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Comparative Assessment of Salivary pH as a Diagnostic Marker in Dental Caries and Chronic Periodontitis

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MK and SM designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MK and AS managed the analyses of the study. Authors MK, RK and SA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Saliva contains various host defining factors. It influences calculus formation leading to periodontal diseases and also plays and important role in caries development. Saliva provides an easily accessible, non-invasive diagnostic marker for a rapidly widening range of diseases and clinical situations.
Aims and Objective: To assess and determine the role of salivary pH in Dental Caries and Chronic Periodontitis.
Materials and Methods: The study population consisted of 60 patients who were divided into three groups of 20 patients each: Group A with clinically healthy gingiva, Group B with Dental Caries and Group C with Chronic Periodontitis. Fasting unstimulated whole saliva from each patient was collected; pH was evaluated using pH meter. Data were analysed statistically using analysis of variance technique.

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Results: The results of the study showed that when compared to control group (group A) (6.76±0.13), salivary pH of Dental Caries group (group B) (6.08±0.12) and Chronic Periodontitis group (group C) (6.61±0.16) were more acidic. Nonetheless when salivary pH of Dental Caries group is compared to that of Chronic Periodontitis group it was more alkaline for Chronic Periodontitis group.
Conclusion: The result of the study showed that salivary pH was more acidic in caries and periodontitis group compared to healthy group which signifies that the salivary pH can be used as an essential tool for Dental Caries and Chronic Periodontitis assessment.

Keywords: Salivary pH; dental caries; chronic periodontitis.

1. INTRODUCTION

Saliva plays a determining role in maintaining healthy homeostatic condition in the oral cavity. It is usually considered to be important for health of teeth and surrounding tissues as per the dental perspective. Saliva acts as lubricant, regulates buffering action, comprise of antimicrobial action, carries out agglutination, digestion of food, water balance, taste sensation and many other miscellaneous functions. In maintaining equilibrium between all these factors salivary pH plays foremost role [1].

Dental Caries and Chronic Periodontitis are considered as two major global oral disorders. Dental caries is a multifactorial microbial disease resulting in demineralization and destruction of tooth structure by acid-forming bacteria. This vicious cycle further continues causing destruction as the salivary pH decreases [2]. Periodontal disease leads to gingival inflammation, connective tissue attachment loss, periodontal ligament destruction and alveolar bone resorption. Role of biomarkers in oral diagnostics has been a great challenge for screening, prognosis determination and evaluating the disease activity [3].The primary etiological factor responsible for dental caries and periodontal disease is the 'dental plaque'. Saliva has a major influence on plaque initiation, maturation and metabolism. Salivary inorganic components such as calcium, phosphorous and other minerals readily get absorbed by dental plaque leading to periodontitis, availability of these components is overseen by saliva and change in salivary pH impede their concentration [4].

Saliva has many advantages over whole blood, plasma and serum, comprising ease of collection, storing, shipping for analysis. For patients, the non-invasive collection techniques seem more convincing, reducing anxiety and discomfort [5]. As saliva plays a significant role in evaluation and prevention of oral diseases such as periodontitis and dental caries it can be used as an important marker in these oral diseases.

Saliva being inexpensive, non-invasive and readily available tool, shows various markers determining the disease activities of dental caries and chronic periodontitis. Thus, this study aims at comparing salivary pH as a diagnostic tool in assessment of caries and chronic periodontitis.

2. MATERIALS AND METHODS

2.1 Study Population

The study was conducted in the out-patient department of Periodontology and Oral Implantology and the analysis of pH was carried out in the Biochemistry laboratory at M.A Rangoonwala College of Dental Sciences and Research Institute Pune, India. The sample size consisted of 60 patients within the age group of 20-45 years. These patients were further categorized in to 3 groups.

Group A: Healthy controls without chronic periodontitis and dental caries.

Group B: (Dental Caries): Patients with more than two active carious lesions without chronic periodontitis.

Group C: (Chronic Periodontitis): Patients with chronic periodontitis showing >30 sites with probing pocket depth (PPD) ≥ 5 mm and with an attachment loss of 1.5 mm or more [6].

Prior to the start of study Decayed Missing Filled (DMFT) Index for caries and Community Periodontal Index (CPI) for periodontal status were recorded. Patients suffering from any known systemic disease, pregnant and lactating women, and smokers were excluded from the study [7].

2.2 Saliva Sampling

After examination patients were recalled between 8:00 am to 10:00 am after an overnight fast, during which subjects were requested not to drink and eat anything except water. Saliva was collected as per the protocol is derived from the World Health Organization/International Agency for Research on Cancer guideline "Common Minimal Technical Standards and Protocols [8]. Patients were asked to rinse their mouth out well, 5 minutes after oral rinse, the subjects were asked to spit whole saliva and not to cough up mucus. The subjects were asked to refrain from talking and drop down their head and let the saliva run passively to the front of the mouth. The subjects spit into sterile 10 ml beaker about once a minute for up to 10 min to collect 5ml of unstimulated whole saliva. The pH of salivary sample was immediately measured in order to prevent any deterioration of the sample.

2.3 Salivary Analysis

Salivary pH was measured with the help of a standardized single electrode digital pH meter (Electronics India, Model 111E). The electrode tip was dipped in 0.1N hydrochloric acid overnight. The pH meter was then calibrated using freshly prepared buffers of pH 7 and pH 4. Following this the electrode was kept dipped in double distilled water. Prior to dipping the electrode in the sample, it was gently cleaned and dried out completely using fresh sterile filter paper. After pH analysis, the electrode tip was washed again with a gentle stream of distilled water and dipped in the double distilled water [9].

2.4 Statistical Analysis

The mean pH for all the three groups was calculated along with mean Gingiva Index and Plaque Index, Decayed Missing Filled Teeth (DMFT) Index and Community Periodontal Index. One-way analysis of variance using Tukey's correction for multiple group comparisons was used to obtain the P values of individual groups and was considered statistically significant if P value was < 0.05.

3. RESULTS

The mean and standard deviation was calculated.

3.1 Reference Range

Gingival Index: 0.1-1.0= mild gingivitis, 1.1-2.0= moderate gingivitis, 2.1-3.0= severe gingivitis.

Plaque Index: 0=excellent, 0.1-0.9=good, 1.0-1.9= fair, 2.0-3.0= poor.

4. DISCUSSION

Saliva apart from lubricating the oral cavity it maintains the homeostasis of the oral environment [10]. Salivary flow flushes and cleanses oral debris and toxic agents. Reduced salivary flow rate and alteration in the pH may cause severe irritation leading to inflammations of the oral masticatory mucosa, making the oral tissues more prone to diseases due to increased microbial load [11].

Table 1. Mean plaque index and gingival index and DMFT index of groups

Groups	Plaque index	Gingival index	DMFT index
A	0.28±0.05	0.36±0.04	1.03±0.03
B	1.47±0.07	0.54±0.05	6.02±0.09
C	2.3±0.02	2.14±0.1	0.46±0.02

Table 2. Average salivary pH and p value of groups

Groups	Average pH (mean ±SD)	p values
A	6.76±0.13	0.001 (A vs B)
B	6.08±0.12	0.539 (B vs C)
C	6.61±0.16	0.001 (A vs C)

P Value: <0.05

Table 3. Community periodontal index

Groups	HG	%	BOP	%	CAL	%	PPD (4-5 mm)	%	PPD (>6mm)	%	Total
A	20	100	0	0	0	0	0	0	0	0	20
B	20	100	0	0	0	0	0	0	0	0	20
C	0	0	17	85	19	95	12	60	9	45	56

HG: Healthy Gingiva; BOP: Bleeding on Probing; CAL: Clinical attachment Level; PPD: probing pocket depth

To rule out salivary pH changes and its effects on oral diseases various studies have been done. To further evaluate in, unstimulated saliva is collected for this study to avoid seepage of fluid from gingival crevicular fluid which may contribute in altering the pH. Geddes et al suggested that in order to avoid alteration in salivary pH, fasting sample should be collected to prevent the exposure of saliva to fermentable carbohydrate [12].

Dental caries and chronic periodontitis are the common consequences of alteration in salivary Ph. They may be synergistically associated, negatively associated or completely independent of each other. The interdependences of dental caries and chronic periodontitis has been a matter of interest for more than 50 years [13]. Epidemiological studies have shown high periodontal index scores in caries free population suggest an inverse relation between these diseases. In another study by Michelle Hurlbutt et al which has shown negative correlation between salivary pH and DMFT index score and salivary pH and periodontal disease index [14].

Studies, where the relation between salivary pH and dental caries have been evaluated, showed that the low salivary pH provides an acidogenic environment for the growth of aciduric bacteria leading to dental caries which further lower down the salivary pH leading to vicious cycle.

To further evaluate the relation between salivary pH of dental caries and chronic periodontitis the present study was conducted at the Department of Periodontology an Implantology at M.A. Rangoonwala Dental College, Pune, India.

The results of the present study noticed differences in the pH of dental carious and chronic periodontitis cases. When comparison done, dental caries group showed acidic pH when compared to that of clinically healthy group, suggesting the favourable environment for enamel demineralization, this result was in accordance with the study conducted by Singh et al and Dong et al which stated that the pH range of 5.8 to 6.2 is associated with carious activity and causes more of tooth decay leading to more dental caries [15,16].

Also difference in dental caries and chronic periodontitis cases were noted, suggesting there is slight alkalinity in periodontitis cases than dental caries cases. An alkaline pH is associated with increased proteolytic activity of periodontopathogens, the optimum pH required for the growth being alkaline which favours the deposition of calcium phosphate, thereby promoting plaque deposition, this result was in accordance with the study conducted by zilm et al which concludes that the pH of saliva in case of periodontitis is slightly alkaline [17]. Also, Takahashi et al concluded in their study that the periodontopathogens grow in a mildly acidic pH. Hereafter, the above studies support the finding of this study [18].

5. CONCLUSION

The groups with a higher risk of periodontitis showed alkaline pH than individuals with dental caries. This may be the reason of increased remineralization potential, due to which there are high number of intact teeth when compared to dental caries group. These findings highlight physicochemical factors of saliva as an important diagnostic marker to assess periodontitis and caries activity. However, further cross-sectional studies with larger samples are required to extrapolate the findings.

CONSENT

All patients were verbally explained about the procedure of study and informed consent from the patient was obtained (as per the Helsinki declaration).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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