

EPIDEMIOLOGY

Dental erosion in four-year-old children from differing socioeconomic backgrounds

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The problem of dental erosion has been recognized for many years. Although its etiology is multifactorial, erosion arising from acidic dietary components represents the most common factor. A variety of substances in the diet, including certain foods and beverages, are acidic in nature and have the potential for causing dental erosion, if consumed in sufficient amounts.¹⁻⁴ Consumption of fruit juices and other soft drinks has increased enormously in the last twenty years, particularly in North America.⁵ Drinks have been developed specifically for the infant market and these baby fruit juices have been shown to give rise to extreme dental tissue destruction with prolonged misuse.⁶ Dental erosion caused by gastroesophageal reflux disease in young children has also been documented.⁷

It is extremely difficult to separate the different etiological factors in tooth tissue loss; erosion is the loss of dental hard tissues by chemical means that does not involve bacteria, but undoubtedly both abrasion and attrition are compounding features. Attrition of the incisal edges in the primary dentition is almost always evident by the time of exfoliation, but abrasion in the primary dentition is uncommon. It has been shown, however, that significantly more tooth substance is removed during toothbrushing if this has been preceded by consumption of erosive drinks or food.⁸ Tooth tissue

loss in the primary dentition as in the permanent dentition may be mainly due to erosion, but there will always be a component of abrasion or attrition, however small.

Severe tooth tissue loss in the primary dentition, from whatever cause, is particularly harmful because of the thinner layers of dental tissues. Unfortunately there is little information on the general prevalence and severity of erosion in children and only anecdotal evidence to suggest that the problem is increasing. The aim of the study was to determine the prevalence of erosion in four-year-old children and to investigate the influence of socioeconomic grouping on erosion in these children.

MATERIALS AND METHOD

The classification of erosion used in this study was based on the Tooth Wear Index of Smith and Knight (1984).⁹ After extensive clinical testing on children of a wide age-range, however, some modifications were made; these are detailed in Table 1, which gives the diagnostic criteria.

Initial training and calibration using the index was followed by a reproducibility study on forty, 4- to 5-year-old children.

As well as recording the buccal, occlusal/incisal, and lingual surfaces for each tooth present, the children were also classified into one of three groups:

☐ Low erosion: Scores of 0 and 1 for all teeth

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Table 1 □ Diagnostic criteria for Erosion Index.

Score	Surfaces	Criteria
0	B/L/O/I	No loss of enamel surface characteristics.
1	B/L/O/I	Loss of enamel surface characteristics.
2	B/L/O	Loss of enamel, visible dentine for < one third of the surface.
	I	Loss of enamel with visible dentine.
3	B/L/O	Loss of enamel, visible dentine for > one third of the surface.
	I	Loss of enamel and substantial loss of dentine, but not exposing pulp or secondary dentine.
4	B/L/O	Complete loss of enamel, or pulp exposure, or exposure of secondary dentine.
	I	Pulp exposure or exposure of secondary dentine.
9		Excluded from analysis. (Teeth with large restorations, extensive caries or traumatized.)

* In case of doubt a lower score is given
B = buccal or labial, L = lingual or palatal, O = occlusal, I = incisal

- Moderate erosion: Any surfaces with scores of 2
- Severe erosion: Any surface with scores of 3 and/or 4

The incisal edges of primary incisor and canine teeth were excluded from this analysis, as these surfaces are particularly subject to attrition.

A total of 178 children, eighty boys and ninety-eight girls ages between 4 and 5 years, were assessed in five differing schools. These schools were selected because they had very clearly defined catchment areas of uniform socioeconomic background. All the schools were situated in an optimally fluoridated water area.

Table 2 gives details of the number of children in each school and information on their socioeconomic background.

The data were analyzed using nonparametric statistics: the chi squared test for independent samples and the Kappa statistic for the reproducibility data.

RESULTS

The training and calibration exercises enabled the diagnostic criteria for the erosion index to be finalized and the procedure simplified, so that even comparatively young children could be examined. The reproducibility studies gave a weighted Kappa statistic value of 0.93, indicating very good agreement.

Table 3 shows the total scores for the erosion index by tooth surface for the 178 children who participated in the main study. The majority of tooth surfaces showed

Table 2 □ Numbers of children examined in the different schools.

School	Number examined	Socioeconomic group/catchment area
I	25	Low: Inner city deprived area, social priority school
II	35	Low: Inner city deprived area, social priority school
III	23	Middle
IV	59	Middle
V	36	High: socioeconomic groups I and II

loss of enamel surface characteristics (score 1). A considerable number of the incisal edges of the incisor and canine teeth had scores of 2 or more, indicating visible dentine. Much of this tooth tissue loss could be attributable, however, to attrition. The surface showing the most extensive hard tissue loss attributable to erosion, was the palatal aspect of the upper incisor teeth. Over 30 percent of these surfaces showed visible dentine, with almost half of these having scores of 3 and 4.

Table 4 indicates the percentage of children falling into the categories of low, moderate, and severe erosion in the five different schools. The children in schools I and II come from an inner city deprived area of low socioeconomic background. There was very little erosion seen in the children from these schools, with only one child having moderate erosion and eight having severe erosion with extensive areas of visible dentine. The children from the higher socioeconomic groups showed a more even distribution into the categories of low, moderate, and severe erosion, but only approximately one third of these children showed low levels of erosion with almost one fifth being in the severe erosion category.

Thus the children from the low socioeconomic groups had statistically significantly less erosion than those from the higher socioeconomic groups ($F = 5.78$, $p = 0.05$).

DISCUSSION

There are few epidemiological data on the prevalence of erosion, but anecdotal evidence indicates that it is an increasing clinical problem. This present study provides the first information on the levels of erosion found currently in a population of young children. This should establish a baseline from which to monitor the clinical situation. There are changing patterns of food and beverage consumption with an increase in soft drink sales from 87 liters per head of the population in 1960 to

Table 3 □ Erosion index, surfaces scores: all 178 participants.

		E	D	C	B	A	A	B	C	D	E
UPPER	Buccal										
	1	161	168	175	163	159	153	158	169	159	158
	2				7	7	8	11		1	
	3					1	1				
	4										
	Occlusal/ Incisal										
	1	149	118	193	92	75	73	99	101	120	146
	2	19	47	70	68	78	72	62	72	31	11
	3		2	2	10	14	15	8	1	3	2
	4				1	1	1	1			
	Lingual										
	1	160	169	165	126	113	109	136	172	161	159
2	1		7	27	29	33	21	1			
3			4	16	20	14	10		1		
4				2	6	7	3				
LOWER	Lingual										
	1	155	164	175	178	168	165	174	169	164	155
	2			1		2	2	1	1		1
	3								1		
	4										
	Occlusal/ Incisal										
	1	130	126	133	139	133	131	146	119	126	135
	2	22	36	42	37	36	35	28	51	35	18
	3		3	1	2	1	1	1	2	4	
	4										
	Buccal										
	1	155	164	175	177	170	167	175	170	164	155
2									1		
3										1	
4											

Table 4 □ Percentage of children with different levels of erosion from each school

(Excludes incisal edges)

School	Low		Moderate		Severe	
	Percent	(No)	Percent	(No)	Percent	(No)
I	96	(24)	0	(0)	4	(1)
II	78	(27)	2	(1)	20	(7)
III	43	(10)	39	(9)	18	(4)
IV	30	(18)	53	(31)	17	(10)
V	36	(13)	45	(16)	19	(7)

272 liters in 1991 in the USA. This may be of direct relevance to levels of erosion and should be investigated, particularly in the child population.

In order to study the prevalence of erosion it was necessary to use simple reproducible diagnostic criteria. Of the indices available for the assessment of tooth tissue loss, the Smith & Knight (1984) Tooth Wear Index has become the most widely accepted.⁹ The original index measured tooth tissue loss from all sources, however, including attrition and abrasion as well as erosion. It was also designed for use in the permanent dentition and in an adult population. Attrition is a significant feature on the incisal edges of incisors and canines in the late primary dentition stage. These surfaces do not give meaningful information concerning tooth

tissue loss due to erosion and were, therefore, excluded from the final analysis of the children into low, moderate, and severe categories of erosion.

It can be seen that nearly half the children examined showed some signs of erosion. The most common site affected was the palatal surface of the upper incisors. When considering the influence of socioeconomic group on the prevalence of erosion, four of five children examined in the low socioeconomic group showed low levels of erosion, compared with only two children of five in the higher socioeconomic groups. The observed differences between the socioeconomic groups may be related to differing dietary patterns, which were not determined in this study. In addition, other factors including oral hygiene practices may be relevant. It has

been well documented that oral hygiene improves with rise in socioeconomic status.^{10,11} Davis and Winter (1988) reported a significant acceleration of abrasion during tooth brushing following demineralization caused by exposure to dietary acids.⁸ This, together with the possible protective effect of the mature pellicle against acid attack, may provide some explanation for this observation.^{12,13}

This study has highlighted significant dental erosion in young children, which will require careful attention by dental practitioners. The erosion index will be useful in identifying those patients who may be particularly at risk of later developing severe tooth tissue loss in the permanent dentition. Any patients found to lie within the severe group of tooth tissue loss, require detailed dietary analysis and advice, in conjunction with appropriate oral hygiene instruction. This may well help to prevent symptoms developing and complex restorative care being required in the permanent dentition should the deleterious habits persist.

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WATER FLUORIDATION: EFFECTIVENESS AND FLUOROSIS

This paper reviewed the literature on the evidence for water fluoridation's effectiveness under current conditions of multiple fluoride use at recommended and at reduced concentrations, the extent of dental fluorosis at different fluoride concentrations, and the "halo" effect of water fluoridation. Using the relative difference in dental caries between communities with low and optimal water fluoride as an indicator, the effectiveness of water fluoridation has decreased over time as the use of other fluorides has increased. Thus the effectiveness of water fluoridation alone cannot now be determined. Compared to the early fluoridation studies, the differences in dental caries and fluorosis prevalence between fluoridated and nonfluoridated areas have markedly narrowed. Both the prevalence and severity of dental fluorosis have increased since 1945; however, the portion of fluorosis due to water fluoridation is now less (40 percent) than that attributed to other fluoride sources (60 percent). Research also suggests that the "halo" effect of community water fluoridation may result in a significantly greater intake of fluoride for people in nonfluoridated communities. This review recognized that since water fluoridation has unique advantages from the perspectives of distribution, equity, compliance and cost-effectiveness over other fluoride technologies, it remains as the fundamental base for caries prevention. The increasingly greater contribution that other sources of fluoride make to dental fluorosis suggests that these sources of fluoride, many of which are used on an elective basis, should be more closely examined for needed changes.

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