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Effects of salivary pellicle on dental erosion: A systematic review

[1]Prachi Smita, Undergraduate Student, Department of Public Health Dentistry, SRM Dental College, Chennai, India.
[2]Dr. Bharathwaj V V, Senior Lecturer, Department of Public Health Dentistry, SRM Dental College, Chennai, India.
[3]Dr. Dinesh Dhamodhar, Reader, Department of Public Health Dentistry, SRM Dental College, Chennai, India.
[4]Dr. Sathiyapriya S, Senior Lecturer, Department of Public health Dentistry, SRM Dental College, Chennai, India.
[5]Dr. Prabu D, Head of the Department, Department of Public Health Dentistry, SRM Dental College, Chennai, India.
[6]Dr. Rajmohan M., Reader, Department of Public Health Dentistry, SRM Dental College, Chennai, India.
[7]Dr. Sindhu R, Senior Lecturer, Department of Public health Dentistry, SRM Dental College, Chennai, India.

Corresponding Author: Dr. Prabu D, Head of the Department, Department of Public Health Dentistry, SRM Dental College, Chennai, India.

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Abstract

Background: Salivary pellicle is a film which forms on any hard surfaces by selectively binding to the glycoproteins from saliva. Dental erosion is the chemical loss of mineralized tooth structure caused by exposure to acids.

Methods: A systematic review of controlled trials was conducted. 519 articles were retrieved from electronic and hand searches

Aim: To evaluate the impact of salivary pellicle on dental erosion.

, and four studies were included in the systematic review. The systematic review evaluated the interventions and outcomes present and the studies that were included. A review of relevant literature was conducted using various databases such as PubMed, PMC, Science Direct, Wiley Online Library, and Cochrane Library, using the keywords "Salivary pellicle effects" and "dental erosion." As per the PRISMA guidelines, the search terms were adapted for each search engine.

Result: In this systematic review, four studies were included which were controlled trial studies. Articles showed the effects of salivary pellicle on dental erosion in relation to thickness of acquired salivary film, location and severity of erosion within the arch.

Conclusion: The present study revealed that pellicles have been shown to protect teeth from dental erosion and the presence of salivary film layer increases measurement artifacts as enamel are etched.

Keywords: Buffering capacity, Demineralization, Hyposalivation, Prismatic enamel, Tubular occlusion.

Introduction

This study is composed of review for effects of salivary pellicle on teeth in terms of regressive alteration of teeth specially erosion. The following are the facts reviewed from the different sources which are mainly experimental articles found on pubmed, Karger, research gate, Wiley.

Saliva is primarily made up of water (about 99%) and a mix of electrolytes, including sodium, potassium, calcium, chloride, magnesium, bicarbonate, and phosphate. It also contains proteins, enzymes, and immunoglobulins. Saliva contains various substances that are important for oral health, including antimicrobial factors, glycoproteins found in mucous membranes, trace amounts of albumin, and specific polypeptides and oligopeptides. There are also glucose and nitrogen products such as urea and ammonia.

Whole or total saliva refers to a complex mixture of salivary glands, gingival folds, buccal exudate, additional mucus from the nasal cavity and pharynx, loose oral bacteria, food debris, shed epithelial cells and blood. cells, and trace amounts of drugs or chemicals. At rest, there is a small, continuous stream of salivary secretion (SF) called non-stimulatory basal secretions in the form of a membrane that covers, moistens, and lubricates oral tissues without exogenous or pharmacological stimulation. Stimulated saliva is produced in the face of any mechanical, gustatory, olfactory, or pharmacological stimulus and contributes approximately 80% to 90% of daily saliva production. Her average daily saliva volume in a healthy person is 1-1.5 litres. The SF index is a parameter that can be used to classify stimulated and unstimulated salivary flow as normal, low, or very low (hyposalivation). In adults, a normal total stimulated SF is 1–3 mL/min, a low range is 0.7–1.0 mL/min, and hyposalivation is characterised by a SF <0.7 mL/min. A normal unstimulated SF is 0.25-0.35 mL/min, with a low range of 0.1-0.25 mL/min, whereas hyposalivation is characterised by an SF below 0.1 mL/min [1].

The salivary membrane is a thin acellular membrane composed primarily of salivary proteins that covers the surfaces exposed in the oral cavity. Salivary film formation is a highly selective adsorption process in which macromolecules from whole saliva are adsorbed to oral surfaces. The salivary membrane begins to adsorb within seconds of being exposed to saliva. The pellicle attains a thickness of 10-20 nm within a matter of minutes. The acidic proline-rich proteins statelin and histatin are among the first proteins adsorbed to the hydroxyapatite (HA) surface. However, studies have shown that the pellicle composition is more diverse and complex, with the presence of high molecular weight glycoproteins (such as MUC5B and MUC7), as well as amylases, cystatins, lysozyme, and lactoferrin. v It is believed that electrostatic interactions are a significant factor in the formation of the initial pellicle on the enamel surface, however, the wide variance in the net charges of the pellicle components suggests that other interactions, such as van der Waals and hydrophobic, also play a role. After the initial adsorption, a second phase known as "maturation" occurs, during which protein aggregates form through protein-protein interactions. The pellicle thickness can then increase to 100 nm or 1,000 nm, depending on the position in the mouth. Formation of protein aggregates, which may be heterotypic complexes and/or micellar-like structures, was previously reported in and could explain the reported thickness increase. These aggregations of proteins are also called “supramolecular precursors”.

The creation of salivary membranes in the mouth is a constantly evolving process influenced by various factors such as the formation of complex heterotypic structures, cross-linking by enzymes, proteolysis, and modification of adsorbed molecules by oral bacteria and saliva production and removal. Although in-vivo studies can provide more accurate information about pellicles, in-vitro studies are also being conducted to gain a deeper understanding of pellicle properties, with the goal of expanding our knowledge of the in-vivo environment. To better understand saliva-substance interactions, several surface models were used in in vitro studies investigating adsorption behaviour. Studies have been conducted on the adsorption of saliva to germanium prisms, hydrophilic and hydrophobic silica surfaces, titanium surfaces, as well as gold and zirconium oxide [2].

Tooth enamel erosion is only seen in individuals who are susceptible, regardless of their food and drink consumption habits. Acidic drinks and foods alone are unlikely to cause erosions. It is rare and very easily misdiagnosed. It is important to perform a comprehensive differential diagnosis to eliminate other potential causes of enamel loss. Distinguishing between tooth erosion and tooth decay is crucial, as the end result may be similar but the two conditions rarely occur in the same location simultaneously. In true erosion, tooth enamel is demineralized by direct contact with acid, whereas caries is a disease caused by exposure to acid produced by microorganisms in the plaque biofilm. It should also be emphasised that erosion is primarily a superficial phenomenon, whereas caries generally begins as subsurface demineralization of the enamel structure, ultimately leading to surface deepening of the tooth. Because enamel erosion is relatively uncommon and the result of many factors, more research is needed to determine why people differ in their susceptibility to erosion [3].

The cause of erosive lesions at a microscopic level resembles the pattern of mineral loss produced by acid etching of tooth enamel, which is used before placing composite restorations. Due to the highly acidic nature of the erosion agent and the instant removal of dissolved minerals, the enamel is eroded from the surface layer by layer. This irreversible process is fundamentally different from superficial demineralization, which occurs beneath microbial plaque and leads to caries. In prismatic enamels, surface loss leads to anisotropic dissolution, with preferential loss of the inter-prism or core regions of the prisms. Prismatic enamel erodes very irregularly, and is probably less susceptible to erosion failure than prismatic enamel. In dentin, erosion begins in the peritubular dentin and dilates the dentin tubules. As tissue loss progresses, the intertubular area is also affected. The fast erosion of dentin can lead to hypersensitivity due to the inability of tertiary dentin formation to keep pace with the loss of surface tissue. In vitro studies by electron microscopy have shown different erosion potentials of different organic acids, with citric and phosphoric acids causing more tissue loss than maleic acid. It does not last after long soaking. In general, it was concluded that not only pH but also acid type, titratable amount of acid (buffering capacity), and possibly chelation properties determine erosion progress. The oral cavity possesses several defense mechanisms against tooth erosion, with saliva being the most notable. The exact role of fluoride in preventing erosion is still not well understood. Theoretically, the pH during erosion stress is so low that fluoride is only effective at very high concentrations of, making it neither practical nor toxicologically safe. Either extrinsic or endogenous mixtures are unsaturated with respect to both hydroxyapatite and fluorapatite, explaining the superficial rather than subsurface nature of mineral loss [4].

Intrinsic alveolar pyorrhoea is caused by the leakage of stomach acid into the mouth or teeth due to vomiting or gastroesophageal reflux. Since the clinical symptoms of tooth erosion only occur when stomach acid acts on tooth structures regularly over several years, inherent tooth erosion is associated with chronic vomiting or long-lasting gastroesophageal reflux. Observed only in related diseases. time. Examples of such conditions include upper gastrointestinal disorders, certain metabolic and endocrine disorders, adverse drug reactions and substance abuse cases, and certain psychosomatic disorders. Psychogenic vomiting, anorexia, bulimia nervosa or rumination due to stress. Based on a review of the medical and dental literature, the main manifestations of all diseases that should be considered as potential intrinsic factors for tooth erosion [5]. Saliva protects enamel and dentin from erosion. Its effectiveness in this role depends in part on salivary factors and varies with the age of the person and the severity and location of the erosion. helps prevent the level of protection provided by saliva varies with age and dental experience [6].

The position dependent differences between buccal and lingual 24-h pellicles formed in vivo are of secondary importance for pellicle-induced protection of enamel surfaces against erosive changes [7].

A salivary film formed in situ within 3 min protects tooth enamel from citric acid. However, under the conditions of the present study, the pellicle does not completely inhibit the erosive action of citric acid [8]. The acquired enamel film that forms on the tooth surface acts as a natural protective barrier against tooth erosion. The numerous proteins that make up the pellicle perform a variety of functions within this thin layer. In our study, we investigated the effects of incorporated mucin and casein on the anti-erosion ability of acquired enamel membranes Protein-protein interactions may play a crucial role in the cuticle's ability to prevent erosion [9]. Acquired pellicles adhere to the tooth surface and have been suggested to provide varying degrees of protection against acid erosion. Pellicles formed on enamel blocks of patients suffering from diet-induced tooth erosion were simulated in vitro compared to pellicles formed on enamel blocks of healthy subjects and enamel samples without pellicles. Changed the effect of the meal challenge [10].

Formation of newly acquired pellicles on the surface was reduced in patients with erosion. This may explain the greater susceptibility of teeth to acid erosion [11]. Dentistry has seen significant progress in recent years, thanks in part to the application of artificial intelligence. Unlike natural intelligence exhibited by living organisms, artificial intelligence is a computer science discipline that involves the use of machines.[12] The field of technology is advancing rapidly and has captured the attention of society with its ground breaking developments.[13] The objective of the study is to evaluate the impact of the salivary pellicle on dental erosion.

Materials And Methods

The study included randomized controlled trials with intervention.

Eligibility Criteria

Inclusion criteria

- Studies conducted during 1999-2012
- Full text articles
- Studies with randomized controlled trials
- Salivary pellicle effects

Exclusion criteria

- Pilot studies
- Animal studies

Search Strategy

The published results pertaining to the effects of the salivary pellicle on dental erosion comprised of original articles and research papers found in databases. Many articles were used to study for the data and to give information based on facts. These sites were used for the study of the most important facts. These sites were pub med and different articles were used for the references. These four articles were used for the purpose of getting more information related to dental erosion along with the influence of salivary pellicle on enamel.

Results

The search produced 519 articles, out of which four articles were evaluated independently. The review included three tables and a flow diagram of the reports that were identified, screened, assessed for eligibility, excluded, and suitable for the review can be seen in Figure 1.

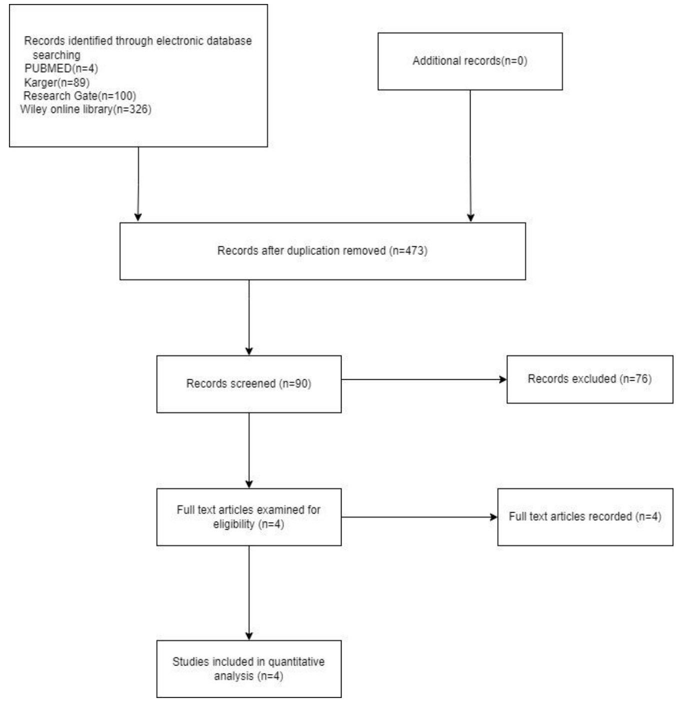

Table 1: Characteristics of intervention in this study.

Author Name	Year	Sample Size	Duration	Intervention
B.T. Amaechi, S.M. Higham, W.M. Edgar	1999	n = 5	1 year	Test group: n=5 (healthy individuals)
Yuriy Nekrashevycha, Lutz Stosserb	2003	n = 120	5 years	Control group: n=60, Test group: n=60
Anette weigand, Salome Bliggenstorfe	2009	n = 50	1 year	Control group: n=10 (healthy volunteers) Test group: n=40 (healthy volunteers)
Adrian Lussi, Anke Bossen, Christoph Hoschele	2012	n = 184	1 year	Test group: n=184(caries free human molar teeth)

Table 2: characteristics of outcome and effective measures

Author name	Year	Effective measure	Results
B.T. Amaechi,	1999	Confocal laser scanning microscopy	The pellicle was thinnest on the superior palate

S.M. Higham, W.M. Edgar		and transverse microradiography	surface and thickest on the inferior lingual surface. The level of erosion was significantly greater in the upper palatal site compared to the lower lingual site, and significantly greater in the lower posterior buccal site than in the upper posterior buccal site.
Yuriy Nekrashevycha, Lutz Stosserb	2003	Scanning electron microscopy	The effectiveness of pellicle protection depends on the acid concentration and duration of the erosion attack, as well as the completion of the pellicle, which can limit the diffusion rate of calcium or acid.
Anette weigand, Salome Bliggenstorfe	2009	Two-way ANOVA and Tukey's test	The samples with a pellicle showed significantly less calcium loss for all acid groups compared to the samples without a pellicle.
Adrian Lussi, Anke`` Bossen, Christoph Hoschele	2012	Digital SEM Micrographs	Abrasion of eroded enamel resulted in a 6% to 14% increase in specular reflection intensity compared to eroded enamel alone, with the increase in reflection depending on the degree of erosion. The presence of salivary membranes induced up to 22% higher reflectance intensity due to smoothing of eroded enamel by attached proteins.

Table 3: Characteristics of bias taken in different studies taken for review.

Author Name	Random Sequenc-E Generat-Ion	Allocation Concealme-Nt	Blinding Of Outcome	Incompl-Ete Outcome	Selec-Tive Bias	Other Bias
B.T. Amaechi, S.M. Higham, W.M. Edgar	-	-	-	-	?	+
Yuriy Nekrashevycha,	?	?	-	-	-	+

Lutz Stosserb						
Anette Weigand, Salome Bliggenstorfe	-	?	-	-	?	+
Adrian Lussi, Anke Bossen, Christoph Hoschele	+	+	-	-	?	-

Discussion

IgA, IgM, and IgG have been identified as components of the acquired salivary membrane. Using staining of these immunoglobulin components of the pellicle with sheep anti-human IgGAM conjugated to fluorescein isothiocyanate (FITC) isomers, the acquired phenotype formed after his 1-h intraoral exposure on the enamel plate. Demonstrated the presence of salivary pellicles. As designed, uniform staining of these proteins allowed us to demonstrate the full thickness of the pellicle. The fluorescence component of staining (FITC) was used to visualize the completely positive staining layer under a confocal laser scanning microscope. The agreement between the two observer measurements confirmed the reproducibility of the technique used to measure the pellicle thickness [14].

SEM comparison of citric acid-induced changes in uncoated enamel with changes in pellicle-covered enamel showed that the presence of the 24-h film protected the surface from severe erosive destruction. Residual pellicle-like structures were observed even after exposure to 0.1% citric acid for 1 or 5 minutes. Polish marks were hidden by the pellicle in many samples exposed for a short time. In addition, pellicles also reduced morphological changes in enamel surfaces exposed to more concentrated acid solutions.

A recent study found no difference in the protective capacity of pellicles formed in situ whether it was between 2-24 hours or 2-3 minutes. The samples were exposed to the oral cavity for 2 hours to form pellicles. However, regarding previous studies on plaque formation times of 2 h or longer, it should be taken into account that the structure and composition of 2 h salivary membranes differ from those of 'mature' salivary membranes. It is widely recognized for both its ability to house cariogenic bacteria and prevent plaque from erosion in the caries process. Previous studies found that the release of calcium from the cuticle itself was below the limit of detection, so it is possible that the mineral content of saliva does not affect the protective capacity of the cuticle [15].

The study confirmed previous findings that the salivary film formed in situ can provide protection against erosion, with enamel samples showing a reduction in calcium loss ranging from 59.8% to 77.5% after being eroded with 1% citric acid for 60 seconds. The protection offered by the salivary film on dentin was estimated to be around 30.5% based on the results of three different acids, with a reduction of approximately 27% in calcium erosion observed after treatment with hydrochloric acid (pH 2.3.5 min). In this study, we are able to directly compare the effects of pellicles on enamel and dentin erosion. This study is the first to compare the protective effects of salivary membranes formed in situ against short-term erosion caused by different acids on enamel and dentin. Although it was previously thought that differences in enamel or dentin structure might impact the composition or adsorption of the pellicle, previous research has shown that the substrate has little effect on pellicle formation and its presence and activity. The erosion-preventing potential of the enamel salivary membrane is attributed to its ability to function to some extent as both a diffusion barrier and a semipermeable membrane [16].

The results of this study indicated a variation in the thickness of the salivary pellicle that formed on the teeth within the same dental arch. It has also been shown that this change can determine the location and severity of erosion within the arch. In addition, pellicles have been shown to protect teeth from tooth erosion. The results indicated that the ability of the pellicle to protect against erosion did not vary based on the type of acid used, implying that the partial removal or dissolution of the pellicle layer caused by the acid was primarily determined by the acid's proton concentration, and was similar across all groups of enamel and dentin. Additional research is required to determine if the protective effect of pellicles varies with differing acid pH levels. Although in situ pellicles are more effective at reducing enamel than dentin erosion, at pH 2.6 the protective capacity of pellicles is independent of the applied acid. The efficacy of skin-induced protection depends on the acid concentration and duration of the erosive attack, as well as the perfection of the skin, which may limit the rate of diffusion of calcium or acid agents [17].

Conclusion

The current study reveals that the thickness of the salivary film that forms in situ varies across the different parts of the dental arch. It has also been shown that this change can determine the location and severity of erosion within the arch. In addition, pellicles have been shown to protect teeth from tooth erosion. The effectiveness of pellicle protection de pends on acid concentration and duration of erosion attack, as well as pellicle perfection, which can limit the diffusion rate of calcium or acid agents. The in-situ pellicles are more effective than dentin erosion in reducing enamel, but at pH 2.6 the protective capacity of pellicles is independent of the acid applied. The presence of a salivary film layer on the enamel surface increases measurement artifacts as the enamel is etched. Prior to reflectance measurements, the surface should be rinsed with a 3% NaOCl aqueous solution to remove the salivary film.

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