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Research Article

Evaluation of Buffering Capacity of Saliva and Cariogenic Potential of Dental Plaque with Current Caries Status

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ABSTRACT

Introduction: Caries diagnosis process involves risk assessment and the use of diagnostic tools to determine the disease status. The aim of this study is evaluating the buffering capacity of saliva and cariogenic potential of dental plaque in relation to current caries status.

Materials & Methods: To evaluate the status of PH, the volume of saliva, salivary flow, salivary concentration, buffering capacity of saliva and cariogenic potential of dental plaque and their relationship with the average number of decayed teeth, samples were collected from 50 patients using GC saliva check buffer and GC plaque indicator kits. To detect proximal caries, bite Wing radiographs was taken and clinical examination was performed by an operator using probe and mirror.

Results: No significant relationship was found between the number of the decayed teeth and salivary volume using Pearson correlation test ($p<0.595$). Based on independent t-test there was no significant relationship between the average number of the decayed teeth and salivary flow ($p<0.052$).A significant relationship between salivary concentration and the average number of decayed teeth was found ($p<0.002$).According to ANOVA test the relationship between other indicators was significant.

Conclusion:According to our investigation saliva PH, buffering capacity, salivary concentration and plaque PH are positively related to dental caries.

Key words: Buffering Capacity ,Dental, caries, Dental Plaque,Saliva

INTRODUCTION

Dental caries affects a large proportion of the world's population as a highly prevalent multifactorial disease . Teeth are constantly bathed in saliva, so the constituents and properties of this oral fluid play an essential role in the occurrence and progression of dental caries(1).Dental caries presents a necessary factor (biofilm accumulation) and also negative(

fermentable sugars) and positive(exposure to fluorides) determinant factors.Biological modulators(saliva), and social(socioeconomic status)factors are important too(2).There are many factors which can cause dental caries;among which,poor dental hygiene and oral care,family history of dental caries,greater concentration of bacteria in oral cavity with acidophilic activity ,decreased salivary flow,more cariogenic diet and reduced level of fluoride in drinking water are the important ones(3).

Saliva is often considered to be of low value and is the least known of all human body fluids. However, it prevents proliferation of microbial populations in the oral environment, so maintaining the integrity of the mineral structure of teeth(4).Salivary stimulation elicited reflexively by taste and mastication leads to an increase in the PH, buffering power, and supersaturation of saliva, which can affect the balance between enamel demineralization and remineralization in early caries(5).

The microbiological counts also refer to be an individual factor. Increasing in mutans streptococci and lactobacilli counts is associated with the developement and progression of caries and sugar consumption and refers to individual values of the condition before the developement of disease(6).The evidence that acid PH has a major role in caries development is almost overwhelming and although is still circumstantial(7).

The source and supply of saliva in health,and its composition when resting or simulated is reviewed in articles.The mean resting flow rate for whole saliva is about 0.4ml/min,and the parafin-stimulated saliva is about 2ml/min(8).

The concentration of ions which make up the lattice structure of hydroxyapatite are higher in stimulated than in unstimulated saliva,thus stimulated saliva is more effective medium for remineralizing enamel crystals which are damaged by initial caries attack(9).In the oral cavity,the resting plaque PH varies regionally because of site-specific effects of saliva.It is generally lowest in interproximal regions,which lack access to saliva once the plaque biofilm has become sufficiently thick to occlude the gingival embrasure beneath the contact point(10).The patient with low salivary secretions has difficult speaking , chewing, forming a food bolus ,and swallowing. In addition there is a rapid and sub-stantial increase in caries and mucosal infection(11).When enamel which has been cleaned is wet by saliva,specific proteins from the saliva are absorbed to the tooth surface and form a delicate membrane referred to as the salivary pellicle or the acquired pellicle.oral bacteria that come in contact with the pellicle adhere to this membrane and form the foundation on which the dental plaque developes(12).

Twice daily toothbrushing reduces the thickness of the dental plaque biofilm(11).

It is obvious that aging of dental plaque gives a greater level of acid production than more immature plaque(13).Numerous clinical studies have established that the proportions of microorganisms designated as capable of acid production at low PH conditions,are significantly increased in plaque from patients with high caries risk(14).

So evaluating the causative factors in saliva of individuals which are at risk of dental caries may be of great advantages such as enhanced diagnostics, early detection of problems, improved patient communication and motivation and an increased dental awareness for patients (15).

MATERIALS & METHODS

This study was carried out as per Ethical Clearance no IR.GUMS.REC.1394.605 based on a thesis for receiving Doctoral Degree in dentistry on 50 subjects (25 men and 25 women) who were students at Guilan University of medical science and were 20-25 years old.The subjects fulfilling the inclusion criteria were free from systemic and local disease such as diabetes and

hypertention which affects salivary secretions..All the subjects signed the informed consent.

Testing the resting saliva:subjects were asked to abstain from eating or drinking for 1 hour prior to the test. we pulled the lower lip, gently dried the labial mucosa with a small piece of gauze and observed the mucosa under light. Droplets of saliva secreted from the orifices of minor glands after a time interval.if it lasted more than 60 seconds, resting flow was low and if it was Less than 60 seconds, resting flow was normal.

We visually assessed the resting salivary consistency in the oral cavity and it reported as follows:

Sticky and frothy saliva: increased viscosity

Watery and clear saliva: normal viscosity

Measuring PH: we asked the patients to expectorate into the collection cup. A PH test strip was immersed into the sample of resting saliva for 10 seconds, and then the color of the strip was compared with the testing chart.

Measuring the saliva quantity: we asked the patients to chew paraffin wax to stimulate the salivary flow. After 30 seconds the patients expectorate into the spittoon and continued chewing for further 5 minutes, we collected all the saliva into the collection cup at regular intervals. The quality of saliva was measured by comparing the ml markings on the side of the cup (Figure 1).

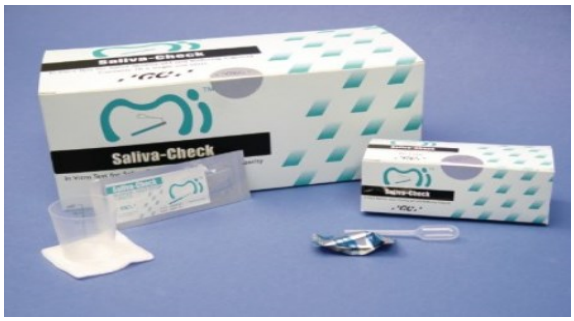

Figure 1: Saliva check buffer kit

Quality of saliva at 5 minutes

≤3.5 ml	Very low
Between 3.5-5.0 ml	Low
≥5.0 ml	Normal

Measure the buffering capacity of saliva: we drew sufficient saliva using a pipette from the collection cup and dispense one drop onto each of the 3 test pads. The test pads (Dentobuff Kit) began to change color immediately and after 2 minutes. The final result was calculated by adding the points according to the final color of each pad.

Test pad color at 2 minutes

Green	4 points
Green/Blue	3 points
Blue	2 points
Red/Blue	1 point
Red	0 point

Combined total	Buffering ability of saliva
0-5	Very low
6-9	Low
10-12	Normal/High ((Figure 2).

Identifying the cariogenic plaque :we used plaque indicator kit which gives a global assessment of how readily the plaque can produce acids when exposed to sucrose.

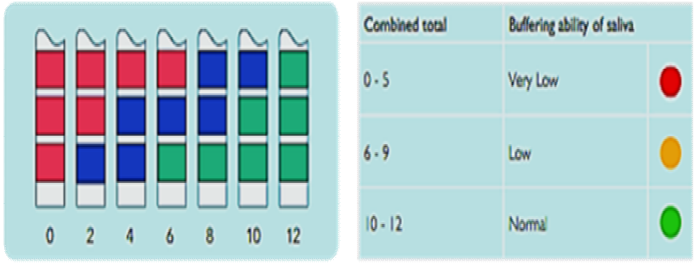

Figure 2: Buffering ability of saliva

A- By using the disposable plaque collection instrument(s), we collected plaque from interproximal sites in the molar area. If visible plaque was also present on the buccal surfaces of the mandibular canines and premolars, or on the labial aspect of the maxillary incisors, this was also collected using a separate collection instrument.

B- We dipped the instrument(s) with attached plaque into the plaque indicator solution for 1

second only. The surface of the plaque turned green.

C- We placed the instrument(s) into the groove(s) of the dispensing dish and leave the samples for 5 minutes.

D-At 5 minutes, we measured the PH value by checking the color and compare with the chart on the dispensing dish as followes:

a) A green color indicates a neutral PH around 7.2.The plaque has a low fermentation ability and the PH has been unaffected by the sucrose challenge.

b) A yellow or orange color indicates a final PH of 6.0-6.6.

c) A pink or red color indicates a final PH of 5.0-5.8.

We applied the plaque disclosing gel (GC Tri Plaque ID Gel™) to the tooth surfaces using a micro brush. Following this, we instructed the patients to lightly rinse their mouth with water.

We observed the disclosing gel coating on the tooth surface.

a) A pink or red gel color on the tooth surface indicates fresh plaque accumulation.

b) A blue or purple gel color indicates mature plaque that is at least 48 hours old.

To detect dental caries in these subjects Bite Wing radiography was taken and clinical examination was performed by an operator using probe and mirror.

RESULTS

Result showed that 4% of samples have normal buffering capacity and over 86% of them have acidic plaque. We found no significant relationship between the number of the decayed teeth with salivary volume using Pearson correlation test($p<0.595$). Based on independent t-test there was no significant relationship between the average number of the decayed teeth and salivary flow ($p<0.052$) but there was a significant relationship between salivary concentration and the average number of decayed teeth ($p<0.002$),(figure 3) .According to ANOVA test the relationship between other indicators such as buffering capacity of saliva ($p<0.0001$), (figure 4), saliva PH ($p<0.01$),(figure 5), plaque PH ($p<0.049$), (figure 6) and the average number of decayed teeth was significant.

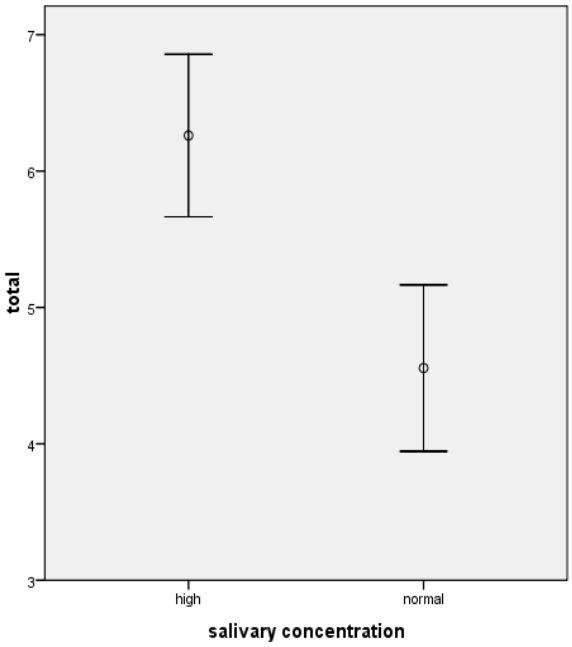

Figure 3-Relation of salivary concentration with caries status

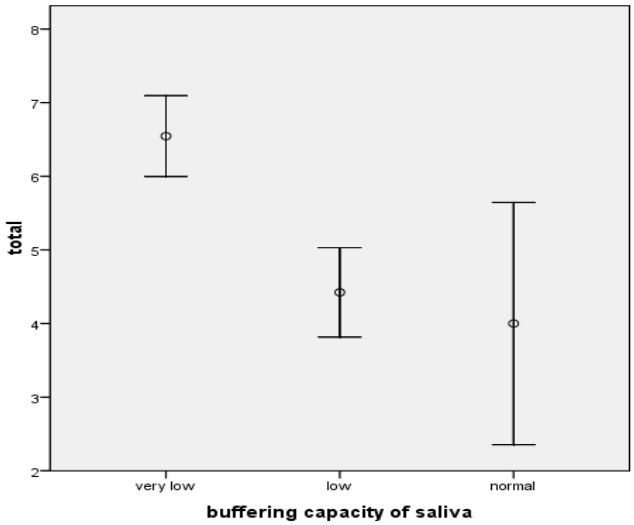

Figure 4-Relation of saliva buffering capacity with caries status

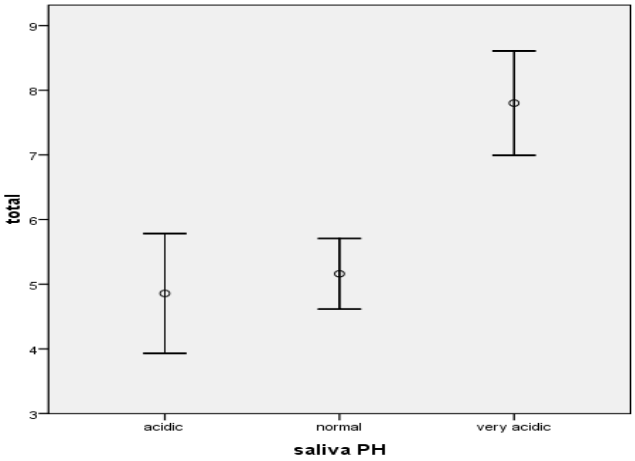

Figure 5-Relation of saliva PH with caries status

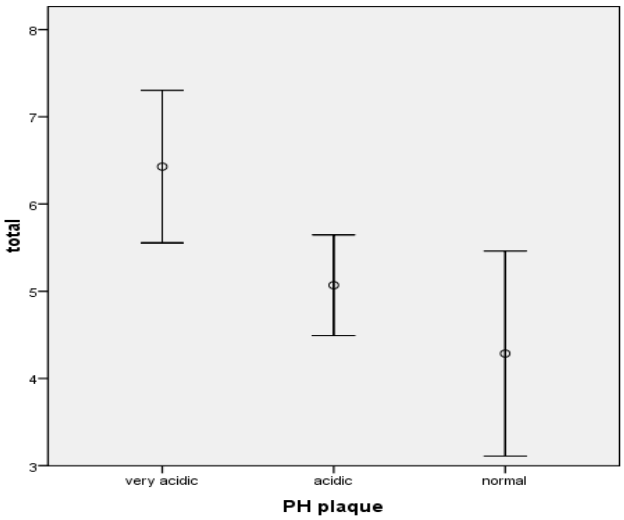

Figure 6-Relation of plaque PH with caries status**.**

DISCUSSION

Dental caries is initiated by the process of fermentation,in which the production of strong organic acids such as lactate,formate and pyruvate cause demineralization of the tooth surface(10). knowledge of factors related to caries may show the use of education as a relevant role for achieving success in terms of dental health maintenance(6).Salivary flow stimulation increases the bicarbonate buffer and salivary mineral content,facilitating calcium and phosphate redeposition onto the enamel and dentin surfaces and reducing dental tissue loss.

Clearance of substrates by saliva is slowest in the anterior region of the maxilla,and in the canine/premolar region of the mandible(10).

Sites in the anterior maxilla consistently give lower PH than similar sites in the mandible,as well as lower plaque fluoride levels(16).

It was observed in this study that there was no significant correlation between saliva volume and number of decayed teeth. It is reasonable to suppose that the frequency of sampling, nature of salivary glands and sampling time during the day is causing this contrast. According to the result of the present study there is no relationship between saliva flow and mean number of decayed teeth which is in agreement with those of some authors(17-19). The possible explanation for the lake of association between salivary flow and caries status is because of cariogenic biofilm which is placed in interproximal space where the access to saliva is limited.

In the present study we observe that there is a significant relationship between salivary concentration and the mean number of decayed teeth. This finding is in correlation with the findings of Biesbrock in 1992(20) . The reason for increased viscosity in patients with higher number of decayed teeth may be explained by poor oral hygiene (19). There is statistically significant relationship between saliva PH and the mean number of decayed teeth but differs from the results of others (21).This contrast is because of using unstimulated saliva instead of stimulated saliva and taking the DMFT score as an index for caries status instead of number of decayed tooth in these studies. There is a reasonably evidence to state that salivary buffering capacity protects the tooth from dental caries. Salivary buffering capacity prevents reduction in PH by neutralizing acid in oral cavity after sugar intake. Our results show that the buffering capacity of saliva is significantly influenced by the mean number of decayed teeth.

This finding is in agreement with those of some authors (22-24) but differs from the results of others (25). An explanation for this contrast may be related to the multifactorial aspects of dental caries and predominating of other factors such as diet and oral hygiene habits.So the salivary buffering capacity may be taken as a measure to predicate the future caries condition. It is well known that dental plaque accumulated over teeth, without mechanical disturbance and supplemented with fermentable sugars, certainly leads to dental enamel demineralization (19).Caries occures preferentially in sites in the dentition characterized by a relatively high exposure to carbohydrate and diminished salivary clearance and buffering effects(26).This study shows significant relationship between PH of dental plaque and the mean number of decayed teeth, which is similar to studies of others (27, 28).Different results in some studies may be because of the variation of plaque weight, microbial composition and acid production in different sites of an individual mouth.The PH of saliva is an important component to maintain the integrity of oral cavity(29).Use of sorbitol or xylitol containing products,which reduces the acidogenic potential of dental plaque and neutralize lactate produced by dental plaque is a useful way to decrease caries progression(30).

CONCLUSION

By using these kits and performing these tests we can help the patients who are trying to maintain healthy teeth

system over their lives. If all these variables are examined together they will be good criteria for determining the progress of caries in future.

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The authors of this study have nothing to declare.

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