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CORRELATION BETWEEN SALIVARY pH AND DENTAL CARIES STATUS USING A CHAIRSIDE TEST AMONG SCHOOL CHILDREN IN CHENNAI CITY: A CROSS SECTIONAL STUDY

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ABSTRACT:

CONTEXT: Dental caries is one of the most prevalent oral diseases, especially among children of all age groups. In India, the trend indicates a consistent increase with an overall caries prevalence of 78.9% in children aged 6-11 years in the past decade. Saliva acts as one of the essential biomarkers in the determination of caries status of an individual. Drop in the pH of saliva influences the oral environment and aids in the precipitation of dental caries. Hence, analyzing the salivary pH and establishing its relevance to the caries status of the oral cavity can be used as a quick, viable chairside test to assess the caries risk of the individual.

AIM: The aim of the study was to analyze the pH of saliva and determine its correlation to the caries status of the oral cavity, expressed by means of DMFT index.

MATERIALS AND METHODS: Routine dental examination was conducted on a group of 125 healthy children aged 7 to 11 years and their DMFT index was recorded. Unstimulated saliva of about 2-3 ml was collected in sterile bottles from each of these children. The collected salivary samples were immediately tested for the pH value using a pH meter. The scores of DMFT index and the salivary pH thus obtained were statistically compared, tabulated and interpreted.

RESULTS: Among all children assessed, 49.6% had caries, 4% had restorations and 1.6% had missing teeth due to dental caries. A strong, significant negative correlation (r=-0.601) was seen between pH and dental caries (p=<0.001*). It has thus been established that the incidence of caries increases with the decrease in pH.

CONCLUSION: From the present study, we can conclude the presence of a strong negative correlation between salivary pH and dental caries, that is as pH decreases carious lesions increase. So, pH analysis is an important indicator of the oral hygiene of the patient and is thus a potential self control test and a motivational tool to improve oral health.

KEY WORDS: Caries risk, chairside test, dental caries, DMFT index, salivary pH.

INTRODUCTION:

Dental caries is a microbial odontogenic infection caused by the interplay of genetic, biological, behavioural and environmental factors. A quadrant of elements, namely cariogenic microorganisms, predominantly mutans streptococci and lactobacilli, a diet rich in fermentable carbohydrates, exposure time and host factors, like salivary pH, saliva secretion rate and buffering capacity contribute to the development and progression of the disease.[1] A change in the oral environment initiates and facilitates the pathogenic bacteria to cause demineralisation of the inorganic and

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destruction of the organic portion of the tooth leading to increased caries activity.[2]

Dental caries is an extensive disease that has witnessed several leaps since time immemorial. Over the decades, the approach to the management of dental caries has shifted from treatment procedures to preventive strategies.[3]Identification of the right risk factors for an individual has become utmost important to have a comprehensive approach towards dental caries prevention.[4] The need of the hour is to establish a simple, viable chairside test that would help clinicians easily assess the caries risk of the patient.

Saliva plays a pivotal role in oral health. It has several exceptional properties which include antibacterial action, preservation of tooth integrity, lubrication and maintenance of pH balance.[5] One of the imperative qualities of saliva is its pH balance. It controls the equilibrium between demineralisation and remineralisation in a cariogenic environment, thus acting as a protective barrier against dental caries.[6] Being one of the widely studied oral biomarkers, the salivary pH is an important factor in determining the prevalence of caries.[7]A drop in the salivary pH provides an acidogenic environment for the growth of aciduric bacteria leading to the incidence of dental caries which further lowers the salivary pH ultimately becoming a vicious cycle.[8] This relevance between the pH of saliva and its influence on the oral environment making it susceptible to dental caries can be used as a valuable tool to develop a chairside test that would aid in caries risk assessment.

Thus, the aim of the study was to establish a simple chairside test analysing the pH of saliva and to determine its correlation to the caries status of the oral cavity, expressed by means of DMFT index.

MATERIALS AND METHODS:

The study was designed as a cross sectional study. After obtaining ethical committee clearance, 125 children meeting the inclusion and exclusion criteria were enrolled for the study. The inclusion criteria was healthy children aged 7 to 10 years. Children with any systemic illness, those who were under medications that would adversely affect the composition of saliva and special children were excluded from the study. After elaborating the purpose of the study, a written informed parental consent was obtained from the parent of all the subjects enrolled in the study.

The children were informed in advance not to take any food or drink two hours prior to the test. The demographic details of the subject were collected and routine dental examination was conducted using basic dental instruments, namely mouth mirror and explorer. DMFT index (WHO modification, 1987) was established for each of these children. The entire saliva sampling was done between 9:00 am and 11:00 am. The subjects were asked to

refrain from talking and drop their head down so as to let the saliva run naturally to the front of the mouth. The subjects were also instructed not to cough up mucus as saliva is collected. They were made to spit into sterile bottles about once in a minute for up to 5 minutes until 3-4 millilitre of unstimulated saliva was collected.

The collected salivary samples were immediately tested for pH in order to prevent any deterioration of the samples, using a hand held pH meter with a digital display (Digital pH meter, model 335, Systronics India Limited, Rajendra Place, New Delhi, India). Standard solutions of known pH 4.0 and 9.0 were used for the calibration of the pH sensitive electrode. The result of the test was read by means of the calibration that was established after the value got stabilised on the digital display, 1 minute from dipping the pH meter in saliva.

The scores of the DMFT index and the salivary pH thus obtained were collected and tabulated using Microsoft Excel 2007. It was then statistically analyzed by means of SPSS Software version 22. Tabular descriptions were used to represent the data and correlations in the research.

RESULTS:

Data of all 125 subjects enrolled for the study was statistically analysed. The mean age of children enrolled for the study was 9.152. Table 1 shows the caries prevalence in the study population. Total percentage of children with caries was 49.6%. Table 2 shows the prevalence of missing teeth due to extraction of carious teeth. Percentage of children with atleast 1 extracted tooth was 1.6%. Table 3 shows the prevalence of restorations in children enrolled for the study. 4% of children have fillings. The number of restored teeth in the examined subjects ranged from 1 to 3.

The salivary pH observed in the subjects ranged from 4.2 to 8.1. 90 subjects fell under the pH window of 6.2 to 7.6, which is the normal pH of saliva. Pearson's correlation was used to analyze the correlation between the salivary pH and DMFT score of the subjects. Table 4 shows the correlation of salivary pH and DMFT score. Pearson's correlation value of r=0.601 was obtained between salivary pH and dental caries. This indicated a strong, significant negative correlation between pH of saliva and dental caries. P value of <0.001 indicated significant results. This table helped to conclude that with a drop in the salivary pH, the incidence of caries increases.

DISCUSSION:

Caries risk assessment has become a vital part of patient management, both in preventive and therapeutic aspects. A good risk assessment tool is one that evaluates the actual caries status and predicts the future caries risk.[9] Literature evidence shows the presence of several disease models for dental caries in the past.[10-16]Historically, the disease model for dental

caries consisted of mutans streptococci and Lactobacillus species, focusing on restoring the carious lesions using a surgical approach. The current recommendation is to implement a risk-assessment-based medical model called CAMBRA (caries management by risk assessment) to diagnose and treat dental caries. Unfortunately, many of the suggestions of CAMBRA have been highly complicated and confusing for clinicians to use it in their daily practice. The risk of caries, however, is usually related to only a few clinical factors which occur commonly in the population.[17] Thus, identification of an effective chairside test to assess the caries risk of an individual would be of high clinical value.

Saliva as a diagnostic biomarker has peaked in the field of dentistry. Considering saliva as a clinical tool, it has several advantages over serum including non invasive collection technique, ease of obtaining sufficient quantities, lesser need for manipulation, feasible transportation and storage procedures. [18]

Saliva influences the occurrence of caries in four ways namely, acting as a mechanical cleansing agent that results in less accumulation of plaque, reducing enamel solubility by presence of calcium, phosphate and fluoride ions, buffering and neutralising the acids produced by cariogenic organisms and by its antibacterial activity.[19] Maintenance of physiological hydrogen ion concentration at the tooth surface and the mucosal epithelial cell surface is important for maintaining homeostasis in the oral environment.[20] The hydrogen ion concentration of a solution is measured as its pH.

The normal range of salivary pH is 6.2-7.6 with an average of 6.7.[21] Critical pH is the pH at which saliva and plaque cease to be saturated with calcium and phosphate, thereby permitting the hydroxyapatite in enamel to dissolve. It is the highest pH at which there is a net loss of enamel from the teeth, which is generally known to be about 5.5 for enamel and 6.5 for dentin [22]. Below the critical pH, saliva remains unsaturated. Calcium and phosphate from the enamel dissolve until the saliva becomes saturated, ultimately leading to demineralisation of tooth structure.[23]Hence, we used salivary pH as a potential tool to assess the caries risk of the individual.

This study aimed at evaluating the efficiency of a chairside test that would help in immediate caries risk assessment of the patient as well as act as a motivational tool in patient education. Children aged 7-11 years were enrolled for the study considering the second window of infectivity where there is an expected rise in the mutans streptococci colonization owing to the eruption of permanent teeth.[24] DMFT index(WHO modification 1987) was used as a tool for direct assessment of the oral hygiene status of the subjects.[25] To avoid discrepancies in pH values that would occur as a result of the effect of food intake in the oral environment, children were instructed to avoid any dietary intake 2 hours prior to sample collection. 2-3 ml of

unstimulated saliva was a quantity feasible to collect from the study population as well as would suffice for the pH analysis.[26] Unstimulated saliva was preferred as it validates a natural flow and ensures there are no physiological changes in the salivary secretion as a result of stimulation.[27] Immediate testing of the salivary samples for pH was done in order to prevent any deterioration of the samples. A digital pH meter that would be portable, occupy lesser space and be less tenacious during usage as compared to a conventional pH meter that uses electrodes would be clinically more feasible and thus was used.[28]

In the present study, a total of 49.6% of the study population had caries, 4% had fillings, 1.6% had teeth extracted due to caries. The high prevalence of dental caries in the study population and the massive difference in percentage between caries and filled teeth can be attributed to several factors including lack of awareness, parental negligence and poor socioeconomic status. Implementation of measures including diet counselling, patient education and motivation, oral hygiene instructions, caries risk assessment, early diagnosis, modelling, public health work would help in improving the oral hygiene status of the individual and community as a whole. [29]

The negative correlation between salivary pH and dental caries helps conclude that as pH decreases, dental caries increase. This significant relationship can be ascribed to the ability of cariogenic microorganisms to thrive in acidic environment. The result of this study is in accordance with the research of Magdalena et al [26] on saliva pH testing in predicting dental caries in children aged 7-10 years.

Thus, maintenance of salivary pH within the normal range plays a critical role in preventing dental caries. This can be achieved by effective plaque control and diet control. It becomes imperative to implement such a chairside test in clinical set ups, so that it is beneficial for the clinician in immediate assessment of caries risk. Such a simple chairside test would also help in defining the degree of caries potential of a given individual and act as a useful self control test to take up prophylactic measures. However there is a need to consider a larger sample population with a wider age window for more clinical establishment.

CONCLUSION:

Within the limitations of the present study, it can be concluded that salivary pH can be used as a proficient chair side tool for caries risk assessment. Utilising such a clinical tool would help in effective heath education and patient motivation, ultimately leading to better oral hygiene of the individual.

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TABLES:

Table 1- Caries prevalence in the research group

CARIES

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	63	50.0	50.4	50.4
	1	21	16.7	16.8	67.2
	2	14	11.1	11.2	78.4
	3	6	4.8	4.8	83.2
	4	8	6.3	6.4	89.6
	5	3	2.4	2.4	92.0
	6	6	4.8	4.8	96.8
	7	2	1.6	1.6	98.4
	8	2	1.6	1.6	100.0
	Total	125	99.2	100.0	
Total		125	100.0		

Table 2- Prevalence of missing teeth due to extraction of decayed teeth

MISSING

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	123	97.6	98.4	98.4
	2	1	.8	.8	99.2
	4	1	.8	.8	100.0
	Total	125	99.2	100.0	
Total		125	100.0		

Table 3- Prevalence of fillings in the teeth of children from the research group

FILLED

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	120	95.2	96.0	96.0
	1	3	2.4	2.4	98.4
	2	1	.8	.8	99.2
	3	1	.8	.8	100.0
	Total	125	99.2	100.0	
Total		125	100.0		

Table 4- Correlation of children's salivary pH with the DMFT index

Correlations

		DMF SCORE	pH	CARIES	FILLED	MISSING
DMF SCORE	Pearson Correlation	1	-.601**	.941**	.180*	.274**
	Sig. (2-tailed)		.000	.000	.045	.002
	N	125	125	125	125	125
pH	Pearson Correlation	-.601**	1	-.582**	-.329**	.019
	Sig. (2-tailed)	.000		.000	.000	.836
	N	125	125	125	125	125
CARIES	Pearson Correlation	.941**	-.582**	1	.017	.093
	Sig. (2-tailed)	.000	.000		.855	.304
	N	125	125	125	125	125
FILLED	Pearson Correlation	.180*	-.329**	.017	1	-.022
	Sig. (2-tailed)	.045	.000	.855		.808
	N	125	125	125	125	125
MISSING	Pearson Correlation	.274**	.019	.093	-.022	1
	Sig. (2-tailed)	.002	.836	.304	.808	
	N	125	125	125	125	125

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).