

Ask the Experts

DENTAL EROSION

Guest Expert

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Editor's Note: If you have a question on any aspect of esthetic dentistry, please direct it to the Associate Editor, Dr. Edward J. Swift, Jr. We will forward questions to appropriate experts and print the answers in this regular feature.

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QUESTION: I seem to be seeing more and more eroded teeth in my practice. Can you shed any light on the nature of this problem?

ANSWER: Indeed, North Americans are experiencing what might be described as an epidemic of dental erosion. Erosion is defined as chemical loss of tooth structure without the involvement of bacteria. Three main groups of patients are at risk: teenage males primarily as a result of the ingestion of large amounts of acidic beverages, teenage females (bulimia), and the elderly. The latter are at risk because a very high percentage of them are taking multiple xerogenic medications for systemic ailments and the lack of salivary protection makes their teeth unusually vulnerable to acid attack.

Once the clinical dentist recognizes that the patient is a victim of dental erosion, it becomes imperative to determine the etiology of the erosion. There are two types of dental erosion. The first is extrinsic erosion that results from the ingestion of acidic foods and beverages. The second is intrinsic erosion that results from gastric refluxate entering the oral cavity. The critical pH of enamel (pH at which it begins to dissolve) is 5.2. Citrus fruits and beverages have a pH of about 1.7 and gastric refluxate is generally < 2 , both of which are clearly well below the critical pH.

The pattern of tooth structure loss provides a major clue as to the origin of the acid creating the destruction. Extrinsic dental erosion generally occurs on the labial surfaces of the anterior teeth, the buccal surfaces of the posterior teeth, and the occlusal surfaces of the mandibular posterior teeth (Fig. 1). Intrinsic erosion generally is seen on the palatal surface of the maxillary teeth and the occlusal surfaces of the mandibular molars (Fig. 2). Thus, depending on the location of erosive tooth loss, the clinician can begin a directed approach to determining the specific erosive etiology.

If extrinsic erosion is the suspected culprit, a diet analysis should be done. This should include everything ingested over four days, with two of those days being on the weekend as the weekend diet often varies considerably from the weekday. Foods that have a very high erosive potential include anything containing citric acid (fruits and beverages), most soft drinks, vinegar, white and red wines, herbal teas, sports drinks, power drinks, sour candies, and chewable vitamins. Erosion is also seen in patients with vegetarian diets and in competitive swimmers (pH of the pool water). Thank goodness beer has a relatively low erosive potential!! Table 1 lists the acidities of many foods associated with extrinsic erosion. Both the pH of a food and its titratable acidity (amount of acid/volume) are important factors in the amount of erosive tooth wear that might occur.

The primary causes of intrinsic erosion are bulimia in teenage girls and gastroesophageal reflux disease (GERD) in middle-aged males. The patterns of tooth structure loss are similar because the cause is the same: gastric acid. For some GERD patients, the tooth structure loss is unilateral. This occurs when the patient routinely sleeps on one side and the acid pools on that side of the mouth.

Dental erosion has three primary signs. The first is cupping of the cusps (Fig. 3), which is pathognomonic of dental erosion. The second sign is restorations “standing proud” (Fig. 4), which occurs because the tooth structure surrounding the restorations dissolves

much more rapidly than the restorative material. The third sign is loss of enamel morphology and is described as the “whipped clay effect” (Fig. 5).

In a high percentage of adult patients, slight cupping of the mandibular first molar cusps will be documented, with no other signs of dental erosion detected. This results from the fact that a high percentage of young children have episodic GERD that resolves on its own after a few years. The first molars are at risk because they are erupted in the oral cavity at that time, while none of the other permanent posterior teeth are exposed to the acid. No treatment is recommended for these patients.

With patients suffering from extrinsic erosion, once the erosive agents are discovered, counseling and behavior modification can be effective in preventing further destruction. With bulimic patients, it is critical that the patient acknowledges the eating disorder and that they complete an ongoing program of psychological counseling before initiating definitive dental treatment. GERD patients may or may not be aware of their problem (25% of them have “silent” GERD with no symptoms), and may require treatment from a gastroenterologist.

When a patient with extensive erosive tooth wear consistent with intrinsic erosion is identified and there is no history of GERD or bulimia, silent GERD should be suspected. These patients should be questioned about the incidence of belching, heartburn, stomach aches, acidic taste in the mouth, hoarseness, coughing, spontaneous vomiting, halitosis, choking and excess salivation. GERD is associated with the development of Barrett’s esophagus, a metaplasia that can progress to esophageal cancer. Early detection might well save a patient’s life.

As a profession, dentistry has long recognized the benefits of prevention as opposed to irreversible treatment. Undiagnosed dental erosion can eventually lead to extensive erosive tooth wear requiring time-consuming, expensive interdisciplinary care. Recognition of the early signs of dental erosion helps ensure that effective preventive strategies can be implemented to prevent further extensive destruction of tooth structure.

Management of Dental Erosion

Once the clinician has recognized a pathologic pattern of erosive tooth wear, a structured protocol should be initiated to institute strategies to prevent the continuation of tooth structure loss.

- 1. *Identify the source of the erosive tooth wear.*** The pattern and location of the erosive tooth wear often gives clues as to the cause. Extrinsic erosion from the ingestion of acidic foods and beverages occurs primarily on the labial surfaces of anterior teeth, the buccal surfaces of posterior teeth and the occlusal surfaces of molar teeth. Intrinsic erosion (bulimia and GERD) primarily occurs on the palatal surfaces of maxillary teeth and the occlusal surfaces of the mandibular molars. It is important to realize that some patients can experience both types of erosion simultaneously. If extrinsic erosion is suspected, a four-day diet analysis should be conducted (two days on weekends) to try to determine the causative agents. Patients should be counseled to change their eating habits and reduce the intake of

acidic foods and beverages. If eliminating the drinking of acidic beverages is not possible, drinking them rapidly with a straw is less destructive than sipping them slowly.

2. ***If intrinsic erosion is suspected referral to a physician is indicated.*** Bulimic patients should be referred for psychological counseling prior to initiating definitive dental treatment. Suspected GERD patients should be referred to a gastroenterologist for definitive diagnosis and treatment.
3. ***Reduce acid intake.*** With both intrinsic and extrinsic erosion, it is desirable to reduce the total intake of acidic foods and beverages. After diet analysis, recommendations should be made to reduce both the amount and frequency of ingestion, as well as suggestions for appropriate substitutions.
4. ***Reduce the level of oral acidity.*** Frequent chewing of sugar-free antacid medications will help to reduce the acidity and also to improve salivary flow rates. Rinsing with water and chewing these mints immediately after acid challenges can provide benefits.
5. ***Increase salivary flow rates.*** Patients with reduced salivary flow rates are especially vulnerable to dental erosion. Elderly patients on multiple xerogenic medications are particularly at risk as are any patients subject to dehydration such as athletes and workers in hot environments. Bulimic and GERD patients are also frequently dehydrated and have reduced salivary flow rates. Saliva is a wonderfully protective substance and works by diluting and clearing the acid, by buffering the acid and by supplying the necessary calcium and phosphorus for remineralization. There are three primary strategies for improving salivary flow rates:
 - a. Use of sugar-free antacids.
 - b. Xylitol chewing gum. Xylitol is a well-documented medication that protects against both root caries and erosion. It acts by stimulating salivary flow rates and, by causing a mutation of *S. mutans* to a less acidogenic form. Erosion patients should be instructed to chew a xylitol containing chewing gum immediately after every meal for five minutes by the clock, and after major acid challenges. One excellent xylitol product is Hershey's (Hershey, PA, USA) Ice Cube Chewing Gum. This gum comes in several flavors, has a high concentration of xylitol, and seems to be well-liked by patients.
 - c. Prescribing pilocarpine (Salagen, MGI Pharma, Bloomington, MN, USA) in consultation with the physician may be considered in xerostomic patients. If improving salivary flow rates is an important strategy for a patient, it is very useful to get baseline data on flow rates before initiating therapy. A kit is available to determine stimulated flow rates, salivary pH, and buffering capacity (Saliva Check, GC America, Alsip, IL, USA).
6. ***Remineralize eroded areas.*** Erosive tooth wear occurs slowly over time and basically is a battle between factors that demineralize the teeth and factors that

remineralize them. Fluoride and amorphous calcium phosphates are the primary weapons to facilitate remineralization.

- a.* Fluoride varnish (e.g., Vanish, 3M ESPE, St. Paul, MN, USA) should be applied every three months.
 - b.* Prescription fluoride toothpaste (e.g., Clinpro 5000, 3M ESPE) should be recommended for daily use.
 - c.* Amorphous calcium phosphate (MI Paste, GC America) should be applied nightly either by rubbing it on the teeth with a finger or in a bleaching tray.
 - d.* Eating foods such as cheese that contain significant amounts of calcium and phosphorus immediately after acid challenges can assist in remineralization.
- 7. *Reduce abrasion.*** The routine use of soft bristle brushes and non-abrasive toothpastes is recommended. In addition, it is important to understand that erosive tooth wear is caused by a process called perimolysis. The tooth structure is first etched by the acid, and then the tooth structure is abraded away by the muscular action of the tongue and muscles of facial expression. Without the action of the muscles, minimal amounts of tooth structure are lost. Erosion patients should be educated to do the following immediately after a significant acid challenge:
 - a.* Rinse the mouth with water. This will eliminate most of the acid.
 - b.* Rinse with sodium bicarbonate. This will neutralize remaining acid.
 - c.* Rinse with a fluoride mouthwash. This will help remineralize the etched tooth structure.
- 8. *Protect exposed dentin with a filled resin.*** Use of a filled dentin adhesive such as OptiBond FI (Kerr, Orange, CA) will protect the dentin from further acid attack. It is not known how frequently this must be re-applied so patients should be examined every three months and the primer can be re-applied as deemed necessary.
- 9. *Fabricate an occlusal nightguard.*** If an erosion patient also has a bruxism habit, a nightguard should be fabricated and the patient educated on the importance of wearing it nightly. The author prefers a hard/soft type appliance (Comfort Zone, Drake Precision Dental Laboratory, Charlotte, NC, USA), as it appears that patient compliance is substantially improved over that seen with hard nightguards. Soft nightguards should NOT be used with bruxism patients as these have been shown to actually trigger additional bruxing behavior.
- 10. *Restore as necessary.*** Restorations should be accomplished using the most conservative approach. This would include sealants, composite resin restorations and the full range of indirect restorations where indicated. With bulimic patients, definitive restorations should be delayed until the physician indicates the behavior is under control. These patients should be placed on a strict three-month recall to monitor potential relapse.

SUGGESTED READING or REFERENCES

1. Gandara, BK and Truelove. EC: Diagnosis and management of dental erosion. *J Contemp Dent Pract* 1999; 1: 16 – 23.
2. Bartlett, D, Phillips, K and Smith, B: A difference in perspective: The North American and European interpretation of tooth wear. *Int J Prosthodont* 1999; 12: 401 – 408.
3. Bartlett, D: A new look at erosive tooth wear in the elderly. *J Am Dent Assoc* 2007; 138: 21S – 25S.
4. Lussi, A, Hellog, E., Zero, D and Jaeggi, T: Erosive tooth wear: Diagnosis, risk factors and prevention. *Am J Dent* 2006; 19: 319 – 325.

Illustrations

- Fig. 1. The mandibular teeth of this patient who sucked lemons daily for 40 years shows typical tooth structure loss associated with extrinsic erosion (buccal and occlusal surfaces).
- Fig. 2. The tooth structure loss with intrinsic erosion associated with bulimia and GERD typically occurs on the palatal surfaces of the maxillary teeth.
- Fig. 3. Cupping of cusps is a pathognomonic sign of dental erosion.
- Fig. 4. These amalgam restorations are “standing proud” as a result of extrinsic dental erosion.
- Fig. 5. The maxillary anterior teeth have been eroded by excessive consumption of diet cola and display what is described as the “whipped clay effect.”

Table 1: pH of common foods and beverages

Fruits	pH Range	Fruits	pH range
Apples	2.9 – 3.5	Lemons/limes/juice	1.8 – 2.4
Apricots	3.5 – 4.0	Oranges/juice	2.8 – 4.0
Grapes	3.3 – 4.5	Pineapple/juice	3.3 – 4.1
Peaches	3.1 – 4.2	Blueberries	3.2 – 3.6
Pears	3.4 – 4.7	Cherries	3.2 – 4.7
Plums	2.8 – 4.6	Strawberries	3.0 – 4.2
Grapefruit	3.0 – 3.5	Raspberries	2.9 – 3.7
Beverages	pH Range	Beverages	pH Range
Cider	2.9 – 3.3	Grapefruit Juice	2.9 – 3.4
Coffee	2.4 – 3.3	7-Up	3.5
Black tea	4.2	Pepsi	2.7
Herbal tea	3.15	Dr. Pepper	2.92
Beer	4.0 – 5.0	Coca-Cola	2.7
Wine	2.3 – 3.8	Root beer	3.0
Ginger ale	2.0 – 4.0	Orange Crush	2.0 – 4.0
Mountain Dew	3.22	Nestea	3.04
Gatorade	2.95	Squirt	2.85
Snapple Lemonade	2.64	Red Bull	3.32
Condiments	pH Range	Condiments	pH Range
Mayonnaise	3.8 – 4.0	Cranberry sauce	2.3
Vinegar	2.4 – 3.4	Sauerkraut	3.1 – 3.7
A-1 Sauce	3.4	Relish	3.0
Mustard	3.6	Ketchup	3.7
Salad dressing	3.3	Sour cream	4.4
Other	pH Range	Other	pH Range
Yogurt	3.8 – 4.2	Tomatoes	3.7 – 4.7
Pickles	2.5 – 3.0	Fermented veggies	3.9 – 5.1
Rhubarb	2.9 – 3.3	Fruit jam/jellies	3.0 – 4.0
Battery acid	1.0	Gastric refluxate	1.6 – 1.9