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Review Article Recent Advances in Preventing Dental Erosion

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Dental erosion is defined as an irreversible loss of dental hard tissue due to exposure to chelating agents or non-bacterial acids. The occurrence of this condition was noted and the incidence and prevalence of dental erosion has been increasingly documented.The Ant erosive agents such as Anacardic acid in which the key component is the cashewnut shell liquid is phenolic lipids. It is a mixture of molecules which are saturated and unsaturated. It is also considered to have an anti-microbial effect and has been studied for the treatment of cancer, oxidative damage, inflammation and obesity disorders. Other anti-erosive agent like Fluoride helps in tooth remineralization. Fluorapatite, rather than hydroxyapatite, forms during the process of remineralization when fluoride is found in oral fluids. In apatite crystal lattice formation, fluoride ions replace hydroxy ions. Fluorapatite, even under acidic conditions, is less soluble than hydroxyapatite, which helps to regenerate tooth enamel. Fluoride is therefore a stronger anti-erosive agent. Various Recent advances in anti-erosive agents are Calcium and phosphate, Casein phosphopeptide amorphous calcium phosphate (CPP-ACP), Protease inhibitors, Oils, Chitosan chitosan and Multivalent metal ions Various techniques to evaluate dental erosion are in vitro techniques and in vivo techniques. In vitro techniques are Scanning electron microscope, Surface Profilometry, Polarized Light Microscopyand Non-Contact Confocal Laser Scanning Microscopy (CLSM). And iv vivo techniques

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are Photographs Clinical review and indices. The most important point of treatment is identifying and removing the erosion factor, above all current materials and methods. Therefore, early identification of the lesions, evaluation and removal of the etiological variables are relevant topics.

Keywords: Dentinal hypersensitivity; dental erosion; laser scanning microscopy; surface profilometry.

1. INTRODUCTION

Dental erosion can also be described as an irreversible loss of dental hard tissue, exposure to chelating agents or non-bacterial acids [1]. During the 19th century [2], the occurrence of this condition was noted and the incidence and prevalence of erosion of dental hard tissue has been rapidly documented since then [3]. This can be evident from the prevalence research held in the last decade in two separate parts of the globe that showed the percentage of subjects among various age groups affected by erosion [4-8]. It is now time for a prevention program to be implemented to monitor the occurrence of this destructive dental disease.

Therefore, the main elements needed to design and achieve a successful preventive program are predictors of erosion-conditions defined as predisposing teeth to dental erosion growth, the prevention and control guidelines and safety guidelines-suggestions for the protection of remaining hard tissues for further damage and deterioration. It is a multifactorial lesion which is straight connected with the standard of living of the organism. Differential diagnosis from other non-carious lesions is extremely difficult for early diagnosis. Erosion can be avoided by non-invasive approaches but at an early stage and with a successful anamnesis. Sensitivity caused by substance loss is eliminated by the products used in the procedure. Regardless there are varying products in the market for the same but supreme treatment material is not yet obtainable. Meanwhile, applications having fluoride can also be considered the best hefty wear prevention approach available. Research is still underway to establish the necessary materials. The recognitionpeople at risk of dental erosion can be an essential step in avoiding wear. Details based on case statement, clinical study, epidemiological data, cohort studies, zoological science, in vitro investigations and in vivo survey have identified gastric acids, dietary or environmental sources that could cause dental erosion. Some determinants have been studied as predictors of causation to dental wear based on this reality.

The study conducted by Milward et al in which he analyzed 38% population were affected of age group 4-5 [5]. Similarly another survey done by UK Child Dental Health Survey analyzed 55% population were affected of age group 5-6 [6]. The study conducted by Batter et al which demonstrated 57% population were affected of age group 11-14 [7]. The comprehensive generality of tooth wear was establish to be moderate (8.9%). Tooth wear due to chemicals was found to be greater in molar teeth (65.6%) than in incisors and canines (34.4%) loss of tooth structure with only loss of structural shape was seen in at most of the (94.8%) of the cases [8]. Erosion is essentially the consequence of a sequence of cycles ofdemineralization/remineralization where the state of overtime demineralization prevails. These happen when the pH decreases below the critical level (approx. 5.5 for enamel and 6.2 for dentin). It allows the tooth minerals to dissolve (hydroxyapatite). By facilitating remineralization and slowing down demineralization, erosion can be avoided. Enamel is formed of calcium and phosphate ions which lead to formation hydroxyapatite crystals that contribute to ion demineralization when exposed to exogenous and endogenous influences.

1.1 Causes of Dental Erosion

- Extrinsic
- Intrinsic

1.2 Sources from Extrinsic

The pH level of the mouth is decreased by acidic foods and beverages, resulting in demineralization of the teeth.

E.g. Fruit juices, such as beer, wine, sports drinks, orange juices, Carbonated juices, lemonades, coco-cola, for starters.

In causing acid erosion, food like fruits, tomato ketchup and stored food in vinegar have been involve. Thus, fruit juices are at high risk of inducing chemical wear in tooth structure in children using feeding bottles.

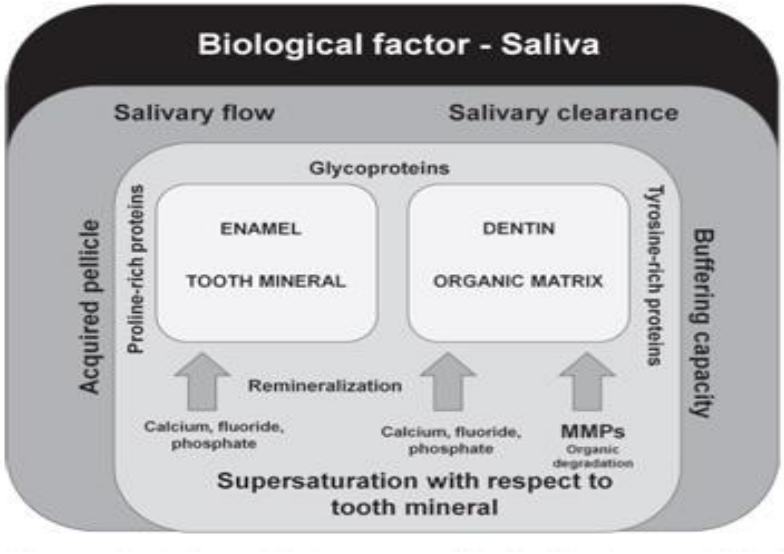

Fig. 1. Salivary factors associated with the control of dental erosion in enamel and dentin

A variety of medications: are caustic and can lead to chemical wear, such as chewable ascorbic acid, aspirin, and certain iron supplements. Often known as perimolysis, intrinsic chemical wear is the process through which stomach acids from the gastric come into contact with the teeth, frequently subordinate to disorders like Anorexia nervosa, bulimia nervosa, gastro esophageal indigestion disorder and reasoning syndrome. A common symptom of bulimia, reducing the salivary flow rate, predisposes a person to chemical wear because of high susceptibility to the reaction of caustic food and drinks [9].

1.3 Intrinsic Sources

- In comparison to good management, self-induced emesis raises the likelihood of chemical wear by a factor of 5.5.
- Medical disabilities: -Vigorous emesis in phagic disorders like malnutrition, passive hurl in gastroesophageal reflux disease (GERD) and either passive hurl or chronic emesis in chronic liquid courage and bust drinking have together been associated to continuous contact of tooth structure with stomach content, the acidifying component of which can be as lower upto 1, that evolving to caustic dissolution of tooth structure.
- Usage of caustic medicines: Case reports have shown that dental erosion is predisposed to dental erosion by acidic medicines often prescribed for long periods of time.9,20 Tablets like acetylsalicylic acid, vitamin C supplements, liquid hydrochloric acid, ferrous tonics, caustic saliva stimulants/replacement and calcium chelating compounds have high erosive potential.
- The use of illicit medicines: - Owing to the consequences of lack of moisture and decreased salivation, the addictive use of some illicit substances like brown sugar and euphoria is linked with large amount of acidic beverage intake, thereby developing tendency of user to the possibility of chemical wear of tooth structure.

- Excessive techniques for oral hygiene: Because of detachment of the more defensive highly mineralized outermost layer of the enamel surface and decrease in the thickness of the acquired salivary thin film, recurrent tooth brushing with coarse dentifrice as performed by few health/esthetic-concerned people may make the dental hard tissue more prone to chemical wear of tooth structure, which would negatively affect its developed protective basis opposing chemical wear [10,11,12].

1.4 Impersonal Aspects of Dental Erosion

- Wide depression with smooth surface tooth enamel.
- Concealing of occlusal surfaces (incisal grooving) with exposure of tooth dentin.

- Increased incisal lucency.
- Erosion on non-occlusal areas.
- High points in silver amalgam restoration.
- Clear, oxidize advent of amalgam.
- Dentin hypersensitivity
- Exposure of pulp in primary teeth.

1.5 Precaution and Monitoring Recommendations

The discussed chemical wear predictors illustrate the idea that it may be difficult to remove the causative factor because people vulnerable to chemical wear which may have psychological or qualified tendency to the variables that predispose them to the condition. Clearly, even though the causative factor is known, this will present difficulties in achieving complete compliance with preventive advice. However, if incorporated in a preventive program, the following guidelines may avoid incidence, restrict damage, commute the practice or prevent the residual tooth structure.

- Diagnosing and recording untimely onset
- Treatment of underlying medical and illness conditions
- Application of remineralizing agents
- Usage of mouth rinses for fluoride
- Application of a neutralizing agent
- Drinking Condition/Method
- The use of safe equipment
- Education for wellbeing

Individuals at hazards should be advised to maintain their oral health. Use a low coarse toothbrush (soft brush) or a low abrasive toothpaste containing high fluoride or bicarbonate [13,14].

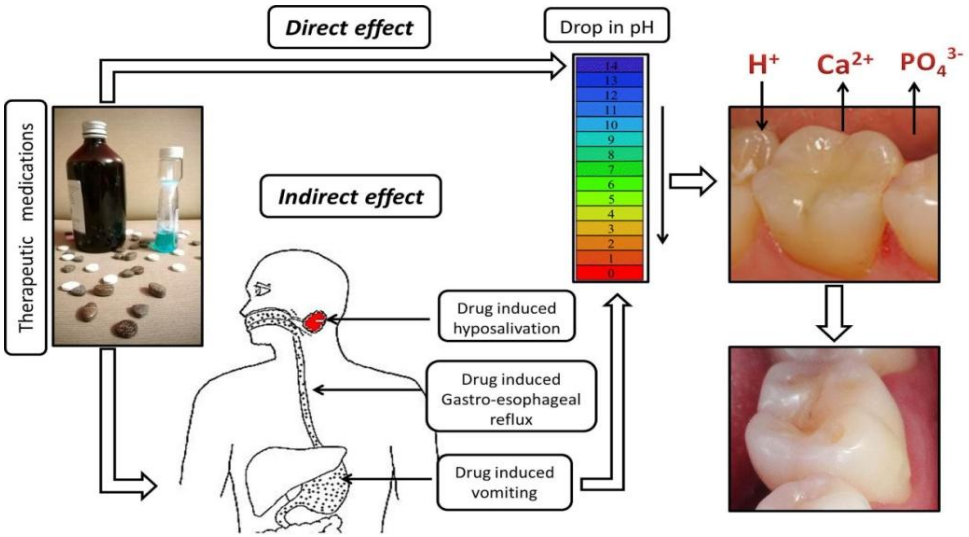

Fig. 2. Machanism of drug including erosion

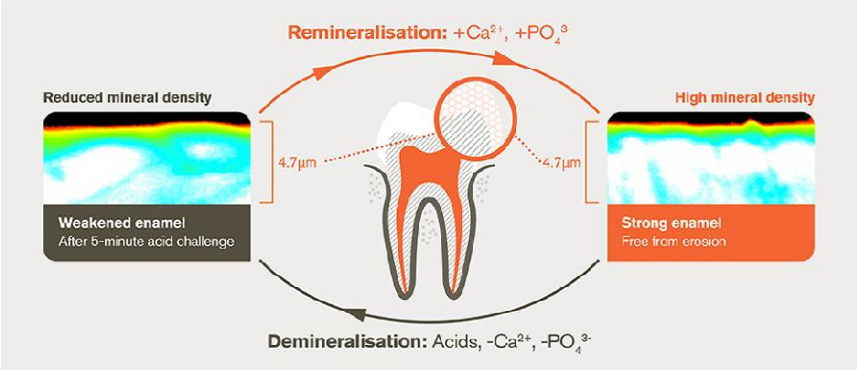

Fig. 3. Precaution and monitoring recommendations

1.6 Safety Guidelines

If the patient is receiving care for the past medical state and a precautionary rule has been developed, one of the treatment protocol mentioned below can be taken into account to protect the abide teeth/tooth structure from further chemical damage and impairment of advent. It has been shown that dentine bonding materials, Seal and Protect (Dentsply, UK) and Opti bond Solo (Kerr, UK), provide corrosion protection and minimize the incidence of in vitro and unaffected tooth wear without adverse effects on the circulation of the pulp (in rat studies). To safeguard erosively exposed dentinal tissues, this can be used. In areas that are not prone to high loads, adhesively retained resins (composite resin or glass ionomer cement) may be used. Porcelain veneers are used as alternative to enhance appearance as well as prevent tooth structure loss.

2. ANTI- EROSIVE AGENTS

2.1 Anacardic Acid

The first chemical study of anacardium occidentale cashewnut shell oil was published in 1847. It was later found to be a mixture of pleural anacardic acid rather than one chemical material. The key component of the cashewnut shell liquid is phenolic lipids. It is a mixture of molecules which are saturated and unsaturated. It is also considered to have an anti-microbial effect and has been studied for the treatment of cancer, oxidative damage, and inflammation and obesity disorders. It is also used in resins, coatings and friction materials [15].

Matrix metalloproteins are responsible for organic matrix degradation. Natural matrix metalloprotein inhibitors such as green tea, polyphenols and anacardic acids are available, which help to remineralize the tooth [16].

2.2 Fluoride

The fluoride treatment, tooth remineralisation can be achieved. Fluorapatite, rather than hydroxyapatite, forms during the process of remineralisation when fluoride is found in oral fluids. In apatite crystal lattice formation, fluoride ions replace hydroxy ions. Fluorapatite, even under acidic conditions, is less soluble than hydroxyapatite, which helps to regenerate tooth enamel. Fluoride is therefore a stronger anti-erosive agent. When taken in greater amounts, fluoride is safer for anti-erosive application.

2.3 Carbonated Drinks

It contains carbonated water, sugar, caffeine, coloring agents, citric acid, phosphoric acid and natural flavors. This causes the salivary pH to drop immediately from 5.76-1.208. This may possibly be due to the fact that carbonated drinks, responsible for their erosive capacity, have increased intrinsic acid and sugar content in their composition [17,18].

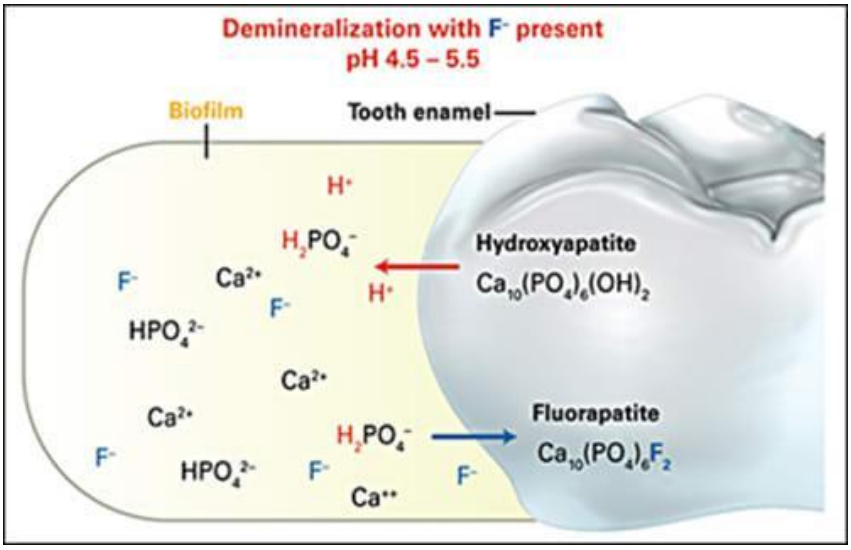

Fig. 4. Demineralization

Table 1. Inherent pH of different liquid beverages

Food Items	Inherent pH
Coffee	6.85
Carbonatedrinks	2.04
Fruit Drink	3.89
Sweetened Milk	7.01

2.4 Recent Advances in Anti-Erosive Agents

To ensure coordination among clinicians in grading erosion, basic erosion wear examination (BEWE) and visual erosion dental examination (VEDE) have been established. The oral cavity is split into 6 areas in the BEWE index, the tooth structures hampered by the highest amount of chemical wear are scored in every region and these scores are summed. Both tooth surfaces are evaluated separately in the VEDE Index.

- Fluoride: Toothpastes containing sodium fluoride can prevent material loss due to chemical wear, but their results, against extreme erosion, are minimal. In the deposition of calcium-fluorine-similar parts on the tooth structure, fluoride induces enamel remineralization. However, during same period, few studies indicate that precipitate avoids coarse components found in tooth dentifrice. While all fluorides increase toughness of the teeth against carious agent acids, existing sources of fluoride does not have the similar level of defense against chemical wear. This shows that frequent use of a balanced stannous fluoride tooth cleaner is the highly successful way to protect tooth structure against the possibility of dental wear [19-22].
- Calcium and phosphate: Calcium can collect on the outer structure of the enamel, which can be otherwise erosive or integral, and can contribute the tooth enamel with considerable protection from caustic harm [20]. Dodecyl phosphates protect and provide strength from dissolving the natural surfaces of hydroxyapatite [23-26].
- Casein phosphopeptide amorphous calcium phosphate (CPP-ACP): A compound with a restoring effect, casein phosphopeptide-amorphous calcium phosphate (CPP-APC) can be applied to mouthwashes and gingiva to avoid chemical wear. Few reports, however, suggest the erosion prevention is inadequate. CPP-APC and tricalcium phosphate (TCP) can prevent tooth wear coarse lesions from being remineralized [25,26].
- Protease inhibitors: The act of protease inhibitors in erosion has been the subject of recent studies. After an erosive attack, the use of protease inhibitors in tooth tissue to prevent the organic matrix can play a protective role against potential loss of minerals. Nevertheless, these preventive measures are not evidence-based, despite encouraging findings in in situ trials. Clinical studies are important to validate these results [27].
- Oils: Oils in the thin film prevent the tooth structure from declining pH. It was found in one of the research that it protects the tooth structure from tooth wear. The use of oils containing fluoride agents may be advised [19].
- Chitosan chitosan: Chitosan is an antibacterial agent that helps to regenerate tissues. It can be used in toothpaste. As it has a high positive charge at acidic pH, it has anti-erosive properties. It can prevent the development of dental erosion by binding to the pellicle by creating a protective layer on the teeth [28].
- Multivalent metal ions: -Metal ions have strong impacts on corrosion, such as stannous and titanium. Any of such materials include stannous fluoride, stannous chloride, or titanium tetrafluoride [28].

2.5 Techniques for Dental Erosion Assessment

2.5.1 *In vitro* techniques

- Scanning electron microscope: One of the prior methods used to assess the in vitro resorption of tooth structure was the application of SEM. SEM micrography have a special three-dimensional presentation that aids in understanding the sample's enamel surface [29]. In order to expose the effects of superficially deposited precipitates resulting from mineral dis-solution by different agents, SEM investigations have been used. These involve differentially acting caustics, fluoride's anti-erosive property, and the potential to re-mineralize and re-harden different agents in eroded enamel [30-31].

- Surface Profilometry: - In comparison to a non-treated reference field, surface profilometry quantifies dental tissue loss. It also offers data on surface roughness [29].
- Polarized Light Microscopy: Polarized light composed of light waves in which a mono plane creates vibrations. Two disk components composed of polarizing plastic include a polarizing microscope [32].
- Non-Contact Confocal Laser Scanning Microscopy (CLSM): CLSM is a tool for acquiring high-resolution three-dimensional optical pictures from specimens with preciseselectivity [33-34].

2.5.2 *In-vivo* Techniques

- Photographs Clinical review and use: Images are useful in calculating toothenamel deformity and tooth deterioration in epidemiology. Without re-examining the patient, photos can be easily searched, organized and rearranged and re-evaluated. They have the potential to establish national and international comparisons for erosion calculation [35].
- Indices: The indices provide morphological as well as quantitative parameters for person and population levels to record erosive wear [36].

Related studies were reported by Rathi et al. [37] and Motwani et al. [38].

3. CONCLUSION

The key goal of care is to retain the structure of the tooth without planning. Restoration with the use of different restorative equipment's may be taken into account, particularly in subjects whose vulnerability cannot be eliminated by the use of conservative techniques or whose requirements are appearance based. It should, otherwise, be held in mindset that in materials where acid exposure persists, surface changes can occur. Prosthetic protocols may be needed in cases of excessive tooth loss. Reduction in the level of erosion by the application of anacardic acid and stannous fluoride on extracted teeth exposed to carbonated drinks and assessment of erosive effect of carbonated drink on tooth. More interventional approaches are used in advanced situations. In the event of tooth loss that cannot be eliminated by restorative treatment, prosthetic treatment may be required. The most required important point of treating subjects is identifying and removing the chemical wear factor, above all current materials and methods. Therefore, early identification of the crippling, evaluation and so removal of the causative variables are relevant subjects.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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