

Dental Erosion in Children

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ABSTRACT

Dental erosion or chemical wearing away of the tooth structure is a dental health problem of the modern world and if not detected early, may result in serious irreversible damage to the dentition. An awareness of its clinical appearance, etiology, and risk factor is important to plan the preventive and curative management of such problems.

This paper discusses the diagnostic protocol along with preventive and various restorative options available to treat this multifactorial nature of tooth wear.

Keyword: Tooth Erosion, tooth wear, gastroesophageal reflux disease (GERD), and diet eating disorders.

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J Oral Health Comm Dent 2009;3(3):56-61

Dental erosion according to Pindborg (1) is a superficial loss of dental hard tissue by a chemical process that does not involve bacteria. Dental erosion seems to be a problem for the dental profession in this millennium. It is still doubtful if this is due to a true increase in its prevalence or the dental profession has become more aware of the condition with better diagnostic acumen.

However, it is more worrying when this condition is found in an alarming proportion among children. The UK Child Dental Survey(2) in 1993 found that there were over 50 per cent of five year old children with erosion in their primary incisors and 25 per cent of 12 to 14 year old children had their permanent dentition affected. If this condition is not controlled and stabilized, the child may suffer from severe tooth surface loss, tooth sensitivity, over closure, poor aesthetics, or even dental abscesses in the affected teeth. The aim of this article is to review the etiologies related to dental erosion, its accurate diagnosis and provide recommendations for effective management of this problem.

Classification of Dental Erosion

Tooth erosion is classified under idiopathic, extrinsic or intrinsic, employing that, according to the case history, the acids producing tooth destruction may be of unknown, exogenous or endogenous origin.

Idiopathic Erosion

Idiopathic erosion is the result of contact with acids of unknown origin where neither any tests nor the history taking are capable of providing an etiologic explanation. It is apparent that many, if not most, clinical case reports of enamel erosion in the literature reflecting idiopathic erosion, are the result of a multifactorial aetiology that has not been elucidated.

Extrinsic Erosion

Extrinsic erosion is the result of exogenous acid that can be airborne contaminants of the work environment, or acidic water in swimming pool, a side effect of gas chlorination leading to the formation of hydrochloric acid. Severe cases have been attributed to oral administration of medications such as iron tonics and acidic preparations used to dissolve small renal calculi. Dietary acids, however, are undoubtedly the principal causative factor for extrinsic tooth erosion. The most frequently consumed, potentially damaging acids are fruit acids and phosphoric acid in fruit juices and soft drinks.(3) More recently ascorbic acid added to a wide variety of drinks and candies has been identified as a possible cause for extrinsic erosion in susceptible individuals.(4)

Intrinsic Erosion

Intrinsic erosion is the result of endogenous acid, or gastric acid contacting the teeth during recurrent vomiting,

regurgitation or reflux. Eating disorders of psychosomatic origin such as nervous vomiting, anorexia nervosa or bulimia are often the cause of regurgitation or vomiting, which in these cases is self induced. Pregnancy, alcoholism, antabuse treatment for alcoholics and gastrointestinal disorders such as gastric dysfunction, chronic constipation, hiatus hernia, duodenal and peptic ulcer and gastroesophageal reflux disease are amongst the most common causes of systemic origin. Recently a study has reported a increased prevalence of erosion in asthmatic children. This was attributed both to anti asthmatic medications and association of Gastroesophageal Reflux Disease (GERD) with asthma.(5)

Index for the Measurement of Erosion

A new index designed especially for children has been proposed by O'Sullivan (2000).(6) This index has 3 codes that measure the site, the severity and the area affected by erosion.

Etiology

Erosion is the result of various extrinsic and intrinsic causes.

- **Extrinsic causes** include acidic beverages, foods, medications and environmental acids.

- ◆ **Dietary acids:** most of the fruits and fruit juices, carbonated drinks and sports drinks have a low pH rendering them acidic in nature. Time and again various studies have proved the direct relationship of erosion with higher consumption of acidic beverages. This finding is particularly important since children and adolescents are the primary consumers of these drinks making them prone to erosion.(7,8)

However, erosive potential of a beverage is not dependent on pH alone. Other factors like mineral content of the beverage, frequency, method of intake and proximity of toothbrushing after intake also influence the susceptibility to erosion. For e.g. drinking from a straw decrease the contact time of acidic beverage with teeth as compared to drinking from the cup.(10)

- ◆ **Medications:** acidic medications such as Vitamin C supplements or hydrochloric acid supplements may also



Fig. 1: Dental Erosion in an Adolescent

lead to erosion via direct contact with teeth while chewing.(11, 12,13)

- ◆ **Occupational and recreational exposures:** certain occupations predisposes an individual to acid environment. For e.g. occupational wine tasters, people working in industrial electrolytic processes. Acidic vapours in the environment have significant erosive potential. Dental erosion has also been reported in swimmers who workout regularly in pools with excessive acidity.(14,15)
- **Intrinsic Causes:** Intrinsic causes of erosion comprise of gastric acid regurgitation into the oesophagus and mouth in conditions such as gastroesophageal reflux disease and excessive vomiting related to eating disorders. Gastric acids with low pH reach the oral cavity and come in contact with teeth leading to erosive wear of teeth.
 - ◆ Gastroesophageal reflux disease (GERD): it is a condition in which contents pass involuntarily into esophagus and escape into the mouth. This may be caused by increased abdominal pressure, improper relaxation of lower esophageal sphincter on increased acid production by stomach.(16) Though disease produces various symptoms in most of the patients, it can also be silent with patient unaware of this condition until dental changes elicit assessment for this condition.

Table 1- Index for Measurement of Erosion

Site of Erosion on each Tooth	Grade of Severity (worst score for individual tooth recorded)
Code A Labial or buccal only	Code 0 Normal Enamel
Code B Lingual or palatal only	Code 1 Matt appearance of the enamel surface with no loss of contour
Code C Occlusal or incisal only	Code 2 Loss of enamel only (loss of surface contour)
Code D Labial & incisal/ occlusal	Code 3 Loss of enamel with exposure to dentin (Enamo Dental Junction)
Code E Lingual and Incisal / occlusal	Code 4 Loss of enamel and dentin beyond (Enamo Dental Junction)
Code F Multi - Surface	Code 5 Loss of enamel and dentin with exposure of pulp
	Code 9 Unable to assess
Area of surface affected by erosion	Code - Less than half of surface affected
	Code + More than half of surface affected

Table 2: Acidity of Common Foods and Beverages(9)

Beverages	pH Range	Beverages	pH Ranges
Cider	2.9-3.3	Grapefruit/ Juice	2.9-3.4
Coffee	2.4-3.3	7 Up	3.5
Tea (black)	4.2	Pepsi	2.7
Beers	4.0-5.0	Coke	2.7
Wines	2.3-3.8	Root beer	3.0
Ginger ale	2.0-4.0	Orange Crush	2.0-4.0

(Clark DC, et al. 1990)

Dental erosion associated with GERD has also been reported in children.(17,18) It affects all age groups from infancy to teenagers. Though the severity of erosion in children is less than that of adults, this may be attributed to a conscious efforts by parents on restricted intake of acidic beverages of children.

A high incidence of GERD is also reported in children with cerebral palsy. Additionally they also have increased tendency towards bruxism. Both these factors put these children at a greater risk for erosion.(19)

- ◆ **Chronic excessive vomiting** is also one of the major intrinsic causes of erosion. Erosion associated with vomiting is primarily seen on the palatal surfaces of maxillary teeth as during the episodes of vomiting the acidic gastric contents frequently come in contact with palatal surfaces of maxillary teeth.(20)

Chronic vomiting results from eating disorders such as anorexia and bulimia which is a common problem seen in teenagers esp. girls. Other causes of chronic excessive vomiting include alcoholism, GIT disorders like peptic ulcers or gastritis, drug side-effects, diabetes or nervous system disorders.

Biological Modifying Factors

Many biological modifying factors that influence erosion caused by acidic food and drinks include: saliva, tooth composition and structure, dental anatomy and occlusion, the anatomy of soft tissues in relation to the teeth and physiological soft tissue movements such as swallowing patterns. The impact of each of these factors is summarized below.

Saliva

Saliva is known to have many properties that can serve a protective function against dental erosion.

- Dilution and clearance of a potentially erosive agent from the mouth;
- Neutralization and buffering of dietary acids.
- Formation of the acquired pellicle by the adsorption of salivary proteins and glycoproteins, which have the ability

to protect the enamel surface from demineralization by dietary acids.

- Presence of calcium, phosphate and fluoride necessary for remineralization.

There is a clear relationship between reduced salivary flow rate and the inability to clear dietary acids from the mouth. In addition, the bicarbonate level in saliva is positively correlated with salivary flow rate; therefore, saliva produced at a low flow rate has a lower pH and has a lower buffering capacity.(21, 22). McCay CM, Will L(23) have reported lowered salivary flow rate and buffer capacity in patients with erosion as compared to that of controls. In addition several medications of diseases also reduce the salivary flow rate. Therefore it is important to assess their salivary characteristics when evaluating a patient with erosion.

Tooth composition and structure

The composition of human teeth is known to be highly variable with respect to trace element concentrations. Various clinical studies have shown marked difference in the response of various human to acid beverages that could be attributed to difference in tooth structure and composition.

Dental anatomy and occlusion

The shape and contour of teeth and their prominence in the mouth relative to drinking and swallowing patterns have been identified as factors that may modify the erosion process. Acid eroded enamel is considered more susceptible to attrition, and thus, dental occlusion is likely to play an important role in the manifestation of erosion induced tooth wear patterns. Conversely, tooth wear, primarily caused by parafunctional habits such as bruxism, will be greatly accelerated in the presence of an erosive challenge to the teeth.

Anatomy of the soft tissue and physiological soft tissue movement

The anatomy of oral soft tissue in relation to the teeth and physiological soft tissue movements can also influence the tooth sites that frequently come in contact with and will thus influence the clearance pattern of acidic substances from the mouth. Soft tissue may also play a more direct role in tooth wear. Jarvinen *et al.* (24) observed that the most severe erosion was found on the palatal surface of teeth touched by the tongue with a lower pH.

Clinical Features of Erosive Lesion

Early stages of an erosive lesion results in matting appearance of enamel surface, most frequently on the labial and buccal surfaces. But proximal and lingual surfaces may also be involved and as in acid regurgitation and bulimia. Clinically the loss of tooth substance is manifested by a shallow, broad, smooth, highly polished wedge shaped depression on enamel surface adjacent to the cemento enamel junction. Some cases

of erosion that progress to involve dentin provoke secondary dentin formation that might protect the tooth against pulp exposure. However, caries is an uncommon occurrence in patients with erosion because eroded teeth do not tend to retain plaque.

Diagnosis of Dental Erosion

Detailed familiarity with the current science of dental erosion aetiology and a differential diagnosis are critical before any dietary or behavioral pattern can be associated with the observation of tooth structure loss. Intraoral photographs for documentation and study models to monitor progression are equally necessary. Further, salivary tests including unstimulated and stimulated flow rate as well as buffering capacity should be performed. A thorough case history will also undoubtedly involve consultation with the patient's physician.

- **Medical history** must include information regarding any systemic conditions that influence the salivary flow, use of any chronic medication, gastric reflux, heartburn, acid mouth taste frequent vomiting and so forth.

Since high intake of acidic foods and beverages have been strongly associated with erosion. Therefore a thorough diet record of each and every patient must be noted down. The diet record of each and every patient should include everything ingested in period of at least last five days. This must also include frequency of intake and manner of ingestion of acidic foods and beverages.

- **Dental history** regarding jaw parafunction and bruxism should also be taken. Patient's occupation and recreational habits must also be recorded in the history.

Table 3: A brief protocol for diagnosis of dental erosion is presented

I. OBTAIN HISTORICAL DATA. CHECK FOR FOLLOWING ITEMS	
<p>Medical History</p> <ul style="list-style-type: none"> ● Excessive vomiting, rumination ● Eating disorder ● Gastroesophageal reflux disease ● Symptoms of reflux ● Frequent use of antacids ● Alcoholism ● Autoimmune disease (Sjogren's) ● Radiation tx of head and neck ● Oral dryness, eye dryness ● Medications that cause salivary hypofunction ● Medications that are acidic 	<p>Oral Hygiene Methods</p> <ul style="list-style-type: none"> ● Toothbrushing method and frequency ● Type of dentifrice (abrasive?) ● Use of mouthrinses ● Use of topical fluorides
<p>Dietary History</p> <ul style="list-style-type: none"> ● Acidic foods and beverage frequency ● Method of ingestion (swish, swallow?) 	
<p>Occupational/ Recreational History</p> <ul style="list-style-type: none"> ● Regular swimmer? ● Wine-tasting? ● Environmental work hazards? 	
II. PERFORM PHYSICAL ASSESSMENT, OBSERVE FOR FOLLOWING FEATURES	
<p>Head and Neck Examination</p> <ul style="list-style-type: none"> ● Tender muscles (bruxism?) ● Masseteric muscle hypertrophy (bruxism?) ● Enlarged parotid glands (autoimmune disease, anorexia, alcoholism) ● Facial signs of alcoholism: <ul style="list-style-type: none"> ◆ Flushing, puffiness on face- ◆ Spider angiomas on skin 	<p>Intra-Oral Examination</p> <ul style="list-style-type: none"> ● Signs of salivary hypofunction: <ul style="list-style-type: none"> ◆ Mucosal inflammation ◆ Mucosal dryness ◆ Unable to express saliva from gland ducts ● Shiny facets or wear on restorations (bruxism?) ● Location and degree of tooth wear (document with photos, models, radiographs)
<p>General Survey</p> <ul style="list-style-type: none"> ● Underweight (anorexia) 	<p>Salivary function assessment</p> <ul style="list-style-type: none"> ● Flow rate ● pH, buffer capacity (in research)

Management of Erosion

Treatment of Etiology

Identification of the etiology is the most important step in management of erosion. For e.g. in case of excessive intake of acidic foods and beverages, patient's education and counselling is important. A patient with GERD must be referred to a medical doctor for treatment before instituting any dental treatment. Patients with reduced salivary flow such as in cases of Sjogren's syndrome or radiation therapy in head of neck region may benefit with the use of sugarless chewing gum, mint or even medications like pilocarpine.

A complete clinical management follows the identification of cause for erosion. It comprises of

- Preventive management
- Restorative Management

Preventive Management

The key elements in the prevention of dental erosion irrespective of the etiology of erosion, include patient education and compliance with diet modification, occlusal splints etc. a complete protocol for prevention of erosion is given in Table 4.

Restorative Management(25)

The loss of tooth tissue sometimes needs active treatment along with preventive measures. These include adhesive restorations and cast alloy restorations for palatal and occlusal

Table 4: Preventive Measures

Diminish the frequency and severity of the acid challenge

- Decrease amount and frequency of or drinks.
- Acidic drinks should be drunk quickly rather sipped. The use of a straw would reduce the erosive potential of soft drinks.
- If undiagnosed or poorly controlled gastroesophageal reflux is suspected, refer to a physician.
- In the case of bulimia, a physician or psychologist is appropriate.
- A patient with alcoholism should be in seeking treatment in rehabilitation programs.

Enhance the defense mechanisms of the body (increase salivary flow and pellicle formation)

- Saliva provides buffering capacity that resists acid attacks. This buffering salivary flow rate.
- Saliva is also supersaturated with calcium and phosphorus, which inhibits demineralization of tooth structure.
- Stimulation of salivary flow by use of a sugarless *lozenge*, candy or gum is recommended

Enhance acid resistance, remineralization and rehardening of the tooth surfaces

- Have the patient use daily topical fluoride at home.
- Apply fluoride in the office 2-4 times a year. A fluoride varnish is recommended.

Improve chemical protection

- Neutralize acids in the mouth by dissolving sugar-free antacid 5 times *a day*, particularly .after an Intrinsic or extrinsic add challenge,
- Dietary components such as hard (provides calcium and phosphate) can be held in the mouth after acidic challenge (e.g., hold cheese in mouth for a few minutes after eating a fruit salad)

Decrease abrasive forces

- Use soft toothbrushes and dentifrices low in abrasiveness in a gentle manner.
- Do not teeth immediately after an acidic challenge to the mouth, as the teeth will abrade easily.
- Rinsing with water is better than brushing immediately after an acidic challenge.

Provide mechanical protection

- Consider application of composites and direct bonding where appropriate to protect exposed dentin.
- Construction of an occlusal guard is recommended if a bruxism habit is present

Monitor stability

Use casts or photos to document tooth wear status

Regular recall examinations should be done to review diet, oral hygiene methods, compliance with medications and topical fluoride

erosion, sandblasted nickel-chromium alloys or heat treated gold are usually used where aesthetics is not important. The castings can be cemented with a resin based material that can bond to both metal oxide and tooth surface. For Labial surfaces, porcelain veneers are preferred for their strength, durability and long lasting aesthetics. Single sitting composite veneering can also be done, but it lacks the durability and aesthetics of porcelain preparations. In case of extensive enamel loss (>50%) or complete loss of enamel on the incisal edges porcelain fused to metal restorations offer a great range of aesthetic restorative correction and strength.

Conclusion

As caries is reducing, erosion is becoming more of a dental health risk in the economically stronger societies. Although it is true that fizzy drinks can cause erosion, the public needs to be informed that fruit juices are not safe alternatives. There is a need for research on the new soft drinks with higher buffering capacity and added calcium. Change of dietary habits may be difficult but still remains the best way of prevention of dental erosion.

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