REVIEW ARTICLE-

Dental erosion: Prevalence, Etiology, Diagnosis and its Management

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Abstract-

Dental erosion is an irreversible loss of dental hard tissue caused by chemical process that does not involve bacteria. The etiology is multifactorial with the main factors being the acids of intrinsic and extrinsic origin. It is of utmost importance that the oral health care team is able to detect the early clinical signs and symptoms of erosion. The Erosive Wear Index, created by Lussi, is found to be an auxiliary diagnosis tool for assessing the status and progress of the erosion. The prevention of dental erosion should be the first choice of treatment and from various studies, it is found that it can be achieved with proper diet, oral hygiene and regular dental care. When allowed to progress, it can lead to dentinal hypersensitivity, aesthetic concerns and loss of vertical dimension all of which affect oral health-related quality of life. When necessary, treatment of dental erosion aimed at correcting or improving its effects might best be of a minimally invasive in nature. The purpose of this review is to provide information on etiological factors, prevalence, early diagnosis and treatment of dental erosion.

Keywords: Erosion; Tooth Wear; Diagnosis, Prevention.

Introduction

Importance of dental erosion and its role in tooth wear increased considerably since the mid-1990s. Early studies on tooth wear in humans were based on teeth from archeologically obtained skulls. Inon teeth from archeologically obtained skulls. In later studies, contemporary adult populations were examined, but neither the early nor the later periods

Early studies on tooth wear in humans were based on teeth from archeologically obtained skulls. In later studies, contemporary adult populations were examined, but neither the early nor the later periods of study founddentalerosion as a possible etiological factor. The diet of our ancestors was often tough and contained coarse particles, which required heavy chewing. The resulting wear facets were further influenced by the abrasive components of the food.

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Modern diets would appear to lack such abrasives but can contain acids, which can demineralize enamel and potentiate attrition and abrasion.[1]Dental erosion has been defined as a chemical process that involves the dissolution of enamel and dentine by acids not derived from bacteria when the surrounding aqueous phase is undersaturated with respect to tooth mineral.Diagnosis can be difficult in the early stage due to hardly any signs and even lesssymptoms and the best way totreat is to prevent it from happening in the first place. Patients usually don't seek treatment until they face hypersensitivity, or their estheticaspect is in question. It is the dentist who aid in early recognition and prevention of dental erosion.[2]

Prevalence

Wide-ranging prevalences have been reported in both primary and permanent dentitions. The reasons for the wide range of prevalence may be related to the relatively small number of subjects in the majority of studies and the use of different criteria for diagnosis. However, when erosion into dentin is considered, studies show prevalences of around 30% in primary molars of 5-year-olds, and 2% in incisal surfaces of permanent incisors in 14-year-olds. For example, in the primary dentition, the UK Child Dental Health Survey showed that the prevalence of erosion on palatal surfaces of the primary teeth was 8% in 2-year-olds and 52% in 5-year-olds, with the proportion of children exhibiting erosion extending into dentin being 24% in 5-year-olds. Children with cerebral palsy are thought to have an increased prevalence of tooth wear, which has been attributed to both oral parafunctional activities, and softening of the enamel from gastroesophageal reflux.[3, 4, 5]

Table1: Prevalence of dental erosion at different age group from different countries.[6]

AUTHORS	AGE(yr)	No. of subjects	Country	Prevalence(%)
Luo et al.2005	3-5	1949	China	1
Wiegand et al. 2006	2-7	463	Germany	13
Hasselkvist et al. 2010	5-6	135	Sweden	13
Arnadottir et al. 2010	15	750	Iceland	6
Hasselkvist et al. 2010	13-14	227	Sweden	12
Hasselkvist et al. 2010	18-19	247	Sweden	22
Daley et al. 2011	22	1010	United Kingdom	77

With increasing mean age of the population-group examined, it was found that there is a trend to more erosive lesions detected. Males seem to develop more erosion than females and involves the palatal surface of the maxillary incisors and the occlusal surface of the mandibular first molars.[6]

Etiology -

The etiology of erosion is multifactorial and not fully understood. The interaction of chemical, biological and behavioral factors is the vital point and explains why individuals are affected in different ways even when exposed to the same acidic content.[7]

Chemical factors

From the chemical point of view, the etiology of dental erosion can be defined as the chronic exposure of the teeth to extrinsic or intrinsic acids under the condition that the oral fluids are under saturated with respect to tooth mineral.[8]

Extrinsic factors

Any acidic product that we put into mouth, that is, what we eat and drink are considered "extrinsic" factors. Several in vitro and in situ studies on humans as well as on animals have evaluated the erosive potential of different food and beverages. They all showed that the erosive potential of an acidic drink is not exclusively dependent on its pH value, but is also strongly influenced by its mineral content, its titratable acidity ('the buffering capacity') and by the calcium-chelation properties of the food and beverages. The pH value, calcium, phosphate and fluoride content of a drink or foodstuff determine the degree of saturation with respect to the tooth mineral, which is the driving force for dissolution. Solutions oversaturated with respect to dental hard tissue will not dissolve it. A low degree of undersaturation with respect to enamel or dentine leads to a very initial surface demineralization which is followed by a local rise in pH and increased mineral content in the liquid surface layer adjacent to the tooth surface. This layer will then become saturated with respect to enamel (or dentine) and will not demineralize further.

When an excess of an erosive agent is present the pH is probably the most decisive factor whereas the buffering capacity is more important at the liquid surface layer adjacent to the tooth surface and/or

when there is only a small amount of acid present around the tooth surface.The greater the buffering capacity of the drink, the longer it will take for saliva to neutralize the acid. Some beverages appear to be less erosive than others within the same pH class.e.g malic acid.[8]

Another example isoccupational-related erosion, like people who are wine tasters and among battery and galvanizing workers, often caused by airborne acid that reaches the teeth.[9-13]A rise in the intake of soft drinks which are high in acidic composition has been observed in recent years.[14]The soft drinks are the ruling factor in inducing dental erosion in the younger generations.[15,16]Extrinsic factors include acidic foods(starchy food, citrus fruits) and beverages like lemon juice, wine, sports drinks, cherries, soda, oranges and others and some medicines- such as vitamin C tablets and tonics.[17]
It has been shown through invitro studies that the milk protein casein and the egg white protein ovalbumin reduce hydroxy apatite dissolution in simple acid solutions. The protective effect of the casein and ovalbumin against erosion is likely to be associated with protein adsorption at the hydroxyapatite surface, the presence of a salivary pellicle may reduce or eliminate this effect.[18]

Intrinsic factors

The "intrinsic" factors include several ailments and lifestyles, which lead to regurgitation of acids into the oral cavity. In these cases, for example in patients suffering from psychological disorders, e.g., in anorexia and bulimia and gastro esophageal reflux disease, vomiting and regurgitation, there is an increased risk for erosion.[19-21] The pH of stomach acid is much lower than the critical pH of enamel dissolution; therefore, reflux of stomach contents into the oral cavity over an extended period of time can cause severe loss of tooth structure. Low salivary flow is another element that results in inadequate cleansing and mitigation of the effects of erosive acids on tooth surfaces.[22]

Behavioural Factors

Lifestyle has a crucial role in the occurrence of erosion. Eating habits and increased consumption of beverages and foods with a high acid content have been strengthened in the last few decades. The erosive potential of drinks is mainly represented by their pH t6and the buffering capacity. In previous studies it is found that the initial pH values of some soft drinks and their buffering capacities were determined. Aerated drinks are more acidic than fruit juices. Therefore, buffering capacities are in the decreasing order of fruit juices, fruit-based aerated drinks, non-fruit based aerated drinks.[23]

Biological factors

Salivary protective properties, its flow rate and buffering capacity, acquired dental pellicle and tooth morphology and positioning in relation to soft tissues and tongue affect the outcome of hard tissue erosion.[24]

Impact on quality of life

Dental erosion is a progressive condition that may have a lifetime effect on patients. Overtime, it has been found from various studies, dental erosion can lead to cosmetic changes and dental hypersensitivity which may become a significant concern for patients. The change in appearance e.g. yellowing from thinning and increased translucency lead to cosmetic changes.[25]The females have greater impact of the tooth surface loss than male and this could be due to the fact that females are more concerned about their oral health. Also the patients in age group 20-40 years (young adult) have greater severity of impact of tooth surface loss than other. This might be explained by the fact that people in this age group are more critical about their quality of life, more concern with respect to their appearance and oral functions and less tolerant to changes in their dental status. Patients who receive restorative treatment experience the ability to eat and drink without pain after the treatment, resulting in a major improvement of oral-health related quality of life. Dentist while making treatment decisions consider not only the patients objective clinical characteristics but also the impact of condition on quality of life. The decision for restorative treatment in patients strongly influenced by their subjective complaints of impaired appearance and pain. [26]

Diagnosis

Diagnosis is the intellectual course that integrates information obtained by clinical examination of the teeth, use of diagnostic aids, conversation with the patient and biological knowledge. A proper diagnosis cannot be performed without inspecting the teeth and their immediate surroundings.[27]The early signs of erosive tooth wear appear as a smooth silky-shining glazed surface. In the more advanced stages changes in the original morphology occur. On smooth surfaces, the convex areas flatten or concavities become present, the width of which clearly exceeds its depth. Undulating borders of the lesion are possible. Initial lesions are located coronal from the enamel–cementum junction with an intact border of enamel along the gingival margin. Further progression of occlusal erosion leads to a rounding of the cusps, grooves on the cusps and incisal edges, and restorations rising above the level of the adjacent tytsooth surfaces. In severe cases the whole occlusal morphology disappears. Erosive lesions have to be distinguished from attrition. They are often flat and have glossy areas with distinct margins and corresponding features at the antagonistic teeth.[27,28]

The most frequently used erosion indices for the assessment of erosive tooth wear in children, adolescents andadults is Erosion index according to Lussi(facial, lingual and occlusal surfaces of all teeth except third molars).[28]

Score	SurfaceCriteria
Facial	
0	Noerosion Surface with a smooth, silky-glazed appearance, absence of developmental ridges possible.
1	Loss of surface enamel. Intact enamel found cervical to the lesion concavity in enamel, the width of which clearly exceeding its depth,thus,distinguishing it from toothbrush abrasion, undulating borders of the lesions are possible dentine is not involved.
2	Involvement of dentine for less than one-half of the toothsurface.
3	Involvement of dentine for more than one-half of the toothsurface.

Occlusal/oral

0	Noerosion Surface with a smooth, silky-glazed appearance. Absence of developmental ridges possible.
1	Slight erosion, rounded cusps, edges of restorationsrising above thelevel of adjacent tooth surface, grooves on occlusalaspectsLoss of surface enamel. Dentine is not involved.
2	Severe erosion, more pronounced signs than grade 1 Dentine is involved.

Index used in the UK National Survey of Children's Dental Health consist of only facial and lingual surfaces of primary and permanent maxillary incisor teeth and the UK National Diet and Nutrition Surveys includes additionally occlusal surfaces of the molar teeth.

Depth

0	Normal
1	Loss of surface characterization, enamel only – on incisor teeth thereisloss of developmental ridges resulting in a smooth, glazed or 'ground glass' appearance on occlusal surfaces the cusps appear rounded and there may bedepressions producing cupping.
2	Enamel and dentine – loss of enamel exposing dentine. On incisors this may resemble a 'shoulder preparation'.
3	The incisors may appear shorter and there may be chipping of the incisal edges onocclusal surfaces cupping and rounding-off of cusps is evident. Restorations may be raised above the level of adjacent toothsurface.
4	Enamel, dentine, and pulp – loss of enamel and dentine resulting in pulpexposure.
9	Assessment cannot bemade.

Area

0	Normal
1	Less than one-third of surfaceinvolved.
2	One-third to up to two-thirds of surfaceinvolved.
3	More than two-thirds of surfaceinvolved.
9	Assessment cannot be made.

However, there is another scale called ordinal scale has been developed for the grading of dental erosion on buccal and lingual surfaces of maxillary anterior teeth and a separate scale has been constructed and used for recording first molar and primary molars cuppings.[6]

Preventive Management

The key elements in the prevention of dental erosion irrespective of the etiology of erosion includes patient education and compliance with diet modification, occlusal splints etc. A complete protocol for prevention of erosion is given below :[29]

1. Diminish the frequency and severity of the acid challenge.

Management

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

- Preventive Management
- Restorative Management

- Decrease amount and frequency of acidic foods or drinks.
- Acidic drinks should be drunk quickly rather than 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 referral is appropriate .
- A patient with alcoholism should be assisted in seeking treatment in rehabilitation programs.

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

- Saliva provides buffering capacity that resists acid attacks. This buffering capacity increases with 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.

3.Enhance acid resistance , remineralization and rehardening of the tooth structures.

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

4.Improve chemical protection.

- Neutralize acids in the mouth by dissolving sugar-free antacid tablets 5 times a day, particularly after an intrinsic or extrinsic acid challenge.

5.Decrease abrasive forces

- Use soft tooth brushes and dentrifices low in abrasiveness in a gentle manner.
- Don't brush teeth immediately after an acidic challenge to the mouth , as the teeth will abrade easily.

6.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.

7.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, topical fluoride and splint usage.[28]

Restorative management

The restorative treatment plan to be adopted depends on the degree of tooth substance loss (eg. loss of vertical dimension). The erosive tooth wear is a multifactorial condition and in many cases it is not possible to determine and eliminate all etiological parameters. In such cases, the long-term success of the rehabilitation may be compromised.

Loss of Vertical Dimension<0.5 mm:

Sealing or Direct Composite Restoration Treatment of erosive tooth wear should be performed at an early stage in order to prevent the development of functional and aesthetic problems. The most minimally invasive measure is the sealing of the tooth surface. In a study, Seal and Protect (DentsplyDeTrey, Konstanz, Germany) and Optibond Solo (Kerr, West Collins, Orange, Calif., USA) were each applied in vitro and in vivo. It was concluded that both products protected the teeth and the technique could be used clinically for patients.[30,31,32]

Loss of Vertical Dimension <2 mm: Direct Reconstruction with Composite Materials:

As long as there is only a loss of 1–2 mm of interocclusal space, the teeth can be reconstructed directly with composite materials. Patients tolerate such a small increase in the vertical dimension usually without any problem. Teeth are rebuilt 'freehand' according to their original anatomy. This restorative measure can also be used for the reconstruction of localized facial or palatal surface defects. The advantage of direct composite restorations is that they are adaptable to the defect and repair is straightforward. The situation is more problematic if the occlusal and vestibular erosions merge, the original tooth shape becomes hardly recognizable and the loss of vertical dimension tends to be greater than 2 mm.[32]

Loss of Vertical Dimension = 2 mm: Rehabilitation with Indirect Ceramic Veneers and Overlays

In general, less-invasive reconstruction procedures such as direct adhesive methods are preferable to indirect methods. However, if the upper front teeth are severely eroded and need to be reconstructed, porcelain veneers may sometimes be applied. If the defects (on posterior teeth) show an extension over two or more tooth surfaces and the vertical tooth substance loss is greater than 2 mm, then the recons-truction with full ceramic overlays is convenient.[33]

Loss of Vertical Dimension= 4 mm: Rehabilitation with Indirect Ceramic Restorations

In patients with severe tooth surface loss on more than two surfaces per tooth and extended loss of vertical dimension, a complex reconstruction with indirect restorations (ceramic crowns, bridges) is often inevitable. This measure should be restricted to very advanced erosion cases. As in other patients with erosive tooth wear adequate preventive measures and recall intervals must be executed.[33]

Conclusion

Wear is a functional loss of dental hard tissue, existing since (pre)historic times when men were using their dentitions more intensely than today to bite and grind abrasive foods. Modern standards of living have changed both food selection and eating habits. Now carbohydrates became an important part of our diet, and as a result of such diet, dental caries developed into being a major dental disease.[1,33]Emphasis should be made on preventive strategies as the mainformofmanagement of dental erosion.The prevention of erosion can be attempted in two ways, namely by weakening the erosive potential of acid challenges and by increasing the resistance of the dentition. By reducing the frequency of contact with acidic foods and the beverages or the medicaments is the mosteffective way found to prevent dental erosion.Furtherresearchisnecessarytodevelopadvancedmeasureswhichwillbeclinicallyefficientandhave greater preventive ability.[34]

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