

Dental Erosions: Diagnosis, Risk Factors

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Introduction

This survey paper discusses the clinical appearance and the risk factors for the occurrence of dental erosions. Tooth erosion is defined as superficial loss of tooth structure caused by a chemical process without involvement of bacteria (Zipkin and Mc Clure 1949). The erosion process can be divided into two stages: In the initial phase one finds softening of the tooth surface as consequence of partial demineralization. Remineralization is possible in this stage, since the still available enamel portions serve as framework in which minerals can be deposited again. In a second, advanced stage the structures of the superficial enamel layers are completely destroyed and dissolved away. Remineralization of these enamel portions is no longer possible. There can be remineralization of the deeper not yet totally destroyed but softened portions of the tooth structure. Usually there is an equilibrium in the oral cavity between demineralization and remineralization processes. If the acid action predominates over the restoration processes, there is a clinical manifestation of dental erosion. The loss of tooth structure is accelerated if abrasive and/or attritive processes are present in addition. This article deals firstly with diagnosis of erosion and then discusses the risk factors. A simple screening index is also discussed.

Clinical appearance

In the initial phase the enamel is demineralized, although softening of the surface cannot be determined clinically. Advanced erosions can extend down into the dentin. Vestibular erosions exhibit in the initial stage a silky-glazed appearance of the tooth, later an indented and stepped surface. An enamel ridge persists at the crown margin. The presence of this enamel ridge can be explained on one hand by plaque residues which form a diffusion barrier against the acid attack, on the other hand by the sulcus fluid which leads to neutralization of the acids in the gingival region (Lussi et al. 2004). Erosions in the occlusal region lead to a rounding of the cusps, grooves on the cusps and incisal edges (Fig. 1).



Fig. 1: Tooth 46 with occlusal erosive tooth wear, rounding of the cusps and grooves. Otherwise the tooth morphology is still quite clear. The commencing erosions correspond to BEWE score 1.

Restorations rising above the level of the adjacent tooth surfaces are typical. Extensive decalcification of the tooth structure is characteristic of palatal erosions. To record the progress of the erosion, photographs or models should be taken periodically. Figures 1 – 7 show typical pictures of dental erosions.



Fig. 2: Patient with a severe occlusal erosive tooth wear. Tooth 37 with occlusal erosions BEWE score 3. The morphology is almost entirely lost. The fissures can no longer be detected. Etiology: gastroesophageal reflux.



Fig. 3: Same patient as Figure 2. The original morphology of the teeth has been lost. Rounding of the cusps and grooves. Etiology: gastroesophageal reflux.



Fig. 4: Facial view of teeth 43 to 45 with commencing erosions BEWE score 1. Silky-glazed appearance of the surface. Slight indentation in tooth 44 from the vestibular aspect can be detected.



Fig. 5: Tooth 21 with BEWE score 3 labially. The surface structure has been lost. Cervically the dentin is exposed but the enamel along the gingival margin is intact. Etiology: frequent consumption of fruit and fruit juices.



Fig. 6: Tooth 43 with vestibular indentation located above the enamel cement border. Intact enamel along the gingival margin can be found. For tooth 44 the amalgam filling rising above the level of the adjacent tooth surface. Since less than 50 percent of hard tissue of the surface area is affected, this corresponds to BEWE score 2. Etiology: Consumption of around 1 kg apples per day.



Fig. 7: Severe oral erosive tooth wear. The erosions commence typically palatal. In teeth 22 and 23 the dentin is exposed over the entire palatal tooth surface (BEWE score 3). Etiology: gastroesophageal reflux.

Risk factors

Factors on the nutrition side (Fig. 8)

It has been known for a very long time that acidic foods and drinks can soften the tooth structure. The share of soft drinks and fruit juices in the total consumption of drinks is increasing constantly in Europe and is more than 50% of the consumption of non-alcoholic drinks. The erosive nature of a drink or food is determined only by several factors. Thus drinks and foodstuffs can have a different erosive potential despite similar pH values. The larger the buffer capacity of a drink or foodstuff, the longer will it take until the pH value can be increased by the saliva. The calcium and phosphate content of a drink or foodstuff is very important. Immersion of enamel samples in a calcium-enriched orange juice available commercially showed no softening of the enamel surface. This orange juice (pH 4) can also be recommended to patients at risk of erosion. Yoghurt as another example of a food that despite its low pH value (pH ~ 4) leads to no erosions. This fact can be attributed to the high concentration of calcium and phosphate which results in oversaturation of yoghurt with regard to the tooth structure. Enamel samples placed in orange yoghurt showed hardening of the enamel surface. By contrast to this, orange juice exhibited a high degree of softening of the enamel hardness (-209 Knoop hardness score) (Lussi and Jaeggi 2006). Mineral water was also found to be harmless with regard to erosions in other investigations (Parry et al. 2001).

Apart from the already discussed properties of erosive foods and drinks, there are still other factors influencing the occurrence of dental erosions *in vivo*. Thus, for instance, the chelator properties of acids can influence the erosion process; on one hand by interaction with the saliva, on the other directly by tooth structure dissolution. Up to 32% of the calcium in the saliva can be bonded in a calcium-chelator complex of citric acid (Meurman and Ten Cate 1996).

Factors on the patient side (Fig. 8)

The nature of the consumption of the erosive food or drink (sipping, sucking, with/without drinking straw) determines the duration as

well as the localization of the acid attack and thus the appearance of the erosions (Millward et al. 1997, Edwards et al. 1998, Johansson et al. 2004).

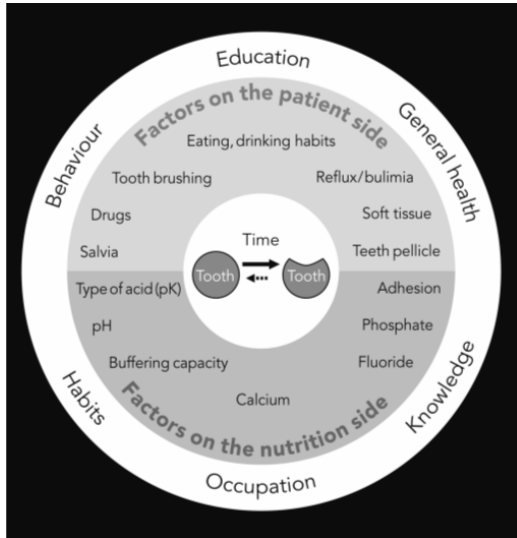


Fig. 8: Interactions of the different factors for the development of erosive tooth wear (Lussi et al. 2006)

The frequency and duration of acid attacks are of decisive importance for the destruction of the tooth structure and thus also for the adoption of prophylactic measures. Contact of the teeth with acids during the night can also lead to erosions because of the reduced production of saliva. Thus for example, apart from caries formation there can be massive erosive tooth structure destruction due to the consumption of acidic, sweet drinks, which some infants drink from their bottles continuously during the night. A splint worn in the night is also contraindicated for reflux patients, since the contact time of the gastric juices with the teeth is lengthened because of the splint not being tight all over.

Other risk factors on the patient side are anorexia and bulimia nervosa with frequent vomiting as well as chronic gastrointestinal disorders with reflux. The prevalence of bulimia nervosa in 18 to 35-year old women is relatively high in the western industrialized countries (5%) and is still rising (Cooper et al. 1987). Most patients who suffer under anorexia nervosa are 12 to 20 years old. The prevalence of anorexia is 2% in this age group (Diagnostic and statistical manual of Mental Disorders, DSM-III-R). With extremely underweight anorexia

patients, making a diagnosis is frequently not difficult. Bulimia patients maintain their normal weight as a rule, so that often several years can pass until their disease is recognized. Chronic vomiting leads as a rule to erosions in the region of the occlusal and oral tooth surfaces of the maxillary teeth, especially in the region of the incisors (Hellström 1977, Scheutzel 1992, Jones and Cleaton-Jones 1989, Milosevic and Slade 1989, Robb et al. 1995). Oral and occlusal erosions in the region of the maxillary teeth, a partially painful, metabolically induced enlargement of the parotid gland and sometimes submandibular salivary glands, xerostomia, erythemas in the region of the pharyngeal and palatal mucosa as well as painful reddening and swelling of the lips with peeling and rhagade formation are frequent symptoms in bulimia patients (Abrams and Ruff 1986). The occurrence of these symptoms and corresponding health and nutrition case history should arouse the suspicion of bulimia in the dentist. Frequently the dentist is the first medical person who detects the bulimia. But gastroesophageal reflux with regurgitation during sleep can also lead to serious erosive lesions. These patients frequently notice their complaint only if thermally sensitive teeth are present because of advanced erosions. Other symptoms are stomach aches, burning in the esophagus / pharynx region and an acid feeling in the oral cavity.

A further very important factor is the saliva. Some protective properties of saliva in an acid attack are: acid dilution, acid decomposition, acid neutralization, reduction of the enamel dissolution by the presence of calcium and phosphate ions in the saliva, remineralization and pellicle formation (Zero and Lussi 2000, Järvinen et al. 1991, Meurman et al. 1994, Lussi and Schaffner 2000, Eisenburger et al. 2001, Feagin et al. 1969, Gedalia et al. 1991, Zero et al. 1994).

A differing extent of pellicle formation in the region of the dental arch could be responsible for the different distribution of the erosions (Amaechi et al. 1999). Teeth with thick pellicle formation (mandibular teeth lingually) showed in the experiment (placing the teeth in orange juice for 2 hours) lower erosion, teeth with thin pellicle

formation (maxillary anterior teeth palatally) showed high erosion. In addition the clearance of acid in the lower jaw is better.

Risk quantification and prevention

As soon as erosions are determined clinically or there are signs of increased risk of erosion, the risk should be quantified accurately for the patient. The short examination (BEWE = **B**asic **E**rosive **W**ear **E**xamination) recently presented by Bartlett, Ganss and Lussi (Bartlett et al. 2008) is very suitable for quantifying the risk of erosions.

The BEWE score facilitates quick assessment of the acid damage of the teeth. It can be learnt easily and supports the examiner in the planning of the further management of the patient. All teeth, apart from the 3rd molars, are examined in each case from the vestibular, occlusal and palatal aspect for acid damage. Erosive defects of a tooth surface are classified into four scores (Table 1). No erosive tooth wear (0), initial loss of surface texture (1), distinct defect with hard tissue loss (2) and severe loss of hard tissue (3). Only the surface with the highest score is recorded for each sextant (17-14/13-23/24-27/37-34/33-43/44-47) (Table 2). The result of the BEWE is not only a measure of the severity of the condition, but, when transferred into risk levels, also a possible guide towards management of the patient (Table 3).

Assessment of loss of enamel / dentin exposure is dispensed with in principle. On the one hand this assessment is difficult and on the other hand a dentin invasion does not correlate in all cases with the severity of a defect, since the dentin layer is not equally thick all over. The dentin is exposed much faster in the cervical region or in the region of crevices. A source of error is eliminated

Score				
0	No erosive tooth wear			
1	Initial loss of surface texture			
2*	Distinct defect, hard tissue loss < 50% of the surface area			
3*	Hard tissue loss ≥ 50% of the surface area			

* in scores 2 and 3 dentine often is involved

Table 1: The basic examination for the dental erosion – Assessment criteria

by dispensing with the assessment and the comparison of the data of different examiners is simplified. In addition this index can be applied both to the patient himself and also to models or photos.

The repetition interval of the BEWE depends upon the degree of severity, upon etiological factors and other individual risk factors. In patients who are exposed to intrinsic or frequently and/or strongly erosive extrinsic acids, there should be a repetition half-yearly. In other cases an interval of 12 months or more is sufficient (cf. Table 3).

The other factors already discussed (see Fig. 8) should also be examined and evaluated. A detailed discussion with the patient can provide information about the etiology of the erosions. Frequently one consultation is not sufficient since the patient is not always conscious of his acid input. It can be appropriate to examine different parameters accurately. Thus it is important to have the food consumed written down in detail by the patient for a few days. When, what and how much of potentially erosive foods and drinks are consumed (main and intermediate meals) is interesting. A saliva analysis (flow rate, buffer capacity) should always be performed for erosion patients. Concrete advice on prophylaxis can be derived finally on the basis of this information (Table 4).

In endogenous acid exposure as occurs in anorexia / bulimia nervosa or gastroesophageal reflux, causal systemic therapy must be initiated. Anorexia and bulimia patients require psychological or psychiatric care. In reflux patients accurate clarification of the cause with subsequent treatment (medicinal or surgical) stands in the foreground.

BEWE record			
Highest score 1st sextant (17-14)	Highest score 2nd sextant (13-23)	Highest score 3rd sextant (24-27)	
Highest score 4th sextant (37-34)	Highest score 5th sextant (33-43)	Highest score 6th sextant (44-47)	Score sum

Table 2: The basic examination for dental erosion scores

Severity of the erosions	Cumulative score of all sextants	Management
None	≤ 2	<ul style="list-style-type: none"> • Routine maintenance and observation • Repeat BEWE at 3-year-intervals
Low	3 – 8	<ul style="list-style-type: none"> • Oral hygiene and dietary assessment and advice, routine maintenance and observation • Repeat BEWE at 2-year-intervals
Medium	between 9 – 13	<ul style="list-style-type: none"> • As above • + Consider fluoridation measures or other strategies to increase the resistance of tooth surfaces • Ideally, avoid the placement of restorations and monitor erosive wear with study casts, photographs or silicone impressions • Repeat at 6 -12 month intervals
High	≥ 14	<ul style="list-style-type: none"> • As above • + Especially in cases of severe progression consider special care that may involve restorations • Repeat at 6 -12 month intervals

Table 3: The guide to clinical management based on the BEWE. The recommendations for management of the patient are not directives, since the opinions of experts deviate strongly from one another in this connection.

It is expedient for patients with *active* erosive lesions to instruct them in adequate dental hygiene: The erosion patient must be advised not to clean his teeth after an erosive challenge. One must not forget that caries still represents the main problem. For prophylaxis against caries, the teeth must be cleaned immediately after the meal. It is important that a specialist provides optimum prophylactic advice individually. Only in this way can it be guaranteed that the adequate prophylactic steps are initiated and continued. In any case a low abrasive toothpaste, a soft toothbrush and a careful brushing technique should be used.

Summary

This overview paper discusses the multifactorial etiology of erosions. The clinical appearance and risk factors for their occurrence are described in detail and a new simple method for assessing the tooth structure (BEWE) is described. It is easy to

Locally:	<ul style="list-style-type: none"> • Control of the acid consumption: <ul style="list-style-type: none"> - Reduce consumption of acidic foods if possible and limit to as few as possible (main) meals • Controlling the acid action duration: <ul style="list-style-type: none"> - Drink drinks rapidly - After acid consumption rinse with water or low-concentration fluoride solution - After acid action / consumption use tooth-conserving chewing gum to stimulate the saliva flow rate • Control of dental hygiene: <ul style="list-style-type: none"> - Tooth cleaning not directly after exposure to acid - Soft toothbrushes - Weakly abrasive toothpastes - Fluoride toothpastes - Tooth-conserving brushing technique - Applying higher concentrated (slightly acid) fluorides regularly for a few minutes
Systemically:	<ul style="list-style-type: none"> • Initiation of causal therapy against endogenous acid exposure: <ul style="list-style-type: none"> - Suspicion of reflux: Referral to gastroenterologist - Anorexia-bulimia patients: Arrange for psychological or psychiatric care

Table 4: Preventive measures. The following advice applies for patients who already suffer under erosions of the tooth structure or have an increased risk of erosion.

perform since its procedure is based on the basic periodontal examination. It is important to distinguish whether a lesion is primarily an erosive or an abrasive process. Case history, findings and correct diagnosis here as well are essential prerequisites for adequate prevention and therapy. The dietary case history can provide information about nutrition habits or food supplements. Further quantification such as determining the flow rate, the pH and the buffer capacity of the saliva are important for assessing the risk of erosion of the patient (Lussi 2006).

For reference list please contact the author.