

## Pilot Study on Prevalence of Enamel Erosion in Patients Having Gastroesophageal Reflux Disease (GERD) Attending IIUM Dental Clinic

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### KEYWORDS

Gastroesophageal Reflux Disease (GERD), enamel erosion, prevalence

### ABSTRACT

Gastroesophageal reflux disease (GERD) is a common digestive disorder that affects millions of people worldwide. Reflux of gastric acid may cause oral acidification that can induce teeth demineralization. Destruction of dental hard tissue by acid reflux necessitates a combine approach involving medical and dental profession. This pilot study aims to assess association between enamel erosion and GERD, and estimate prevalence of enamel erosion among GERD patients. A total of 22 patients (GERD and control) were involved in this case-control study. Dental charting was done using five-point ordinal scales of modified Tooth Wear Evaluation System (TWES 2.0). Cohen's Kappa Coefficient was used for assessment of intra-rater and inter-rater reliability. Fisher's Exact Test was used to determine association between enamel erosion and GERD, reflecting prevalence. Out of 11 GERD patients, 63.6% exhibit enamel erosion, whereas only 9.1% of control patient presented with enamel erosion. Fisher's Exact Test showed a significant prevalence of enamel erosion in GERD patients ( $p=0.024$ ). This study showed a clear association between enamel erosion and GERD, and it can be considered as an oral manifestation in patient with GERD. Future study involving large sample size is recommended to show clear statistical evidence of association between enamel erosion and GERD.

### INTRODUCTION

Millions of people worldwide deal from a common digestive ailment known as gastroesophageal reflux disease, also referred to as GERD. It is a condition that is caused by reflux of gastric contents into the esophagus. GERD is a significant health concern since it is correlated with decreased quality of life and significant morbidity. Successful treatment of GERD has been proven to significantly enhance

quality of life, by reducing physical pain, increase vitality, physical and social function, and emotional well-being [1]. If the symptoms worsen, GERD can cause esophagitis, Barrett's esophagus, or esophagus adenocarcinoma [2].

The effects of GERD are not only restricted to the esophagus, but also extra-esophageal involvement has also frequently been observed [3]. The predominant esophageal manifestation of GERD are regurgitation and heartburn. However, GERD extra-esophageal manifestations depend on the organ involvement. GERD may cause asthma, bronchitis, and pulmonary fibrosis. On the other hand, hoarseness of voice, cough, laryngitis, subglottic stenosis, indicate laryngeal involvement. Furthermore, GERD found to induce sinusitis, pharyngitis, and dental erosions [4].

Based on the latest review, the average worldwide incidence of dental erosion among adult population

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is 20-45%. Moreover, there has been a growth in incidence of dental erosion in all age groups. Etiology of dental erosion is multifactorial which may be linked to intrinsic or extrinsic factors. Intrinsic factors are gastric reflux caused by GERD mainly, and eating disorders such as anorexia and bulimia. Such factors usually induce erosions on palatal and lingual tooth surfaces [5]. On the other hand, the extrinsic factors include acidic drinks or foods such as soft drinks, juices, energy drinks. Additionally, acidic medications such as vitamin C and chewable aspirins, occupational or environmental acid exposure as in case of exposure to chlorine in chlorinated pools. Moreover, lifestyle involving frequent contact with extrinsic factors or method of intake of foods is another important factor related to dental erosion [6]. However, GERD is the most common cause with incidence of dental erosion of 32.5 to 38.96% [7].

The gastric content may reach the oral cavity, causing oral acidification that can induce chemical demineralization of teeth [8]. The pH of the regurgitated intrinsic acids is 2.0, enabling it to dissolve the hydroxyapatite of the enamel [9]. Destruction of the dental hard tissue due to acid reflux will be complicated by hypersensitivity, pulp disease, phonetic altering, and secondary occlusal discrepancies, in addition to impact on aesthetic appearance [10]. Thus, management of both GERD and dental erosion require a combined approach involving medical and dental professions [8]. The purpose of this pilot study was to assess the association between enamel erosion and GERD and to estimate the prevalence of enamel erosion among GERD patients.

## **MATERIALS AND METHOD**

Ethical approval was obtained from IIUM Research Committee (Registration number: IREC 2023-042). This is a case control study with 12 months duration. All participants received detailed explanation about the project and the procedures that to be conducted. It is non-invasive dental assessments. Consent has been obtained from all participants.

The subjects involved in this study were grouped into two categories. The first category are patients with enamel erosions with concurrent GERD. These patients were recruited from Sultan Ahmad Shah Medical Specialist Centre (SASMEC@IIUM), Kuantan, Pahang, Malaysia. Additionally, patients were also recruited from the Polyclinic, Kulliyah of Dentistry, IIUM Kuantan for any dental procedure. The sampling of cases was done through

arrangement with a gastro-enterologist at SASMEC@IIUM who documented the diagnosis of GERD. Patients who attended the Polyclinic, Kulliyah of Dentistry, IIUM Kuantan were selected into this category based on a thorough history taking reporting heartburn for two or more times per week for the last 3 weeks.

The second category is the control subjects. They are selected from normal subjects who attended the Polyclinic, Kulliyah of Dentistry, IIUM Kuantan. Sampling of patient was done based on the following inclusion criteria: male and female gender, age: 18 – 70 years old, subjects have enamel erosion documented by dental examination, and/or history of GERD documented by a report from a physician/general surgeon or patients with history of heartburn two or more times per week for the last 3 weeks. On the contrary, the exclusion criteria were as follows: i) fully upper and lower jaw edentulous, ii) medically compromised, iii) refusal to give informed consent, iv) presence of any of the confounding variables of enamel erosion other than GERD such as: history of acidic soft drinks, juices, or energy drinks, or acidic medications such as vitamin C and chewable aspirins, v) significant occupational history with exposure to chlorine in chlorinated pools.

Index that was implemented for this study is the Tooth Wear Evaluation System (TWES 2.0) [11] with slight modification. The TWES 2.0 is where one grade is recorded for each tooth surface (occlusal/incisal, buccal, and palatal/lingual). The individual values are entered in a graphical grading document (Figure 1) based on 5-point ordinal scale (Table 1). Highest grade per tooth is relevant to determine the evaluation of each subject. Finally, the individual findings (history and clinical examinations) are combined to form a structured diagnosis (Table 2). Interestingly, the pattern and distribution of wear provide strong clues to the underlying cause (intrinsic vs. extrinsic acids, abrasion, attrition, or multifactorial origin).

Sample size was calculated by G Power Software 3.1.9.7 based on the study by Oginni et al. [12]. In the reference study the prevalence of enamel erosion among GERD patient was 16% with significant p value (0.02). The sample size was calculated based on the reference study with estimated proportion of 20%, power 80%, and confidence level 95%. In this study minimum of 68 subjects need to be studied for the rejection of null hypothesis. Since this is a pilot study, only 30% of subjects were involved, thus a total of 22 subjects were recruited with 11 controls who attended the

Polyclinic Kulliyyah of Dentistry, IIUM and 11 patients with known cases of GERD. Intra and inter calibration was conducted by two prosthodontics specialist from Kulliyyah of Dentistry, IIUM prior to commencement of the study to ensure the reliability and consistency of clinical assessments. Calibration was done using Cohen's Kappa Coefficient. Substantial agreement was achieved on each test (Kappa: 0.61-0.80).

	SEXTANT 1					SEXTANT 2					SEXTANT 3						
Buccal																Buccal	
Occlusal/Incisal																Occlusal/Incisal	
Palatal																Palatal	
Upper Teeth	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28	Upper Teeth
Lower Teeth	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38	Lower Teeth
Lingual																Lingual	
Occlusal/Incisal																Occlusal/Incisal	
Buccal																Buccal	
	SEXTANT 6					SEXTANT 5					SEXTANT 4						

Figure 1 TWES 2.0 Grading Document

Table 1 Tooth Wear Evaluation System (TWES 2.0) Grading Scale

Surface	Score	Description
Occlusal/Incisal	0	No (visible) erosion
	1	Visible erosion within the enamel
	2	Visible erosion with dentin exposure and loss of clinical crown height $\leq 1/3$
	3	Loss of clinical crown height $> 1/3$ but $< 2/3$
	4	Loss of clinical crown height $\geq 2/3$
Buccal/Palatal/Lingual	0	No (visible) erosion
	1	Erosion within the enamel
	2	Erosion with dentin exposure (less than 50% of the area)
	3	Erosion with dentin exposure (50% or more of the area)
	4	Erosion with dentin exposure (complete-tooth loss of enamel or pulp exposure)

Patients' data was tabulated in the data collection sheet once the patient qualified to join the study. Patients were divided into two groups; first group is GERD group and the second is control group. Detailed history was taken using specific examination and diagnosis form. Tooth surface charting of each subject was analysed using TWES 2.0 for enamel erosion. Data were analysed using IBM SPSS Statistics 25. Since this study is a pilot study using a small sample size, Fisher's Exact Test was used to determine the association between enamel erosion and GERD, reflecting the prevalence.

Table 2 Taxonomy of Tooth Wear Diagnosis According to TWES 2.0

Category	Degree of Severity and Clinical Description
Generalized	The most severe generalized grade comes first
	0: No tooth wear. Normal anatomy, no tissue loss.
	1: Mild wear. Loss of enamel surface texture, shallow cupping, incisal translucency fading
	2: Moderate wear. Enamel loss with localized dentin exposure; flattened cusp tips/incisors.
Generalized	3: Moderate to Severe wear. Dentin exposed over $>1/3$ of surface; significant contour changes, incisal edge loss
	4: Severe wear. Deep dentin exposure, potential pulpal involvement, tooth shortening, loss of function
	Localised

## RESULTS AND DISCUSSION

Finding of the current study as displayed in Tables 3, 4 and 5 are suggestive of the proposed theory that states there is a significant association between GERD and enamel erosion. Although the study is a pilot investigation using a small sample size which is about 30% of the sample size based on the minimum sample calculation, the proposed association between GERD and enamel erosion still observable.

GERD is characterized by the reflux of gastric content to the oral cavity, causing oral acidification

that can induce chemical demineralization of teeth [8]. The pH of the regurgitated intrinsic acids is 2.0, enabling it to dissolve the hydroxyapatite of the enamel [9]. Destruction of the dental hard tissue by acid reflux causes hypersensitivity to cold or hot stimuli, unaesthetic appearance, pulp complications, phonetic alteration, changed teeth function and secondary occlusal discrepancies [10]. The results of this study highlight a significant association between GERD and enamel erosion ( $p = 0.024$ ). Out of the 22 screened subjects, those diagnosed with GERD exhibited a higher prevalence of enamel erosion (63.6%) compared to the control group (9.1%) (Table 4). Similar findings were reported by Alavi et al. [13] who conducted a study involving 140 patients aged between 30- and 40-years old undergoing endoscopy procedures. Their research revealed a higher prevalence of enamel erosion among individuals diagnosed with GERD (22.6%) following endoscopy, compared to both suspected cases (5.3%) and healthy individuals (7%). Similarly, Yanuchevich et al. [7] verified these findings in their analysis of 28 studies involving 4,379 participants (2,309 GERD subjects and 2,070 control subjects), they found that the prevalence of enamel erosion is 51.5% among individuals with GERD, compared to 21.4% in control groups. A significant association between enamel erosion and GERD was revealed. This finding underscores the importance of recognizing enamel erosion as an oral manifestation of GERD.

In the current study, the average age of the GERD group is notably higher than that of the control group. Enamel erosion was absent in the two youngest subjects diagnosed with GERD, both aged 20 years old. Notably, one of the GERD subjects aged 56, presented with generalized enamel erosion, whereas others displayed localized erosion. This raises the concern about effect of age on severity of enamel erosion among GERD patients. Wild et al. [14] conducted a cross-sectional study examining the association between GERD and dental erosion in children. Their research involved 59 children, aged 9-17 years old, exhibiting GERD signs and symptoms, alongside 20 control children. Interestingly, they did not observe any significant association between GERD and dental erosion among the pediatric participants. Further future study is recommended to investigate relation between age and progression of enamel erosion in patients having GERD. In the present study, gender distribution within both the GERD and control groups appears almost balanced. This may suggest that the observed differences in enamel erosion prevalence are not influenced by gender. This is supported by Asanuma et al. [15] who reported that the incidence of GERD is almost equal in males and females.

**Table 3** Gender and age distribution of study population

	Gender n (%)		Age n (%)			
	Male	Female	18–31	32– 44	45–57	58– 70
<b>GERD</b>	5 (45.5)	6 (54.5)	5 (33.3)	2 (66.7)	3 (100.0)	1 (100.0)
<b>Control</b>	6 (54.5)	5 (45.5)	10 (66.7)	1 (33.3)	0 (0.0)	0 (0.0)
<b>Total</b>	11	11	15	3	3	1

**Table 4** Association between enamel erosion and GERD

	Enamel Erosion n (%)			p value
	With	Without	Total	
<b>GERD</b>	7 (63.6)	4 (36.4)	11 (100.0)	0.024
<b>Control</b>	1 (9.1)	10 (90.9)	11 (100.0)	

**Table 5** Taxonomy of enamel erosion

	Taxonomy n (%)					Total
	No Enamel Erosion	Localized Enamel Erosion		Generalized Enamel Erosion		
		Mild	Moderate	Mild	Moderate	
<b>GERD</b>	4 (36.4)	5 (45.4)	1 (9.1)	1 (9.1)	0 (0.0)	11 (100.0)
<b>Control</b>	10 (90.9)	1 (9.1)	0 (0.0)	0 (0.0)	0 (0.0)	11 (100.0)

**CONCLUSION**

The study reveals a significant association between GERD and enamel erosion. Gender distribution within both groups suggests that observed differences in enamel erosion prevalence are not influenced by gender, despite the complex role of gender in GERD manifestation. This study highlights the importance of considering enamel erosion as an oral manifestation in patients with GERD and underscores the need for early detection and management of dental health issues in GERD patients. Further future studies using a large sample size are recommended to emphasize the prevalence of enamel erosion in GERD patients.

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**DECLARATION OF INTEREST**

Authors declare no conflict of interest.

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