

Pilot study on dental erosion in a Norwegian electrolytic zinc factory

O. SKOGEDAL, J. SILNESS, T. TANGERUD, O. LAEGREID AND O. GILHUUS-MOE

Department of Operative Dentistry, Dental Faculty, University of Oslo, Oslo, and

Departments of Prosthetic Dentistry and Oral Surgery, Dental Faculty,

University of Bergen, Bergen, Norway

ABSTRACT - In 12 workers in a Norwegian factory using electrolytic methods to extract zinc, a relationship was found to exist between degree of erosion, number of teeth affected and the length of service. The prevalence of caries, abrasion and attrition was not higher than in comparable population groups. The correlation between diagnosis of erosion based on clinical examination, and diagnosis based on evaluation of color slides was good.

(Accepted for publication 6 June 1977)

Dental erosion may be caused by dietary acids, vomiting, and by droplets of acid in the atmosphere (haze). In a Norwegian zinc plant, where zinc is extracted by means of an electrolytic process using sulfuric acid as the main ingredient of the electrolyte, acid haze was suspected to cause dental erosion. At the request of factory representatives it was decided to set up a pilot study to get an impression of the dental conditions of the workers in the electrolysis section. The purposes of the pilot study were (1) to determine the frequency of occurrence and degree of possible dental erosion in the workers of the electrolysis section, (2) to elucidate whether erosion was associated with other dental hard tissue lesions, and (3) to compare diagnoses based on clinical examination with those based on evaluation of color slides.

MATERIAL AND METHODS

The sample comprised 12 individuals. They were distributed according to age and length of service as shown in Table 1.

The following data concerning each of the participants were collected:

- work prior to the present occupation,
- acids or abrasive particles in the food,
- toothbrushing habits (frequency, technique, hardness of brush, type of toothpaste),
- regurgitation,
- use of medicines,

- bruxism,
- acute dental traumas.

Clinical examination - Abrasion, attrition and erosion were defined according to PINDBORG². Erosions were classified using the following criteria: *etching* (Et): rough, pitted surface of the enamel without loss of contour (Fig. 1). *Grade 1* (G. 1): loss of enamel only. *Grade 2* (G. 2): loss of enamel with involvement of dentin (Figs. 2, 3). *Grade 3* (G. 3): loss of enamel and dentin with exposure of secondary dentin (Figs. 4, 5). *Grade 4* (G. 4): loss of enamel and dentin resulting in pulpal exposure. Furthermore, caries prevalence scores (percent DMFS) were obtained. Caries was examined clinically using the criteria of the World Health Organization⁵ and, in addition, radiographs were evaluated.

Color slides - Erosions were classified on the basis of color slides. Kodak Ektachrome X film was used, and photographs were taken to record:

- 1,2-anterior teeth of both jaws, occlusion and slight opening of mouth (facial surfaces);
- 3-6-maxillary anterior teeth, facial surfaces, lateral view, incisal view, and lingual surfaces in mirror;
- 7,8-mandibular anterior teeth, facial surfaces and lingual surfaces in mirror;
- 9,10-maxillary posterior teeth, lingual surfaces in mirror, right and left side;
- 11,12-mandibular posterior teeth, lingual surfaces in mirror, right and left side.

RESULTS AND DISCUSSION

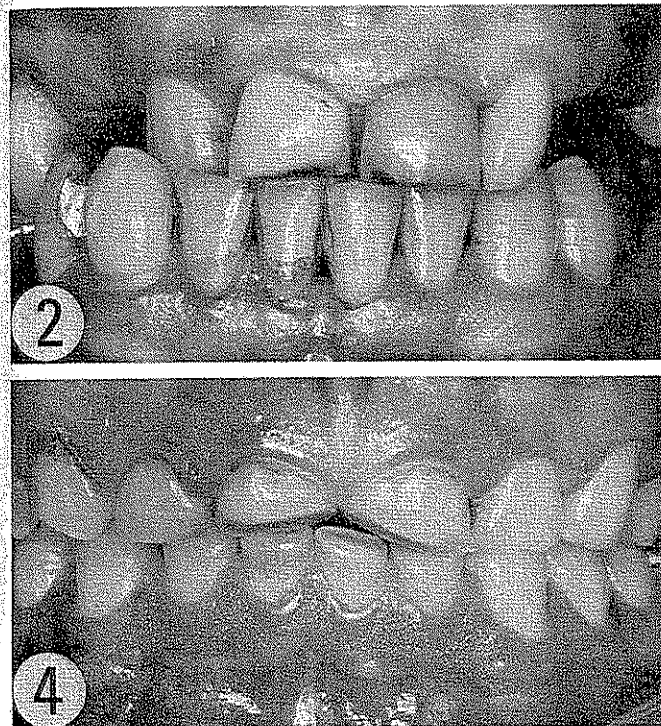
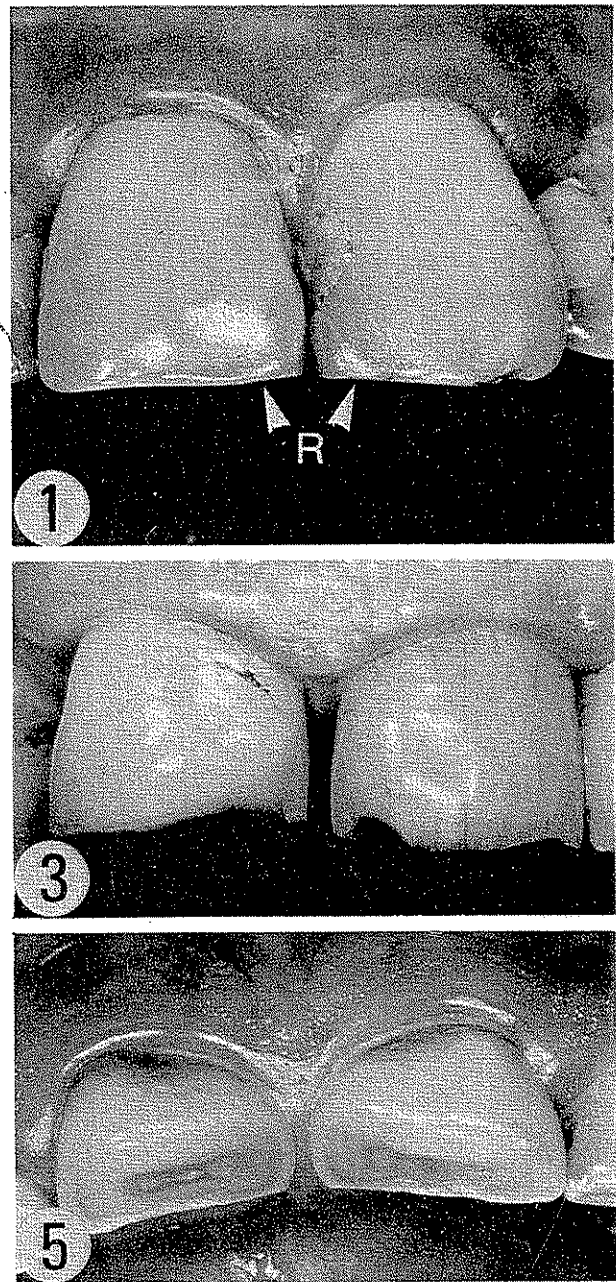
The results are presented in Table 1 and Figs. 6-8.

The caries prevalence scores, $46 \pm 17\%$ DMFS (Table 1), were comparable to other population

Figs. 1-5
in industrial
enamel
Figs. 2-5
which i
of secon

group
This
ish a
differ
divid
amou
faces
On
erosio
sis of
rathe

Figs. 1-5. Classification of dental erosions among workers in industry using electrolytic methods. Fig. 1. Etching of enamel giving a rough, pitted surface (R) above arrows. Figs. 2, 3. Grade 2 erosion with involvement of dentin, which is stained. Figs. 4, 5. Grade 3 erosion with exposure of secondary dentin.



groups within the same range of age in Norway. This observation corroborated findings among British acid workers³, whose caries experience was not different from that of the controls. Most of the individuals examined had restorations, whereas the amount of untreated caries lesions totaled 48 surfaces.

Out of the 12 workers seven were affected by erosion of the dental hard tissue (Table 1). Analysis of the past history data did not indicate that the rather high prevalence of erosion could be attri-

buted to digestive or dietary factors. Instead, since regular controls, carried out by the factory, showed that sulfuric acid, zinc sulfate and other ingredients of the electrolyte were present in the haze of the electrolysis section, the erosion must be related to chemical agents of the haze.

This is still more so as the clinical pattern of hard tissue destruction and loss agreed with that reported for industrial erosion^{3,4}. Further, in agreement with what has been observed⁴ in an Italian zinc plant, etching of enamel and erosion combined with attri-

Table 1. Dental hard tissue lesions of 12 acid workers

	Age, years	Length of service, years	Caries prevalence DMFS %	Erosion Deepest lesion					Abrasion	Dentinal attrition of posterior teeth
				0	Et	G.1	G.2	G.3		
1	37	2	33	×						
2	30	3	34	×						
3	42	3	48	×					×	×
4	22	4	33					×	×	×
5	26	5	48		×				×	
6	46	5	29	×						×
7	27	7	70			×				
8	29	7	50	×						
9	28	8	37				×			×
10	32	8	29				×			
11	29	9	63				×			
12	38	11	80				×			×
Mean	34	6	46							
Total				5	1	1	4	1	3	6

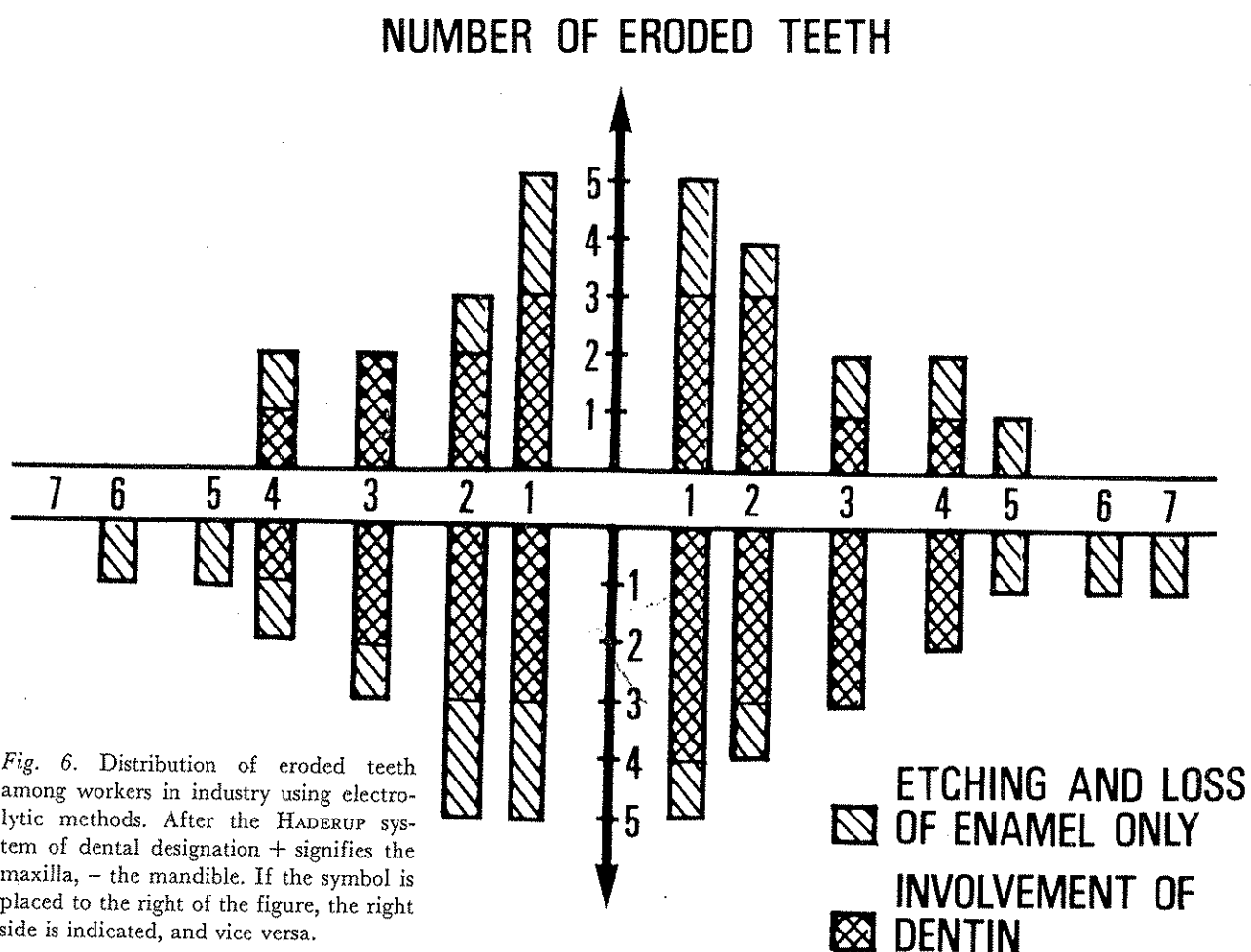


Fig. 6. Distribution of eroded teeth among workers in industry using electrolytic methods. After the HADERUP system of dental designation + signifies the maxilla, - the mandible. If the symbol is placed to the right of the figure, the right side is indicated, and vice versa.

DEGREE
EROSION
G.3.
G.2.
G.1.
Et

Fig. 7. 1
of service

tion w
(Fig. 6
The
ber of
length
6 years
appear
tion is
tween
longitu
dence
of ero
(Fig.
may b
The
sion a
out o
deepe
G. 1
evalu
may
screer
volvir
metho
ber o
ing n
be di
tudin
parise
W.
facial
frequ
other
uals
surfa
attrit

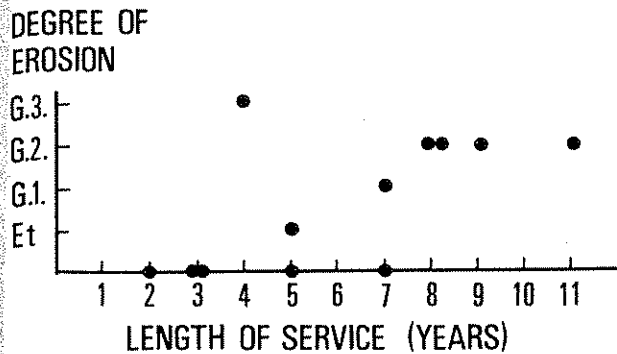


Fig. 7. Relationship between degree of erosion and length of service in industry using electrolytic methods.

tion were also seen to occur on posterior teeth (Fig. 6).

The severity of the lesions (Fig. 7) and the number of affected teeth (Fig. 8) increased with the length of service in the electrolysis section. About 5–6 years seemed to be a critical length of time for the appearance of G. 2 erosions. However, a cross-section investigation only indicates relationship between length of service and severity of erosions, and longitudinal studies are needed to get definite evidence of causality. The relationship between degree of erosion (Fig. 7) and number of eroded teeth (Fig. 8) was good, and any of the two observations may be used to assess severity of erosive lesions.

The correlation between clinical diagnosis of erosion and evaluation of color slides was good. In 11 out of 12 cases the diagnoses (the scores) of the deepest lesion were identical for both methods. One G. 1 erosion remained undetected on color slide evaluation. Accordingly, the first signs of erosion may not be revealed by this method. However, screening of patients with extensive erosions, involving the dentin, may be based on slides. This method may have several advantages: a great number of individuals may be examined in a time-saving manner, since probe and mirror inspection may be dropped. In addition, objective data for longitudinal studies of populations, as well as for comparison between populations, may be collected.

Wedge-formed abrasion defects were observed on facial surfaces of three participants (Table 1). The frequency of such defects was not higher than in other Norwegian population groups³. In six individuals attrition of dentin was observed on the occlusal surfaces of posterior teeth (Table 1). In addition to attrition of dentin, three of these individuals also

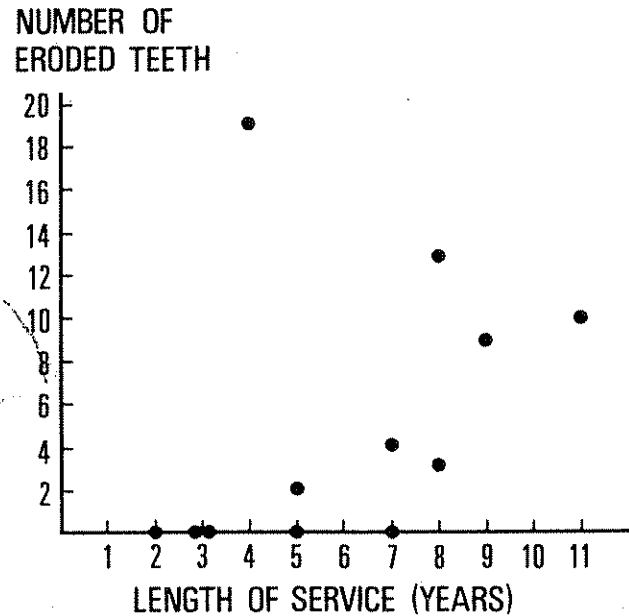


Fig. 8. Relationship between number of eroded teeth and length of service in industry using electrolytic methods.

displayed erosions. Correlations between degree of attrition and age seemed to exist, whereas no association between erosion and posterior tooth attrition could be ascertained in the limited material available.

The characteristic dental feature of several of the participants in this study was the high prevalence of hard tissue erosion, the severity of which seemed to increase with the length of service.

REFERENCES

1. CATE, H. J. T. B.: Dental erosion in industry. *Br. J. Industr. Med.* 1968; 25: 249–266.
2. PINDBORG, J. J.: *Pathology of the dental hard tissues*. Munksgaard, Copenhagen 1970, pp. 294–321.
3. SANGNES, G. & GJERMO, P.: Prevalence of oral soft and hard tissue lesions related to mechanical toothcleansing procedures. *Community Dent. Oral Epidemiol.* 1976; 4: 77–83.
4. SILVESTRI, B.: Le alterazioni dentarie degli operai addetti alla produzione elettrolitica dello zinco. *Med. Lav.* 1965; 56: 283–292.
5. *Oral health surveys. Basic methods*. World Health Organization, Geneva 1970, p. 22.

Address:
Ole Skogedal
Department of Operative Dentistry
Dental Faculty, University of Oslo
Box 1109, Blindern
Oslo 3
Norway