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Original Article

Assessment of dental erosion status among battery factory workers in Mandideep, India

Abstract:

Introduction: Occupational factors may be considered responsible for dental erosion among battery factory workers since they were exposed to sulfuric acid fumes created by the harmful processes known as forming and charging. **Methods**: A sample consisted of 138 battery factory workers (85 acid exposed workers and 53 controls) drawn as a convenient sample from 3 different battery factories of Mandideep, India. A pre-tested proforma, completed by interview, was used to collect information on medical and dental histories. Clinical examination of battery factory workers was done to assess dental erosion using tooth wear index given by Smith and Knight. Data related to dental erosion score of acid worker and control group was compared using Mann Whitney U test. Categorical data was analyzed by chi-square test. **Results:** The battery factory workers showed a propensity for higher erosion scores. The result of present survey showed a total of 74 percent of acid exposed workers had erosion compared to 37.7 percent of the controls. Statistical difference in erosion scores between acid exposed group and control group was found significant (p value<0.05). **Conclusion**: Present study revealed that long term exposure of sulphuric acid mists in the working environment significantly increased the chances of dental erosion among exposed workers. There is urgent need for surveillance and routine monitoring of acid fumes at workplace coupled with education about occupational hazards, positive worksite oral health promotion and training for standardized behaviors such as use of personal protective equipment to decrease occupational erosion.

Key Words: Dental Erosion; Battery factory; Occupational; India .

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Introduction

The Tooth wear or tooth surface loss is a common term used to describe the surface loss of dental hard tissues from causes other than developmental ones, dental caries, and trauma. The wear of teeth is irreversible and increasing with age. With healthy ageing more people keeping their natural dentition till old age, the problems associated with tooth wear are likely to place greater burden upon dental professionals. With multifactorial etiology, tooth wear varies in severity, location, and clinical representation. Tooth wear has conventionally been subdivided into 3 categories: attrition, abrasion, and erosion, usually based on etiologic factors and clinical features. Among these dental erosion is most common and causes great damage to dental hard tissues [1,2,3,4].

Dental erosion is defined as the loss of tooth structure usually caused by acids without the involvement of bacteria [4]. Dental erosion is basically a multifactorial condition caused by extrinsic (acidic food, drugs, occupational exposure) or intrinsic (acid regurgitation) factors or combination of both [4,5].

Majority of people employed in various industries are exposed to perilous environment. This deteriorates the general and oral health of people, working in industries for long hours. Every occupation is associated with one or other ill effects on health [6]. Occupational dental erosion is caused by exposure to different types of acidic contaminants in the workplace such as chemicals, petrochemicals, metals and semiconductors [7].

Industrial environmental factors may be considered responsible for dental erosion among battery workers since they were exposed to sulfuric acid fumes created by the harmful processes known as forming and charging. Increased concentration of acid

mists, prolonged working hours and unprotected acid handling and limited safety measures further compromise battery workers oral health in such conditions [4,6,8].

There are many studies conducted among battery factory workers in western countries to assess prevalence and severity of dental erosion [9,10,11,12]. Active search for literature on dental erosion status among battery factory workers in India through MEDLINE not even retrieved a single study. Author has also searched for published material and only a single study done in Ghaziabad was found to be documented [13]. So, little information is available with respect to dental erosion status among battery workers in India. The present study is done in Mandideep (Bhopal) to obtain baseline data on prevalence and severity of dental erosion among battery factory workers. This data can be useful in future for planning preventive, curative and promotive oral health programme for battery factory workers.

Methods

The survey was conducted from November 2010 to March 2011 in Mandideep (District-Raisen), Madhya Pradesh, India. A convenient sampling method was used for the survey and the workers from three battery factories of mandideep formed study sample. Workers of Britex , EM-ES and Goel battery factories participated in the study. Ethical clearance for the study was obtained from the Ethics Committee, People's College of Dental Sciences and Research centre, Bhopal. Permission from the authority of respective battery factory was taken prior to the survey. Written consent was also taken from the workers who were literate and for illiterate workers verbal consent was taken.

To ensure uniform interpretation, understanding and application by the examiner, of the codes and criteria for dental erosion to be observed and recorded in the proforma used, the examiner was calibrated and trained by an experienced investigator. The recorder in the study was also trained in the department of public health dentistry.

A pre-tested proforma, completed by interview, was used to collect information on demographic details, dietary habits, oral hygiene practices, gastric complaints. Details on acidic food and beverage consumption and tooth sensitivity were also recorded. Each clinical examination was carried out under good artificial light and CPI probe. All workers who consented to participate were examined for dental erosion. Dental erosion was assessed according to recommended diagnostic criteria [4,14,15].

0=No loss of enamel surface characteristics

1= loss of enamel surface characteristics

2=Facetting or concavity within the enamel

3=Loss of enamel exposing dentine for less than one third of the surface

4= Loss of enamel exposing dentine for more than one third of the surface or pulp visible through dentine

Only buccal/labial and lingual/palatal surfaces of the teeth were recorded. The incisal and occlusal surfaces were excluded from the examination because factor other than the erosion may be responsible for wear process. A total of 138 workers examined and basically divided in to two groups. One group belonged to acid exposed workers of forming and charging departments consisting of 85 workers and other control group of 53 participants consisted of all workers in other acid mist free departments. All male workers were included in the study because only 4 female workers were employed in acid free departments.

Results

The Mean age of battery workers was 41.3 years (SD=10.6 and range 22-57) and of the control 36.8 years (SD=8.6 and range 22-52). The mean employment period for the battery workers was 12.3 years (SD=5.4 and range 2-24) and of the control 10.1 years (SD=4.6 and range 2-21. Almost 34% (29) of the workers had been employed for 10 years or less and 66% (56) for 11 year or more in acid worker group.

Table I Demographic characteristics of battery factory workers

Characteristic	Acid exposed group N(%)	Control group N(%)
1.Total population	85(61.6%)	53(38.4%)
2.Duration of employment		
10 years or less	29(34%)	25(47.2%)
11 years or More	56(66%)	28(52.8%)
3.Dental Sensitivity		
Yes	49(57.6%)	6(11.3%)
No	36(42.4%)	47(88.7)
4.Soft drink, fruit juice and acidic fruits consumption		
Once or twice in a week	76(89.4%)	39(73.5%)
Thrice or more in a week	9(10.6%)	14(26.5%)
5.Gastric problem		
Yes	22(25.8%)	14(26.4%)
No	63(74.1%)	39(73.5%)

Tooth sensitivity was reported by 57.6% (49) battery workers and in control group only 11.3%(6) reported sensitivity. Occasional consumption (once or twice in a week) of Soft drink, fruit juice and acidic fruits was reported by 89% of acid workers and 73.5% of control group workers. So, these dietary habits were found uncommon among both acid workers and control group workers. Oral hygiene practice was reported poor among acid workers as only 33% of them were using tooth brush with tooth paste for teeth cleaning. In control group, teeth cleaning habit with tooth brush and paste was reported by 62% workers. Only 8% of study participants visited dentist within last one year.

Table II Dental Erosion scores in acid exposed group and control group

Score	Acid exposed group N(%)	Control group N(%)
4	13(15.3%)	0(0%)
3	25(29.4%)	6(11.3%)
2	17(20.0%)	5(9.4%)
1	8(9.4%)	9(17.0%)
0	22(25.9%)	33(62.3%)
Total	85(100.0%)	53(100.0%)

The battery factory workers showed a propensity for higher erosion scores. The result of present survey showed a total of 74 percent(63) of acid workers had erosion compared to 37.7 percent (20) of the controls. Forty two(49.4%) of acid workers had grade 2 and 3 erosions and 15.3 percent had grade 4 erosion. Statistical difference in erosion scores between acid exposed group and control group was found highly significant (p value<0.05).

A total of 2304 teeth in acid exposed group and 1415 teeth in control group were examined, corresponding to 4608 and 2830 surfaces in both the groups' respectively. In the total sample, erosion was most commonly found in the maxillary anterior teeth. Labial surfaces were more affected than the palatal surfaces. Dental erosion was more commonly detected in the central incisors than lateral incisiors and canines. Dental erosion was less commonly detected in posterior teeth and mandibular anterior teeth. In these teeth the pattern of erosion was found similar to that caused by gastric problem which mostly affect lingual surfaces of all teeth. Among acid exposed group statistically significant difference (pvalue<0.05) found between duration of employment (10 years or less and 11 years or more) and dental erosion score.

The acid exposed workers claimed the use of personal protective equipment as follows: protective gloves (83%), dress (28%), and shoes (18%); respiratory mask(8%), ear protector (0%), eye protector (0%), and face guard(7%).

Table III Erosion scores according to duration of employment in acid exposed group

Erosion score	Duration of employment	
	10 years or less	11 years or more
4	0(0.0%)	13(23.2%)
3	2(6.9%)	23(41.1%)
2	5(17.2%)	12(21.4%)
1	6(20.7%)	2(3.6%)
0	16(55.2%)	6(10.7%)
Total	29(100.0%)	56(100.0%)

Chi-square value-44.9, Degree of freedom=4, p value<0.05

Discussion

In battery factories sulfuric acid having higher concentration of sulphur trioxide , which fumes strappingly at room temperature and has a sharp penetrating odor. Acid mist is frequently detected in the work place as it continuously discharges from open containers and leakage from pipes. Exposure is detectable to human beings at a level of 0.5 to 0.7 mg/m^3 , is irritating at 1.0 to 2.0mg/m3 and causes coughing at 5.0 to 6.0 mg/m^3 [4].

In different study settings acid mist concentration varied from .08 to 5mg/m^3 [9,10,11]. High concentration of acid fumes in the working environment is related to the higher prevalence of teeth erosion. Unfortunately data on acid fume concentration in all three factories involved in current study is not available because monitoring system was not attached with all the factories. However, the workplace environment, high proportion of affected workers in their oral health, unprotected acid handling and inadequate safety measures may be the reasons that workers may be exposed to excessive acid fumes.

The present study revealed that tooth surface lost by acid fumes was mainly restricted to labial surfaces of the upper anterior teeth. Incisal one-third to one-half of the labial surfaces of the upper incisor teeth was commonly affected. The canine teeth were rarely involved and affected on the labial surfaces nearest the midline. This type of site predilection suggests a direct action

of acid fumes on the teeth exposed during talking or during breathing through the mouth. It was likely that acid workers breathed through their mouths, when the acid level in the atmosphere became so high that nose breathing became unpleasant because of sharp penetrating odour of acid fumes. The parts of the incisors which are usually covered by the lips are never eroded and this is the reason why the cervical areas are unaffected, although the thickness of enamel is less there. The lesser effect on lower anterior teeth is probably due to salivary washing and buffering effect. The erosion of posterior teeth was rarely observed, possibly because they are protected by the cheeks and lips. Similar results were reported by studies done by Ten Bruggen Cate HJ [10], Petersen and Gorinsen [11] and Amin WM et al. [4].

Previous studies have suggested a relationship between the occurrence of dental erosion in acid workers and length of exposure or duration of employment [9,10]. This study confirmed that the proportion of subjects with erosion and severity of erosion increased with prolonged time of exposure or increased duration of employment(11 years or more). This is in agreement with the study done by Amin WM et al. in Jorden [4] and Basavaraj et al. in India [13].

Differences between occupational dental erosion in developed and developing countries was observed in past. Up to 100% of acid-exposed workers in African and Asian countries showed erosion [4,16,17], whereas only 8–31% of European, Korean and Japanese workers exhibited dental erosion [8,11,17]. Possibly, this might be a result of inadequate use of personal protective equipments, insufficient preventive measures to decrease acid exposure or a violation of the governmental rules and regulations concerning maximal tolerable concentration of potentially erosive agents at workplaces.

Better oral health condition in the control group compared to acid exposed group confirmed the relationship between increased dental erosion score and a hazardous work place environment. The reasons behind this may be limited or no acid exposure among control subjects, maintenance of a good oral hygiene through regular tooth brushing by control group workers and limited or inadequate use of personal protective equipments by acid exposed workers.

Conclusion

High prevalence of dental erosion was observed among acid exposed workers than control group workers. Present study revealed that long term exposure of sulphuric acid mists in the working environment significantly increased the chances of having dental erosion among exposed workers. When a workplace exposure is expected, a workplace exposure assessment should be undertaken. A workplace survey may help to find new cases with early stage dental erosion. Efficient surveillance and routine monitoring of acid fumes in the workplace place environment and Installation of efficient ventilation and exhaust system of the work sites should be made mandatory. Education about occupational hazards, positive worksite oral health promotion and training for standardized behaviors such as use of personal protective equipment and gargling during/after working are considered as preventive strategies to decrease occupational erosion. Government must take appropriate measures like Set up of dental and medical health care services nearby the workplace and a strict law for the rights of workers regarding health should be formulated along with regular inspections and follow up.

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