

## Factors related to the presence of dental erosion and abrasion in Peruvian adults.

### Factores relacionados con la presencia de erosión y abrasión dental en adultos peruanos.

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**Abstract:** **Introduction:** Non-carious lesions are an oral health problem in adults, consequently it is necessary to create mechanisms for their diagnosis and prevention. **Objective:** To determine the frequency of erosion, abrasion and related factors in patients treated at a university dental clinic. **Material and Methods:** A cross-sectional study was conducted in a sample of 153 adults treated at a university clinic in Lima, Peru, in 2018. Personal aspects (age, sex, characteristics of saliva), dietary factors, health condition, oral habits, and tooth brushing were identified. The presence of abrasion was determined according to clinical criteria through direct observation. Erosion was identified using the Basic Erosive Wear index. Generalized linear models with Poisson distribution with robust variances were used. **Results:** The frequency of dental abrasion (70.6%) is higher than erosion (26.1%). The presence of erosion is associated with asthma (PR= 2.11), abrasion is related to age and poor dental hygiene habits (PR= 1.67 and 1.30, respectively). **Conclusion:** The presence of dental abrasion is greater than dental erosion. Age and poor dental habits are factors associated with tooth abrasion. The characteristics of saliva regarding pH and salivary flow were within normal *p*-values.

**Keywords:** saliva; dental abrasion; tooth erosion ; diet; oral hygiene; toothbrushing.

**Resumen:** **Introducción:** Las lesiones no cariosas son un problema de salud bucal en adultos siendo necesario establecer mecanismos para su diagnóstico y prevención. **Objetivo:** Determinar la frecuencia de erosión, abrasión y factores relacionados, en pacientes que acudieron a una clínica odontológica docente universitaria. **Material y Métodos:** Estudio transversal en una muestra de 153 adultos asistentes a una clínica docente asistencial de Lima en el 2018. Se identificaron factores personales (edad, sexo, características de la saliva), factores dietéticos, condición de salud, hábitos orales y cepillado dental. A través de la observación directa se identificó la presencia de abrasión de acuerdo a criterios clínicos, y de erosión utilizando el índice Basic Erosive Wear. Se

utilizaron modelos lineales generalizados con distribución de Poisson con varianzas robustas. **Resultados:** La frecuencia de abrasión dentaria (70,6%) es mayor que la erosión (26,1%). La presencia de erosión está asociada al asma (RP= 2,11), la abrasión está relacionada con la edad y los malos hábitos de la higiene dental (RP= 1,67 y 1,30 respectivamente). **Conclusion:** La presencia de la abrasión

dental es mayor que la erosión dental. La edad y los hábitos dentales inadecuados son factores asociados con la abrasión dentaria. Las características de la saliva en pH y flujo salival estuvieron dentro de los valores normales.

**Palabras Clave:** saliva; abrasión de los dientes; erosión de los dientes; dieta; higiene bucal; cepillado dental.

## INTRODUCTION.

Non-carious dental lesions are the wearing away of tooth surfaces. They have a multifactorial etiology<sup>1</sup> and are classified as: abrasion, erosion and abfraction. These factors rarely act individually, they interact with each other causing damage to the hard tissues of the teeth in children and adults.<sup>2</sup>

Dental erosion occurs due to the chemical action of acids, with no bacterial involvement. These acids can be of intrinsic or extrinsic origin or a combination of both.<sup>3,4</sup> Intrinsic factors may correspond to gastroesophageal reflux, vomiting, bulimia, anorexia, and decreased salivary flow that generates acid saliva and poor salivary buffering capacity.<sup>5-7</sup> Among the extrinsic factors there are the consumption of acidic foods such as soft drinks, fruits (apples, lemons, oranges), natural sugary juices or drinks that can lower the salivary pH, the use of medications, and swimming in pools.<sup>8-10</sup>

Abrasion is the pathological dental destruction caused by frequent contact with foreign abrasive substances,<sup>11</sup> with the surface of the cervical region of the teeth being the most susceptible, due to the micromorphology and the deficient amount of enamel in this area. There are differences in the literature regarding the clinical forms of abrasion. They are referred to as grooved lesions, and wedge-shaped lesions, indentations with a glossy shiny looking surface.<sup>12,13</sup>

Various etiological factors are involved such as diet, biting toothpicks, holding hard objects between teeth, brushing teeth using excessive force and with hard bristle brushes, older age, among others.<sup>14,15</sup>

In the study of hard tissue lesions, it is important to consider the role of saliva as a protector of the oral environment. It presents a wide variability in its behavior, and its pH is affected by various factors such as diet, water intake, and medications.<sup>16-18</sup>

Different authors have reported the increase in non-carious cervical lesions in recent years, regardless of sex, age, place of origin or occupation. They are probably related to diet,<sup>19,20</sup> medications, salivary pH, amount of saliva, brushing technique, and type of toothpaste.<sup>21,22</sup>

Researchers have agreed on the multifactorial nature of these lesions; however, the contribution of the various factors is still unclear.<sup>23</sup> Knowledge of the etiology of these lesions and the risk factors involved will lead to a correct diagnosis and the removal of the causal factor,<sup>24</sup> the prevention and timely treatment of these lesions adopting a comprehensive approach. The present study can serve as a basis for stimulating further research. Only erosion and abrasion were studied, abfraction will be covered in future research. The aim of this study was to determine the frequency of erosion, abrasion and related factors in adults treated at a university dental clinic in Lima, Peru.

## MATERIALS AND METHODS.

### Type of study and sample

A cross-sectional observational study was carried out. The population was made up of adults treated at the university clinic of the School of Dentistry at Universidad Nacional Mayor de San Marcos (UNMSM) during the period April-October, 2018.

People between 18 and 65 years old, in apparent

good health, in sound mental status, and with a minimum of 20 teeth were included. People with psychiatric disorders, pregnant women, patients with immunological diseases (HIV, lupus) or with fixed orthodontic treatment were excluded.

The sample was calculated by estimating a proportion with  $p=13.9\%$ <sup>25</sup> a confidence level of 95%, and precision of 5%, resulting in 153 subjects. Participants were selected in consecutive cases until the established number was reached.

#### Variables and data collection procedure.

The variables were measured at the diagnostic clinic of the School of Dentistry at UNMSM.

Personal aspects such as age, sex, dietary factors, health conditions, oral habits, and tooth brushing were identified through a self-report questionnaire.

Dietary factors were evaluated through questions about the consumption of industrial beverages (packaged juices, energizers, sodas), alcoholic beverages, non-industrial beverages (sugary juices of acidic fruits and excessive consumption of coffee), considering as frequent the intake of more than two times a day.<sup>9</sup>

Health conditions evaluated included vomiting, nausea, regurgitation, and asthma. Oral habits (having at least one) were defined as biting toothpicks or similar objects, opening metal bottle caps, biting or holding hard objects between the teeth.<sup>26</sup> The following factors related to tooth brushing were considered: the type of bristles (thin, medium, and thick), the amount of toothpaste used, little (less than a quarter of the brush), normal (less than half of the brush), and excessive (half or more of the total bristles of the brush), the frequency of brushing per day (one, two, three, or more times), and the self-perception that the participants had about the force applied during brushing (little, regular or enough).

At the end of the questionnaire, the unstimulated saliva sample was collected. The patient was kept in a sitting position, without having eaten food one hour before the procedure. To measure salivary flow rate, the patient was asked to first swallow before the test and then accumulate saliva within the mouth for four minutes, followed by depositing it in a sterile measuring cup. Salivary pH was recorded using universal pH tapes. To identify non-carious erosion and abrasion lesions, the patient's mouth was divided into sextants,

registering only the tooth most affected by each one of them.

The erosion diagnosis was made using the Basic Erosive Wear Index (BEWE),<sup>27</sup> which measures the severity of the condition, where code 0 indicates no loss of tooth surface, code 1 corresponds to initial loss of surface texture, code 2 implies an evident defect that affects less than 50% of the tooth surface, and code 3, the defect is evident with loss of more than 50% of the surface. The presence of at least one tooth with code 1 or more was considered as a case.<sup>27</sup>

A groove or indentation abrasion<sup>12,13,28</sup> was determined as a tooth wear area with a hard and polished surface, without the presence of bacterial plaque or staining, and with flat, smooth, and shiny enamel. Wedge shaped abrasion corresponded to a more advanced stage with clean, glossy, and shiny walls of a yellow-brown color, with indefinite margins, which could be accompanied by gingival recession and/or dentin sensitivity.<sup>13,28</sup> In order to consider as a case, the presence of at least one tooth with an abrasion indicator was taken. The subjects were evaluated by two examiners who had a Kappa agreement index higher than 0.70 in each of the variables studied.

#### Statistical analysis

The statistical package Stata v.15 was used for the statistical analysis. The prevalence ratios (PR) were estimated through generalized linear models using Poisson distribution with robust variances considering a level of significance  $p<0.05$ .

#### Ethical considerations

The present research was approved by the Vice-Rectorate for Research of the UNMSM, with code A18050102. Voluntary acceptance and informed consent were requested from each of the participants. The research protocol and informed consent were followed in accordance with the ethical standards of the Declaration of Helsinki.

## RESULTS.

The sample consisted of 153 participants, with a mean age of  $40.1\pm 17.6$  years. However, as it was widely dispersed, it was categorized as under 35 years ( $n=70$ ), and over or equal to 35 years ( $n=79$ ). The frequency of participants with erosion and abrasion was 26.1% ( $n=40$ ) and 70.6% ( $n=108$ ), respectively.

**Table 1.** Characteristics of tooth erosion in the studied sample (n=153).

		First sextant		Second sextant		Third sextant		Fourth sextant		Fifth sextant		Sixth sextant	
		N	%	N	%	N	%	N	%	N	%	N	%
Degree of erosion	No erosion	126	91.3	131	89.1	137	93.8	138	93.2	138	90.2	135	90.6
	Initial loss	11	8.0	14	9.5	8	5.5	8	5.4	13	8.5	11	7.4
	Loss < 50%	1	0.7	2	1.4	1	0.7	1	0.7	2	1.3	3	2.0
	Loss > 50%	0	--	0	--	0	--	1	0.7	0	--	0	--
Most affected tooth	Incisors	--	--	11	68.8	--	--	--	--	4	26.7	--	--
	Canines	--	--	3	18.8	--	--	--	--	5	33.3	--	--
	Incisors and canines	--	--	2	12.5	--	--	--	--	6	40.0	--	--
	Premolar	2	16.7	--	--	2	22.2	5	50.0	--	--	11	78.6
	Molar	8	66.7	--	--	6	66.7	3	30.0	--	--	3	21.4
	Premolar and molar	2	16.7	--	--	1	11.1	2	20.0	--	--	0	--
Most affected surface	Vestibular	5	41.7	14	87.5	4	44.4	7	77.8	14	93.3	10	71.4
	Lingual	6	50.0	2	12.5	3	33.3	2	22.2	1	6.7	3	21.4
	Vestibular and lingual	1	8.3	0	--	2	22.2	0	--	0	--	1	7.1

**Table 2.** Characteristics of tooth abrasion in the studied sample (n=153).

		First sextant		Second sextant		Third sextant		Fourth sextant		Fifth sextant		Sixth sextant	
		N	%	N	%	N	%	N	%	N	%	N	%
Degree of abrasion	No abrasion	90	65.2	119	81.0	93	63.7	84	56.8	102	66.7	76	51.0
	Groove abrasion	37	26.8	22	15.0	43	29.5	50	33.8	42	27.5	60	40.3
	Wedge abrasion	11	8.0	6	4.1	10	6.8	14	9.5	9	5.9	13	8.7
Most affected tooth	Incisors	--	--	3	10.7	--	--	--	--	11	21.6	--	--
	Canines	--	--	20	71.4	--	--	--	--	20	39.2	--	--
	Incisors and canines	--	--	5	17.9	--	--	--	--	20	39.2	--	--
	Premolar	12	25.0	--	--	22	41.5	34	53.1	--	--	42	57.5
	Molar	29	60.4	--	--	20	37.7	19	29.7	--	--	19	26.0
	Premolar and molar	7	14.6	--	--	11	20.8	11	17.2	--	--	12	16.4
Most affected surface	Vestibular	42	87.5	21	75.0	40	76.9	43	67.2	30	58.8	49	67.1
	Lingual	2	4.2	4	14.3	9	17.3	11	17.2	13	25.5	13	17.8
	Vestibular and lingual	4	8.3	3	10.7	3	5.8	10	15.6	8	15.7	11	15.1

**Table 3.** Frequency of the factors studied in the sample.

Factors		N (%)	
Personal demographics	Gender	Male	66 (43.1)
		Female	87 (56.9)
	Age	< 35 years	70 (47.0)
		>= 35 years	79 (53.0)
		Saliva pH *	6.7 +/- 0.5
		Saliva flow rate (ml/4min) *	2.8 +/- 1.9
Diet Frequently consumes	Mass-produced (industrial) beverages	No	111 (72.6)
		Yes	42 (27.5)
	Non-industrial beverages	No	109 (71.2)
		Yes	44 (28.8)
	Coffee-like beverages	No	89 (58.2)
		Yes	64 (41.8)
	Alcoholic drinks	No	147 (96.7)
		Yes	5 (3.3)
Health factors	Nausea and vomiting	No	136 (88.9)
		Yes	17 (11.1)
	Regurgitation (reflux)	No	124 (81.1)
		Yes	29 (19.0)
	Asthma	No	146 (95.4)
		Yes	7 (4.6)
Oral Habits	Without	51 (33.6)	
	With	101 (66.5)	
Toothbrushing	Type of bristles	Soft	27 (17.7)
		Medium	88 (57.5)
		Hard	38 (24.8)
Amount of toothpaste	Little	33 (21.9)	
	Regular	84 (55.6)	
	Plenty	34 (22.5)	
Toothbrushing frequency	Once a day	21 (13.9)	
	Twice a day	76 (50.3)	
	Thrice a day	54 (35.8)	
Force applied while brushing	Little	21 (13.7)	
	Regular	99 (64.7)	
	Plenty	33 (21.6)	

\*: Mean +/- Standard Deviation

**Table 4.** Factors associated with the presence of dental erosion in Peruvian adults.

		Bivariate		Multivariate*	
		OR (CI 95%)	p-value	OR (CI 95%)	p-value
Personal demographics					
Gender	Male	Reference		Reference	
	Female	1.43 (0.81 - 2.51)	0.221	1.44 (0.74 - 2.78)	0.283
Age	< 35 years	Reference		Reference	
	>= 35 years	1.00 (0.57 - 1.78)	0.992	0.90 (0.50 - 1.61)	0.719
	Saliva pH	1.27 (0.79 - 2.02)	0.323	1.18 (0.72 - 1.91)	0.516
	Saliva flow rate	1.01 (0.89 - 1.15)	0.897	0.99 (0.87 - 1.13)	0.900
Diet					
Frequently consumes	Industrial beverages	0.76 (0.40 - 1.46)	0.411	0.57 (0.27 - 1.21)	0.141
	Non-industrial beverages	0.74 (0.38 - 1.42)	0.359	0.62 (0.30 - 1.29)	0.200
	Coffee-like beverages	1.04 (0.61 - 1.79)	0.875	0.98 (0.51 - 1.86)	0.945
	Alcoholic drinks	1.54 (0.51 - 4.67)	0.449	1.72 (0.63 - 4.66)	0.288
Health factors	Nausea and vomiting	0.64 (0.22 - 1.87)	0.418	0.56 (0.21 - 1.46)	0.236
	Regurgitation (reflux)	1.61 (0.92 - 2.83)	0.100	1.18 (0.58 - 2.40)	0.657
	Asthma	2.96 (1.71 - 5.14)	<0.001	3.11 (1.44 - 6.74)	0.004

\*: Adjusted for all variables in the Table. **OR:** Odds Ratio. **CI:** Confidence Interval.

**Table 5.** Factors associated with the presence of dental abrasion in Peruvian adults.

		Bivariate		Multivariate	
		OR (CI 95%)	p-value	OR (CI 95%)	p-value
Personal demographics					
Gender	Male	Reference		Reference	
	Female	1.07 (0.87 - 1.32)	0.501	0.95 (0.78 - 1.16)	0.589
Age	< 35 years	Reference		Reference	
	>= 35 years	1.61 (1.27 - 2.03)	<0.001	1.67 (1.30 - 2.14)	<0.001
	Saliva pH	0.96 (0.81 - 1.14)	0.657	1.04 (0.91 - 1.18)	0.565
	Saliva flow rate (ml/4min)	1.01 (0.96 - 1.05)	0.845	1.00 (0.95 - 1.05)	0.982
Oral Habits	Has a habit with their teeth	1.39 (1.07 - 1.80)	0.013	1.30 (1.01 - 1.67)	0.047
Toothbrushing					
Type of bristles	Soft	Reference		Reference	
	Medium	1.13 (0.82 - 1.56)	0.448	1.16 (0.84 - 1.61)	0.359
	Hard	1.21 (0.86 - 1.70)	0.268	1.29 (0.94 - 1.78)	0.116
Amount of toothpaste	Little	Reference		Reference	
	Regular	1.15 (0.86 - 1.54)	0.329	1.15 (0.90 - 1.47)	0.274
	Plenty	1.16 (0.83 - 1.60)	0.389	1.01 (0.73 - 1.39)	0.968
Toothbrushing frequency	once a day	Reference		Reference	
	twice a day	1.12 (0.80 - 1.56)	0.502	1.14 (0.90 - 1.44)	0.269
	thrice a day	1.03 (0.72 - 1.46)	0.879	1.30 (1.00 - 1.70)	0.054
Force applied while brushing	Little	Reference		Reference	
	Regular	0.86 (0.65 - 1.14)	0.296	0.95 (0.73 - 1.23)	0.681
	Plenty	1.11 (0.83 - 1.47)	0.479	1.03 (0.77 - 1.37)	0.859

**OR:** Odds Ratio. **CI:** Confidence Interval.

Among those who presented erosion, only one case had lost more than 50% of tooth structure, the others had an initial loss on the vestibular surface. Wedge shaped abrasion on the vestibular surface prevailed in all sextants. In anterior teeth, abrasion was more frequent in canines and erosion in maxillary incisors. In posterior teeth, abrasion was more frequent in premolars. Erosion was more frequent in upper molars and lower premolars. (Table 1 and Table 2).

Regarding dietary factors, frequent consumption of coffee (41.8%) and non-industrial beverages (28.8%) was more prevalent; 19% presented regurgitation, and 4.6% asthma. The presence of poor oral hygiene habits accounted for 66.5%. Regarding tooth brushing, the use of a brush with medium bristles (57.5%), a normal amount of paste (55.6%), brushing twice a day (50.3%), and a regular level of strength (64.7%) were more prevalent. (Table 3)

A statistically significant relationship between dental erosion and the presence of asthma was only observed at both bivariate and multivariate levels (PR= 2.96 and 2.11, respectively). (Table 4).

Dental abrasion was associated with age, being greater in people over 35 years of age, who had at least one habit associated with their teeth. (Table 5)

## DISCUSSION.

The present study shows that abrasion is more common than erosion. Posterior teeth are the most affected by both pathologies.

The surface most affected by abrasion was the vestibular area, similar to the findings reported by Rodríguez *et al.*,<sup>29</sup> The lingual surface was the least affected. This pathological dental wear may be caused by the frequent use of toothpaste containing abrasive substances and performing tooth brushing too frequently and using excessive force.<sup>11</sup>

The presence of abrasion is related to an incorrect dental habit, and the older age of the participants, coinciding with data reported by other authors and the etiology of these lesions.<sup>14,30</sup> Gonçalves *et al.*,<sup>14</sup> and Li *et al.*,<sup>20</sup> found that the lower premolar teeth were the most affected compared to the upper ones, both due to erosion and abrasion, findings that agree with the present study.

This could be attributed to the protective role of

serous saliva and its buffering quality on the lingual surfaces of the mandibular teeth. This assertion is supported by Carbone *et al.*<sup>17</sup>

Rodríguez *et al.*,<sup>29</sup> reported mild erosion, as well as wedge shaped erosions that could be considered less severe, similar to what was found in the present study. Additionally, in agreement with the present study, Gonçalves *et al.*,<sup>14</sup> found no association of sex with the presence of these lesions. However, Picos *et al.*<sup>6</sup> identified a greater presence of these lesions in females. Skalsky *et al.*,<sup>19</sup> reported the presence of lesions regardless of age and sex.

Gastroesophageal reflux and the consumption of industrial beverages have been considered as risk factors for the presence of erosion by various authors.<sup>2,9,11</sup> The results did not show a statistically significant association, which could be explained by the buffering effect of saliva. In the present study, pH was  $6.73 \pm 0.54$ , which facilitated the effect of the buffering and remineralizing effect of saliva.

The mouth is frequently exposed to foods that have a much lower pH than that of saliva and that can cause a chemical dissolution of the enamel (erosion). Under such conditions, buffer mechanisms are also put into action to normalize salivary pH as soon as possible. There are specific buffer mechanisms, and others such as bicarbonate, phosphate, and some protein systems. Phosphate buffer plays a primary role in conditions of low salivary flow. Above a pH of 6, saliva is supersaturated with phosphate with respect to hydroxyapatite (HA). When the pH is reduced below the critical pH level (5.5), HA begins to dissolve, and the released phosphates attempt to restore the lost equilibrium, which will ultimately depend on the phosphate and calcium ion content of the surrounding medium.<sup>31</sup>

The presence of vomiting did not show a significant relationship, but it should be considered that only 17 of the 153 participants had this condition, which may limit the interpretation of these results.

Different authors<sup>5-7,32</sup> have highlighted the relationship between asthma and dental erosion. In our study it was noted that only 4.6% of the patients had asthma. A relationship was observed with the presence of erosion that may be attributed to the changes that occur in saliva, not only to a decrease in the amount

of it, but also to an increase in the concentration of myeloperoxidase, which is usually related to the changes in the buffer capacity that plays a role in the appearance of these lesions.<sup>32</sup>

The extrinsic etiological factors of non-carious lesions, such as dietary habits with excess intake of carbonated drinks or acidic foods,<sup>6-7</sup> the use of a hard bristle toothbrush with excessive toothpaste and with the application of too great a force while brushing, can be countered by the protective role of the saliva, which in the present study was within normal values. This would explain the results obtained.

Dietary factors, oral habits, oral hygiene, and health condition were evaluated using a self-report questionnaire, which could be a limitation preventing a more objective measurement of these variables. However, due to the nature and design of the present research, there was no other type of measurement that could offer more reliability. Dietary habits were evaluated based on the frequency of consumption without considering its concentration and quantity, which could also be a limitation, since there may be frequent consumption, but with a low concentration and quantity. Despite this, it is considered that the erosive capacity of beverages plus the frequency of consumption per day are a risk factor,<sup>9</sup> besides concentration.

## CONCLUSION.

The presence of dental abrasion is greater than dental erosion. Age and poor dental habits are factors associated with tooth abrasion. The characteristics of saliva in pH and salivary flow were within normal values.

**Conflict of interests:** The authors declare that they have no conflict of interest.

**Ethics approval:** Approved by the Vice-Rectorate for Research of the UNMSM, code A18050102. Informed consent was provided by all participants.

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**Authors' contributions:** Evaristo-Chiyong T: Conception and design of the study, data collection, analysis of results, writing and editing of the manuscript, final reading. Delgadillo-Avila J: Conception and design of the study, data collection, writing and editing of the manuscript, final reading. Chacón-Uscamaita P: Study design, data collection, analysis of results, bibliographic review, writing and editing of the manuscript, final reading. Gómez-Meza D: Study design, data collection, bibliographic review, writing of the manuscript, final reading. Cáceres-Gutiérrez L: Study design, data collection, bibliographic review, writing of the manuscript, final reading. Campodónico-Reátegui R: Conception and design of the study, data collection, writing of the manuscript, final reading. Maita-Véliz L: Study design, manuscript writing, final reading.

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