

# Prevalence of dental erosion and the implications for oral health

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The literature on dental erosion is made up of a number of areas, some of which are reviewed here: there are anecdotal case reports, linking a small number of clinical cases with a possible etiological factor. The second area of evidence concentrates on case control studies in which there is a strong association with dental erosion, for example, patients with bulimia. The final piece of epidemiological evidence is beginning to emerge as prevalence studies, but the information from prevalence data worldwide is scanty. It is difficult to compare prevalence studies because of the different indices used in the various studies and also because of the different teeth assessed in the sample. Standardization of indices used would overcome some of these differences as would the reporting of results in a comparable way. However, identifying the true prevalence of erosion *per se* is fraught with difficulty because there may be more than one etiological factor operating and attrition and or abrasion may complicate the picture, especially in older populations. Case reports frequently associate evidence of erosion with excessive use of particular drinks or foodstuffs so they must be viewed with caution. There is an increasing awareness, amongst the dental profession, of the potential for this particular form of tooth wear to occur. It is important that the dental team is vigilant and instigates preventive measures before tooth tissue loss becomes clinically significant. The importance of erosion in dental health promotion should not be overlooked.

Key words: erosion; epidemiology; oral health.

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## Introduction

Loss of tooth tissue occurs in a number of ways, dental caries and trauma being the more obvious ones but tooth wear in its own right is now assuming greater importance. Tooth wear can occur by abrasion, attrition and erosion. It can be difficult to discriminate between these mechanisms although the site of the wear as well as its appearance may be helpful in determining the likely etiology. Loss of tooth tissue as a result of wear is increasingly reported in the literature. This has arisen, in older age groups, because of the longer retention of teeth but also as a result, probably, of the greater awareness of the potential for this to occur. The wider availability and frequent consumption of soft drinks (still and carbonated beverages) and fruit juices, alongside anecdotal reports of tooth surface loss, has led to claims of an acceleration, as well as an increased prevalence

overall, in tooth wear due to erosion in younger populations. However, there are as yet no longitudinal data to support these claims.

Erosion differs from dental caries in that it manifests as an irreversible loss of dental hard tissue by a chemical process that does not involve bacteria. Such tissue loss is insidious in nature and may not be apparent until the patient reports symptoms of sensitivity or the fracture of thinned incisal edges. Unlike dental caries, erosion occurs on plaque-free sites.

Prevalence surveys are few in number, with anecdotal case reports or small series studies occupying the bulk of the literature on the epidemiology of dental erosion. Only one case control study has been published to date. This paper will consider the data from these sources – case reports or small series, a case control study, and prevalence studies. Many of the studies report the use of different indices so making comparisons difficult. Additional-

ly, the indices currently available appear only to measure tooth wear and not erosion specifically, unless modifications have been made to the criteria and the way in which they are applied.

### Case reports

The occurrence of dental erosion has appeared in the literature as case reports as long ago as the late seventeenth century (1). Early reports focused on the clinical presentation of erosive lesions in adult populations. Later papers concentrated more on the putative etiological factors such as acidic beverages and fruit. Cases of dental erosion related to fruit-based drinks and fruit were reported in the 1950s when, in the UK at least, consumption of such beverages was minimal. Overall data on consumption does not say anything about individual patterns. In 1973 LEVINE (2) warned against the use of excessive fruit and juice consumption in two cases of dental erosion in young females attending a dental hospital. The first subject drank fresh orange juice three times a day, each glass containing the juice of 6 oranges. The second subject, who was dieting, consumed the juice of 10 oranges, two whole oranges or apples, per day, as well as a kilo of stewed rhubarb per week.

More recent papers have looked specifically at the drinking habits of younger children. SMITH & SHAW (3) also highlighted the potential erosive effects of baby juices when given for prolonged periods of time in some form of comforter or bottle, used at night time. The authors cautioned against prolonged exposure and mentioned that in the case they reported, the juice had been given in a reservoir feeder for prolonged periods at night. In this case, that of a 2-yr-old child, it was the palatal surfaces of the maxillary incisors that were worst affected, with pulpal exposure on one tooth.

ASHER & READ (4) examined twelve patients aged between 9 and 15 yrs attending a dental hospital for their care. The children in this study were reported by parents to have drunk between one and three 725 ml bottles of fruit-flavoured drinks per week (equivalent to between 22 to 66 drinks if properly diluted, per week). It was obvious to the authors that many children consumed the fruit-flavoured drink in a more concentrated form than recommended by the manufacturers. The conclusion was that erosion was directly related to the excessive consumption of low pH colas and citric acid drinks.

The study of MILLWARD *et al.* (5) also involved a referred dental hospital population of children aged between 4 and 16.5 yrs. Of the 101 children, 49 were girls and 52 were boys. Using a modification of the SMITH & KNIGHT Index of Tooth Wear

(6), they found that 21 children had 'mild' erosion, 45 'moderate' erosion and 35 'severe' erosion. There were highly statistically significant differences between the groups in relation to drinking habits. For example, of the children who had fruit-based drinks at bedtime, 60% had evidence of severe erosion compared with those with mild erosion of whom only 14% had such a bedtime drink.

Many of these reports highlight the dangers of misuse of products, particularly drinks, which have frequently not been used in accordance with the manufacturer's instructions on dilution and often drunk in excessive amounts. Similarly, unusual patterns of erosion have been attributed to the consumption of cola-type beverages. HIGH (7) described an unusual pattern of erosion thought to be due to the consumption of such a drink.

In adults referred to a dental hospital because of erosion (8), 26 subjects completed a dietary questionnaire. Although many of the subjects consumed large quantities of fruit and fruit-based drinks, the authors concluded that they were unable to relate the severity of the lesions to the quantity, frequency or period of consumption of the drinks involved.

Other reports of tooth surface loss in young adults have focused on some of the other causes of erosion rather than purely dietary ones. ECCLES (9), one of the first authors to propose an index for the measurement of erosion, reported on 19 patients with erosion aged between 11 and 21 yr. In 5 of the patients, no cause could be found for the tooth tissue loss, in 4 patients a dietary cause alone could be elicited, but in the remaining eleven the most likely etiology was some form of regurgitation, with or without an associated dietary component.

### Case control studies

JÄRVINEN *et al.* (10) have reported a case control study investigating factors that were thought to influence dental erosion. The study involved 106 subjects with dental erosion selected from general dental practices in Helsinki. These patients were matched with a control group. Because five cases of erosion were detected (according to strictly defined criteria) among 100 controls in the random sample from the source population (the patients of Helsinki dentists), the prevalence of erosion with 95% confidence limits was estimated to be 5%. In only one case of the 106 was it not possible to elicit a cause. For the remainder, dietary factors were isolated in 26 cases, gastric regurgitation in 26 cases and a combination of the two factors for 46 patients. The remaining 8 cases had other or more mixed etiologies. Citrus fruits and soft drinks were

identified as being the main causative dietary agents for dental erosion in this Finnish population, being consumed by between one-third and a half of the subjects. Gastric problems were also a major risk factor. Of the cases, 7 were anorectic and 35 had gastric disease diagnosed by a physician. A logistic multivariate model applied to these data gave the relative importance of the associations between erosion and the variables identified. This study is an important one because it further highlights the need to investigate salivary flow as a factor in the etiology of erosion.

### Prevalence studies

The earliest study to publish details of a population-based survey was that of SOGNAES *et al.* in 1972 (11). These workers examined 10,000 extracted teeth from Southern California and showed that about 1700 teeth (18%) had erosive lesions, with incisor teeth most commonly affected. A similar survey (12), but this time on skulls dating back to Roman and Anglo Saxon Britain, was carried out to look for evidence of this form of tooth wear. A total of 151 adult skulls were assessed for wear using the index of SMITH & KNIGHT (6). A control group was made up of 947 cases who formed part of a separate study to assess pathological tooth wear in a dentist-attending population in the south-east of England. Of the 151 skulls, 30 (19.9%) showed extensive evidence of wear. The site of the tooth surface loss led the authors to conclude that the causal factor was gastric regurgitation.

Most of the skulls had evidence of severe wear on the lingual surfaces of both upper and lower teeth. The wear patterns occurred in both males (13 cases) and females (9 cases) in all age ranges. The severe lingual wear found in these 22 skulls was very similar to the patterns seen in the control group, where extensive tissue loss from the lingual surfaces has been linked to a specific cause.

In all ages, occlusal wear was greater in the skulls than in the control group and became more marked with age. This was to be expected, given the coarser diet of the skull population. Generally, the levels of lingual and buccal wear were the same in both populations, suggesting that the occlusal surfaces rather than the sides of the teeth bore the brunt of the coarser diet in the skulls group. The cervical wear in the latter population, however, did not develop beyond criterion 0 in most individuals (i.e. there was no contour change or loss of surface characteristics of the enamel). Level 1 cervical wear (showing loss of enamel surface characteristics and minimal loss of contour) was evident in the control group between the ages of 26 to 45 yr.

After 45 yr, it was 'normal' for anterior teeth to have cervical wear to level 2 (with defects up to 1 mm in depth). Thus although the occlusal surfaces of the skulls group were subject to greater wear, the cervical areas of the teeth were subject to less wear.

In the United States, a survey of incoming patients to the dental hospitals in Los Angeles and Boston (13) purported to look specifically at the prevalence of erosion in 527 patients, age range 14 to 80 yr of both sexes. However, the illustrations contained in the paper indicated that many of these lesions resembled abrasion rather than erosion. The prevalence of erosion as described by the authors was found to vary by city and by tooth type. Approximately 25% of all teeth exhibited erosion but with a higher rate in Los Angeles. Interestingly, a slightly higher proportion of the Boston population had received fluoridated water (11% against 0%), but a higher proportion of the Boston groups were frequent consumers of citrus fruits (16.9% against 0.3%) (14).

A random sample of Swiss adults was selected to examine the prevalence of dental erosion (15). Examinations of 391 people were carried out in their own homes using a scoring system modified from that of LINKOSALO & MARKKANEN (16). Of the total sample, 197 were aged between 26 and 30, and 194 were between 46 and 50 yr of age. For facial lesions, 7.7% of the younger group and 13.2% of the older group had one or more erosive lesions with involvement of dentin. For occlusal surfaces, 29.9% of the younger group and 42.6% of the older group had erosion involving dentin, with 3.2 and 3.9 teeth affected, respectively. Only 2% of the older subjects had lingual erosion, and in these there was a correlation with chronic vomiting. For the remainder of the subjects, there was a statistically significant relationship between observed erosion and dietary habits such as intake of fruit juices, citrus or other fruits.

In children, prevalence studies have only been reported in the United Kingdom. In a study in 1992, a random sample of 1035 14-yr-old children were examined for the presence of dental erosion (17). Fifty-one per cent of the sample were males and 49% were female. Thirty per cent of the children had exposed dentin, but mainly incisally and more commonly in females. In addition, 80 (8%) children also had exposed dentin on occlusal and/or lingual surfaces. A slight inverse relationship was found between the severity of tooth wear and levels of deprivation in the city studied, in that as the levels of deprivation worsened, the prevalence of tooth wear increased.

Conversely, in a study of 178 4 and 5 yr olds carried out in the West Midlands (18), there was a

positive correlation between socio-economic group and the prevalence of erosion, the children from the low socio-economic groups having less erosion. For example, 19% of the high socio-economic group children had severe erosion (surface scoring 3 or 4 on the Tooth Wear Index) compared with only 4% of the children from a low socio-economic background. Overall, nearly half the children showed some erosion with the most commonly affected site being the palatal surfaces of maxillary incisors.

The National Survey of Child Dental Health (19) carried out in the UK in 1993, included for the first time an assessment of dental erosion of maxillary incisor teeth of a representative random sample 5 to 15 yr olds. The index used was a modification of the SMITH & KNIGHT index (6), but assessing the amount of tooth surface loss only from the palatal and buccal surfaces of maxillary incisor teeth in both the primary and permanent dentitions. Results from the calibration exercise conducted during the dentists' training for the survey (standard deviation per unit ranging between the groups of dentists from 0.54 to 2.83) indicated that dentists found it difficult to agree in determining the presence of erosion of the enamel, so comparisons between countries on this basis may be suspect. As dentists from different countries did not examine the same children it is not possible to assess the degree of random variation. It is, however, suggested that the low levels of agreement between dentists in the case of enamel erosion are borne in mind when considering the results. Erosion into dentine and the dental pulp are easier to identify, and the importance of this in terms of treatment implications is considered to be greater. The results showed that over half the 5 and 6 yr olds had evidence of erosion, and in nearly a quarter, dentin was involved. Loss of tooth tissue was greatest on palatal surfaces of the incisors, with 52% of 5 yr olds affected, compared with only 18% presenting with buccal erosion. In the permanent dentition, for those over 11 yr of age, nearly a quarter had evidence of erosion, with 2% of teenagers having wear into dentin.

A year later, a similarly conducted mainland UK survey (20) was published on 1.5 to 4.5 yr olds using the same criteria on erosion as in the National Child Dental Health Survey. However, the training of dentists for the school and pre-school children's dental health surveys differed; dentists working on the former survey attended a two-day residential course while those working on the less complicated pre-school children's survey attended only a one-day briefing and had less detailed written instructions. Overall, 10% of children had erosion of the buccal surfaces of their primary incisor

teeth and 19% had erosion affecting the palatal surface. Erosion into dentin or pulp on the palatal surface affected 8% of children.

Accompanying the oral health survey of these pre-school children was a large diet and nutrition enquiry (21). Although the report concluded that dental erosion was not found to be significantly related to dietary behaviour, closer examination of the tables in the report reveal a weak relationship between the frequent consumption of sweetened drinks and carbonated beverages and dental erosion; 32% of 3.5 to 4.5 yr olds who consumed carbonated drinks (including low calorie carbonated drinks) had evidence of palatal surface erosion compared with 28% of the same age group who consumed such drinks less frequently. The data on buccal surface erosion were 19% and 12%, respectively. There was a trend observed also between bedtime consumption of drinks and the prevalence of this form of tooth wear, with 41% of 3.5 to 4.5 yr olds who consumed drinks containing non-milk extrinsic sugars (includes: fruit juices, squashes and carbonated drinks) showing evidence of palatal surface erosion compared with 30% of children who did not have drinks containing non-milk extrinsic sugars.

## Implications for health

### General Health

For patients in whom reflux is a chronic feature the likely sequelae are oesophagitis leading to strictures or perforations (22, 23). In a proportion of patients reflux and aspiration of gastric contents will result in chronic respiratory symptoms including asthma, recurrent obstructive bronchitis or recurrent pneumonia (24–27). In these contexts, dental erosion would appear to be of minor importance despite its clinical significance (28, 29).

### Oral Health

Wear, including erosion of hard tooth tissue, is a normal feature of the aging process but assumes significance when it results in a dentition that cannot function adequately or where a patient's appearance is compromised.

Erosion of tooth tissue can have catastrophic consequences for oral health. Such tissue loss can result in sensitivity or pain as well as poor appearance. Sensitivity is not however a reliable finding, since loss of tooth tissue usually occurs at a sufficiently slow rate to allow for the deposition of secondary dentin. Pain is usually indicative of rapid loss of tissue from manifest lesions (29). Many patients with dental erosion do not report a deterioration in appearance until there has been sufficient

loss of tooth tissue, particularly on the palatal surfaces of maxillary incisors, for the thinned incisal edges to fracture. Restoration of lost enamel and/or dentin can be a difficult and expensive process requiring intensive maintenance care as well as continual monitoring. In the longer term, clinicians may observe sequelae such as temporomandibular joint dysfunction (30), dento-alveolar compensation (31) and an entity known as abfraction or stress corrosion (32). The latter is seen in areas of hyperocclusion or malocclusion when masticatory forces are transmitted to the fulcrum of the tooth, at the cervical region. The resultant stresses in this region create small cracks or fractures. The enamel or dentine is thus disrupted leaving the tissue vulnerable to chemical dissolution and breakdown. Abrasion, because of the site of these lesions, may be a feature of abfraction (32).

It is not always easy to isolate the aetiological factor. The cause of dental erosion cannot always be reliably predicted from the location of the lesion (33, 34). In addition, there may be the complication of separating out the effects of other aspects of tooth wear, namely attrition and abrasion.

Dentists and other members of the dental team need to be aware of the potential for erosion to occur and to take note of the potential risk factors for each of their patients. Because dental erosion may become a more prevalent feature of the dentition, opportunities for oral health promotion must not be lost. Issues such as relative risk factors, titratable acidity and abrasivity of commonly used dentifrices need to be highlighted for the dental team so that they can give appropriate advice to patients. Prevention remains the priority option (35, 36).

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