A Study of the Relationship between Salivary Buffer Capacity and DMFT

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Abstract

The existence of carbohydrates that promote rapid fermentation as an exogenous factor and the low buffer capacity of secreted saliva at rest are considered to constitute the main factors that influence the rate at which dental plaque pH declines. The present study examined the relationship between salivary buffer capacity and DMFT (carries experience) in order to analyze the buffer capacity of saliva at rest, an important factor related to clearance capacity in the oral cavity. The results thus obtained are reported below. The total mean±SD of buffer capacity value was 5.09±0.87. The 50 subjects were divided into the median value into the high-buffer capacity sub-group of 25 subjects (5.83±0.37) and the low-buffer capacity sub-group of 25 subjects (4.36±0.52). The average DMFT of the high-buffer capacity sub-group (4.40±4.74) was lower than that of the low-buffer capacity sub-group (8.68±5.39), indicating a significant difference (p<0.01) between the two sub-groups.

Keywords:
salivary buffer capacity, DMFT, carries experience

Introduction

The phenomenon whereby acid production from dietary carbohydrates generated by dental plaque bacteria is accompanied by a decline in pH, followed after a given period of time, by a recovery in pH level has been observed both in vivo and in vitro. Saliva, which is an oral cavity fluid, has been verified to have a significant effect on this type of fluctuation in dental plaque pH (1-4).

The existence of carbohydrates that promote rapid fermentation as an exogenous factor and the low buffer capacity of secreted saliva at rest are considered to constitute the main factors that influence the rate at which dental plaque pH declines (5).

The present study examined the relationship between salivary buffer capacity and DMFT (carries experience) in order to analyze the buffer capacity of saliva at rest, an important factor related to clearance capacity in the oral cavity.

Materials and Methods

Subjects and saliva sampling time

Fifty male students (average age: 21.7 years) were selected as the test subjects. Saliva sampling from these subjects was performed between 14:00 and 16:00. This study was conducted with the approval (EC 02-029) of the Ethics Committee of the School of Dentistry at Matsudo, Nihon University. The subjects, who were provided with an adequate explanation, freely agreed to participate in the study.

Measurement of buffer capacity

The salivary volume was determined based on to the spitting method (6), and measured half anaerobically in a sampling cup within 30 minutes. After mixing 1.0 ml of saliva with 5.0 ml of distilled water, 1 ml of 0.01N hydrochloric acid (Wako Pure Chemical Industries, Osaka, Japan) was added. The pH was measured using a pH electrode, (Hanna Instruments, Padova, Italy) and the buffer capacity was evaluated using this pH value. In addition, a total of 6.0 ml of
distilled water was used as the control and the buffer capacity was measured by adding hydrochloric acid, using the same method.

**Investigation of caries experience**

Using a mirror and probe under a bright light, caries experience was determined according to the standards of the Japan Association of School Dentists. The presence of decayed, missing and filled teeth (DMFT) was calculated and recorded for each subject.

**Statistical analysis**

For the statistical analysis, the t-test was used to compare the mean values between the two sub-groups.

**Results**

The mean±SD of salivary buffer capacity for all subjects was 5.09±0.87. The 50 subjects were then divided at the median value into a high-buffer capacity sub-group of 25 subjects (6.83±0.37) and a low-buffer capacity sub-group of 25 subjects (4.36±0.52). The buffer capacity value of the control solution was 2.90 (Fig. 1). The variances from the average buffer capacity of the high-buffer capacity sub-group and of the low-buffer capacity sub-group as compared to the control solution were 2.93 and 1.46, respectively. The average DMFT for the total 50 subjects was 6.54±5.47. The average DMFT of the high-buffer capacity sub-group (4.40±4.74) was lower than that of the low-buffer capacity sub-group (8.68±5.39), indicating a significant difference (p<0.01) between the two sub-groups (Fig. 2).

**Discussion**

There are a few methods reported for measuring salivary buffer capacity. Some examples are as follows. Based on the method of using an ejected fluid consisting of a modified fluoride ion dilution (7,8) to measure buffer capacity, 5.0 ml of distilled water was mixed with 1.0 ml of saliva in vitro and the salivary buffer capacity at rest was measured. In order to quantify the salivary buffer capacity, a method based on dripping acid into a given volume of saliva and evaluating the volume of acid required to lower the pH level of the saliva from the initial level to pH6, pH5, and pH4 was employed (6). Ericsson (9) also developed a clinical testing method whereby hydrochloric acid is mixed with saliva and the resulting pH is measured.

Ueda and Dreizen et al. similarly reported a buffer pH method whereby a given amount of acid is added to saliva and the resulting pH is measured, developed to simplify the buffer capacity measurement method (6, 7, 10). This method has the merit of lending itself to quick chair-side implementation. The present study employed the buffer pH method for saliva evaluation. This method is considered to be useful for epidemiological studies involving large numbers.
of subjects. However, when performing high-accuracy measurement of buffer capacity for individual subjects, it will be necessary to study buffer capacity using the area under the curve and an integration method (7). Thus, more detailed analysis will be required.

The negative correlation between the buffer capacity and caries experience has been widely reported (6, 11). In light of the negative correlation between buffer capacity and caries experience, Ericsson (12) inferred that the most clearly demonstrated caries resistance factor is the buffer capacity. The report on the survey of dental diseases (13) based on the DMFT of male subjects 20–24 years of age showed a value of 8.60. In this study, for the low average DMFT (6.54) sub-group, it was thought that the number of subjects was small and that a large number of these subjects are children of dentists who have benefited from thorough preventive maintenance of the mouth from infancy. These factors are believed to have influenced the results. The author measured buffer capacity for a caries-susceptible sub-group (11 persons) and a caries-free sub-group (12 persons) and found that the buffer capacity of the caries-free sub-group was significantly higher than that of the caries-susceptible sub-group (7). In the present study, the total 50 subjects were divided into a high-buffer capacity sub-group and a low-buffer capacity sub-group and DMFT of these two sub-groups were compared. A significant difference in DMFT values between the high-buffer capacity sub-group and the low-buffer capacity sub-group was reported.

Until now, there has been no study on the relationship between buffer capacity and DMFT through the buffer pH method targeting resting saliva and no comparison with distilled water, which has no buffer effect, and the creation of criteria for clinical application has not been attempted. We plan to study the creation of criteria for a cleaning test through the buffer capacity of saliva as part of the assessment of the risk of dental caries based on the results of this study, increasing the number of subjects and dividing them into 3 or 4 groups, with a view to the feasibility of clinical application to the assessment of the risk of dental caries based on the buffer capacity of saliva. Further, studies on the relationships among salivary buffer capacity, residual salivary volume, salivary clearance and dental caries are planned.

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