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Research Study *Medical research*

The Relationship between Brushing Teeth and Saliva Conditions on the Accumulation of Calculus in High School Students in Medan city, Indonesia

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ABSTRACT

Brushing teeth is an effort to maintain the cleanliness and health of the oral cavity. This study aims to determine the relationship between brushing and salivary conditions on calculus accumulation in high school students in Medan, Indonesia. Measurements used the Saliva Check buffer kit and atomic absorption spectrophotometer (AAS) to determine the concentration of calcium ions in saliva. The salivary condition assessment parameters measured were calcium level, volume, salivary flow rate, pH and buffer capacity.The results showed that the average volume of saliva was 2.64 + 1.61 ml / 5 minutes, salivary flow rate was 0.52 + 0.32 ml / minute, pH: 7.80 + 0.23 (alkaline), salivary buffer capacity 7.0 + 2.59 (low), calcium content 2.91 + 0.72 Mmol / l, the average frequency of brushing teeth 2 times a day, and calculus index 1.42 + 0.47.The conclusion of this study is that there is no significant relationship between brushing teeth and salivary conditions (volume, flow rate, pH, buffer capacity, calcium ion concentration) on calculus accumulation (p> 0.05).

Keywords: Brushing teeth, salivary condition, calculus accumulation

INTRODUCTION

Oral and dental health is a part of body health that cannot be separated from one another. The results of the Basic Health Research or RISKESDAS in Indonesia in 2013 stated that dental and oral health problems including periodontal disease in the last 12 months amounted to 25.9% of the Indonesian population. North Sumatra Province is recorded as an area with the proportion of the population having oral and dental problems reaching 19.4%.One of the problems in oral health is the buildup of plaque and calculus in the oral cavity. Calculus is one of the local etiological factors that play a role in the development of periodontal disease severity(Chung and An, 2012; Kemenkes, 2013; Kinane, Stathopoulou and Papapanou, 2017).Previous studies have suggested that salivary pH has a major influence on the formation of calculus. However, other studies suggest that salivary pH has no significant effect on calculus formation. According to the calculus precipitation theory, calcification from plaque to calculus can occur when the pH of the saliva and the concentration of calcium and phosphate ions are high enough to cause precipitation of calcium phosphate salts. The buffer capacity is closely related to the pH of saliva because it is able to neutralize acidic conditions. Therefore, pH and buffer capacity have an effect on the formation of caries and calculus(Chung and An, 2012; Arabacı *et al.*, 2015; Mitra *et al.*, 2017). Saliva examination has many advantages because it is very beneficial for dentists in diagnosing and detecting problems early as well as increasing patient awareness of dental health. Research is needed to determine the relationship between salivary

conditions (free calcium levels, buffer capacity, pH, volume, and flow rate) in an individual's saliva and periodontal disease parameters such as calculus formation(Gopinath and Arzreanne, 2006; Kitasako *et al.*, 2006).This study aims to determine the relationship between brushing and salivary conditions (calcium levels, volume, salivary flow rate, pH and buffer capacity) on the accumulation of calculus in high school students in Medan, Indonesia. This research is expected to provide education to the public about the relationship between brushing teeth and the condition of saliva on the formation of calculus and its impact on oral health.

METHOD

Study Design

This research is descriptive analytic with cross sectional approach. The research location is Public High School in Medan, Indonesia with 60 subjects who suffer from calculus, consisting of men and women who are given an informed concern to be signed. Data collection was obtained from questionnaires (brushing teeth), measuring the condition of saliva and measuring calculus.

Instruments

The instruments used were diagnostic tools (Mouth glass, Explorer / Sonde, Tweezers, Nierbeken), 15 UNC Periodontal probe, Atomic Absorption Spectrophotometer (AAS), GC saliva check buffer, saliva pot, digital scale, and ice flask.

Salivary Conditions Test

The saliva was collected after the subject was asked beforehand to fast 1 (one) hour after breakfast and during that 1 hour the subject was not allowed to eat and drink. Subjects were instructed to sit in an upright position with their head slightly bent forward, to assist with saliva collection within 5 minutes. Respondents were asked to spit saliva into the saliva collecting pot for 5 minutes. The volume of saliva obtained is measured and recorded in units of ml. Salivary flow rate test. The total volume of saliva collected is divided by 5 minutes. The resulting salivary flow rate obtained is recorded in units of ml/minute(Lipson and Ellison, 1989; Nishi *et al.*, 2017). The pH test for saliva is carried out by dipping the pH strip in the saliva for 10 seconds then removing it. Compare the saliva pH strip of the subjects with the pH indicator strip on the GC Saliva check buffer. The pH score calculation must be immediately before the strip dries as it will affect the visual interpretation of the paper color. The salivary buffer capacity test was carried out by taking 3 ml of saliva taken with a micropipette then dropping it into 1 ml buffer strip each for 1 column on the test strip(Kitasako *et al.*, 2008; Lavy *et al.*, 2012). Measurement of salivary calcium levels by taking 1 ml of saliva, put it in a 25 ml measuring flask using a syringe. The sample solution was diluted using aquabides until it was parallel to the marking lines and the solution was homogenized. The sample solution was filtered with filter paper into a 10 ml measuring flask and homogenized again. Measurement of calcium levels in the saliva was then carried out using an atomic absorption spectrophotometer (AAS) at a maximum wavelength of 422.7 nm(Rabiei *et al.*, 2013; Rajesh, Zaareena and MA, 2015).

Examination of Calculus

Examination of calculus was carried out using the Oral Hygiene Index method. Examination of calculus is done by checking the amount of calculus deposits that can be found on 2 tooth surfaces (buccal and lingual or palatal) of each index tooth using a glass of mouth, dental explorer. The index teeth selected were modified index,specificallyteeth 16, 26, 36, 33, 32, 41, 42, 43, and 46. Each tooth surface will be given a score between 0-3. The scoring criteria are as follows: Score 0: no calculus on the teeth, score 1 if there is only supragingival calculus, Score 2 if there is only subgingival calculus, and score 3 if there is supragingival and subgingival calculus. The final score is calculated from the total calculus score divided by the number of tooth surfaces examined. If the result is 0 it means that there is no accumulation of calculus; if 0.1 - 0.6 means the accumulation of calculus is low, if 0.7-1.8 means the accumulation of calculus is moderate; 1,9-3 means high calculus accumulation(Mandel and Gaffar, 1986; Pawlaczyk-Kamieńska, Torlińska-Walkowiak and Borysewicz-Lewicka, 2018).

Data Analysis

Data analysis was done descriptively and analytically. Descriptive analysis was performed univariately to determine the description of each variable, namely salivary pH, salivary calcium content, salivary volume, salivary buffer capacity, and salivary flow rate. The data normality test was carried out first using the Kolmogorov-Smirnov test. When the data were normally distributed, the analysis to determine each variable, namely salivary pH, salivary calcium content, salivary volume, salivary buffer capacity, and salivary flow rate on calculus accumulation used the Chi square test with a confidence level of 95%.

RESULTS

Subject Characteristic Distribution

An overview of the distribution of research subjects can be seen in Table 1. Research subjects were distributed based on gender, the percentage of boys was 53.3% and girls were 46.7%. Based on age, children aged 14 years amounted to 15%, 15 years old amounted to 43.3%, and 18 years old amounted to 41.7%. The distribution of data based on salivary conditions can be seen in Table 2. The distribution of these data is grouped into the characteristics of the simplified oral calculus index, salivary buffer capacity, salivary pH, salivary flow rate, salivary volume and salivary calcium content.

Table 1. Subject Characteristic Distribution

Characteristic of Subject	ı	%
Gender		
Male	32	53.3
Female	28	46.7
Age		
14	9	15
15	26	43.3
16	25	41.7
toothbrush frequency		
1 time a day	6	10
2 times a day	44	73.3
Visit to the Dentist		
Yes	13	21.7
No	47	78.3
Toothbrush Time		
in the morning before breakfast	6	10
in the morning after breakfast	6	10
in the morning after breakfast and the night before going to bed	5	83
in the morning before breakfast and the night before going to bed	43	717

Table 2. Saliva Characteristic Distribution

Variable of Saliva Characteristic	n (60)	%
Oral Calculus Index Simplified		
Low	1	1.7
Moderate	44	73.3
High	15	25.0
Buffer Saliva		
Very Low	16	26.7
Low	41	68.3
Moderate	3	5
Saliva pH Value		
Normal	10	3.3
Alkali	48	96.7
Saliva Flow Rate		
Low	18	30
Moderate	16	26.7
High	26	43.3
Saliva Volume		
Low	15	25
Moderate	17	28.3

High	28	46.7
Calcium Concentration		
Normal	13	21.7
Low Hypercalcium	36	60.0
ModerateHypercalsium	11	18.3

Relationship Between Saliva Characteristics And Oral Calculus Index

The results of measurements of salivary volume, flow power, pH value, buffer, and calcium concentration can be seen in Table 3, dan the relationship between the characteristics of saliva and the oral calculus index can be seen in Table 4. The parameters of the oral calculus index are divided into low, medium and high. The characteristics of saliva that were assessed were volume, flow rate, buffer capacity, pH and calcium concentration of saliva.

Table 3. The Results of Saliva Measurements

Variabel	Mean	SD
Saliva Volume	2.64	1.61
Flow Rate	0.52	0.323
pH	7.41	0.54
Buffer Capacity	7.0	2.59
Calcium Concentration	2.91	0.725
Toothbrush Frequency	2.12	0.64
Calculus Index	1.42	0.478

Table 4. Relationship of Saliva Characteristics and Oral Calculus Index

Characteristics		**Oral Calculus Index Distributions**						p Value
		Low		Moderate		High		
		n	%	n	%	n	%	
Saliva Volume	Low	0	0	14	93.3	1	6.7	0.274 (p>0.05)
	Moderate	0	0	11	4.7	6	35.3	
	High	1	3.6	19	67.9	8	28.6	
	Total	**1**	**1.7**	**44**	**73.3**	**15**	**25.0**	
Saliva Flow Rate	Low	0	0	17	94.4	1	5.6	0.139 (p>0.05)
	Moderate	0	0	10	62.5	6	37.5	
	High	1	3.8	17	65.4	8	30.8	
	Total	**1**	**1.7**	**44**	**73.3**	**15**	**25.0**	
pH Value	Normal	1	50	1	50	0	0	0.000 (p<0.05)
	Alkali	0	0	43	74.1	15	25.9	
	Total	**1**	**1.7**	**44**	**73.3**	**15**	**25**	
Saliva Buffer Capacity	Very Low	0	0	12	75.0	4	25.0	0.001 (p<0.05
	Low	0	0	30	73.2	11	26.8	
	Moderate	1	33.3	2	66.7	0	0	
	Total	**1**	**1.7**	**44**	**73.3**	**15**	**25.0**	
Calcium Concentration	Normal	0	0	13	100	0	0	0.037 (p<0.05)
	Low Hypercalcification	1	2,8	26	72,2	9	25,0	
	Moderate Hypercalcification	0	0	5	45,5	6	54,5	
	Total	**1**	**1,7**	**44**	**73,3**	**15**	**25,0**	

DISCUSSION

Based on the results obtained, it shows that the number of subjects is male, namely 32 people (53%) and 28 women (47%). Subjects in the 15 year age group were the largest number of subjects compared to other groups, amounting to 26 people (43.3%). Based on data on oral hygiene habits, the highest percentage of toothbrush frequency was twice a day, namely 46 respondents (76.7%). Another study conducted in the Netherlands in the age group of 14-16 years showed that 71% of subjects brushed their teeth twice a day and 24% brushed their teeth once a day. The percentage of experience visiting a dentist shows that only 13 respondents have had their teeth

checked by a dentist and as many as 47 respondents (78.3%) have never visited a dentist. Another study also stated that in urban areas, 68% of respondents aged 14-16 years and 83% of respondents aged 35-55 had at least one dentist visit(Gilthorpe *et al.*, 2003; Leroy, Eaton and Savage, 2010). In this study, most of the respondents, namely 38 respondents (63.3%) experienced calculus with a moderate Oral Calculus Index score, and 14 respondents (23.3%) were subjects with light calculus formation, and only 8 respondents (13.3%) which is high criteria. A total of 48 respondents (80%) had an alkaline pH of saliva and 10 respondents (16.7%) had a low pH of saliva.Based on the results of the statistical analysis of the relationship between volume, salivary flow rate, pH, calcium concentration in saliva on calculus accumulation, it shows that pH conditions, buffer capacity and calcium concentration are closely related to calculus accumulation. The average pH of the subjects showed that most of them were alkaline, the average buffer capacity was still low, which was 7.0 and the average calcium concentration was 2.91, which was categorized as moderate hypercalcification. The normal calcium ion level in saliva is 1-2 mmol / L. The increase in calcium ion levels occurs due to the accumulation of calculus in the oral cavity(Rehak, Cecco and Csako, 2000; Roberts-Harry and Clerehugh, 2000; Rahayu, 2016). The results of statistical analysis of the relationship between the frequency of brushing teeth and calculus accumulation showed a positive, although not significant, relationship. Calculus cannot be removed just by brushing your teeth. It is necessary to clean the calculus using a special instrument that can release the calculus properly without damaging the tooth structure. Brushing properly and correctly can help prevent calculus adhesion because if you increase the frequency of brushing with the wrong way it will damage the tooth structure and cause abrasion in the neck of the tooth(Lang, Cumming and Löe, 1973; Harvey, Serfilippi and Barnvos, 2015). The buffer capacity will function to restore the decreased salivary pH due to the entry of the substrate into the oral cavity so that the saliva pH returns to normal values. Conversely, patients with low salivary buffer capacity have less calculus buildup because the pH of the saliva tends to remain acidic for a long time, leading to demineralization of the enamel. Therefore, the formation of tartar is more likely to occur when the calcium ion level exceeds the normal calcium ion level of 1.14 Mmol / l for a long time. In contrast, patients with low salivary calcium levels (<1.14 mmol/l) had less calculus build-up(Mandel and Gaffar, 1986; Ericson and Bratthall, 1989).

CONCLUSION

There was a significant relationship ($p < 0.05$) between pH, buffer capacity and calcium ion concentration in saliva on calculus accumulation.

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CONFLICT OF INTEREST

All authors have nothing to declare.

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