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Erosion of tooth enamel surfaces among battery chargers and automobile mechanics in Ibadan: a comparative study

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Summary

A cross sectional comparative survey was conducted among battery chargers and automobile mechanics in Ibadan to determine the effect of exposure of acid in form of solution or fumes on tooth enamel wear. One hundred and five subjects were recruited and examined for erosion. This number comprised 67 automechanics and apprentices and 38 battery chargers and their apprentices. Other groups of automobile workers sharing the workshops were excluded from the study. All respondents aged between 11 and 68 years of age. Verbal informed consent was taken from all the subjects. One thousand and one hundred teeth were examined using the upper and lower central sextants. One hundred and sixty teeth were found to be missing. The teeth examined comprised 712 teeth of automechanics (88.55%) and 388 teeth of battery chargers (85.08%). Out of the 712 teeth of automechanics, only 23 teeth (3.2%) showed evidence of tooth wear whereas in the battery chargers group, 159 teeth out of 388 teeth (41%) had tooth wear. ($P < 0.05$). The battery charger group also showed a higher percentage of missing teeth, (14.9%) as against 11.44% of the automechanic group ($P > 0.05$).

This study has shown that battery chargers are subjected to occupational hazard of exposure to highly erosive acids and fumes. Prevention through oral health education targeted at this group of subjects and early diagnosis are very important.

Keywords: *Toothwear, erosion, acid, battery-charging, health-education*

Résumé

Une cross section d'étude comparative avait été entreprise parmi les chargeurs de batterie et les mécaniciens automobile à Ibadan pour déterminer l'effet d'acide sous forme de solution ou de fumé sur l'email dentaire.

Cent cinq sujets avaient été recrutés et examinés pour l'érosion dentaire. Parmi les quels, 67 étaient des mécaniciens automobile et apprentis et 38 étaient des chargeurs de batterie et apprentis. Les autres groupes de travailleurs dans le garage étaient exclus de cette étude. La tranche d'âge des participants variant entre 11 et 68 ans.

Un consentement verbal était reçu chez les sujets. Mille cent dents étaient examinées avec les sextants absents. Les dents examinées étaient 712 chez les mécaniciens (88,55%) et 388 dents chez les chargeurs de batterie (85,08%). Parmi les

712 des mécaniciens rien avec 23 (3,2%) montraient une évidence de dents usées.

Le groupe de chargeurs de batterie montrait aussi un taux élevé de dents perdues, 14,3% contre 11,44% dans le groupe de mécanicien ($P > 0,05$).

Cette étude a montré que les chargeurs de batterie sont exposés au danger de travail due au contact avec des acides ou fumés qui sont très. La prévention par l'éducation sur la santé dentaire et le diagnostic a temps chez ses groupes d'individus sont très important.

Introduction

Erosion is one of the triad of attrition, abrasion and erosion which are all causes of tooth wear in both children and adults [1]. Attrition is tooth wear from tooth-to-tooth contact whereas abrasion is caused by an object-to-object contact such as toothbrush. Erosion is the irreversible loss of dental hard tissue due to a chemical process and not directly associated with mechanical or traumatic factors or with dental caries [2,3].

Gastro-oesophageal reflex, anorexia and bulimia nervosa, chronic alcoholism and gastric disturbances are all causes of palatal dental erosion [2,4]. The habitual sucking of citrus fruits and acidic soft drinks like frozen fruit juices and ice lollies or the chewing of hydrochloric acid tablets as well as the consumption of the so called low calorie beverages are all common causes of dental erosion of the labial surfaces found in the literature [2,4]. Erosion of the labial surfaces of the teeth is also regarded as an occupational disease especially in people working in battery factories, consequent to exposure to acid fumes [1,2,4]. The site of the erosion may be more closely determined by the nature of the causative factor [5].

The features of erosion include concave loss of tooth surface with smooth, shiny margins, unlike the roughened areas normally associated with decalcifying surfaces in caries [6,7].

In the developed countries, most common aetiological factors of erosion is consumption of acidic beverages like pure fruit juices, frozen fruit juices and ice lollies. The consumption of these acidic beverages is presumably low in Nigeria mainly because of socio-economic reasons. In the review of literature, no study has been carried out among battery chargers who are believed to be exposed to acid solutions and fumes. The prevalence of tooth erosion was therefore assessed among battery chargers, using the automechanics as control, to determine the effect of acid and its fumes on the teeth.

Materials and methods

The Nigerian Motor Mechanics and Technicians Association is

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a trade union registered in Nigeria. It comprises of motor mechanics and allied trades operating in zones within Ibadan metropolis, each zone with its own headquarters and union officials.

Adeoyo Unit 1 Zone was the focus of this study. This zone comprises Dandaru (Parliament Road junction), Bere, Oje and Agodi Gate area. The secretariat of the zonal headquarters was contacted to inform the union's leaders about the study and to obtain their consent. The information about the study was disseminated to the members at their meeting and a list of workshops within the zone was obtained from the secretariat. Not all the mechanic workshops visited had battery chargers. Due to limited resources, 67 automechanics and their apprentices and 38 battery chargers and their apprentices were examined. The reason for the study and the procedures were explained to these workers and verbal consents were taken. A structured questionnaire (Appendix 1) was administered followed by a dental examination of the labial and palatal/lingual surfaces of the upper and lower central sextants.

3 2 1	1 2 3
3 2 1	1 2 3

These index teeth were used because the anterior teeth are presumed to be the ones most exposed to the fumes and the solutions of the acid by the act of tasting on the tips of the tongues and by sucking with pipettes as claimed by the respondents, since according to Jarvinen et al [5], the site of erosion is related to the nature of the causative factor.

Adequate sterile examination instruments and conform latex gloves were used for the examinations. The questionnaires sought information on age, type of allied trade, alcohol intake and its frequency, type of tooth-brushing, technique of tooth-brushing, intake of fruit juices and carbonated drinks, mode of contact of the acid (for the battery chargers). Teeth missing and teeth affected with erosion were charted in the questionnaires. The questionnaires were coded and analyzed.

Results

One hundred and five respondents were recruited into this study, comprising 67 auto-mechanics and apprentices and 38 battery charges and their apprentices. All respondents were males aged between 11 and 68 years of age. The age distribution is shown in Table 1.

Table 1: Age distribution of the respondents

Age range (yrs)	Automechanic No	%	Battery chargers No	%
11-20	23	34.3	12	31.6
21-30	19	28.4	13	34.2
31-40	13	19.4	7	18.3
41-50	8	11.9	3	7.9
51-60	2	3.0	2	5.4
60 and above	2	3.0	1	2.6
Total	67	100	38	100

$P > 0.05$

$\chi^2 = 0.40$
 $P = 0.94$

One thousand one hundred teeth (1,100) were examined instead of the expected number of 1,260. One hundred and sixty teeth were found to be missing (12.7%). The examined teeth comprised 712 teeth for the automechanics (88.55%) and 388 (85.1%) for the battery chargers $p > 0.05$ - Table 2.

Table 2: Number of teeth examined in the two groups

Group	No. of Teeth expected	No. of Teeth examined %	No. of missing teeth	% Edentulousness
Automechanic	804	712 (88.6)	92	11.4
Battery Chargers	456	388 (85.1)	68	14.9
Total	1,260	1,100 (87.3)	160	12.7*

$P > 0.05$

$\chi^2 = 2.16$
 $P = 0.141$

*12.7% is the percentage of edentulousness in the total number of teeth examined and not, the addition of percentages of edentulousness in automechanics and battery chargers.

Table 3: Number of teeth affected by erosion

	No. of teeth examined	No. of teeth with erosion	% of teeth with erosion (%)
Auto-mechanics	712	23	3.2
Battery Chargers	388	159	41.0
Total	1,100	182	

$P < 0.05$

$\chi^2 = 171.09$
 $P = 0.0001$

Table 3 shows the number of teeth affected by erosion. Only 23 (3.2%) of the total number of teeth examined for automechanics were affected while 159 (41%) of the teeth of the battery chargers were affected ($P < 0.05$). Table 4 shows the techniques of tooth-brushing and the type of tooth-cleaning devices used by the two groups of respondents. The percentages of the number of respondents using the different techniques of tooth-brushing and different types of tooth cleaning devices were similar in both groups. All the respondents gave a negative response to intake of fruit juices and acid beverages.

Discussion

The triad of attrition, abrasion and erosion has been known for many years, but erosion seems to be the least common. In the developed World, however, with the current substantial decline in dental caries in adults, dental erosion is now being recognised as a major cause of tooth damage [8,9].

Although toothwear has usually been divided into attrition, abrasion and erosion, as a matter of fact, it is a combination of these but often with differing proportional effects [9]. The site of the wear can also be diagnostic with more pronounced wear (shinning surface) on the labial or lingual

Table 4

	Technique of tooth brushing (%)			Total	Types of tooth cleaning device (%)			Total
	Vertical %	Horizontal %	Both inter-changeably %		Toothbrush %	Chewing stick (%)	Both inter-changeably %	
Auto								
Mechanics	21 (31.3)	38 (56.7)	8 (11.9)	67 (100)	8 (11.9)	49 (73.1)	10 (14.9)	67 (100)
Battery								
Chargers	12 (31.6)	22 (57.9)	4 (10.5)	38 (100)	4 (10.5)	28 (73.7)	6 (15.8)	38 (100)
	$P > 0.05$		$\chi^2 = 0.05$ $P = 0.98$		$P > 0.05$		$\chi^2 = 0.05$ $P = 0.97$	

surfaces, whereas attrition occurs more on incisal or occlusal surfaces as a result of tooth-to-tooth contact. Abrasion, on the other hand, is more likely to manifest on buccal and labial cervical areas of teeth [9]. The process of erosion may go on alongside abrasion and or attrition and it is often practically difficult to separate the effects as well as the causative factor [9].

Battery charging is a type of roadside vocational enterprise peculiar to developing countries like Nigeria. It involves changing the 'flat' acid content of automobile batteries with freshly prepared one, and then electrically charging them with currents. This, as claimed by the battery chargers in this study, prolongs the shelf life of 'flat' batteries that should otherwise be thrown away. This group of workers are often exposed to acid solutions and fumes from the batteries by mixing the concentrated acid with diluents, by tasting on the tip of the tongue and by sucking with the use of pipettes.

The erosion observed in the respondents was mainly on the labial surfaces of the teeth examined, which confirmed the source of acid irritation to have been external and due to acid solution and fumes [10]. This is different from the lingual and palatal surface erosion observed in patients suffering from chronic regurgitation of acid gastric contents [1,2,4].

Table 1 shows the age distribution of the respondents. Highest percentage fell in the 11-30 years age range for the two groups. This is because, apprentices were included in the study and the majority of these groups of workers are young adults. Table 2 shows the degree of edentulousness in the two groups. It shows a slightly higher percentage in the battery chargers, possibly as a result of extraction following gross tooth wear. Table 3 shows that only 3.2% of the teeth of the automechanics was affected by erosion while 41% of those of the battery chargers were affected. This is quite significant ($P < 0.05$). The mechanism of tooth wear in erosion is similar to that of caries. Erosion involves a more rapid demineralisation by acid, on plaque free surfaces as against caries in which demineralisation is slower because of the dynamic equilibrium between phases of demineralisation and remineralisation [9], and occurs on plaque covered sites. It is noteworthy to mention that not all the teeth presumably exposed to acid fumes and solutions were affected by erosion. This is because not all subjects exposed to acid exhibit tooth erosion [10]. There must therefore be some inherent defects of the enamel and dentine which render some people more susceptible to tooth wear than others. The response of the two groups to alcohol intake, acid beverages and fruits showed no statistical significant difference. Majority of them

claimed to take alcohol occasionally. Likewise, the percentage of the techniques of tooth-brushing and types of tooth cleaning devices by both groups are very similar (Table 4). Therefore these other forms of aetiological factors of toothwear seemed to play no major role in the difference observed in the prevalence of tooth erosion in the two groups in this study. It is thus shown from this study that exposure to acid solutions and fumes by the battery chargers may cause tooth erosion (Fig. 1). Dentists must be aware that highly erosive acids are being handled by this group of workers. Prevention through oral health education targeted at this group of subjects and early diagnosis are very important.

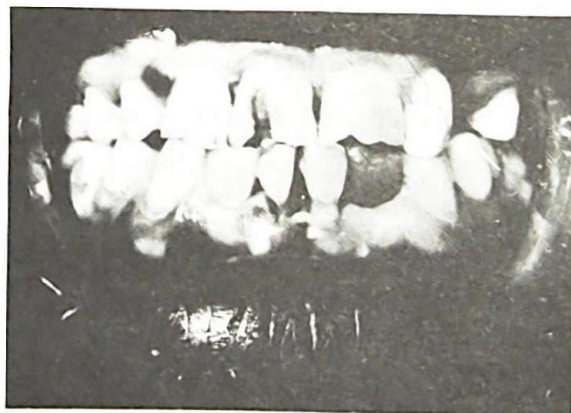


Fig. 1: Intraoral photograph of a battery charger showing severe erosion of labial and incisal surfaces of the anterior teeth.

Appendix I

Erosion of Tooth Enamel Surfaces

- (1) Name..... Serial No.....
 Age..... Occupation.....
 (Type of allied trade)
 Sex.....
- (2) What category of work do you belong to
 Master
 Apprentice
- (3) Do you take alcohol Yes No
 If yes, How often
 Occasionally Moderate Severe
- (4) Type of Tooth Brushing
 Chewing Stick
 Toothbrush/Toothpaste
 Cotton wool/Foam
 Chewing stick and Toothbrush
 Others
- (5) Technique of Toothbrushing
 Horizontal Vertical (Roll)
- (6) Do you take fruit juices? Yes No
 (e.g. Just juice, Five Alive Sugar Lollies etc)
 If yes, How often
 Occasionally Moderate Severe
- (7) Do you take Carbonated Drinks? Yes No
 e.g. Coke, Sprite, 7-Up etc
 If yes, How often
 Occasionally Moderate Severe
- (8) [For the Battery Chargers only]
 What is the mode of contact of the acid?
 - Exposure to fumes while mixing
 - Tasting of the acid
 - Sucking of the acid through a pipette
 - Others

DENTAL EXAMINATION

- (9) Teeth Present/Teeth missing
 Upper & Lower Central Sextant)

3	2	1	1	2	3
- (10) Teeth Affected with erosion
 (Upper & Lower Central Sextant)

3	2	1	1	2	3

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