

Research Article

High Prevalence of Dental Erosion in Children with Erosive Esophagitis

Carolina Soares da Silva^{1*}, Matias Epifanio¹, Vanessa Adriana Scheeffler¹, Melina Utz Melere¹, Cíntia Steinhaus¹, Marília Rosso Ceza¹, Amanda Rodrigues Sari², Fernanda Coradini Noal², Fernando Borba de Araújo², and Cristina Helena Targa Ferreira¹

¹Department of Gastroenterology, Hospital da Criança Santo Antônio - Santa Casa de Misericórdia of Porto Alegre and Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA), Brazil

²Department of Pediatric Dentistry, Universidade Federal do Rio Grande do Sul (UFRGS), Brazil.

*Corresponding author

Carolina Soares da Silva, Departamento de Gastroenterologia Pediátrica do Hospital da Criança Santo Antônio – Santa Casa de Misericórdia de Porto Alegre, Rua Professor Annes Dias, 295, Bairro Centro, CEP 90020090, Porto Alegre, Rio Grande do Sul, Brazil, Tel: (055 51) 999925680; Email: carolina.soaresdasilva@yahoo.com.br

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Abstract

Objective: Studies have shown that one of the intrinsic causes of dental erosion is tooth exposure to hydrochloric acid as a consequence of gastroesophageal reflux disease (GERD). The study aims to evaluate the occurrence of dental erosion in pediatric patients with symptoms suggestive of GERD and/or GERD confirmed by esophagogastroduodenoscopy (EGD).

Materials and methods: Patients referred for EGD were selected for the study from May 2016 to June 2018. Patients who presented erosive esophagitis were defined as having GERD. The dental examination was performed shortly before EGD. The Basic Erosive Wear Examination (BEWE) was used to classify the degree of dental erosion. A medical history was applied to the parents or legal guardians of the patients in order to evaluate the diet and the presence of symptoms suggestive of GERD.

Results: A total of 122 patients was included, and erosive esophagitis was found in 28 (22.9%), of them. Of these, 27 (96.4%), presented dental erosion, showing an association between dental erosion and erosive esophagitis ($p < 0.05$). The higher the degree of erosive esophagitis, the higher the mean BEWE index. The presence of symptoms suggestive of GERD was not associated with the severity of dental erosion.

Conclusions: This study showed the existence of the relationship between GERD, confirmed by the presence of erosive esophagitis in EGD, and dental erosion in a pediatric population. The presence of symptoms suggestive of GERD did not prove to be associated with the severity of dental erosion.

ABBREVIATIONS

GERD: Gastroesophageal Reflux Disease; EGD: Esophagogastroduodenoscopy; BEWE: Basic Erosive Wear Examination

INTRODUCTION

Gastroesophageal reflux disease (GERD), is characterized by the presence of complications caused by the retrograde flow of gastric contents into the esophagus and/or adjacent organs, resulting in a variable spectrum of symptoms [1,2]. A systematic review showed a prevalence of 18.1% - 27.8% of GERD in North America, 8.8% - 25.9% in Europe and 23% in South America [3].

Among the complications of GERD is erosive esophagitis. Its diagnosis is based on esophagogastroduodenoscopy (EGD), the only examination that allows the macro and microscopic evaluation of the esophageal mucosa. Erosive Esophagitis is characterized by the presence of visible ruptures in the esophageal mucosa, diagnosed through EGD [4]. The presence of erosive esophagitis seen in EGD confirms the diagnosis of GERD. However, its absence does not exclude it since some patients may present reflux symptoms and do not present alterations in

EGD. Biopsies allow the histological evaluation of the esophageal mucosa, but the presence of microscopic esophagitis alone is not sufficient for the diagnosis of GERD [4]. GERD can cause clinical manifestations in different organs and systems, such as the oral cavity [1].

Dental erosion is characterized by the loss of dental hard tissue caused by a chemical process without the influence of bacteria. It is currently a major oral health problem, with an estimated prevalence of 4-82% in adults and 10-80% in children [5,6]. Erosion-causing acid may derive from extrinsic (e.g., diet), intrinsic or a combination of both sources. Studies have shown that the main intrinsic cause of dental erosion is tooth exposure to hydrochloric acid caused by GERD [7,8].

The relationship between GERD and dental erosion has been increasingly evaluated in Pediatrics. The present study aims to evaluate the occurrence of dental erosion in pediatric patients with symptoms suggestive of GERD and/or GERD confirmed by the presence of erosive esophagitis in EGD. Our hypothesis is that children with erosive esophagitis (who are proven to have

GERD), have a higher incidence of dental erosion, considering that there is an association between GERD and dental erosion.

MATERIALS AND METHODS

A cross-sectional study was conducted with a convenience sample. To ensure that the results are reliable, we performed the sample power calculation based on the difference between the groups with and without erosive esophagitis and dental erosion, the result being 99.4% of the sample power. The study was approved by the ethics committee of the Santo Antônio Children's Hospital, Santa Casa de Misericórdia Hospital in Porto Alegre on January 20, 2016, with registration number 51481715.1.0000.5683.

The parents or legal guardians of the patients signed the informed consent form to participate in the study. Patients referred for EGD, regardless of clinical indication, complaint, and diagnostic suspicion, were selected for the study. The endoscopic examination was performed at the Santo Antônio Children's Hospital from May 2016 to June 2018.

Inclusion criteria were: children aged between 5 and 13 years indicated to EGD and signing of the Informed Consent Term by the parents or legal guardians. All patients who underwent EGD were included, even those who were examined for a reason other than GERD screening. Children with systemic diseases, chronic disease and/or cerebral palsy were excluded because these patients can use medications or supplements that have erosive potential. Through our exclusion criteria we also try to limit the possibility of erosive esophagitis being found for causes other than GERD (eg, Crohn's disease, eosinophilic esophagitis).

Prior to EGD and oral cavity examination, a medical history was applied to the parents or legal guardians of the patients to evaluate the presence of symptoms suggestive of GERD in the last 7 days prior to the exams. In addition, data were collected such as: age, gender, health status, presence of systemic / chronic diseases, use of medications and supplements, eating habits and the reason that led the child to undergo the exam. Dietary data of the patients included in the study were also collected. Parents or legal guardians were asked about the habit of eating acidic foods such as soft drinks (soft drinks, sports drinks, sparkling water), natural or processed juices, and acidic fruits (for example: strawberry, orange, apple, pineapple, lemon); how the drink was ingested (glass or straw), speed of ingestion (quickly or slowly). The frequency of consumption was separated into three levels: 1- never or seldom; 2 - frequently; 3 - everyday. Data such as the consumption of liquids before and during sleep were also collected.

The endoscopic examinations were conducted by two Pediatric Gastroenterologists who were trained and experienced in EGD. Patients with a macroscopic erosive lesion were defined as patients with esophagitis according to the Los Angeles classification (Table 1) [9,10]. The evaluating professional did not receive any information on the result of the oral cavity evaluation.

The oral cavity evaluation was performed right before EGD, with the patient already anesthetized. The examination was performed by a dental surgeon who was experienced in dental

Table 1: Los Angeles Classification.

Grade A: one (or more) mucosal break no longer than 5mm, that does not extend between the tops of two mucosal folds.
Grade B: one (or more) mucosal break more than 5mm long that does not extend between the tops of two mucosal folds.
Grade C: one (or more) mucosal break that is continuous between the tops of two or more mucosal folds but which involves less than 75% of the circumference.
Grade D: one (or more) mucosal break which involves at least 75% of the esophageal circumference.
Source: reference 9 and 10.

erosion analysis and is a member of the pediatric dentistry team at the Universidade Federal do Rio Grande do Sul (UFRGS). The evaluating professional did not receive any information on the results of the endoscopic study performed later.

Prior to the start of data collection, this examiner was trained through a theoretical calibration, with a discussion of the BEWE criteria, by an experienced researcher. The examiner was calibrated through clinical photographs of teeth provided by the Department of Pediatric Dentistry at UFRGS, which were previously classified by the experienced researcher. Initially, the images were evaluated and the BEWE index was recorded. Within seven days, the photos were re-evaluated and the records were compared. Kappa coefficients (inter and intra-examiner), were above 0.80, which was considered good.

For the classification of dental erosion, the Basic Erosive Wear Examination (BEWE) Index was used: score 0, without erosive wear; score 1, initial loss of surface texture; score 2, loss of hard tissue with less than 50% of the surface area; score 3, loss of hard tissue with more than 50% of the surface area [11]. The BEWE Index is validated and is widely used in studies and in clinical practice because it is a simplified score and was recommended by the latest consensus of the European Federation of Conservative Dentistry in 2016. Through this index it is possible to make an early diagnosis of erosive wear. BEWE has the advantages of evaluating erosive lesions in the early stages, being able to detect initial loss of tooth structure.

At the end of the oral cavity examination, the parents or legal guardians were informed of what was found and the child was referred to their dental surgeon or another dental surgeon in the community.

Regarding the statistical analysis, BEWE scores were presented as counts, percentages and mean values. Other categorical variables were described as counts and percentages. The Goodman-Kruskal Gamma correlation coefficient was used to evaluate the association between the esophagitis grades and the BEWE score. Comparisons between the values of the BEWE score of symptomatic and non-symptomatic groups were performed using the Mann-Whitney U test. The statistical analysis of the diet data used the Poisson regression to analyze the factor prevalence ratio (individual/dental) associated with tooth erosion. The significance level adopted in the study was $\alpha = 0.05$. Data were processed using the IBM-SPSS version 22.0 program.

RESULTS

One hundred and twenty-two patients were included in the

study. The mean age was 8.7 years old (SD: 2.3 years-old), and 64 (52.5%), patients were male. Of the 122 patients, 83 (68%), presented dental erosion, while 28 (22.9%), presented erosive esophagitis in EGD. Of the 28 patients with erosive esophagitis, 27 (96.4%), presented dental erosion. Ninety-four patients did not have erosive esophagitis in EGD and of these, 56 (59.6%), presented dental erosion. Among the BEWE grades, 25 patients (20.5%), presented BEWE 1; 40 patients (32.8%) BEWE 2, and 18 patients (14.8%) BEWE 3.

In relation to the degrees of erosive esophagitis, 19 patients (15.6%), had grade A esophagitis, and 9 patients (7.4%), had grade B esophagitis or higher. No patient in the study had grade D esophagitis.

When comparing the degree of erosive esophagitis with the BEWE index, a substantial increase in mean BEWE scores was observed following an increase in the degree of esophagitis, which was represented by a Goodman-Kruskal Gamma Coefficient = 0.58 (p <0.001). Patients without esophagitis had a mean BEWE score of 1.11; patients with grade A esophagitis presented a mean BEWE score of 1.79; and patients with grade B esophagitis or higher presented mean BEWE score of 2.33 (Table 2).

Children with erosive esophagitis had a 65% increase in the prevalence of dental erosion compared to the group without erosive esophagitis (PR = 1.62; 95% CI: 1.35-1.94; p <0.001). When adjusted for age and gender, children with erosive esophagitis had a 57% increase in the prevalence of dental erosion when compared to the group without erosive esophagitis (PR = 1.57; 95% CI: 1.31-1.89; p < 0.001). When adjusted for age

and erosive esophagitis, the male gender remains statistically significant with a 32% increase in the prevalence of dental erosion when compared to the female gender (PR = 1.32; 95% CI: 1.04-1.68; p 0.024). When adjusted for the presence of symptoms suggestive of GERD, the presence of erosive esophagitis remains statistically significant with a 45% increase in the occurrence of dental erosion when compared to the group without erosive esophagitis (PR = 1.45; 95% CI: 1.20- 1.76; p <0.001).

In the evaluation of the symptoms suggestive of GERD, the most prevalent symptom in the studied population was abdominal pain (72% of patients). The analysis showed that the presence of symptoms suggestive of GERD was not associated with the severity of dental erosion. Mean BEWE scores between patients with and without the symptoms were similar in all groups analyzed. In the case of abdominal pain, the patients who did not present this symptom had the mean BEWE score higher when compared with the group presenting abdominal pain (Table 3).

We performed the statistical analysis of the diet data of 110 patients included in the study, together with the dental team. When comparing the group with tooth erosion versus the group without erosion, 65.2% of the patients with erosive wear consumed acidic drinks, while only 24.5% of the patients without erosion consumed this type of drink (p 0.76). In the group of patients with erosion, 50.9% consumed acidic beverages daily versus 20% of the patients in the group without erosion (p 0.72). Regarding the speed of acid drink intake, 68.8% of patients who drank slowly had dental erosion and 31.2% did not (p 0.816). Of

Table 2: Distribution and mean values of BEWE score according to the degree of severity of the esophagitis

Esophagitis degree	n	BEWE				Mean
		0	1	2	3	
Absent	94	38 (67.4)	21 (42.3)	22 (43.5)	13 (30.8)	1.11
A	19	1 (5.3)	3 (15.8)	14 (73.7)	1 (5.3)	1.79
B or higher	9	0 (0.0)	1 (11.1)	4 (44.4)	4 (44.4)	2.33

Comparing the degree of erosive esophagitis with the BEWE index, a substantial increase in mean BEWE scores was observed following an increase in the degree of esophagitis, which was represented by a Goodman-Kruskal Gamma Coefficient = 0.58 (p <0.001).

Abbreviations: BEWE: Basic Erosive Wear Examination

Table 3: Mean values of BEWE score in patients with present or absent gastrointestinal symptomatology.

Symptom	Present		Absent		P
	n (%)	Mean	n (%)	Mean	
Vomiting/regurgitation	42 (35.6)	1.41	76 (64.4)	1.26	0.492
Choking	19 (16.1)	1.26	99 (83.9)	1.32	0.816
Abdominal pain	85 (72.0)	1.18	33 (28.0)	1.67	0.027
Eructations	54 (45.8)	1.46	64 (54.2)	1.19	0.156
Dysphagia	20 (16.9)	1.55	98 (83.1)	1.27	0.279
Refusal to eat	48 (40.7)	1.33	70 (59.3)	1.30	0.905
Chest pain	30 (25.4)	1.27	88 (74.6)	1.33	0.770

Data are presented as counts, percentages, and medians. P: statistical significance (obtained with the Mann-Whitney U test).

Abbreviations: BEWE: Basic Erosive Wear Examination

the patients who drank acid drinks in a glass, 71% had dental erosion and 29% did not ($p = 0.579$).

In the analysis with Poisson regression, which evaluated the factor prevalence ratio (individual/dental) associated with dental erosion, ingestion of acidic beverages and fruits was not associated with dental erosion ($p = 0.76$ and 0.78 , respectively), as well as ingestion of acidic beverages and fruits frequently or daily ($p = 0.72$ and 0.44 , respectively). Ingestion of acidic liquids before or during sleep was also not associated with dental erosion in the analyzed sample ($p = 0.82$ and 0.98 , respectively).

Dental erosion was detected in 83 patients (68%). The most affected dental surfaces were free smooth surfaces (buccal and lingual / palatine ones), and the most affected dental group were the upper anterior teeth.

DISCUSSION

The result of this study showed that there is an association between GERD, confirmed by the presence of erosive esophagitis in EGD, and dental erosion. Of the total of patients with erosive esophagitis, 96.4% had dental erosion, showing a higher prevalence than patients without erosive esophagitis (59.6%). Moreover, a progressive change in the frequency of BEWE scores was observed in higher values according to the degree of erosive esophagitis.

However, the prevalence of dental erosion was also high in patients without GERD. This can be explained by the proper training of the dentist who analyzed the oral cavity and/or because the patient was anesthetized during the examination (analysis under ideal conditions).

The results of the present study did not show a significant association between dental erosion and dietary acid intake, but there seems to be a trend towards association. This may have occurred due to the sample size.

Pace et al. (2008), carried out a systematic review of the literature to evaluate the relationship between dental erosion and GERD. The prevalence of dental erosion was 32.5% in adult patients with GERD and 17% in the pediatric population. It was concluded that there is a strong association between the two conditions, and the severity of erosion correlates with the presence of GERD symptoms [12]. Differently from what was found in that systematic review, the present study shows that the presence of symptoms suggestive of GERD had no relation to the severity of dental erosion since the group with symptoms and the group without symptoms had similar mean BEWE scores. The lack of correlation between the presence of erosive esophagitis and the severity of dental erosion can be explained by the fact that the symptoms related to GERD are nonspecific and the presence of these symptoms in the pediatric population is subjective. The presence of erosive esophagitis in EGD is an objective and confirmatory factor for GERD. In addition, because these symptoms are nonspecific, they could be caused by causes other than GERD (for example, hypersensitive esophagus and functional dyspepsia).

The systematic review performed by Picos et al. (2018), analyzed 10 studies, carried out since 2007. An association between GERD and dental erosion was found in 6 studies. The

general prevalence of dental erosion ranged from 10.6% to 42%. When comparing the prevalence rates among individuals with and without GERD, a prevalence of dental erosion was observed in 48.81% versus 20.48%, respectively. The frequency of dental erosion in adults with GERD was 38.96%; in the pediatric population, the frequency found was 98.1%. The authors conclude that dental erosion is a complication of GERD and that the severity of tooth loss is greater in the group with GERD [13]. As in the present study, the prevalence of dental erosion was high in the pediatric population.

Ramachandran et al. (2017), evaluated 25 patients with GERD and 25 healthy controls. The diagnosis of GERD was based on EGD. For the dental erosion analysis, the BEWE index was used. A prevalence of dental erosion of 88% was found in patients with GERD compared to 32% in patients without GERD [14]. The study above was carried out with an adult population, but shows results similar to those of the present study, with a high prevalence of dental erosion in GERD patients.

The present study was carried out with a pediatric population. The age range chosen is justified by the fact that when it is aimed at evaluating the severity of erosive wear, the time that the tooth has been in the mouth directly influences the amount of hard dental tissue lost due to the chemical process causing the pH to drop. The youngest patients included in the research have almost all the deciduous teeth in the mouth. In the upper age group, the end of the mixed dentition and the presence of the complete permanent dentition is already observed, in addition to the sufficient time for the erosion to be established in the cases in which there was frequent contact of the acid with the dental surface.

Sarath Kumar et al. evaluated 51 Indian children from Chennai, with a mean age of 7.43 years. The diagnosis of GERD was confirmed by 24-hour pH-metry and EGD. A detailed medical and dental history was taken, in addition to the analysis of the diet in order to eliminate potential confounding factors. For the dental erosion analysis, the Eccles and Jenkins index was used. A prevalence of 82.35% of dental erosion was found in the sample analyzed [15]. A case-control study conducted in Brazil evaluated 179 children aged 2 to 14 years-old (43 with GERD and 136 without GERD). The diagnosis of GERD was based on 24-hour pH-metry, while dental erosion was evaluated using the O'Sullivan index. The authors found a prevalence of 25.6% of dental erosion in GERD patients compared to 5.9% in GERD-free patients, concluding that children with GERD have an increased risk of dental erosion [16]. The variation in prevalence rates found in the different studies when compared to one in the present work can be explained by differences in their methodologies, mean age and sample size, indexes used for erosion analysis, tests employed for GERD diagnosis, and lack of control for confounding variables.

We do not use pH-impedance testing, as we do not have this test in our service. In addition, the examination has some limitations, such as the lack of definition of reference intervals in the pediatric population. Another limitation is that in patients with significant esophagitis, the test may underestimate the number of reflux episodes as a result of low baseline impedance values, compromising the ability to fall from baseline by more than 50%, which is accepted for definition of reflux by impedance.

A low impedance baseline can alert the clinician to the presence of esophagitis, but it does not prevent the need for endoscopy. Finally, there is a diversity in performance and interpretation of pH-impedance recordings among users, with divergent results in the reproducibility of inter- and intra-observer studies [4]. The presence of erosive esophagitis in EGD, excluding other causes, is synonymous with GERD, so we chose to use this test.

The pattern of dental involvement according to the etiology of erosion is still a controversial topic in the literature [13]. GERD was associated with greater involvement of the palatal, lingual and posterior occlusal surfaces [17]. In our study, some of the most affected surfaces were the lingual and palatal surfaces of the teeth.

The present study may have as a limitation the fact that some patients with symptoms suggestive of GERD do not present macroscopic alterations in EGD and may present with non-erosive or negative endoscopic reflux disease (NERD), functional dyspepsia or hypersensitive esophagus. The study, however, showed that those with erosive esophagitis have dental erosion and, in the studied population, the presence of symptoms suggestive of the disease was not related to the severity of dental erosion.

As the medical history was performed before the EGD and the oral cavity evaluation, the parents / legal guardian did not yet know the results of the exams when they answered the questions, making it unlikely that any memory bias may have interfered with their answers. In addition, families were unaware of the study hypothesis when obtaining medical history.

CONCLUSION

In spite of the possible limitations, this study shows the existence of an association between dental erosion and GERD in a pediatric population, confirmed by the presence of erosive esophagitis in EGD, thus making the joint work between a dental surgeon and the gastropediatrician of utmost interest. A dental surgeon must know how to early recognize erosive wear and refer patients to a gastropediatrician for GERD investigation. In turn, the gastropediatrician should refer patients diagnosed with GERD to a dental evaluation.

Increased knowledge about dental erosion and its probable association with GERD determine the need for further studies in order to better understand the interaction process between the two conditions. Given the prevalence found in the literature and this study, its greater knowledge is essential to minimize complications.

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