

Gastroesophageal Reflux Disease and Tooth Erosion: A Cross-Sectional Observational Study

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Background/Aims: Gastroesophageal reflux disease (GERD) is common in children. Recurrent exposure to gastric acid in GERD may contribute to tooth erosion. **Methods:** In this prospective study, 54 GERD patients qualified according to endoscopy, pH-metry, and the GERD questionnaire and 58 healthy controls qualified by the GERD questionnaire were assessed. Two groups underwent dental evaluations for the presence, severity, and patterns of erosion and for the stage of dentition using a Tooth Wear Index. The health care providers who performed the dental exams did not know which children had been diagnosed with GERD. **Results:** A total of 112 children, 3 to 12 years old were enrolled in the study, and 53 of 54 (98.1%) GERD patients and 11 of 58 (19.0%) controls had dental erosions ($p < 0.0001$). In GERD patients, the posterior occlusal surfaces of milk teeth were more affected ($p < 0.0001$). There was no correlation between GERD and the affected surfaces in permanent teeth, nor in the patterns or erosion grades (localized or general). In both groups, milk teeth had more erosions than permanent teeth, but the difference was not statistically significant. **Conclusions:** According to this study, there is a positive correlation between GERD and dental erosion. Posterior occlusal surface erosions in milk teeth could indicate GERD. (*Gut Liver* 2013;7:278-281)

Key Words: Gastroesophageal reflux; Tooth erosion; Child

INTRODUCTION

Gastroesophageal reflux (GER) is a normal physiologic process that occurs in healthy infants, children and adults. Reflux occurs when there are episodes of transient relaxations of the lower esophageal sphincter or when the sphincter tone adapts inad-

equately to changes in abdominal pressure.¹ Gastroesophageal reflux disease (GERD) is a chronic form of acid reflux which allows refluxed acid to move upward through the esophagus into oropharynx produce symptoms or complications.² Studies show GERD is common and may be overlooked in infants and children. For example, GERD can present as repeated regurgitation, nausea, heartburn, coughing, laryngitis, or respiratory problems like wheezing, asthma, or pneumonia. Infants and young children may demonstrate irritability or arching of the back, often during or immediately after feedings. Infants with GERD may refuse to feed and experience poor growth.³ Esophageal complications of GERD are reflux esophagitis, hemorrhage, stricture, Barrett's esophagus, and adenocarcinoma.⁴ Dental erosion as extra esophageal manifestations of GERD has been reported with varying prevalences in the population and may be as high as 42%.⁵ Some studies in children and adolescents with GERD, reported the high occurrence of dental erosions with enamel loss in facial, occlusal, and lingual surfaces.⁶ Also an increased risk of dental caries was reported in children with GERD.⁷ On the other hand, a large case control study found no significant associations between GERD and either dental erosion or tooth sensitivity, but significant associations between GERD, xerostomia, oral acid/burning sensation, subjective halitosis, erythema of the palatal mucosa and uvula⁸ where reported. Strong associations have been reported between GERD, asthma⁴ and between asthma and tooth erosion.⁹ The prevalence of dental erosions due to GERD has not been clearly reported and there are a few studies to evaluate the efficacy of GERD treatment for prevention of these dental erosions.¹⁰ The first randomized clinical trial to demonstrate quantitatively suppression of tooth erosion after treatment with a proton pump inhibitor has recently been published.¹¹ We evaluated whether any presence of specific type of erosions could be a key to search for GERD and require referral

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of the child to gastroenterologist for proper treatments and also if any specific dental care is needed in known GERD patients.

MATERIALS AND METHODS

The study was performed at the Children's Hospital Medical Center, from January 2009 to January 2010. This cross sectional study evaluated the association between losses of tooth structure as a result of dental erosion due to GERD. One hundred and twelve children, 58.9% male and 41.1% female, from 3 to 12 years old (mean age, 5.9 years) were enrolled in the study. In GERD group, 54 patient were assessed by endoscopy (24, 44.4%), 24 hour pH-metry (5, 9.3%), and GERD questionnaire¹² (24, 537%). Control group included 58 healthy children who were in the same age and at the well baby clinic. All the children in the control group had no known disease or medical/dietary treatment during 2 weeks preceding the study. Also, parents or family doctors had no concern regarding the well being of the children according to the same GERD questionnaire. Because of ethical reasons no other investigations were performed in control group.

Exclusion criteria were children with dental erosion due to diet sources including (carbonated drinks, vinegar, and citrus fruits), medications (vitamin C and some iron preparations), eating disorders (bulimia and anorexia) as well as GERD due to extraintestinal causes such as rising intracranial pressure, urinary tract infection, and metabolic disease.

The research protocol was approved by the medical ethics committee of our center. Informed consent was obtained from all the patients. They evaluated for signs of dental erosion. All patients and control group underwent a dental evaluation of their teeth for the presence, severity, pattern of erosion, stage of dentition, and also a history to determine other potential etiologic factors responsible for dental erosion. In order to eliminate bias, the health care providers who performed the dental exams did not know whether a particular patient had been diagnosed with GERD. Patients were examined clinically to quantify loss of tooth structure by using Aine tooth wear erosion index (Table 1).¹³ For each patient and control groups a cumulative score for affected dental surface (lingual, occlusal, and buccal) were determined.

Table 1. Aine Erosion Index¹³

Erosion grading scale	
0	No erosion
1	Mild opacities or white spots/etched appearance
2	Occlusal surface filled with small holes (punched-out appearance), incisal edges thinned and flattening of cusps
3	Dentin exposure at the bottom of the holes on occlusal surfaces or dentin affected in other surfaces

1. Questionnaire

All patients and control group completed a questionnaire to identify other cause of erosion. They include brushing, fluoridated water, dental fluoride treatments, frequency, consumption of sweets, bottle feeding, diet sources including (carbonated drinks, vinegar, and citrus fruits), medications (vitamin C and some iron preparations), eating disorders (bulimia and anorexia) as well as GERD due to extraintestinal causes such as rising intracranial pressure, urinary tract infection, and metabolic diseases which excluded from the study. Some GERD patients and all control group completed a second 35-item Orenstein's modified questionnaire¹² about the presence and frequency of typical GER symptoms (regurgitation, heartburn, dysphagia, and chest pain) and atypical symptoms (hoarseness, cough, wheezing, asthma, etc.) with cut-off score >7 points.¹²

2. Statistical analysis

Data were analyzed with the SPSS statistical software package version 17 (SPSS Inc., Chicago, IL, USA). Categorical data were shown as frequency and percent. The contingency table (the chi-square and the Fisher's exact tests where appropriate) p-values less than 0.05 were considered statistically significant.

RESULTS

Total of 112 children (aged 3 to 12 years) were enrolled in this study. There were 58.9% males and 41.1% females. Characteristics of the patients and the main outcomes are summarized in Tables 2-5. According to Aine erosion index, 59 (98.1%) of GERD group had dental erosion while 11 (19.0%) of control group had the erosion (p<0.0001). In GERD patients with milk teeth, erosion was most commonly found in upper posterior occlusal surface (34, 63.0%). In the control group, erosion was most commonly found in upper anterior buccal surface (9, 15.5%). In GERD patients with permanent teeth, erosion was most commonly found in lower posterior occlusal surface (6, 11.0%). However, there was no statistical significant difference between GERD and control groups with permanent teeth.

In regard to erosion grade, 34 (64.2%) of GERD group and 8 (72.7%) of control group showed grade 1 dental erosion (p=0.880). The most common pattern of dental erosion was generalized form in both groups (Table 5). Thirty-four patients from

Table 2. Comparison of Exciting Erosion in GERD and Control Groups

Group	No erosion	Erosion	p-value	Total
GERD	1 (1.9)	53 (98.1)	<0.0001	54 (100.0)
Control	47 (81.0)	11 (19.0)		58 (100.0)

Data are presented as number (%).
GERD, gastroesophageal reflux disease.

Table 3. Erosion Surfaces According to Milk and Permanent Teeth

Erosion surface	Milk teeth			Permanent teeth		
	GERD	Control	p-value	GERD	Control	p-value
U.A.baccal	29 (53.7)	9 (15.5)	<0.0001	1 (1.9)	0 (0.0)	0.480
U.P.baccal	21 (38.9)	3 (5.2)	<0.0001	1 (1.9)	0 (0.0)	0.480
U.A.palatal	27 (50.0)	3 (5.2)	<0.0001	1 (1.9)	0 (0.0)	0.480
U.P.palatal	16 (29.6)	1 (1.7)	<0.0001	0 (0.0)	0 (0.0)	-
U.P.occlusal	34 (63.0)	3 (5.2)	<0.0001	5 (9.3)	0 (0.0)	0.020
L.A.baccal	23 (42.6)	3 (5.2)	<0.0001	0 (0.0)	0 (0.0)	-
L.P.baccal	19 (35.2)	0 (0.0)	<0.0001	4 (7.4)	0 (0.0)	0.050
L.A.palatal	17 (31.5)	1 (1.7)	<0.0001	0 (0.0)	0 (0.0)	-
L.P.palatal	16 (29.6)	0 (0.0)	<0.0001	1 (1.9)	0 (0.0)	0.480
L.P.occlusal	31 (57.4)	1 (1.7)	<0.0001	6 (11.1)	0 (0.0)	0.010

Data are presented as number (%).

GERD, gastroesophageal reflux disease; U, upper; A, anterior; P, posterior; L, lower.

Table 4. Comparison of Erosion Grades in GERD and Control Groups

Group	Erosion present	Erosion grade			p-value
		Grade 1	Grade 2	Grade 3	
GERD	53 (98.1)	34 (63.0)	14 (25.9)	5 (9.2)	0.88
Control	11 (19.0)	8 (13.8)	3 (5.2)	0 (0.0)	

Data are presented as number (%).

GERD, gastroesophageal reflux disease.

GERD group (64.2%) and six children from control group (54.5%) showed generalized form of dental erosion ($p=0.590$).

DISCUSSION

The effects of chronic exposure of the oral cavity to gastric acid can be various. Soft tissue symptoms (nonspecific burning and sensitivity) have been mentioned in the literature, but pathognomonic soft tissue lesions have not been documented. Dental erosion can be considered to be the most predominant oral manifestation of GERD.¹⁴ Erosion begins with subtle changes in the enamel surface and can progress to severe loss of tooth substance. Because the causes of such tooth lesions are multifactorial and the subtle changes are present in the beginning stages of such lesions, diagnosis may be difficult.¹⁵ Dental erosion is a common finding in patients with GERD and should be considered an atypical manifestation of this disease.¹⁶ Dental erosion is defined as the loss of tooth substance by a chemical process that does not involve bacteria.^{14,17}

Detecting chronic acid reflux in children is a key to preventing the long term tooth damage associated with GERD. Ersin *et al.*⁷ studied 38 children with diagnosis of GERD according to esophageal pH recordings and evaluated the prevalence of dental erosion. Erosion in GERD group was more severe than con-

Table 5. Comparison of Erosion Patterns in GERD and Control Groups

Group	Erosion present	Erosion pattern			p-value
		Localized	Generalized	Both	
GERD	53 (98.1)	18 (33.3)	34 (63.0)	1 (1.9)	0.59
Control	11 (19.0)	5 (8.6)	6 (10.3)	0 (0.0)	

Data are presented as number (%).

GERD, gastroesophageal reflux disease.

trols. Linnett *et al.*¹⁸ evaluated 52 Australian children suffering from GERD and 52 healthy siblings. In this study, 14% of teeth in the study group showed dental erosion while only 10% in the control group showed dental erosion. Severity of dental erosion was greater in the study group; 43% of the affected teeth had grade 3 erosion and 9% in the control group had grade 3 erosion. In a study in United States by Dahshan *et al.*,⁶ dental erosion was measured using Aine index in 24 children diagnosed with GERD. Twenty children had dental erosion, 10 with mild erosion (grade 1), six with moderate (grade 2), and four with severe erosion (grade 3). In a recent study by Wild *et al.*,¹⁹ there was no association between GER symptoms and dental erosion by tooth location or affected surface after controlling for age, dietary intake, and oral hygiene. Salivary flow did not correlate with GER symptoms or erosion. Erosion location and surface were independent of total bacteria and levels of *Streptococcus mutans* and *Lactobacilli*. In our study, correlation between GERD and dental erosion was evident ($p<0.0001$). In GERD patients with milk teeth, posterior occlusal surface were more affected ($p<0.0001$). There was no correlation between GER and affected surface in permanent teeth and there was no correlation between GER and erosion grade or pattern.

In conclusion, there is a positive correlation between GER and dental erosion and we really need to start looking for dental

erosion in pediatric patients with GER and integrate proper dental care into their treatment regimens. According to this study, presence of erosions especially in posterior occlusal surface of primary teeth could be a key to search for GER and refer child to gastroenterologist. However, reflux diagnostic questionnaire is a suitable method in initial diagnosis of GERD²⁰⁻²² but the 24-hour pH probe monitoring may be considered the gold standard test for quantitating reflux and for evaluating atypical symptoms and endoscopy with biopsy may be useful to evaluate GERD that is unresponsive to medical therapy. Further studies in this field are needed using more elaborate methods to diagnosed GERD.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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