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Evaluation of pH of Gingival Crevicular Fluid as a Local Factor in Etiology of Cervical Lesions

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Abstract **Background**: The term Erosion is not due to a single factor but multifactorial due to acids, mechanical wear and tear, trauma from axial and non-axial loads. The aim of the study was to evaluate the influence of local factor, the pH of gingival crevicular fluid on dental erosion. **Materials and methods:** The 200 adult volunteers of both sexes 30-50 yrs of age were involved in the study. Saliva and GCF samples were collected in the morning from 2 to 3 hours after breakfast with the help of proximal strips. The criteria for gingivitis was evaluated by measuring the plaque index, the gingival index, probing depth and bleeding on probing (BOP). Participants were divided into two groups: Control group-Normal gingiva (n=100) and moderate and severe gingivitis (n-100) with cervical lesions. **Results:** The collected data were analysed with IBM.SPSS statistics software 23.0 Version. The pH of GCF and Saliva were near neutral (6.5 and 6.4) in patients without gingivitis. In moderate and severe gingivitis, the pH was 5.4 and 6.1 of GCF and Saliva ($P \leq 0.05$). **Conclusions:** The pH of gingival crevicular fluid can be a contributing factor in the etiology of dental erosion in the process of lowering pH near enamel and dentin in the cervical areas.

Keywords: *erosion, GCF, non cavitated lesions*

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1. Introduction

Dental erosion is derived from Latin verb erosum (to corrode), is defined as the superficial loss of hard tissues of the teeth by a chemical process that does not involve the action of bacteria [1]. Dissolution of mineralized tooth structure occurs upon contact with acids that are introduced into the oral cavity from intrinsic or extrinsic sources. The solubility of enamel is pH dependent at the critical level of 5.5 [2]. Larsen and Nyvad reported that in vitro erosion was minimal for beverages with a pH higher than 4.2, but more evident for beverages with pH lower than 4.0.Although acidity was related to erosion they also concluded that extent of erosion was not associated with titratable acidity [3]. Survey by Khan and Young concluded that cervical lesions may have a multifactorial etiology [4,5]. The etiologic classification of tooth erosion is extrinsic (exogenous), intrinsic (endogenous) or idiopathic (unknown). The common etiology of dental erosion can be due to environmental, diet, medication and lifestyle. Intrinsic sources arise from gastric secretions (GERD) and chronic vomiting. The characteristic, clinical signs of erosion are wide, clean and polished surfaces with well-defined borders on all sides [6]. The duration of erosion is not in itself a marker of only chemical action but also due to factors like friction from tongue during chewing, swallowing and speaking or other associated factors. In the healthy sulcus the amount of gingival fluid is minimal but during inflammation the gingival fluid flow increases, and its composition starts to resemble that of an inflammatory exudates with an acidic pH [7].

Since the prevalence of cervical lesions is increasing, identification of the systemic and local risk factors is the key for diagnosis, prevention and treatment is an important factor. Hence the aim of the study was to evaluate the influence of local factor, the pH of gingival crevicular fluid on dental erosion.

2. Materials and Methodology

The 200 adult volunteers of both sexes 30-50 yrs of age were involved in the study. Subjects was chosen from the departments of Conservative Dentistry and Endodontics and Oral medicine and Radiology. The exclusion criteria for all study participants were as follows: Patient not on antibiotic therapy within three months prior to treatment and pregnancy. The subjects did not have any fillings in the site where measurements were made. Samples were collected in the morning from 2 to 3 hours after breakfast. The examination was conducted after explaining the study to participants and obtaining their informed consent. The criteria for gingivitis was evaluated by measuring the plaque index, the gingival index, probing depth,and bleeding on probing (BOP). Participants were divided into two groups: Control group- Normal gingiva (n=100) and

100 patients with moderate and severe gingivitis with cervical lesions. Following isolation of the site with cotton rolls to prevent contamination with saliva, supragingival plaque was removed, the tooth was air dried . The proximal strips were cut into 2 mm in width ,which was inserted into the interproximal site in the premolar region of first quadrant respectively . After insertion for 10 secs the pH value was assessed by comparing the strips with the color of the color index supplied by the manufacturer. To determine salivary pH, the reactive strip of the dental Saliva pH indicator strips was submerged in unstimulated saliva for 10 seconds. The color obtained was compared with the chart: highly acidic = 5.0 to 5.8; moderately acidic = 6.0 to 6.6; and healthy saliva = 6.8 to 7.8.

3. Results

The collected data were analysed with IBM.SPSS statistics software 23.0 Version.

The pH of GCF and Saliva were near neutral (6.5 and 6.4) in patients without gingivitis (Table 1). In moderate and severe gingivitis the pH of GCF and Saliva was 5.4 and 6.1 ($P \leq 0.05$).

4. Discussion

Erosion is the loss of surface by non-bacterial acids. Compared to dental caries which originates as subsurface mineralization, erosion is a surface phenomenon. Erosive lesions are usually concave and rounded defects without the roughness normally associated with or without caries [8,9].

Erosion associated with gastrointestinal reflux (voluntary and involuntary regurgitation) are concave depressions on the palatal surfaces of maxillary anterior teeth and in severe cases at the buccal and occlusal surfaces of mandibular posterior teeth which is termed as perimolysis or periomylolysis. [10] Erosion associated with diet may be evident on labial surfaces of maxillary anterior teeth and present as scooped-out depressions. In 1988, International Dental Federation (FDI) analyzed the past data and concluded that enamel erosion is rare, easily misdiagnosed and occurs only in susceptible individuals regardless of food and beverage consumption patterns. Therefore, consumption of acidic food or beverage alone is highly unlikely to cause erosion but it is due to multifactorial in nature [11].

Lesions are due to combination of two or more processes. Grippo et al classified cervical lesions as Erosion Corrosion, Abrasion Corrosion, Abrasion Abfraction, Biocorrosion Abfraction. Abrasion-corrosion may be due to brushing teeth immediately after drinking an acid beverage or gingival crevicular fluid as a source of acid in these lesions [12,13]. Sulcular fluid can be collected by means of absorbing paper strips, micro papillary pipettes, gingival washings. In our study we have selected absorbing paper strips to evaluate the pH of the gingival fluid similar to the study done by Carlen et al [14].

Patients with moderate and severe inflammation, the pH of gingival crevicular fluid was mildly acidic at 5.4 compared to crevicular fluid of normal gingiva 6.5 (Table 1 & Table 2).

In most of the patients the salivary pH was nearly neutral. This study shows that the acidic GCF due to gingivitis can be a synergetic factor along with other etiological factors in the etiology of erosion.

Gingival crevicular fluid seeps from gingival connective tissue through the thin sulcular wall into the gingival sulcus. This fluid cleanses material from sulcus, has antibacterial properties, contains plasma proteins, antibodies and MMPs and improves adhesion of the epithelium to the tooth. The amount of gingival fluid is greater when inflammation is present and sometimes it is proportional to its severity. It also increases by mastication of coarse foods, tooth brushing and gingival massage, ovulation and hormonal contraceptives. Gingival fluid is not increased by trauma from occlusion [7].

Table 1. pH Of GCF And Saliva In Normal And Gingivitis Patients: (P≤0.05).

Groups		N	Mean	Standard Deviation	Std. Error Mean
GCF	Control	100	6.5820	0.31921	0.03192
	Experimental	100	5.4320	0.44469	0.04447
Saliva	Control	100	6.4060	0.31840	0.03184
	Experimental	100	6.1430	0.39855	0.03985

Table 2. Independent Sample Test

		Equality Of Variances		T-Test For Equality Of Means						
		F	Sig.	T	Df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval Of The Difference	
									Lower	Upper
GCF	Equal Variances Not Assumed			21.008	179.618	0.0005	1.15000	0.05474	1.04198	1.25802
SALIVA	Equal Variances Not Assumed			5.156	188.794	0.0005	0.26300	0.05101	0.16237	0.36363

Upon acidic exposure, the minerals from the peritubular/intertubular dentin junction are initially extracted. Next, the peritubular dentin is degraded and a superficial layer of demineralized organic matrix is exposed followed by a partially demineralized zone until the sound inner dentin is reached [15]. Dentin organic matrix can be degraded both mechanically and chemically. Chemically, it can be degraded by MMPs that are a family of zinc-dependent proteolytic enzymes [16]. It is believed that most MMPs are from saliva and gingival crevicular fluid.

The activation of MMPs seems to play a role in dentinal erosion progression, since they have a crucial role in the collagen breakdown that leads to progression of dentin caries lesions. The low pH (critical pH) of the erosive agent causes dentin demineralization(DM), exposing the collagen fibrils. Concomitantly, dentin-bound and/or salivary MMPs are activated. When the pH returns to approximately neutral levels, MMPs degrade the collagen (DC), allowing dentin loss to progress [17]. This mechanism of dentin erosion begins with a low pH.

The lower pH of GCF during moderate and severe gingivitis can be a contributing etiological factor in erosive lesions. The use of gels delivering MMP inhibitors has shown to prevent erosion and this concept opens a new perspective for protection against dental erosion [18]. This concludes that erosion is caused due to multifactorial etiology, with low pH being a dominant factor that cause dentin demineralization and collagen degradation of collagen.

5. Conclusion

In the etiological process of dental erosion, the pH of gingival crevicular fluid can be a one of the contributing local factor.

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