

TOOTH EROSION



Definition

Tooth erosion is a form of tooth wear caused by the action of acid on tooth substance. This acid could be dietary, gastric or environmental. It is, therefore, distinct from those types of tooth wear that are caused by friction or mechanical wear but in many cases the clinical presentation of tooth wear results from a combination of acidic and frictional causes.

Epidemiology

Few epidemiological studies of the prevalence and severity of tooth erosion have yet been performed on a national basis. Studies have focused on small groups of patients, often pre-selected, for example because of symptoms. Thus erosion was seen largely in patients with symptoms of gastric reflux (Gastro-oesophageal reflux disease or GORD) and later was recognised in patients with anorexia or bulimia or in patients with unusual dietary habits. It can also be a problem in alcoholics.

In some cases erosion has been recognised as an occupational disease where workers have been exposed to acidic fumes, for example in factories making batteries. It is also an occupational disease among wine-tasters and may be seen in professional swimmers who use chlorinated swimming pools. Over the last 10-15 years, however, there has been a steady increase in reports of erosion seen especially in young adults, adolescents and young children. Studies from Switzerland, UK, Republic of Ireland, The Netherlands and Iceland suggest that some signs of erosion can be seen in 20-40 % of subjects but severe erosion into dentine or even into the pulp is perhaps seen in 5% of subjects. The cause of this erosion, especially in children, adolescents and young adults has been largely linked to the high consumption of soft drinks, both fruit juice and carbonated drinks, by these age groups. This link has been made largely in Europe and the problem has received little attention in the literature coming from the USA.

Clinical presentation

Erosion may present on the anterior and posterior teeth and may be limited to the enamel only (Figure 1) or also affect dentine to a greater or lesser extent. Frequently, erosion is seen affecting the palatal surfaces of four maxillary incisor teeth. Erosion in the molar and premolar teeth may present as dish-like depressions on the occlusal surfaces, usually extending into dentine. If teeth have been restored prior to erosion occurring, the restorations stand proud of the surrounding enamel (Fig. 2). There may be a loss of vertical dimension and, particularly, a pattern of tooth wear involving the palatal surface of

maxillary molar teeth, buccal surfaces of mandibular molars and palatal wear of maxillary anterior teeth. This pattern is strongly suggestive of erosion caused by gastric acid. Nevertheless, other factors may play a part in the overall clinical picture. If there is a loss of occlusal enamel in the molar teeth the consequent loss of vertical dimension may produce “step-like” wear facets palatally on the maxillary anterior teeth, especially if the enamel has also been lost on these surfaces. Erosion in the maxillary anterior teeth may be so severe that it extends close to, or even into, the pulp. Rapidly progressing erosion may cause hypersensitivity of the teeth but commonly the progress is too slow for symptoms to arise. Nevertheless, patients may complain of discomfort in their teeth during eating or drinking and of increased sensitivity to cold stimulation.

Lesions of erosion are first detectable as a loss of enamel lustre and a matt appearance of the enamel. This progresses to clearly detectable loss of tooth substance in the enamel and then in the dentine as described above and shown in the figures. If the thinning of the maxillary anterior teeth is sufficiently great, fracture of the unsupported incisal edges may occur (Fig. 3). Erosion usually progresses quickly in dentine when other types of tooth wear become superimposed on the erosion.

Aetiopathogenesis

In recent years the high consumption of soft drinks has been the aetiological agent that has been most implicated in the upsurge of tooth erosion that has been reported particularly from Europe. Although a low salivary buffer capacity may exacerbate the effects of these acidic drinks on teeth, there is conflicting evidence in the literature concerning the contribution of a low buffer capacity to the severity or progression of erosion. It would seem logical to assume that a low buffer capacity would at least extend the time during which tooth enamel was eroded after contact with an acidic drink. Swishing a drink around in the mouth appears to increase the severity of erosion while drinking through a straw reduces the severity of erosion. Although much attention has been placed in recent years on the role of extrinsic acids, mostly from foods but also from medicines and the workplace in the causation of erosion, intrinsic acid in the form of refluxed gastric acid is still a major aetiological factor in tooth erosion. Scanning electronmicrographic appearances of eroded enamel and dentine are shown in Fig. 4 and Fig.5 respectively.

Diagnosis

Tooth erosion is one of the various manifestations of non-carious tooth destruction that have been termed *tooth wear*. Many patients present with tooth wear that is the result of several aetiological factors that do not fall conveniently into one or other of the categories, attrition, abrasion or erosion. Clinical examination is the most usual way for tooth erosion to be detected. Tooth erosion may be present in patients with gastro-oesophageal reflux disease, bulimia and anorexia. Patients undergoing cytostatic drug treatment for malignancies may suffer from frequent vomiting which rapidly may cause erosion. It is clearly important for doctors and nurses treating patients with these conditions to be aware of the possibility that the patient could also have significant tooth erosion.

The location of tooth erosion and its severity should be recorded. Several indices are available for this, ranging from the relatively simple index of Eccles and Jenkins, that was designed for recording the severity of erosion, through the more detailed modification of the same index proposed by Lussi and

the detailed Tooth Wear Index of Smith and Knight. In epidemiological studies, the degree of inter- and intra- examiner variability in detecting and scoring tooth wear may be as great a problem as determining the aetiology. Careful calibration of examiners is helpful. For an individual practitioner, study casts are a useful record of the status at any particular time and can be used to monitor progression of erosion. Computer-aided image analysis of impressions or study models is being developed and may become useful clinical tools for recording progression of erosion.

Good history taking is essential to determine the consumption of acidic drinks, and other dietary factors that may contribute to the observed erosion. Medication, particularly frequent use of asthma inhalers containing steroid or effervescent medications, should be checked as they may contribute to tooth erosion. The possibility of gastro-oesophageal reflux should be considered, not only bulimia and anorexia that patients are understandably reluctant to admit to, but also other possible causes of reflux including hiatus hernia. It may be necessary for the dentist to refer the patient to a gastroenterologist for investigations including gastroscopy and 24-h monitoring of oesophageal pH that is the “gold standard” for diagnosis of gastro-oesophageal reflux disease. Prompt diagnosis of reflux will in most cases lead to medication or possibly surgery to reduce reflux that will, in turn, remove the erosive challenge to the teeth.

Treatment

Restorative treatment of teeth affected by tooth erosion is often complex and very expensive, especially if occlusal erosion has caused a significant reduction in vertical dimension. As there are few long-term studies on how tooth erosion and related tooth wear progresses in young people, recommendations on restorative measures are difficult to make. Various non- or minimally-invasive procedures have been tried in order to prevent further tooth wear but clearly extensive crown and bridge work is sometimes required. As the durability of crown and bridgework is limited and patients with erosion are often young, conservative approaches that may also offer a degree of protection or prevention against further wear are therefore urgently needed. Restorative techniques should preferably involve no further destruction of remaining tooth substance. Dentine-bonding agents have been shown to be effective in reducing sensitivity and offering protection against further dissolution of erosive lesions. These should be applied and the patient monitored before any final decision is taken on restorative measures.

Prognosis and complication

Pain or discomfort in teeth that have lost their protective enamel covering is the most common complication of erosion. Once hard tissue has been lost because of tooth erosion it will not be regained. Total destruction of the dental hard tissues is the worst scenario though seldom encountered today. Nevertheless, recognition of the problem and prompt prevention may lead to a limitation of the damage that would otherwise occur. This applies to erosion caused by intrinsic as well as extrinsic acid. Similarly preventing the other types of tooth wear, that generally proceed more rapidly once enamel has been eroded away, will improve the prognosis. It could be considered a complication of erosion that the teeth often require crowns to restore function and aesthetics. A major

complication of tooth erosion is the loss of vertical dimension caused by molar erosion. Restoring the dentition then requires the costly and technically more demanding restoration of the vertical height.

Prevention

With the high prevalence of tooth erosion recorded in some surveys, tooth erosion has now achieved the status of a community-wide dental problem in several countries. Nevertheless, true prevention is difficult to achieve. Much that can be done is aimed at limiting further erosion in individuals already found to be affected by this condition. Population-based strategies of prevention, such as widespread modification of the composition of soft drinks and educational campaigns to increase awareness of the causes of tooth wear may be possible. The groups most at risk of developing erosion are, however, teenagers and young adults, and these are rather resistant to the messages of health educators, at least when the message relates to reducing the consumption of erosive drinks that are so much a part of their lifestyle. More can possibly be done with an at-risk strategy aimed at specific individuals with early signs of erosion or with known risk factors for erosion, such as those taking erosive medicines and patients with bulimia. For such a strategy to work collaboration between the dentist and other health-care professionals is important. Topical fluoride, the mainstay of caries prevention, appears to protect against abrasion following acid challenge but has no direct effect in preventing erosion.

Drink modification has been developing in recent years with varying success. Calcium lactate has been shown to reduce the erosive potential of to Coca Cola® but this research does not appear to have been taken up by the manufacturer. The addition of calcium to low pH fruit drinks has been shown in *in-situ* and *in-vitro* studies to be less erosive than the same drinks without added calcium. Drink modification has considerable potential in combating erosion but clinical trials are needed.

Diet modification is a difficult area in which to achieve successful disease prevention. Nevertheless the strong links between dietary factors and tooth erosion make it sensible for the dental team to at least try to get patients with tooth wear to modify their diet. Consuming cheese or milk products after drinking an erosive beverage may promote re-hardening of the enamel. This is probably also a useful method of neutralising acid in the mouth after a bout of reflux or vomiting but patient compliance is perhaps questionable. Chewing-gum containing carbamide (urea) has been shown to raise salivary pH rapidly. This may, therefore, reduce the erosive effect of acid in the mouth.

The pattern of drinking erosive beverages is thought to contribute to tooth erosion especially when cola-type drinks are swished around the mouth before swallowing. Drinking through a straw has been shown to reduce the potential for tooth erosion from acidic drinks, especially on the palatal surfaces of the maxillary incisors that are most commonly affected in patients with erosion.

Dentists should advise their patients not to brush shortly after consuming carbonated drinks as this may increase loss of enamel. Similarly, mouth rinses with a low pH should not be recommended for prolonged use nor as pre-brushing rinses. Remineralizing toothpaste has been shown to increase the hardness of acid-treated teeth significantly more than conventional fluoride toothpastes in *in-vitro* studies.

Saliva and pellicle are important factors in protection of tooth substance against acid attack. Studies have shown that erosion is usually found in areas of the dental arches that are lacking in pellicle.

Increasing salivary flow will lead to greater accumulation of pellicle as well as increasing the buffering action of saliva and, consequently, will promote remineralization. Sugar-free chewing gum, fluoride-containing or carbamide-containing gum should be advised particularly for adolescents who may be least willing to limit their consumption of acidic beverages. A number of preparations intended to promote salivation are available for patients including those with dry mouth symptoms who may not be willing to chew gum. Profylin™ (Prophylactor AB, Sweden) and Xerodent™ (Dumex-Alpha, Denmark) lozenges are examples of such topical preparations and Xerodent™ has the added advantage of containing fluoride.

Reflux disease and vomiting are important causes of tooth erosion. Recognition of the erosion and presumptive diagnosis by the dentist should lead to appropriate referral for further investigation. Medication to reduce gastric reflux and acid production includes drugs such as over-the-counter antacids or prescription drugs such as omeprazole (Losec®), esomeprazole (Nexium®) and ranitide (Asyran®). Antacids may help and they may be kept in the mouth for a while before swallowing for a local buffering effect. Should hiatus hernia be diagnosed then surgical intervention may be necessary.



Figure 1 Characteristic smooth-appearing enamel surface of incisors, where the developmental ridges have disappeared because of erosion caused by excessive beverage use

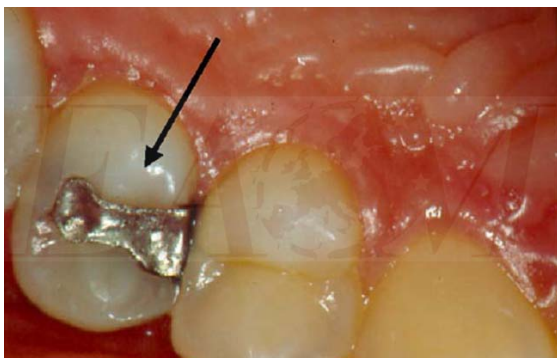


Figure 2 The arrow points at the margins of amalgam fillings, which appear elevated due to surrounding enamel dissolution caused by erosion.



Figure 3 2nd to 3rd grade erosion of teeth of a patient with long-term bulimia. Note the irregular appearance of the incisal edges.

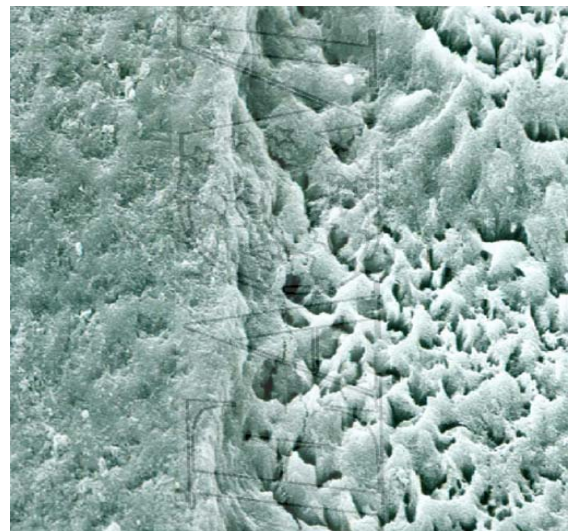


Figure 4 Scanning electron micrograph of eroded enamel (on the right) showing characteristic honeycomb structure of dissolved enamel prisms.

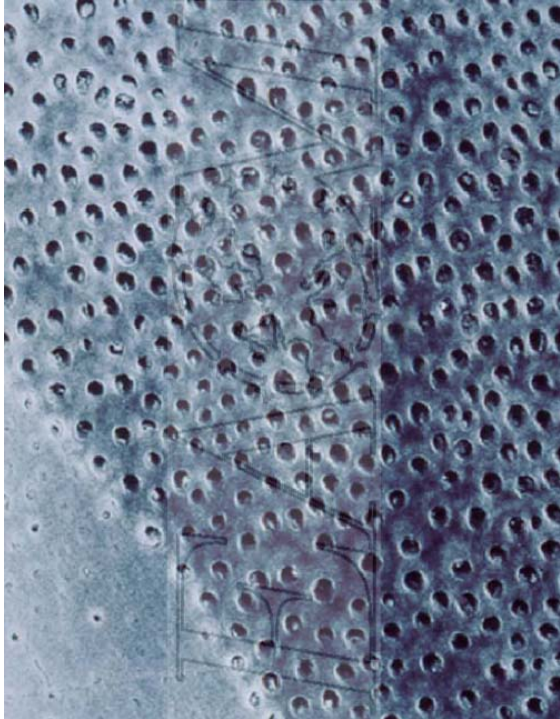


Figure 5 Scanning electron micrograph of eroded dentin (on the right) showing open dentin tubules caused by dissolution of the hard tissue

Further reading

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