

Evaluation of Nexus of Dental Erosion and Gastro-esophageal Reflux Disease: A Hospital-based Cross-sectional Study

MANOJ MAHADEO RAMUGADE¹, ABRAR SAYED², KISHOR DATTATRAY SAPKALE³, SAPNA SONKURLA⁴

ABSTRACT

Introduction: Gastroesophageal Reflux Disease (GERD) is a common ailment in modern society due to unhealthy food habits and stress. It not only affects the digestive pathway but also exhibited as Dental Erosion (DE) in an acidity prone patient. Thus, the existence of the close relationship between GERD and dental erosion needs to be evaluated.

Aim: This study was conducted to evaluate the prevalence of DE in patients diagnosed with GERD using clinical examination and adopting Lussi's Erosion Index to measure its severity.

Materials and Methods: Total 200 patients were evaluated in this study, 100 patients diagnosed with GERD by the gastroenterologist and 100 patients in the control group from the Out-patient Department from January 2018 to May 2019. All participants who have given voluntary consent for the study

were examined clinically for the presence of DE. Prevalence of DE was evaluated and its severity was assessed by clinical and visual examination using Lussi's Erosion Index (LEI) according to the various grades.

Results: The results of this study showed that 88 (88%) GERD patients showed erosion of atleast one tooth as compared to 47 (47%) in the control group which was found to be clinically significant. In GERD patients Grade I erosion is prevalent in 54 (54%), Grade II in 32 (32%) and Grade III was observed in only 2 (2%). The palatal surface of maxillary incisors and occlusal surfaces of maxillary and mandibular molars were most commonly affected teeth in DE.

Conclusion: Dental erosion may be considered as one of the markers for the presence of GERD in the general population and vice-versa.

Keywords: Hyperacidity, Intrinsic acid, Lussi's erosion index, Tooth wear

INTRODUCTION

Modern lifestyle, unhealthy food habits, digestive tract pathology and stress are the identified risk factors associated with many digestive diseases such as GERD, acidity or the peptic ulcer. Gastro-esophageal Reflux (GER) may be described as a normal, post-prandial and physiologic retrograde flow of gastric contents into the oesophagus [1]. GERD not only has the local effects confined to the esophagus but has also been observed associated with the presence of DE with loss of surface enamel or dentin due to gastric acid reflux [1].

GERD has shown various oro-dental ailments and the most common is DE. DE may be caused due to exposure to intrinsic or extrinsic acid. The extrinsic factors include excessive, regular consumption of acidic food or beverages, acidic sports drink intake or chewing Vitamin C tablet whereas; intrinsic factors associated with GERD are acid regurgitation, recurrent stress-induced vomiting or excessive alcohol consumption etc., [2-5]. Erosion due to intrinsic acids is also evident in women addicted to induce vomiting as in bulimia or anorexia nervosa and rumination [4,5]. Other oral manifestations of GERD may include; halitosis, burning sensation with ulceration of oral mucosa, dysgeusia, xerostomia or sometimes with increased salivation [6]. A study carried out in GERD patients revealed that the prevalence of GERD in patients less than 20 years was 4.4%, whereas it was 11.6% in adults [7]. DE may cause loss of enamel and dentin, and in advance stages may cause hypersensitivity, pulp exposure and loss of tooth form. Thus, this cross-sectional study was planned to evaluate the prevalence and severity of DE.

MATERIALS AND METHODS

A cross-sectional study was conducted in a Tertiary care hospital to evaluate the prevalence and severity of DE. In the present study 100 patients diagnosed with GERD and 100 patients from the Out-patient Department (OPD) were examined from January 2018 to May 2019. Ethical approval was obtained from the institutional

Local Ethical Committee for the study (GDCH/Ethical committee/Project/1085-86/08). Using Roff formula, with average population size 134 (average OPD), confidence level 95% and confidence interval 9.8; 100 patients were selected at random by a team of restorative dentists in each group. Patient's personal information including name, age, gender, residence, qualification and occupation etc., was noted for record purpose. For the study, patients diagnosed with GERD having a history of frequent gastric refluxes atleast for one year with or without history of vomiting; 2 or more times a week or history of peptic ulcer due to GERD were preferably selected. Written informed consent was obtained from all voluntary participants.

A structured case history questionnaire related to gastric reflux frequency, vomiting frequency, its duration, dietary habits, medicinal and other related habits contributing to DE etc., were also recorded. The pattern of DE was recorded and the severity of DE was measured using Lussi's Erosion index as it is simple, reliable and reproducible indexing system [8,9]. According to this index, Grade I, DE (Mild) denotes loss of enamel, rounded cusps and incisal grooving, Grade II (Moderate) denotes DE extended into dentin in about half of tooth surface whereas; Grade III (Severe) indicates DE extended into dentin involving more than half of tooth surface.

STATISTICAL ANALYSIS

Data obtained was compiled on MS Office Excel Sheet (v. 2010) and subjected to statistical analysis using Statistical package for social sciences (SPSS v 21.0, IBM). Descriptive statistics like mean age, gender-wise distribution (overall and group-wise) has been depicted. Comparison of frequencies of subjects with erosion, maximum erosion severity, affecting tooth tissue (enamel or dentin) with the control group and teeth sensitivity was done using Chi-square test. For all the statistical tests, $p < 0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving power to the study as 80%.

RESULTS

Out of 100 GERD patients, 57 (57%) were males and 43 (43%) were females; whereas in control group 62 were males and 38 were female participants [Table/Fig-1].

Groups	n=100 Patients/Group		Minimum (in years)	Maximum (in years)	Mean (in years)	Std. deviation
	M	F				
GERD patients	57	43	20	60	41.65	13.295
OPD patients (Control group)	62	38	20	60	37.21	12.637

[Table/Fig-1]: Gender and Age-wise distribution of participants.

Total of 88 (88%) participants of GERD group has shown the presence of DE of a varying degree from Grade I to Grade III whereas; only 47 (47%) showed DE in control group patients (Chi-square value=28.408, df=10, p=0.0002). Results also showed that Grade I is the most common type of erosion which was observed in 54 (54%) patients with GERD and 45 (45%) patients in the control group [Table/Fig-2,3].

Erosion grading	Grade I (Mild)	Grade II (Moderate)	Grade III	Total
In GERD patients	54	32	2	88
In OPD patients (Control group)	45	2	0	47

[Table/Fig-2]: Dental erosion severity grades.

Chi-square value=28.408, df=10, p=0.001

	Affecting tooth tissue (Grade I/Grade II/Grade III)					Total
	No erosion	Grade I	Grade II	Grade I + Grade II	Grade I + Grade II+Grade III	
GERD patients	12	54	15	17	2	100
OPD patients	53	45	2	0	0	100

[Table/Fig-3]: Grade-wise distribution of patients (Grade I/Grade II/Grade III).

Chi-square value=174.68, df=20, p<0.001

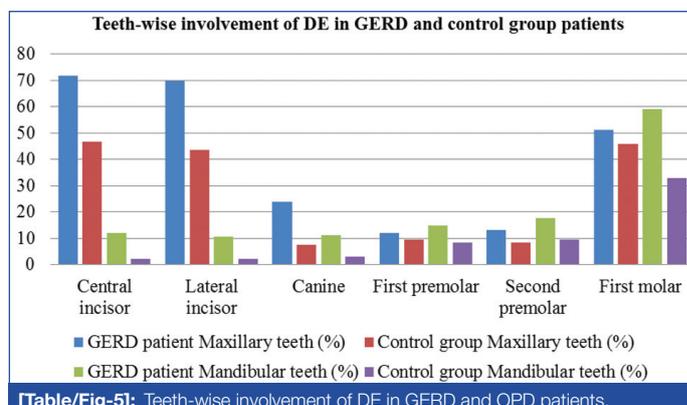
It was also observed that the teeth of both the arches were affected by erosion with more or less severity. Dental sensitivity was also observed in 68 (68%) GERD patients and 25 (25%) in the (OPD patients) control group [Table/Fig-4]. In GERD group, the prevalence of DE in maxillary and mandibular teeth showed that 71.59% of the maxillary anterior teeth had erosion whereas; 59.09% of mandibular posterior teeth showed DE which is more than their anterior counterparts. It was also observed that the lingual surfaces of mandibular anterior teeth were affected the least by DE with the prevalence of 2.27%.

Group	Teeth sensitivity		
	Absent	Present	Total patients
GERD patients	32	68	100
OPD patients	75	25	100

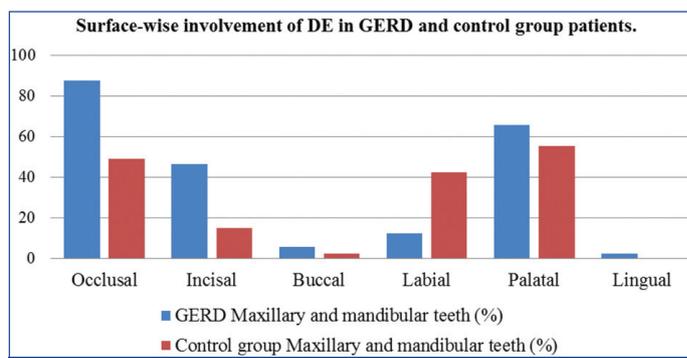
[Table/Fig-4]: Teeth sensitivity.

Chi square value=48.396, df=5, p<0.001

In the control group, the maxillary anterior and posterior teeth have the same prevalence of DE in 46.81% teeth whereas; amongst mandibular teeth, 31.14% molars showed DE. The palatal surfaces of maxillary anteriors showed maximum erosion in 55.26% teeth whereas; occlusal surfaces of mandibular posterior teeth were more commonly affected in 40.43% teeth. Lingual surfaces of mandibular anterior teeth were unaffected by tooth erosion. In both the groups, the teeth showed concurrent evidence of varying grades of severity of DE and it had affected different surfaces of the majority of teeth [Table/Fig-5,6].



[Table/Fig-5]: Teeth-wise involvement of DE in GERD and OPD patients.



[Table/Fig-6]: Surface-wise involvement of DE in GERD and OPD patients.

DISCUSSION

GERD is considered as a common dental disease attributed to modern lifestyle and unhealthy food habits. Digestive acids of endogenous origin contain hydrochloric acid which is produced by parietal cells; generating pH of 2-3 [10]. This pH is more acidic than exogenous acids which not only causes DE but also affects the inner mucosal lining of the oropharynx, oesophagus or the respiratory system [11-15]. Studies in the literature showed that the frequency of GERD significantly increases after the age of 40 years and there is a wide disparity in its prevalence [2,3,6,16].

Various in-vitro and in-vivo clinical studies have been carried out which showed assertive relationship between GERD and DE in children and adults [Table/Fig-7] [7,17-26]. An evidence-based Montreal consensus was carried out in 2006 in which 44 doctors around the globe confirmed by voting that in patients diagnosed with GERD the occurrence of DE has increased [3].

Sl. no.	Author	Year	Studied population	Prevalence
1	Jarvinen V et al., [17]	1988	109	20%
2	Firouzei MS et al., [18]	2011	15	87%
3	Meurman JH et al., [19]	1994	117	24%
4	Gudmundsson K et al., [20]	1995	14	21%
5	Bartlett DW et al., [21]	1996	36	64%
6	Loffeld RJ [22]	1996	293	32.5%
7	Gregory-Head BL et al., [23]	2000	20	50%
8	Dahshan A et al., [24]	2002	24/37	83%
9	Munoz JV et al., [25]	2003	181	47.5%
10	Oginni AO et al., [26]	2005	125	16%
11	Okimoto E et al., [7]	2015	1859	4.4% in young patients 11.6% in adults

[Table/Fig-7]: Prevalence of dental erosion in various studies [7,17-26].

Pace F et al., in their systematic review evaluated 17 different observational and case-control studies and concluded 24% as an average incidence of DE in patients with GERD. They also observed the prevalence of GERD with DE in children and adults as 17% and 32.5% respectively [27]. Tolia V et al., in their systematic

review found a higher prevalence of DE in children diagnosed with GERD [14].

Bartlett DW et al., in their study observed that 23 (64%) out of 36 patients had significant palatal erosion with a history of severe GER. They have also concluded that all these patients were 'silent refluxer' and the regurgitation of gastric secretion in GER causes palatal erosion [21]. In other studies, it was evident that in patients with GERD; the prevalence of DE is 6%-10% [28,29].

Meurman JH et al., examined 117 patients with GERD and observed dental erosion in 28 (24%) patients of the studied population [19]. In a different study by Muñoz JV et al., compared the prevalence of dental erosion over 2 years in 253 individuals; out of which 181 patients had GERD and 72 were the healthy volunteers. Results of the study showed that regardless of age, the prevalence of dental erosion was significantly higher and severe in the GERD group. Investigators also concluded the DE as an extra-esophageal manifestation of GERD [25].

Lussi A et al., in the study observed that; 42.6% of Swiss adults between the age of 46-50 years; had an average of 3.9 teeth affected by erosion and having at least one tooth with severe erosion observed on the occlusal surface [8]. Jarvinen V et al., observed that 20% of patients out of 109 patients having gastro-oesophageal symptoms had DE [17].

In another study by Jones RR et al., DE was observed in 69% of bulimic female patients causing exposure of enamel and dentin due to the acidic gastric juices. DE was observed on the palatal surfaces of maxillary teeth and the facial surfaces of the central incisors and canines in 50% and 70% of the patients respectively [30]. A comparative study was done by Bartlett DW et al., to compare the erosive effect of gastric juice and a carbonated drink on the enamel and dentine and concluded that gastric juice (pH 2.5) has a greater potential to cause erosion than a carbonated drink [31].

From the observations in the present study, a conclusion regarding the prevalence of tooth erosion can be drawn that high prevalence of DE can be due to changing lifestyles and dietary habits which lead to chronic gastric disturbances resulting in chronic hyper-acidity. In developing Asian countries like India; spices and oils are essential parts of regular meals. Similarly, due to routine intake of such food and unscheduled or skipped meals may also lead to gastritis; while in western countries, DE might be due to anorexia nervosa, bulimia, habitual intake of acidic beverages or alcohol etc.,

In this study, out of 100 patients examined, only 5 (5%) had a peptic ulcer. Also, out of 100 GERD patients, 54% showed mild erosion, 32% showed moderate erosion and 2% showed severe DE. This severity has been essentially related to the high acidic pH (around 1.0-2.5) of gastric reflux or the vomitus. Such a low pH is capable of DE resulting in dentin exposure earlier and with a greater severity than the other acid sources.

Similar results were observed in the present study as in the literature about the prevalence of DE in GERD patients [18,21,24]. A probable explanation thus can be established regarding the surfaces affected by DE that, the palatal surfaces of maxillary anteriors and the occlusal surfaces of maxillary molars were in direct contact with gastric reflux or the vomitus for a longer time. Thus, this site-specificity and severity for DE have been attributed to the acid reflux exposure and less cleaning activity by saliva and the tongue. Lingual surfaces showed least erosion and it relates to the continuous cleansing action of the tongue and the saliva.

Clinically, the dental clinician must not overlook the importance of dietary history with other medicinal or other contributing history while diagnosing and treating DE. Also, DE has similar clinical features with other wearing diseases of teeth and it causes irreversible dissolution of enamel which may lead to loss of vertical height, loss of aesthetics and dentinal sensitivity. Thus, the operator must rule out the causative factors and directs the management towards its

prevention, early diagnosis and treatment and regular follow-up to prevent the extensive loss of tooth structure. Further studies are recommended to evaluate effect of multifactorial origin of DE in a large population.

LIMITATION

DE is a known multifactorial disease where GERD is a prime intrinsic factor identified in its causation. In the present study, randomly selected patients with diagnosed GERD were evaluated as the cause of the DE; while the other extrinsic factors concurrently responsible for the erosion, could not be isolated. Thus, absolute role of GERD on dentition exhibiting as DE could not be established exclusively.

CONCLUSION

DE might be considered as a connotative feature of the patient diagnosed with GERD with its high prevalence. It can be concluded that severity of DE could be dependent on pH of the acid reflux, its duration of contact with the teeth as well as the time of its oral clearance after acid reflux or vomiting. The erosive loss of teeth may be severe if GERD has not been diagnosed and treated promptly. Thus, prevention is the key in the successful management of DE.

REFERENCES

- [1] Fenoglio-Preiser CM, Noffsinger AE, Stemmermann GN, Lantz PE, Listrom MB. The non-neoplastic esophagus, in *Gastrointestinal Pathology: An Atlas and Text*. Lippincott-Raven, Philadelphia, Pa, USA. 1999:31-91.
- [2] Marsicano JA, de Moura-Grec PG, Bonato RC, SalesPeres Mde C, Sales-Peres A, Sales-Peres SH. Gastroesophageal reflux, dental erosion, and halitosis in epidemiological surveys: a systematic review. *Eur J Gastroenterol Hepatol*. 2013;25(2):135-41.
- [3] Ranjtkar S, Smales RJ, Kaidonis JA. Oral manifestations of gastroesophageal reflux disease. *J Gastroenterol Hepatol*. 2012;27(1):21-27.
- [4] Poddar U. Diagnosis and management of gastroesophageal reflux disease (GERD): an Indian perspective. *Indian Pediatr*. 2013;50(1):119-26.
- [5] Yoshikawa H, Furuta K, Ueno M, Egawa M, Yoshino A, Kondo S, et al. Oral symptoms including dental erosion in gastroesophageal reflux disease are associated with decreased salivary flow volume and swallowing function. *J Gastroenterol*. 2012;47(4):412-20.
- [6] Di Fede O, Di Liberto C, Occhipinti G, Vigneri S, Lo Russo L, Fedele S, et al. Oral manifestations in patients with gastro-oesophageal reflux disease: a single-center case-control study. *J Oral Pathol Med*. 2008;37(6):336-40.
- [7] Okimoto E, Ishimura N, Morito Y, Mikami H, Shimura S, Uno G, et al. Prevalence of gastroesophageal reflux disease in children, adults, and elderly in same community. *J Gastroenterol Hepatol*. 2015;30(7):1140-46.
- [8] Lussi A, Schaffner M, Hotz P, Suter P. Dental erosion in a population of Swiss adults. *Community Dent Oral Epidemiol*. 1991;19(5):286-90.
- [9] Lussi A. Dental erosion; clinical diagnosis and case history taking. *Eur J Oral Sci*. 1996;104(2):191-98.
- [10] Freeman HJ, Kim YS. Digestion and absorption of protein. *Annu Rev Med*. 1978;29:99-116.
- [11] Prasad GA, Bansal A, Sharma P, Wang KK. Predictors of progression in Barrett's esophagus: current knowledge and future directions. *The Am Jnl of Gastro*. 2010;105(7):1490-502.
- [12] Rubenstein JH, Taylor JB. Meta-analysis: the association of oesophageal adenocarcinoma with symptoms of gastro-oesophageal reflux. *Alimentary Pharmacology and Therapeutics*. 2010;32(10):1222-27.
- [13] Bartlett D. Intrinsic causes of erosion. *Monographs in Oral Science*. 2006; 20:119-39.
- [14] Tolia V, Vandenplas Y. Systematic review: the extraoesophageal symptoms of gastro-oesophageal reflux disease in children. *Ali Pharm and Ther*. 2009;29(3):258-72.
- [15] Fass R, Achem SR, Harding S, Mittal RK, Quigley E. Review article: supra-oesophageal manifestations of gastro-oesophageal reflux disease and the role of night-time gastro-oesophageal reflux. *Alim Pharm and Ther*. 2004;20(9):26-38.
- [16] Spechler SJ. Epidemiology and natural history of gastro-oesophageal reflux disease. *Digestion*. 1992;51(1):24-29.
- [17] Jarvinen V, Meurman JH, Hyvarinen H, Rytomaa I, Murtomaa H. Dental erosion and upper gastrointestinal disorders. *Oral Surg Oral Med Oral Pathol*. 1988;65(3):298-303.
- [18] Firouzei MS, Khazaei S, Afghari P, Savabi G, Savabi O, Keshteli AH, et al. Gastroesophageal reflux disease and tooth erosion: SEPAHAN systematic review no. 10. *Dent Res J (Isfahan)*. 2011;8(Suppl 1):S9-S14.
- [19] Meurman JH, Toskala J, Nuutinen P, Klemetti E. Oral and dental manifestations in gastroesophageal reflux disease. *Oral Surg Oral Med Oral Pathol*. 1994;78:583-89.
- [20] Gudmundsson K, Kristleifsson G, Theodors A, Holbrook WP. Tooth erosion, gastroesophageal reflux, and salivary buffer capacity. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 1995;79:185-89.
- [21] Bartlett DW, Evans DF, Anggiansah A, Smith BG. A study of the association between gastro-oesophageal reflux and palatal dental erosion. *Br Dent J*. 1996;181(4):125-31.

- [22] Loffeld RJ. Incisor teeth status in patients with reflux oesophagitis. Digestion. 1996;57:388-90.
- [23] Gregory-Head BL, Curtis DA, Kim L, Cello J. Evaluation of dental erosion in patients with Gastroesophageal reflux disease. J Prosthet Dent. 2000;83:675-80.
- [24] Dahshan A, Patel H, Delaney J, Wueth A, Thomas R, Tolia V. Gastroesophageal reflux disease and dental erosion in children. J Pediatr. 2002;140:474-78.
- [25] Munoz JV, Herreros B, Sanchiz V, Amoros C, Hernandez V, Pascual I, et al. Dental and periodontal lesions in patients with gastro-oesophageal reflux disease. Dig Liver Dis. 2003;35:461-67.
- [26] Oginni AO, Agbakwuru EA, Ndububa DA. The prevalence of dental erosion in Nigerian patients with gastro-oesophageal reflux disease. BMC Oral Health. 2005;5:1.
- [27] Pace F, Pallotta S, Tonini M, Vakil N, Bianchi Porro G. Systematic review: gastro-oesophageal reflux disease and dental lesions. Aliment Pharmacol Ther. 2008;27(12):1179-86.
- [28] Bloom BS, Glise H. What do we know about gastroesophageal reflux disease? Am J Gastroenterol. 2001;96:51-56.
- [29] Talley NJ, Zinsmeister AR, Schleck CD, Melton LJ 3rd. The natural history of gastroesophageal reflux. Gastroenterology. 1992;102(4):A28.
- [30] Jones RR, Cleaton-Jones P. Depth and area of dental erosions, and dental caries, in bulimic women. J Dent Res. 1989;68(8):1275-78.
- [31] Bartlett DW, Coward PY. Comparison of the erosive potential of gastric juice and a carbonated drink in vitro. J Oral Rehabil. 2001;28(11):1045-47.

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Conservative Dentistry and Endodontics, Government Dental College and Hospital, Mumbai, Maharashtra, India.
2. Associate Professor, Department of Conservative Dentistry and Endodontics, Government Dental College and Hospital, Mumbai, Maharashtra, India.
3. Associate Professor, Department of Conservative Dentistry and Endodontics, Government Dental College and Hospital, Mumbai, Maharashtra, India.
4. Assistant Professor, Department of Conservative Dentistry and Endodontics, Government Dental College and Hospital, Mumbai, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Manoj Mahadeo Ramugade,
Room No. 101, Government Dental College and Hospital, Mumbai, Maharashtra, India.
E-mail: manojmids05@yahoo.co.in

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Sep 02, 2019
- Manual Googling: Oct 11, 2019
- iThenticate Software: Dec 03, 2019 (14%)

ETYMOLOGY: Author Origin**AUTHOR DECLARATION:**

- Financial or Other Competing Interests: No
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Sep 01, 2019**Date of Peer Review: **Oct 11, 2019**Date of Acceptance: **Nov 19, 2019**Date of Publishing: **Dec 01, 2019**