



Philipp Kanzow

## Etiology and pathogenesis of dental erosion

Philipp Kanzow, Dr med dent<sup>1</sup>/Florian J. Wegehaupt, PD Dr med dent<sup>2</sup>/Thomas Attin, Prof Dr med dent<sup>3</sup>/Annette Wiegand, Prof Dr med dent<sup>4</sup>

The condition of dental erosion is defined as acid-related loss of tooth structure which does not involve microorganisms. Depending on the origin of the acid, extrinsic (usually caused by acids in food) and intrinsic (caused by endogenous acid) erosion can be distinguished. The presence and severity of erosive defects depend on various parameters such as nutrition, saliva, general diseases, and mechanical stress by abrasion and attrition. As an example, dietary habits which involve frequent intake of acidic food and beverages, occupational

acid exposure, as well as certain drugs or diseases that affect saliva flow rate are accompanied by an increased risk of erosive dental hard tissue defects. By a thorough clinical examination and an accurate anamnesis, various erosion-related risk factors can be identified and strategies to reduce or eliminate these factors be identified. (*Quintessence Int* 2016;47:275–278; doi: 10.3290/j.qi.a35625; originally published in *Quintessenz* 2015;66(9):1013–1017)

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Dental erosion is defined as the irrevocable loss of tooth structure caused by the direct effect of acid on tooth surfaces.<sup>1</sup> In the initial stage, the effect is only limited to enamel, but can further extend into dentin. In advanced stages, the patient often notices painful hypersensitivities as well as esthetic or functional limitations. Erosive defects can etiologically be distinguished from primarily mechanically induced defects

such as abrasion and attrition. However, these various phenomena often clinically overlap and, therefore, make a precise differentiation difficult.

Based on the origin of the erosion-causing acids, a distinction between endogenous and exogenous erosions is made. Intrinsic erosion most often affects the palatal and occlusal tooth surfaces, while extrinsically triggered erosion is initially localized on the labial surfaces of the anterior teeth. Erosion in the initial stage appears as smooth silky-shining surface, resulting in concavities of smooth surfaces or a cupping of the cusps. The acid exposure leads to dissolution of the inorganic dental hard tissue, which results in a rough surface similar to an etching pattern. As a result, the microhardness of the superficial layer, and thus mechanical resistance, is reduced. With further progression, extensive loss of substance occurs. Dentin demineralization leads to the exposure of the organic matrix that acts as a diffusion barrier and is capable of reducing further erosion progression.<sup>2</sup>

<sup>1</sup> Assistant, Department of Preventive Dentistry, Periodontology and Cariology, University Medicine Göttingen, Göttingen, Germany.

<sup>2</sup> Senior Assistant, Clinic for Preventive Dentistry, Periodontology and Cariology, Center for Dental Medicine, University of Zurich, Zurich, Switzerland.

<sup>3</sup> Head of Department, Clinic for Preventive Dentistry, Periodontology and Cariology, Center for Dental Medicine, University of Zurich, Zurich, Switzerland.

<sup>4</sup> Head of Department, Department of Preventive Dentistry, Periodontology and Cariology, University Medicine Göttingen, Göttingen, Germany.

**Correspondence:** Dr Philipp Kanzow, Department of Preventive Dentistry, Periodontology and Cariology, University Medicine Göttingen, Robert-Koch-Str. 40, 37075 Göttingen, Germany.  
Email: philipp.kanzow@med.uni-goettingen.de



In addition to the type and frequency of acid exposure, modifying (host) factors determine the extent and progression of erosive defects. These factors include, in particular, saliva properties such as flow rate, buffering capacity, pH, and composition.

## SOURCES OF EXTRINSIC AND INTRINSIC ACIDS

### Extrinsic acids

Extrinsic acid exposures include the consumption of acidic food (eg, citrus fruits, soft drinks, wine, salad dressings; Fig 1), acidic drugs (eg, acetylsalicylic acid, iron tablets, vitamin C supplements), as well as occupational acid exposure (Table 1). Occupational acid exposure might affect industrial workers (eg, in battery, galvanizing, or ammunition factories), professional swimmers, and wine tasters.<sup>3-6</sup> Patients with eating disorders often show an increased consumption of acidic food (such as vinegar) or acidic diet soft drinks.<sup>7,8</sup>

The extent of dental hard tissue erosion is determined by the erosivity of the erosion-causing solution (pH, buffer capacity, and mineral concentration), and also by the frequency and type of consumption. Certain drinking habits (drinking in sips, use of a straw in direct tooth contact, and intensive rinsing) lead to a prolonged pH drop in the oral cavity compared to a short consumption.<sup>9</sup> Järvinen et al<sup>10</sup> have shown that the intake of citrus fruits more than twice daily, the daily drinking of soft drinks, and the weekly consumption of vinegar or sport drinks is capable of increasing the risk of dental erosion significantly. The risk for developing erosive lesions is also increased when children are drinking fruit syrup or soft drinks from a feeding bottle at bed- or nap-time.<sup>11</sup>

When dietary-related erosion is diagnosed, patients should be advised to restrict the consumption of acidic food and drinks to main meals. Acidic beverages should be consumed cooled and as fast as possible in order to reduce their erosivity.<sup>12,13</sup> The manufacturers of soft and sports drinks can reduce the erosive potential of the beverages by replacing strong demineralizing acids with those with a lower erosive potential and by the addition of calcium, phosphate, and fluoride ions. Also,



**Fig 1** Patient with erosive defects on labial surfaces due to excessive consumption of Coca-Cola.

Table 1	Examples of extrinsic acid sources	
Category	Examples	
Acidic food		Soft drinks
		Citrus fruits
		Salad dressings
		Vinegar
		Wine
Acidic drugs		Acetylsalicylic acid (aspirin)
		Iron tablets
		Vitamin C supplements
Occupational acid exposure	Acidic vapors	Battery factories
		Ammunition factories
		Galvanizing factories
	Liquids	Wine tasters
		Professional swimmers

the addition of calcium citrate or tricalcium phosphate can reduce the erosive potential of orange juice. It was shown that the addition of Ca<sup>2+</sup> effervescent tablets to orange juice reduced the erosivity, but did not have a negative impact on taste.<sup>14</sup> Yogurt contains quite high concentrations of calcium and phosphate concentration, and is therefore non-erosive despite its low pH.<sup>15</sup>

Staufenbiel et al<sup>16</sup> found that erosive lesions are more prevalent in patients with a vegetarian diet than in nonvegetarians. Besides the frequent consumption of fruits, vegetarians used less often fluoridated toothpaste or fluoridated salt.<sup>16</sup>

A comparison of the erosivity of different acid sources is difficult because not only purely chemical



**Figs 2a and 2b** Patient with bulimia. The incisal edges are distinctly shortened (a), as the palatal surfaces of the maxillary anterior teeth are mainly affected (b).



**Fig 3** Palatal and occlusal localized lesions due to gastroesophageal reflux disease.

**Fig 4** Patient with gastroesophageal reflux disease. Significant occlusal and palatal erosive defects: note the elevated fillings in the anterior and posterior region.

parameters (pH, proportion of free acid, concentration of calcium, phosphate, and fluoride ions), but also the adhesion to the tooth surface as well as dietary habits (frequency, quantity, temperature, etc) must be considered. In-vitro studies have compared the erosivity of different products by measuring surface hardness after a 2-minute exposure time. It was shown by Lussi and Hellwig<sup>17</sup> that diet Coca-Cola reduced microhardness twice as much compared to apple juice.

### Intrinsic acids

Intrinsic erosion is caused by acidic gastric fluid coming into contact with the oral cavity, eg in patients suffering from bulimia (bulimia nervosa; Fig 2), gastrointestinal reflux disease, or alcohol abuse.<sup>18,19</sup>

Eating disorders represent one of the most common psychosomatic disorders. Particularly young women between 15 and 25 years are often affected (prevalence

of 0.5% to 3%; the ratio of diseased women to men is 10:1).<sup>7</sup> Compared to anorexic patients and patients with other eating disorders, bulimic patients are more often affected by erosion due to the frequent vomiting.<sup>20</sup> Since gastric fluid has a pH of around 1 and a high amount of free acid, its erosive potential is higher than the erosive potential of extrinsic acids.<sup>21</sup> Furthermore, patients with eating disorders often show a lower salivary flow rate as a result of general dehydration or as a side effect of psychotropic drugs, which might further increase the risk for developing erosive lesions.

Also, patients suffering from gastrointestinal reflux (Figs 3 and 4) are often affected by erosive tooth loss, as a malfunction of the esophageal sphincter allows acidic stomach content to come into contact with the oral cavity. The prevalence of dental erosion in reflux patients amounts to 17% to 68%. Conversely, 25% to 83% of all patients with erosion suffer from reflux.<sup>22</sup>



Chronic alcohol abuse is often associated with frequent vomiting and can cause gastrointestinal reflux. In addition, alcoholics consume potentially erosive alcoholic beverages on a regular basis. In several studies an increased prevalence of dental erosion was observed in alcohol-dependent patients.<sup>23,24</sup> The severity of erosive lesions depends on the severity of reflux disease.<sup>25,26</sup>

### Treatment of patients with dental erosions

Besides a thorough clinical examination, an accurate medical history is necessary to identify potential risk factors as early as possible. The medical history includes questions about nutrition habits (frequency of consumption of erosive food and drinks), general diseases, medication, and environmental factors (occupation, hobbies, etc). Records of dietary intake might be helpful.

Endogenous erosive lesions indicating the presence of gastrointestinal or eating disorders require further general medical or psychologic examination.

Salivary tests can be used to determine saliva flow rate as well as pH buffering capacity. Especially in high-risk patients, intensive dental care is necessary to decelerate the progression of erosive lesions. Additionally, the size of erosive defects can be monitored with photos or models as well as by using adequate indices, such as the “Basic Erosive Wear Examination”.<sup>27</sup>

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