composition and structure, oral hygiene practices, medical conditions and socioeconomic factors.¹⁰

As far as acidic foods were concerned in our study, questions were based on different types of forms of food (candies and jellies). There was no correlation between dental erosion and the frequency of the candy consumed but most of them were found to consume candies rather than jellies. The caries risk of sugar-containing-candy became well-known. However, many candies also contain organic acid, like citric acid, malic acid and/or fumaric acid, for a fresh taste. These organic acids are potentially erosive for the dental enamel as they can induce a drop in salivary pH. These types of candy slowly melt in the mouth and consumption often takes more than 15 minutes. Consequently, the intra-oral pH may decrease for a long time to values between 4 and 4.5; a considerable risk for the development of dental erosion.²⁵

AI Majed *et al*⁵ reported a significant relationship between dental erosion and carbonated beverages or fruit juices. Similar findings were obtained by Waterhouse²⁶ and Karim²⁷ But a few authors found no association between consumption of acidic drinks and dental erosion which was consistent with our study.^{2,3,28}

Associations between fruit consumption and tooth erosion were reported only in those cases when the consumption was excessive. It was found that considerable risk of erosion has been reported when citrus fruits were eaten more than twice per day.^{6,29} But in our study we found no significant association between the consumption of fruits and erosive tooth wear which was in accordance with another study undertaken by Okunseri *et al*.¹⁴

Foods taken at night seem to be a major indicator for the presence of dental erosion. In our study options were given as to those items that could not be removed from the tooth easily. Another study was done in Saudi Arabia among 12-14 year old boys and the study concluded that a significant relationship was found between dental erosion and the frequency of drinks taken at night.⁵ Also night time exposure to acidic drinks has been suggested to be more destructive due to the much reduced salivary flow rate.¹⁰ Our study showed a lack of association between the same. This could be because of a low proportion of children who reported this habit which made it difficult to uncover any possible association. The present results showed that overall prevalence of dental erosion was low compared to previously conducted studies in developed countries.

CONCLUSION

Finally to conclude, prevalence of dental erosion was 1.4%, which was very low when compared with other studies. Females are affected slightly more than males but no significant association was found. When severity was considered all the lesions were limited to the enamel. Comparison of type of school showed that children from public schools were affected significantly higher than private. As far as acidic drinks were concerned there was no significant association with dental erosion. The main limitation of the present study was the duration of exposure of each acidic agent was not checked which could be one of the reasons for no significant association between dental erosion and dietary habits.

Further epidemiological studies with a larger sample size and the same standardizations as the above study with detailed information on duration of exposure of acidic food or drinks is required to resolve the questions about the wide variation in the prevalence of dental erosion and the unclear cloudy picture of the effect of dental erosion and dietary variables.

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