

Original Article

Independent Variables of Dental Erosion among Tertiary Care Hospital Patients of a Developing Country

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ABSTRACT **Background and Aim:** Dental erosion is a multifactorial condition, which is mostly influenced by environmental factors. The aim of this study was to determine the prevalence of dental erosion, its associated risk factors, and their correlation with severity of the condition. **Materials and Methods:** A total of 430 patients who attended the outpatient section of Government Dental College, Thiruvananthapuram, Kerala, India, were selected by systematic sampling method. Erosion was diagnosed by clinical examination and graded using Basic Erosive Wear Examination (BEWE) index. A pretested structured questionnaire on age, gender, medical history, medication history, and food habits was used. **Results and Conclusion:** Among the study population, 44% (95% confidence interval, 39.3%–48.7%) had dental erosion. Age above 45 years (79.7%, $P = 0.000$), male population (50%, $P = 0.032$), residents of rural area (49.1%, $P = 0.000$), patients with asthma (84.2%, $P = 0.000$), diabetes (90.9%, $P = 0.000$), gastroesophageal reflux disorder (91.7%, $P = 0.001$), and frequent consumption of orange (68.9%, $P = 0.000$) were identified as factors associated with erosion. The prevalence of dental erosion in the community was high. Results of the study established that better awareness of the condition, better facilities for its early diagnosis in the community, and development of proper preventive strategies are required to reduce the severity of dental erosion.

KEYWORDS: Dental erosion, diet, prevalence

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INTRODUCTION

Tooth wear, the loss and destruction of dental hard tissue, is attributed to a mechanical and/or chemical process. It has been observed to affect all age groups in the population. The condition can manifest in three forms—attrition, abrasion, and erosion. Dental erosion is now recognized as an important cause of tooth tissue loss in both children and adults (5%–50%).^[1] In the *International Classification of Diseases (ICD)*, erosion of teeth is coded as 521.3 (*ICD-9*) and K03.2 (*ICD-10*).^[1] Problems arise when the loss of dental hard tissue is substantial enough to cause either tooth sensitivity or aesthetic and functional problems for an individual.

Erosion has a multifactorial etiology, involving intrinsic and extrinsic factors with biological, chemical, and

behavioral conditions, influencing its development. Dietary factors (excessive consumption of acidic foods and drinks),^[2-4] systemic conditions (gastroesophageal reflux disorder [GERD]),^[5,6] asthma,^[7] vomiting and eating disorder,^[8] low pH drugs,^[9] acidic environment workers,^[10-13] habit,^[14] and lifestyle^[15] are the main etiologic factors. Polymorphisms in enamel formation genes are associated with an individual's susceptibility to dental erosive wear.^[16] Once dental erosion is initiated, the hard tissues of teeth are softened, which increases susceptibility to mechanical forces, leading to attrition

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and abrasion.^[3] The clinical erosive lesion is smooth, polished, and rounded with the loss of tooth surface characteristics, and any restoration present becomes prominent.^[17]

Over the past years, awareness of the deleterious effects of erosion has increased in both adults and children. Erosion can be a particular problem for young children, (21.5% prevalence)^[18] as the enamel and dentin layers of the primary dentition are much thinner than the permanent teeth. The incidence and progression of dental erosion are high in young children, and the progression is associated with certain lifestyle factors.^[19,20]

Management of dental erosion includes identification and elimination of the main causative factors, prevention and monitoring, as well as operative intervention. There are few epidemiological surveys on the prevalence of erosion in the population of our country, and no surveys regarding dental erosion has been conducted in the capital region of Kerala. The magnitude of the problem needs to be identified to plan the required preventive and curative measures. The objective of this study was to analyze the prevalence of dental erosion, its associated risk factors, and their correlation with severity of the condition.

MATERIALS AND METHODS

SAMPLE

This hospital-based cross-sectional survey was conducted among patients attending the outpatient department of oral medicine and radiology, Government Dental College, Thiruvananthapuram, Kerala, India. The institutional ethics committee approved the research project (IEC/R/16/2015/DCT/dtd 1/12/2015). Subjects were selected through systematic sampling. Informed consent was obtained from all the participants. The study population comprised 430 individuals of both sexes, older than 12 years, and having at least two teeth in each sextant. Patients requiring emergency care and patients with restricted mouth opening for examination were excluded.

SAMPLE SIZE CALCULATION

Sample size was calculated based on a study with a prevalence of 30.6%.^[20] With 95% level of confidence, the sample size of the study was found to be 388 and was rounded to 430, considering a factor of 10% noncooperation. Systematic sampling technique was used by selecting every sixth patient attending the outpatient department. The samples were collected

over one month, and each subject was examined by a single dental practitioner.

CLINICAL EXAMINATION AND ADMINISTRATION OF QUESTIONNAIRE

Diagnosis of the present condition was determined by patient history, inspection, and palpation using mouth mirror and probe under illumination. After thorough oral prophylaxis, the samples were subjected to intraoral examination following biosafety protocol.

Erosion was graded based on the Basic Erosive Wear Examination (BEWE).^[21] All teeth except third molars were examined from the vestibular, occlusal, and palatal aspect for erosion. The most severely affected surface in each sextant was recorded with a four-level score: 0, no erosive tooth wear; 1, initial loss of surface texture; 2, distinct defect, hard tissue loss <50% of the surface area; and 3, hard tissue loss ≥50% of surface area. The sum of the score defined the severity of erosion and the maximum score was 18. On the basis of cumulative score, the samples were categorized as no erosion (≤2), low erosion (3–8), medium erosion (9–13), and high erosion (≥14).

The sociodemographic information of the samples was collected using a questionnaire. Data on dietary factors (consumption of soft drinks, carbonated beverages, fresh fruits, and food preserved in vinegar), history of systemic diseases (such as GERD, cyclic vomiting, anorexia nervosa, bulimia nervosa, rumination, asthma, and diabetes), medication history (intake of aspirin tablets, vitamin C supplements, iron tablets, tranquilizers and antihistamines, antiemetic, and antiparkinsonian drugs), and habits (such as alcohol consumption and smoking) were also collected.

STATISTICAL ANALYSIS

The data were entered into Excel sheet (Microsoft) as ordinal variables. Prevalence was expressed as proportion with 95% confidence interval (CI). Chi-squared test was used to evaluate the association of independent variables and dental erosion. Odds ratio was used to compare the relative occurrence of dental erosion with respect to the independent variables of interest. The independent variables that showed significant association with dental erosion were tested with multiple logistic regression to identify the independent predictors of the condition. The level of significance was set at 5%, and the data were analyzed using the Statistical Package for the Social Sciences (SPSS, IBM Corporation) software, version 20.

RESULTS

The overall prevalence of dental erosion, measured using BEWE,^[21] was 44% (95% CI 39.3%–48.7%) [Table 1]. Among the 189 participants, 44% were diagnosed with dental erosion, 165 (38.4%) had low erosion, and 24 (5.6%) had medium erosion [Table 2], based on the cumulative score of erosion. The

Table 1: Percentage of erosion

Erosion score	No. of patients	Percentage (%)	95% CI
Absent	241	56	39.3–48.7
Present	189	44	

Table 2: Percentage distribution of samples according to erosion score

Erosion score	Count	Percent
No erosion	241	56.0
Low level of erosion	165	38.4
Medium level of erosion	24	5.6
High level of erosion	0	0

Table 3: Association of dental erosion according to the independent variables (n = 430)

Independent variables		Erosion				Odds (95% CI)	χ^2 (Chi-square)	P value
		Absent		Present				
		Count	Percent	Count	Percent			
Age (years)	≤25	113	88.3	15	11.7	1	115.08	0
	26–45	104	56.5	80	43.5	5.80 (3.14–10.69)		
	>45	24	20.3	94	79.7	29.51 (14.64–59.64)		
Sex	Male	90	50	90	50	1.53 (1.04–2.25)	4.59	0.032
	Female	151	60.4	99	39.6	1		
Locality	Rural	164	50.9	158	49.1	2.39 (1.50–3.83)	13.62	0
	Urban	77	71.3	31	28.7	1		
Asthma	No	238	57.9	173	42.1	1	13.08	0
	Yes	3	15.8	16	84.2	7.34 (2.11–25.56)		
GERD	No	240	57.4	178	42.6	1	11.41	0.001
	Yes	1	8.3	11	91.7	14.67 (1.89–113.66)		
Diabetes	No	239	58.6	169	41.4	1	20.75	0
	Yes	2	9.1	20	90.9	14.04 (3.25–60.60)		
Frequency of brushing	Once daily	75	38.5	120	61.5	3.85 (2.57–5.76)	44.79	0
	More than once	166	70.6	69	29.4	1		
Oranges	None	32	52.5	29	47.5	1	46.91	0
	Occasionally	172	68.8	78	31.2	0.50 (0.28–0.88)		
	Frequently	37	31.1	82	68.9	2.45 (1.30–4.62)		
Grapes	None	64	60.4	42	39.6	1	34.89	0
	Occasionally	142	66	73	34	0.78 (0.48–1.27)		
	Frequently	35	32.1	74	67.9	3.22 (1.84–5.64)		
Foods preserved in vinegar	No	197	57.3	147	42.7	1	1.04	0.308
	Yes	44	51.2	42	48.8	1.28 (0.80–2.05)		
Carbonated drinks	No	197	57.3	147	42.7	1	1.04	0.308
	Yes	44	51.2	42	48.8	1.28 (0.80–2.05)		
Alcohol consumption	No	238	56.1	186	43.9	1	0.09	0.764
	Yes	3	50	3	50	1.28 (0.26–6.41)		
Iron supplements	No	239	56.6	183	43.4	1	3.19	0.074
	Yes	2	25	6	75	3.91 (0.78–19.58)		

age-wise distribution of the samples was <25 years (128 patients, 29.8%), 25–55 years (249 patients, 57.9%), and >55 years (53 patients, 12.3%). Mean age of the patients was 36.3 years (22–51 years). Dental erosion was found to be more prevalent (79.7%, 94/118) among individuals of age 45 years and older [Table 3]. Only 11.7% (15/128) of the population younger than 25 years had the condition. Most of the patients who did not have dental erosion were younger than 25 years (88.3%, 113/128). A total of 76 participants older than 45 years (64.4%, 76/118) had low level erosion. Medium level erosion was not observed in the age category of younger than 25 years [Table 4].

Of the 430 participants, 180 (41.9%) and 250 (58.1%) were males and females, respectively. Among the male participants, 90 had dental erosion (50%), whereas among females, 99 had the condition (39.6%). Geographically, patients were categorized into those from urban (25.1%) and rural areas (74.9%). Dental erosion was more prevalent among patients from rural

Table 4: Severity of dental erosion according to the independent variables (n = 430)

Independent variable	No Erosion		Low		Medium		χ^2 (Chi-square)	P value	
	Count	Percent	Count	Percent	Count	Percent			
Age (years)	≤25	113	88.3	15	11.7	0	0	0	
	26-45	104	56.5	74	40.2	6	3.3		
	>45	24	20.3	76	64.4	18	15.3		
Sex	Male	90	50	72	40	18	10	13.06	0.001
	Female	151	60.4	93	37.2	6	2.4		
Locality	Rural	164	50.9	135	41.9	23	7.1	15.8	0
	Urban	77	71.3	30	27.8	1	0.9		
Asthma	No	238	57.9	152	37	21	5.1	14.14	0.001
	Yes	3	15.8	13	68.4	3	15.8		
GERD	No	240	57.4	155	37.1	23	5.5	11.69	0.003
	Yes	1	8.3	10	83.3	1	8.3		
Diabetes	No	239	58.6	148	36.3	21	5.1	20.96	0
	Yes	2	9.1	17	77.3	3	13.6		
Frequency of brushing	Once daily	75	38.5	98	50.3	22	11.3	53.59	0
	More than once	166	70.6	67	28.5	2	0.9		
Oranges	None	32	52.5	27	44.3	2	3.3	73.29	0
	Occasionally	172	68.8	70	28	8	3.2		
Grapes	Once in a week	30	41.7	39	54.2	3	4.2		
	2-3 days in a week/daily	7	14.9	29	61.7	11	23.4	51.14	0
Foods preserved in vinegar	None	64	60.4	35	33	7	6.6		
	Occasionally	142	66	68	31.6	5	2.3		
Soft drinks	Once in a week	28	39.4	39	54.9	4	5.6		
	2-3 days in a week/daily	7	18.4	23	60.5	8	21.1	1.57	0.456
Alcohol consumption	No	197	57.3	127	36.9	20	5.8		
	Yes	44	51.2	38	44.2	4	4.7	1.57	0.456
Alcohol consumption	No	197	57.3	127	36.9	20	5.8		
	Yes	6	46.2	6	46.2	1	7.7	0.59	0.743
	No	238	56.1	162	38.2	24	5.7		
	Yes	3	50	3	50	0	0		

areas (49.1%) than urban population (28.7%). Among the patients from rural areas, 71.1% of participants had medium level erosion.

Among 19 patients with asthma who were under medication, 16 (84.2%) had dental erosion, whereas 11 patients (91.7%) with GERD had erosion. Of the 22 patients with diabetes, 90.9% (20 patients) had dental erosion. Regarding the severity of dental erosion and systemic disease, among patients with asthma, 68.4% had low-level erosion and 15.8% had medium erosion. Approximately 83.3% of patients with GERD showed low dental erosion. Among patients with diabetes, 77.3% and 13.6% of patients had low and medium dental erosion, respectively. Dental erosion was noticed in 61.5% participants who brushed once daily compared to those who brushed more than once (29.4%). Participants who consumed oranges frequently had higher probability (68.9%) of developing dental erosion compared to those who had it occasionally. Approximately 67.9% of participants who took grapes frequently had dental erosion.

Alcohol consumption and smoking were the habits included in this survey. None of the study participants were smokers. No significant association was observed between alcohol consumption and dental erosion. None of the participants were using low pH drugs on a regular basis, except iron supplements, and no statistically significant association was observed. Independent predictors of dental erosion given by multiple logistic regression were older than 45 years, male patients, patients with asthma, GERD, diabetes, frequent consumption of oranges, and brushing teeth once daily [Table 5].

DISCUSSION

In this study, the prevalence of dental erosion was found to be 44%. The source population was mainly from the southern district of Kerala (Thiruvananthapuram), India. The values were observed to be much higher than the previous study conducted in south India (8.9%).^[22]

However, the prevalence was comparable to the study conducted in Poland, where it was found to be 42%.^[23]

The study evaluated the severity of dental erosion based on BEWE score.^[21] Approximately 38.4% of the participants presented with low erosion and 5.6% had medium erosion. The sample did not have any patients in the high erosion category. A study conducted by Strużycza *et al.*,^[23] showed the prevalence of erosion as low (28.9%), medium (12%), and high (1.4%).

These data confirm that dental erosion is progressive, with initiation in younger age groups. The incidence of dental erosion is high in schoolchildren according to Juliana *et al.*^[24]

As age increases, the prevalence of dental erosion was observed to be higher, and the difference was found to be statistically significant. In this study, individuals older than 45 years showed a higher percentage of dental erosion (79%). A study conducted on Swiss adults showed 42.6% prevalence in older age group (46–50 years).^[25] Most of the studies showed higher prevalence of erosion with increasing age. In this survey, individuals younger than 25 years showed a lower percentage of dental erosion (11.7%).

Regarding the severity of dental erosion, participants older than 45 years had high percentage of low and medium erosion, whereas those younger than 25 years did not show any type of medium erosion. The increased prevalence of dental erosion in older age group was due to the change in the surface texture of tooth and long-term exposure to acidic foods.^[26,27]

Patients with systemic conditions and prevalence of erosion obtained among them were as follows: asthmatics (84.2%), GERD (91.7%), and diabetics (90.7%). The difference was observed to be statistically significant. Supriya *et al.*,^[7] in 2019, showed dental erosion in patients with asthma. Gabriela *et al.*,^[28] in their study, concluded that there was no association between asthma and erosion in children aged from 6 to 12 years.

Table 5: Independent predictors of dental erosion (multiple logistic regression)

Independent variables		B	Std. error	Sig.	Odds ratio (95% CI)
Age, years (≤25)	26–45	1.48	0.36	0	4.4 (2.17–8.91)
	>45	2.74	0.42	0	15.42 (6.75–35.26)
Sex (Female)	Male	0.64	0.28	0.023	1.9 (1.09–3.31)
	Yes	2.41	0.74	0.001	11.08 (2.62–46.94)
Asthma (No)	Yes	2.97	1.21	0.014	19.51 (1.81–210.26)
	Yes	1.79	0.79	0.024	6.01 (1.27–28.37)
Frequency of brushing (Once daily)	More than once	–0.81	0.3	0.007	0.44 (0.25–0.8)
	Occasionally	–0.55	0.4	0.169	0.58 (0.27–1.26)
Orange (None)	Frequently	0.79	0.45	0.083	2.2 (0.9–5.35)

Yoshikawa *et al.*^[6] observed dental erosion in GERD group in their study. Kisely *et al.*^[8] found association between dental erosion and eating disorders in their study. In cases of asthma and GERD, our study results were similar to previous studies. The aforementioned three conditions mainly showed low-level dental erosion. The study results showed asthma, GERD, and diabetes to be the risk factors for dental erosion. Further studies are required to confirm the results as the samples obtained with these systemic conditions were limited.

A total of 61.5% participants who brushed teeth once daily had dental erosion compared to those who brushed more than once (29.4%), medium-level erosion was mainly found in those subjects (11.3%). Awareness to patients regarding abrasive nature of commonly used dentifrices should be made to reduce the abrasion of eroded tissues.^[19] Proper brushing habit can be considered as a protective factor based on the results of this study. This will help to remove retained acidic content of food on teeth.

Significant association of dental erosion was observed with oranges (82%) and grapes (67.9%). Also, the frequent consumption of the aforementioned items was observed to increase the risk of erosion compared to occasional intake. Regarding severity, medium-level erosion was found to be more in orange consumers. Several studies proved the association of dental erosion with fruit juice and cola drinks.^[4]

The erosive potential of an acidic drink depends on the amount of drink as well as the amount and flow of saliva.^[16] The findings in this study showed concurrence with other similar studies.

Smoking and alcohol consumption were studied. In this study, alcohol users were limited in number and none of the participants were smokers. Hence, no association could be assessed using the study findings. Dukić *et al.*^[15] found a significant correlation between alcoholism and unstimulated salivary flow rate, which could result in dental erosion.

This study analyzed the association of dental erosion with low pH drugs. The study population included only patients using iron supplements. Statistically significant association was not obtained in this study ($P = 0.074$). According to Hellwig and Lussi,^[9] acidic medicines have the potential to soften dental hard tissues. When the pH is too low or when no fluoride is present, the protective effects are diminished, leading to softening of the tooth surface. Oral dryness can occur as a consequence of medications such as tranquilizers, antihistamines, antiemetic, and antiparkinsonian medicaments. Clinical proof of the occurrence of erosion subsequent to use of

these medicaments is still lacking. However, regular and prolonged use of these medicaments can cause erosion, and this aspect needs to be further evaluated.

Aesthetic rehabilitation of erosion can be performed using veneers, palatal veneers, and composite.^[29-31] Calcium carbonate suspensions are effective in reducing enamel erosions,^[32] and remineralization can be achieved using lasers and amorphous calcium phosphate.^[33-36] Dentifrice with fluoride enhances remineralization and the mechanical properties of restorative materials.^[37-39]

Although this study was conducted in a hospital setting, community-based surveys are required for further clarification of the results obtained. At present, no established strategy is available for dental health-care professionals to identify the condition in routine dental examination. In our study, improper dietary habits and certain systemic conditions are the main contributory factors for dental erosion.

CONCLUSION

The prevalence of dental erosion is high in the community, and the lack of awareness among patients is a big concern. The condition is progressive, with its initiation in the younger age groups, and is associated with both internal and external risk factors. Dental erosion should be diagnosed at an early stage and the possible etiological factors should be identified. Appropriate restorative treatment must be provided in the early stage itself to prevent further progression.

ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

The institutional ethics committee of the Government Dental College, Thiruvananthapuram, Kerala, India, reviewed and found no ethical issues with this study and granted approval for the conduct of the study (IEC/R/16/2015/DCT/dtd 1/12/2015).

DATA AVAILABILITY STATEMENT

Data set used in this study is available on request from Dr. Satheesh SL (e-mail: drsatheeshsl@yahoo.com).

FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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