Study Of Assessment Of PH Of Plaque And Saliva And Its Correlation With Dental Caries Index - An In-Vivo Study

Research Article

Jerry Jose[1], Ajitha Palanivelu[2*]

[1] Post Graduate Student, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India.
[2] Professor, Department of Conservative Dentistry and Endodontics, Clinical Genetics Lab, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai - 600077, India.

Abstract

Introduction: Salivary pH is taken as an indicator in many local and systemic disorders. The influence of salivary pH and its buffering capacity do not have a proportionate effect on the reduction in the risk of dental caries. Studies have shown prophylactic measures in the form of mouthwashes do not benefit the patient unless the plaque is periodically removed professionally. The aim of the study is to conduct an in vivo study to correlate the relation of dental plaque pH and salivary plaque pH and correlate with the dental caries index.

Methodology: The pH of plaque and pH of saliva from 50 caries prone individuals and 50 caries free individuals was examined under routine clinical evaluation. The analysis was carried out using a digital pH meter set at 0.5 increment. An inclusion criterion of DMFT 5 adult population was taken and above were analysed. The results obtained were then analysed and interpreted.

Results: The dental plaque pH of caries prone individuals is shown to have a significantly lesser salivary pH than the non-caries individuals who have shown dental plaque pH to have higher pH values.

Conclusion: It can be concluded that dental plaque pH of caries prone individuals is significantly lower than caries free individuals.

Keywords: Caries Index; Plaque; Saliva; Dental Caries.

Introduction

Dental caries is a multifactorial disease that starts with the microbial shift in the biofilm causing a change in the salivary flow and composition. It is a chronic disease which progresses over time. The process of demineralization and remineralization of tooth structure plays a crucial role in the salivary pH [1]. The change in oral pH is one of major factors in formation of dental caries. Its correlation with periodontal disease is widely known. Changes in microbial and environment have a direct correlative effect in the formation of dental caries. Various factors are responsible for the formation of dental caries with oral pH being one of the major factors in the formation of dental caries It has a direct correlation with the formation of decay by creating an acidic environment for microorganisms to dissolve the organic matrix of the tooth structure. Studies have shown that salivary pH have been used to analyse various systemic diseases [2, 3]. A drop in the dietary pH by dietary sugars is one of the major factors in the formation of dental caries with the lowest pH in the higher chances of formation of dental caries called 'critical pH'. It is seen that dental plaque produces lactic acid in large amounts with plaque pH being a major influential factor to form acid production [4, 5]. It is seen in studies that the dental plaque pH of a caries prone individual is much lower, but the correlation of salivary pH and dental plaque pH of caries prone individuals is not present till date. The aim of the current study was to conduct a clinical cross-sectional study to evaluate the correlation between pH of saliva and pH of plaque in individuals prone to caries and pH of saliva and pH of plaque of caries free individuals i.e., DMFT of 0 is evaluated and correlated with the Dental caries index chart.

*Corresponding Author:
Ajitha Palanivelu,
Professor, Department of Conservative Dentistry and Endodontics, Clinical Genetics Lab, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai - 600077, India.
Tel: +91 9444174551
E-mail: ajitharijesh@gmail.com

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Previously our team has a rich experience in working on various research projects across multiple disciplines [6-20]. Now the growing trend in this area motivated us to pursue this project. The current aim of the study was to evaluate the relation of pH of plaque and pH of saliva in caries prone and caries free individuals and correlating them to the dental caries index.

Material And Methods

An in-vivo cross-sectional study was conducted in the Department of Conservative Dentistry and Endodontics, Saveetha Dental College, Saveetha University, Chennai, India. Two groups were taken into the Group 1 being the Control group and the Group II being the experimental group. The population to be evaluated was evaluated based on randomization done using random allocation method (SNOSE method).

An inclusion criterion of DMFT 5 and above was taken into consideration, Patients from the age of 20 to 55 years were taken into the study. The exclusion criteria being patients with systemic diseases such as Diabetes mellitus, patients with uncontrollable pain, patients who were uncooperative, patient who showed severe periodontal problems.

After taking the consent of the patient the collection of the saliva was carried out according to the protocol derived from the World Health Organization for Research on Cancer guideline "Common Minimal Technical Standards and Protocols". The participants were given drinking water (bottled) and asked to rinse their mouth out well (without drinking the water). Followed by which after 5 minutes the participants were asked to put their head down and let the saliva run naturally and spit into the collection tube about once a minute for about 10 minutes. The salivary samples were collected between 9:00am and 11:00am.

For the collection of the plaque samples, the plaque was collected from six different sites such as upper central incisors, the buccal surface of the upper first premolars and molars, lingual surfaces of the lower molars, and incisors with the help of a sterile spoon explorer. These samples were further diluted with 10ml of distilled water and analysed.

Method of pH estimation

The plaque and salivary samples were collected and mixed with 10ml of distilled water in a glass test tube and stirred for 5 min for homogeneity and then pH was measured using a digital pH meter with a 0.5 increment set.

Statistical Analysis

The statistical analysis was carried out using IBM SPSS for Windows, v. 21.0 (IBM Corp., Armonk, USA). The normality test (Kolmogorov-Smirnov and Shapiro-Wilk tests) have shown non parametric distribution. Mann-Whitney U test was used to assess the influence of caries distribution. pH of plaque showed significant decrease ($p<0.05$) showed sufficient correlation in dental caries formation in comparison to pH of saliva.

Results And Discussion

From the results achieved it is seen that the pH of plaque and saliva in caries prone individuals is less when compared to the pH of caries free individuals who had a DMFT score of 0 ($p<0.05$) (figure 1). It is also seen that the correlation of pH of plaque and pH of saliva in individuals are quite similar to each other showing the fact that a correlation is seen between the pH of saliva and pH of plaque in individuals ($p<0.05$) (figure 2).

Dental plaque is seen as a diverse community of microorganisms found on the tooth surface as a biofilm embedded in an extracellular matrix of polymers of host and microbial origin [21]. It is a naturally occurring process which occurs on the external surface of the tooth in a relatively short period of time. The distinct changes seen in plaque formation include acquired pellicle formation, irreversible adhesion involving weak long-range physio-chemical interactions between the cells and pellicle and

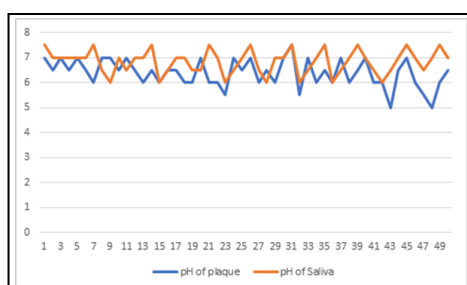**Figure 1. Line diagram showing the correlation of pH of plaque and pH of saliva in caries prone individuals.**

Figure 2. Line diagram showing the correlation of pH of plaque and pH of saliva in caries free individuals.

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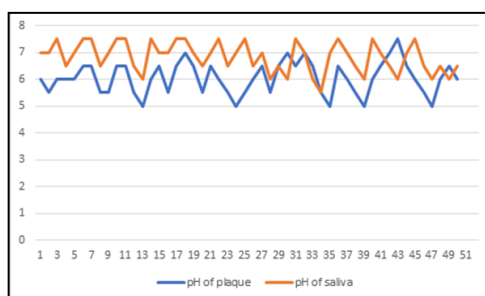
co-adhesion resulting in attachment of secondary colonizers of already attached cells [22]. Dental caries is a major cause of concern among individuals. Studies have been in different populations regarding the incidence of formation of dental caries [23, 24]. It is seen that in various populations a different incidence of DMFT score is seen this can be contributed to different factors with plaque pH being a major factor in the formation of dental caries. Bibby et al had done a study to evaluate the change in pH of saliva and pH of plaque by consuming different eatables. It was seen that during different intervals of time there was a drastic decrease in the levels of pH showing that food consumables have a direct effect on the pH of caries [25].

Our institution is passionate about high quality evidence based research and has excelled in various fields [26-36]. It is seen that the frequent exposure to low pH can lead to inhibition of the acid sensitive species and selection of microorganisms with an aciduric potential such as Mutans streptococci and Lactobacillus species . The subgingival flora consists of being mainly gram positive to be more of increased levels of anaerobic, asaccharolytic gram negative microorganisms [37]. It has been observed that the proportion of streptococci, nocardia and Neisseria has decreased whereas those of Veillonella, Fusobacterium and Actinomyces has increased during plaque development [38]. The plaque formation first starts with the formation of biofilm consisting of various microorganisms.

It is said that a biofilm consists of 95% of bacteria existing in nature are in the form of biofilms. With the advent of nonspecific plaque hypothesis, it was seen that with the proliferation of microbial organisms in the absence of oral hygiene colonize on tooth specially on the gingival crevice to form plaque. Inflammatory periodontal diseases develop in the case of bacterial proliferation which increases beyond the threshold of host resistance causing disease progression to occur in due course of time [39]. It is seen that caries occurrence is in direct correlation with the amount of plaque adherence with the tooth structure. Mutans streptococci is one of the main etiological agents in formation of dental caries in humans and is a direct correlation with the formation of dental caries in caries prone individuals [40]. Lactobacillus and Candida albicans are other sets of organisms that cause formation of dental caries in correlation with Mutans streptococci. Studies have shown that Lactobacillus causes acid formation creating an acidic environment much lower than Candida albicans [41]. It is seen that the increase of pH is caused by the salivary factor called sailin and other alkaline protein which allows the salivary pH to rapidly return to its normal neutral value [42].

Dental pH is affected by various factors and researchers have used various methods such as using artificial sweeteners to increase the dental plaque pH. It is generally influenced by systemic conditions in which studies have shown that in down's syndrome the salivary pH is much lower in individuals with down syndrome than in normal individuals leading to the formation of dental caries [43]. Various researchers have used the potential of salivary pH to increase its baseline value to create an alkaline environment to prevent dental caries formation. Leonard Jr et al had conducted a study by using 10% carbamide peroxide to increase the salivary pH baseline values from an acidic value to an alkaline value [44]. Another major factor is the pH of saliva which has an indirect effect in the formation of dental caries. It is seen that the salivary flow rate and buffering capacity has an indirect effect in the for-

mation of dental caries. The buffering capacity of saliva is based on the amount of bicarbonate, phosphate and protein buffer system [45]. It is seen that a low salivary pH of 5-6 has a direct effect on the formation of dental caries with an alkaline salivary pH individuals showing a lesser tendency of formation of dental caries [46].

Conclusion

From the cross-sectional study, it can be concluded that the salivary pH and plaque pH of caries prone individuals are much lower than the salivary pH and plaque pH of caries free individuals which shows that pH is a major factor leading to the formation of dental caries. Caries activity is in direct correlation with the pH of plaque and pH of saliva and its correlation to each other is quite similar where pH of plaque of caries prone individuals is comparatively much lesser than their salivary pH. Further studies are required to necessitate the difference of plaque pH and salivary pH of individuals

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