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SHORT COMMUNICATION

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Incidence and progression of erosive tooth wear according to tooth type in schoolchildren of Mexico City

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Abstract

This study aimed to estimate the cumulative incidence and the progression of erosive tooth wear (ETW) according to tooth type over a follow-up period of 18 months in adolescents living in Mexico City. We examined 10,776 teeth from 424 participants and used the Basic Erosive Wear Examination index (BEWE) to assess ETW. Our results showed that the overall cumulative incidence rate of ETW was 5.9% (587 from 9933 teeth), and the progression of ETW was 10% (85 from 843 teeth). Notably, the cumulative incidence of initial texture loss (BEWE = 1) was 29.1% for maxillary central incisors, and 30.4% of mandibular first molars progressed to loss of hard tissues (BEWE $\geq$2).

Keywords

Tooth erosion; Incidence; Progression; Epidemiology; Adolescent; Oral health

1. Introduction

Tooth wear refers to the cumulative surface loss of mineralized tooth substance due to physical or chemo-physical processes such as dental erosion, attrition and abrasion. Dental caries, resorption and trauma are not considered to be the causes of tooth wear. Erosive tooth wear is a type of tooth wear with dental erosion as the primary etiological factor [1].

ETW is characterized by loss of the natural surface morphology and contour. The typical signs of ETW on occlusal surfaces are cusp cupping and flattening of the occlusal structures, with advanced stages often resulting in the loss of the entire occlusal morphology and the development of hollowed-out surfaces. Restorations may protrude above the adjacent tooth surface. Typical signs of ETW on smooth surfaces are flattening of the surface, sometimes accompanied by an intact rim along the gingival margin [2].

Several studies have suggested that different types of teeth may have varying susceptibility to ETW [3, 4]. However, to date, only one study has reported on the incidence of ETW incidence across different tooth types over a follow-up period of 3 years, revealing the highest incidence to be among the maxillary central incisors (23.4%), while the greatest progression among the mandibular first molars (59.4%) [5].

The chronology of tooth eruption may explain why certain teeth are more vulnerable to ETW. The earliest-erupting teeth remain exposed to etiological factors for longer periods of time [6]. Additionally, the thickness of the enamel may influence the degree of damage; regions where the enamel is thinner are more likely to be affected by ETW [7, 8]. Finally, it is recognized that the mechanical processes of wear (attrition and abrasion) caused by the ETW, can affect each type of tooth differently, depending on its function or its position [3, 9].

ETW has emerged as a significant oral public health concern in both industrialized and developing countries, underscoring the importance of studying its impact across diverse populations [10, 11]. However, more evidence is needed to determine which teeth are most affected. The objective of this study was to estimate the cumulative incidence rate and the progression of ETW according to tooth type over a period of 18 months.

2. Materials and methods

2.1 Subjects

The present study was performed as a follow-up to the primary etiological study [12]. The study was conducted on a convenience sample of schoolchildren from 11 to 14 years old enrolled in public schools located in north of Mexico City. The selected area comprised 1,173,351 inhabitants (12.7% of the total population of Mexico City). A total of 510 first-year high-school students, aged between 11 and 14 years, were considered eligible. A total of 480 adolescents and their parents or guardians provided signed informed consent agreeing to participate in the study. Fifteen adolescents were excluded because they had orthodontic appliances. Consequently, 465 adolescents were examined at baseline, and 424 were reexamined 18 months later; the dropout rate was 8.8%.

2.2 Clinical examination

The operational definition of dental erosion was based on the BEWE criteria (Basic Erosive Wear Examination) [13]:

0 = No erosive tooth wear.

1 = Initial loss of surface texture.

TABLE 1. Cumulative incidence of ETW according to tooth type after a follow-up of 18 months.

Tooth Type	Remained free of ETW	Cumulative incidence of ETW		Total teeth
	BEWE = 0 → BEWE = 0 n (%)	BEWE = 0 → BEWE = 1 n (%)	BEWE = 0 → BEWE = 2 n (%)	
Maxillary				
Anterior Teeth				
Central incisors**	353 (70.9)	142 (28.5)	3 (0.6)	498 (100)
Lateral incisors*	640 (89.4)	74 (10.3)	2 (0.3)	716 (100)
Canines	642 (95.5)	30 (4.5)	0 (0.0)	672 (100)
Posterior Teeth				
First premolars	742 (95.2)	35 (4.5)	2 (0.3)	779 (100)
Second premolars	734 (99.7)	2 (0.3)	0 (0.0)	736 (100)
First molars	756 (94.6)	28 (3.5)	15 (1.9)	799 (100)
Second molars	550 (100.0)	0 (0.0)	0 (0.0)	550 (100)
Mandibular				
Anterior Teeth				
Central incisors**	604 (82.5)	128 (17.5)	0 (0.0)	732 (100)
Lateral incisors	767 (95.4)	37 (4.6)	0 (0.0)	804 (100)
Canines	800 (99.1)	7 (0.9)	0 (0.0)	807 (100)
Posterior Teeth				
First premolars	818 (100.0)	0 (0.0)	0 (0.0)	818 (100)
Second premolars	754 (100.0)	0 (0.0)	0 (0.0)	754 (100)
First molars**	557 (87.2)	39 (6.1)	43 (6.7)	639 (100)
Second molars	629 (100.0)	0 (0.0)	0 (0.0)	629 (100)
Total	9346 (94.1)	522 (5.2)	65 (0.7)	9933 (100)

**p-Value < 0.05 of McNemar's test, **p-Value < 0.001 of McNemar's test. ETW: erosive tooth wear; BEWE: Basic Erosive Wear Examination.*

2 = Distinct defect; hard tissue loss <50% of the surface area.

3 = Hard tissue loss ≥50% of the surface area.

The definitions are listed below:

• Cumulative incidence: Percentage of teeth at baseline free from ETW on all examined surfaces, code "0" (BEWE = 0), and that developed ETW over 18 months with at least one surface having code "1", "2" or "3" (BEWE = 0 → BEWE ≥1).

• Progression: Percentage of teeth with ETW (BEWE >0) at baseline that increased their severity during the 18-month period (BEWE = 1 → BEWE ≥2 or BEWE = 2 → BEWE = 3).

All permanent teeth (central incisors, lateral incisors, canines, premolars and molars, maxillary, and mandibular teeth) present during the baseline examination were reexamined 18 months later. The criteria for selecting teeth in the study included being fully erupted, and not having extensive restorations that covered more than two-thirds of a surface. A previously trained examiner performed both evaluations of the ETW (at baseline and 18 months) and was calibrated by an expert; the intra-examiner kappa coefficient was 0.93. The dental examination was conducted in a multipurpose room. The participant sat in a school chair, and a portable artificial light was used to illuminate the oral cavity. The dental surfaces were dried with gauze before being evaluated. The evaluations at both the start of the study and 18 months later were conducted under the same conditions, using Hu-Friedy PCP11 probes, No 5 ARAIN dental mirrors, and gauze pads.

2.3 Statistical analysis

Statistical analysis was conducted using Stata v. 14 (Stata Corp, College Station, TX, USA). Descriptive analysis was performed, and the cumulative incidence rate and progression rate were calculated for each tooth, as explained above. A McNemar's test was used to compare ETW per tooth between baseline and 18-month examination for both incidence and progression. A p-value < 0.05 was considered statistically significant.

3. Results

Overall, 10,776 teeth were examined in this study. The average number of permanent teeth examined for each adolescent was 25.45 ± 3.29 (median = 27).

As shown in Table 1, of the 9933 teeth that were free from ETW at the beginning of the study (BEWE = 0), 587 (5.9%) developed ETW after 18 months, 522 (5.2%) teeth presented

TABLE 2. ETW progression at 18 months according to tooth type.

Tooth Type	Teeth with ETW without progression of severity		Teeth with ETW that progressed in severity.		Total teeth
	BEWE = 1 → BEWE = 1 n (%)	BEWE = 2 → BEWE = 2 n (%)	BEWE = 1 → BEWE= 2 n (%)	BEWE = 2 → BEWE = 3 n (%)	
Maxillary					
Anterior Teeth					
Central incisors*	269 (89.1)	9 (3.0)	23 (7.6)	1 (0.3)	302 (100)
Lateral incisors	118 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	118 (100)
Canines	22 (95.7)	0 (0.0)	1 (4.3)	0 (0.0)	23 (100)
Posterior Teeth					
First premolars	22 (88.0)	2 (8.0)	1 (4.0)	0 (0.0)	25 (100)
Second premolars	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0)
First molars*	25 (86.2)	1 (3.5)	3 (10.3)	0 (0.0)	29 (100)
Second molars	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0)
Mandibular					
Anterior Teeth					
Central incisors	114 (99.1)	0 (0.0)	1 (0.9)	0 (0.0)	115 (100)
Lateral incisors	40 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	40 (100)
Canines	7 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (100)
Posterior Teeth					
First premolars	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100)
Second premolars	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100)
First molars*	38 (21.0)	88 (48.6)	54 (29.8)	1 (0.6)	181 (100)
Second molars	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100)
Total	658 (78.1)	100 (11.9)	83 (9.8)	2 (0.2)	843 (100)

**p-Value < 0.001 of McNemar's test. ETW: erosive tooth wear; BEWE: Basic Erosive Wear Examination.*

initial loss of enamel surface texture (BEWE = 0 → BEWE = 1), and 65 (0.7%) developed hard tissue loss in less than 50% of some of their surfaces (BEWE = 0 → BEWE = 2). Teeth with higher cumulative incidence were the maxillary central incisors (29.1%, 145/498), the mandibular central incisors (17.5%, 128/732), and the mandibular first molars (12.8%, 82/639) ($p < 0.001$). The mandibular first molars developed ETW more severely than other teeth (BEWE = 0 → BEWE = 2) (6.7%, 43/639) ($p < 0.001$).

Table 2 shows that among the 843 teeth with ETW (BEWE >0) at baseline, 10% (n = 85) displayed increased severity of ETW during the follow-up period (9.8%; n = 83) from the initial loss of enamel surface texture to hard tissue loss in less than 50% of some of their surfaces (BEWE = 1 → BEWE = 2) and 0.2% (n = 2) progressed from minor to greater tissue loss on 50% of any of their surfaces (BEWE = 2 → BEWE = 3). The tooth most affected by the progression of ETW was the mandibular first molar: 30.4% (55/181).

4. Discussion

Our results revealed an overall cumulative incidence rate of ETW of 5.9% (587/9933), with 10% (85/843) of cases that progressed during the study period. Notably, the maxillary central incisors exhibited the largest cumulative incidence (29.1%) of initial loss of enamel surface texture (BEWE = 1), while the mandibular first molars were the most affected based on hard tissue loss (BEWE = 2; 6.7%). In contrast, the mandibular first molars also showed the greatest increase in ETW severity (30.4%) during the study period.

In contrast to previous studies that focused on specific tooth groups, *i.e.*, some included incisors and the molars [14] while some excluded premolars [5], we examined all the permanent teeth to avoid underestimating the extent of ETW in our investigated group. However, our relatively short follow-up of 18 months limits the generalizability of our findings, indicating the need for longer longitudinal studies.

The results of this study confirm that the incisors and molars are the most affected teeth [15]. This correlates with the data from other studies that noted highest levels of severity in molars (especially the lower ones) and ETW limited to the enamel in upper anterior teeth [5]. These teeth might be more exposed to risk factors, due to the chronology of the eruption or due to their location within the dental arches. Additionally, the properties of enamel can vary according to the origin of the tooth, the type of tooth and the surfaces of the tooth [4].

Given the high risk of developing ETW in our cohort, identifying risk factors associated with its cumulative incidence and progression, such as dietary, dental hygiene, general health and salivary factors, is crucial for developing effective prevention programs that would help reduce its incidence and progression [16, 17].

The clinical significance of our findings is underscored by the fact that the mandibular first molar, a tooth critical to masticatory function due to its numerous occlusal contacts and exposure to substantial forces, was most affected by ETW [17]. Early detection and prompt management of ETW are thus imperative to preserve the tooth's function and overall oral health. Moreover, our study underscores the need for longer-term longitudinal investigations, particularly in Latin America, to obtain comprehensive insights into the natural history and risk factors associated with ETW progression in high-risk populations.

5. Conclusions

In conclusion, our study has identified the mandibular first molars as the tooth type with a heightened risk of developing more severe forms of ETW relative to other types of teeth, as well as a higher risk of progression following ETW onset. Notably, superficial enamel wear was observed as the predominant form of ETW, with the maxillary central incisors demonstrating a greater incidence of this form of wear. These findings underscore the need for targeted preventive interventions focused on high-risk tooth types and early detection of ETW to minimize its progression and preserve oral health.

AVAILABILITY OF DATA AND MATERIALS

The data can be made available upon reasonable request to the corresponding author.

AUTHOR CONTRIBUTIONS

ÁEGAP—designed the research study; performed the research; wrote the manuscript. ÁEGAP and AGP—analyzed the data. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The Research and Ethics Committee of the Faculty of Higher Studies Iztacala of National Autonomous University of Mexico approved the research protocol (CIE/01/27/1015). The adolescents' parents or guardians were informed and asked to sign the letter of consent; in addition, the adolescents were asked to provide verbal consent if they were willing to participate.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Schlueter N, Amaechi BT, Bartlett D, Buzalaf MAR, Carvalho TS, Ganss C, *et al*. Terminology of erosive tooth wear: consensus report of a workshop organized by the ORCA and the cariology research group of the IADR. Caries Research. 2020; 54: 2–6.

[2] Carvalho TS, Colon P, Ganss C, Huysmans MC, Lussi A, Schlueter N, *et al*. Consensus report of the European federation of conservative dentistry: erosive tooth wear—diagnosis and management. Clinical Oral Investigations. 2015; 19: 1557–1561.

[3] Kitasako Y, Sasaki Y, Takagaki T, Sadr A, Tagami J. Erosive tooth wear among different tooth types and surfaces in Japanese adults 15 to 89 years old. Oral Health & Preventive Dentistry. 2017; 15: 357–364.

[4] Carvalho TS, Lussi A. Susceptibility of enamel to initial erosion in relation to tooth type, tooth surface and enamel depth. Caries Research. 2015; 49: 109–115.

[5] El Aidi H, Bronkhorst EM, Huysmans MC, Truin GJ. Dynamics of tooth erosion in adolescents: a 3-year longitudinal study. Journal of Dentistry. 2010; 38: 131–137.

[6] van Rijkom HM, Truin GJ, Frencken JE, König KG, van't Hof MA, Bronkhorst EM, Roeters FJ. Prevalence, distribution and background variables of smooth-bordered tooth wear in teenagers in the hague, the Netherlands. Caries Research. 2002; 36: 147–154.

[7] Kono RT, Suwa G, Tanijiri T. A three-dimensional analysis of enamel distribution patterns in human permanent first molars. Archives of Oral Biology. 2002; 47: 867–875.

[8] González-Aragón Pineda ÁE, Borges-Yáñez SA, Lussi A, Irigoyen-Camacho ME, Angeles Medina F. Prevalence of erosive tooth wear and associated factors in a group of Mexican adolescents. The Journal of the American Dental Association. 2016; 147: 92–97.

[9] Shellis RP, Addy M. The Interactions between attrition, abrasion and erosion in tooth wear. Monographs in Oral Science. 2014; 25: 32–45.

[10] Schlueter N, Luka B. Erosive tooth wear—a review on global prevalence and on its prevalence in risk groups. British Dental Journal. 2018; 224: 364–370.

[11] Jaeggi T, Lussi A. Prevalence, incidence and distribution of erosion. Monographs in Oral Science. 2014; 25: 55–73.

[12] González-Aragón Pineda ÁE, Borges-Yáñez SA, Lussi A, Aguirre-Hernandez R, García-Pérez Á. Prevalence, incidence, and progression of erosive tooth wear and their respective risk factors among schoolchildren in Mexico City. Pediatric Dentistry. 2020; 42: 300–307.

[13] Bartlett D, Ganss C, Lussi A. Basic erosive wear examination (BEWE): a new scoring system for scientific and clinical needs. Clinical Oral Investigations. 2008; 12: S65–S68.

[14] Brusius CD, Alves LS, Susin C, Maltz M. Dental erosion among South Brazilian adolescents: a 2.5-year longitudinal study. Community Dentistry and Oral Epidemiology. 2018; 46: 17–23.

[15] Aidi HE, Bronkhorst EM, Huysmans MCDNJM, Truin G. Factors associated with the incidence of erosive wear in upper incisors and lower first molars: a multifactorial approach. Journal of Dentistry. 2011; 39: 558–563.

[16] Buzalaf MAR, Magalhães AC, Rios D. Prevention of erosive tooth

wear: targeting nutritional and patient-related risks factors. British Dental Journal. 2018; 224: 371–378.

[17] Hattori Y, Satoh C, Kunieda T, Endoh R, Hisamatsu H, Watanabe M. Bite forces and their resultants during forceful intercuspal clenching in humans. Journal of Biomechanics. 2009; 42: 1533–1538.

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