

# Comparative Experimental Study on the Effect of Removing Tooth Surface Bacteria with or Without Dentifrice

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## Abstract

The purpose of this study was to confirm the tooth cleaning effect by comparing the effect of removing the tooth surface bacterial film according to the use of a dentifrice.

Using each tool, wipe a total of 3 times from the back of the tongue to the front and instruct all experimenters to gently rinse their mouth with water.

After obtaining the average of absorbance measured in each case, paired t-test compares the effects of removing lingual bacterial membranes before and after the use of the tongue debris, and compares the means between groups with on-way ANOVA and post-test.

The average of the group using the dentifrice was 10.3, and the group that did not use the dentifrice was 11.1, showing similar removal rates. Even if the subjects brush their teeth without a dentifrice, it was found that the removal of tooth surface bacterial membrane was effective. Therefore, it is judged that tooth brushing that does not contain a dentifrice has the same effect of removing tooth surface bacteria as using a dentifrice.

In the follow-up study, it is necessary to analyze the types and characteristics of dentifrice, determine the exact method of brushing teeth, and set a certain time and intensity to derive and analyze more specific results.

**Keywords:** dentifrice, tooth surface, brushing, bacterial, effect

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## Introduction

Dental caries and periodontal disease, which can be called serious oral diseases in the oral cavity, are caused by a combination of various causative factors locally and systemically. Among them, the tooth surface bacterial membrane can be said to be the main cause(Kim J.Bet *et al.*, 2009).

Dental plaque is a thin film in which glycoprotein components of ingested food are attached to the tooth surface, and is also called plaque or scale. The acid generated in the tooth surface bacterial membrane demineralizes the minerals in the hemorrhoids, causing dental caries. In addition, anaerobic bacteria in the tooth surface bacterial membrane create harmful toxins in the periodontal tissue, which is a direct cause of periodontal disease (Kwon H.Ket *al.*, 2006). The tooth surface bacterial membrane is an adhesive bacterial mass film formed by adhering various bacteria in the oral cavity(Kang B.Wet *al.*, 2014), and is not removed by self-purification in the oral cavity. The tooth surface bacterial membrane can be removed using physical methods such as brushing and the action of a dentifrice.

Dentifrices are auxiliary detergents used to efficiently clean the tooth surface during the brushing processJeong H.Yet *al.*, 2010). The main constituents of the dentifrice are abrasive agent, detergent, binding agent, humectant, water, flavoring, sweetening, preservative, and preventative agents(Kim J.Bet *al.*, 1999). Of these, the semaphore cleans the tooth surface bacterial membrane attached to the tooth surface, and polishes the tooth surface so that the tooth surface bacteria membrane does not reattach easily and makes it lubricated. Cleaners, also called detergents, lower the surface tension of water and create conditions that are easy to fall off by penetrating into substances attached to the tooth surface, emulsifying and floating food residues to exert a cleaning effect (CM Healy *et al.*, 1999).

Sodium Lauryl Sulfate is currently the most commonly used dentifrice. It is a representative surfactant with strong irritation. It is also referred to as a foaming agent because of the characteristic phenomenon of foaming surfactants(Herlofson BB *et al.*, 1994). Studies have reported that allergic contact dermatitis(Jung H. Y *et al.*, 2010), irritation of the oral mucosa and tissue detachment(Ryu G. Cet *al.*, 2001)were caused by SLS of the dentifrice. Therefore, this study attempted to confirm the tooth cleaning effect by comparing the effect of removing the tooth surface bacterial membrane according to the use of a cleaning agent.

## **Materials and Methods**

### **Experiment subject**

The experimental study was conducted from November 3, 2019 to November 27, 2019, targeting a total of 50 people in their 20s in Busan. The effect of toothbrushing with or without detergent was analyzed by O'Leary index and the oral environment management ability index (PHP index) using toothbrushing colorant.



**Figure 1. Check the tooth surface bacteria**

### **Survey**

In this experimental study, a total of 50 questionnaires were distributed.

It consisted of 5 questions in total, consisting of 2 questions on general characteristics (gender, age), 3 questions on oral hygiene management method (type of toothpaste, number of teeth brushing, time of brushing teeth).

### **Experiment method**

In order to check the adhesion of the tooth surface bacteria before and after brushing according to the presence or absence of the toothbrushing agent, a tooth surface colorant is applied and compared as well as analyzed with the values of O'Leary index and oral environment management ability index (PHP index).

### **O'Leary Plaque record**

The O'Leary index is divided into four parts: mesial, distal, buccal, and lingual for all teeth, and divides one tooth into four areas. If the tooth surface bacterial membrane is attached to each part, it is marked as 1 point, and if not, it is marked as 0 point.

- $O'Leary\ index = (\text{number of teeth with bacterial membrane on teeth} / \text{number of total teeth}) \times 100$

O'leary index =	[Grid of 16 triangles for upper teeth]															
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
	[Grid of 16 triangles for lower teeth]															

Figure 2. O'Leary index chart

**Oral environment management ability index (PHP index) test**

The designated teeth for the oral environment management ability index test are the buccal surfaces of the upper left and right first molar teeth (No. 16 and 26), the labial surface of the upper right central incisor and lower left central incisor (No. 11 and 31), and the lingual of the mandible left and right first molar teeth (No. 36 and 46). These six designated teeth were divided into three parts: the mesial part, the center part, and the distal part. The central part is divided into 3 equal parts: the gingival side, the middle side, and the occlusal side. Each tooth surface was divided into 5 parts and marked as 1 point if the bacterial membrane was attached to each area, and 0 point if not. At this time, the lowest point was 0 and the highest was 5 (Sin S. Het *al.*, 2019).

- PHP index = (Sum of points for each tooth surface / number of specified teeth)

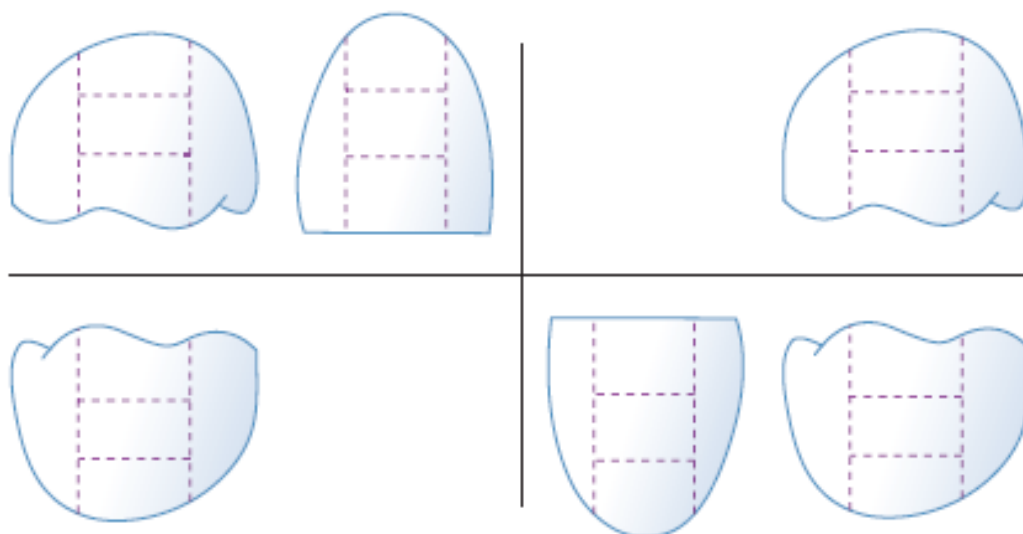
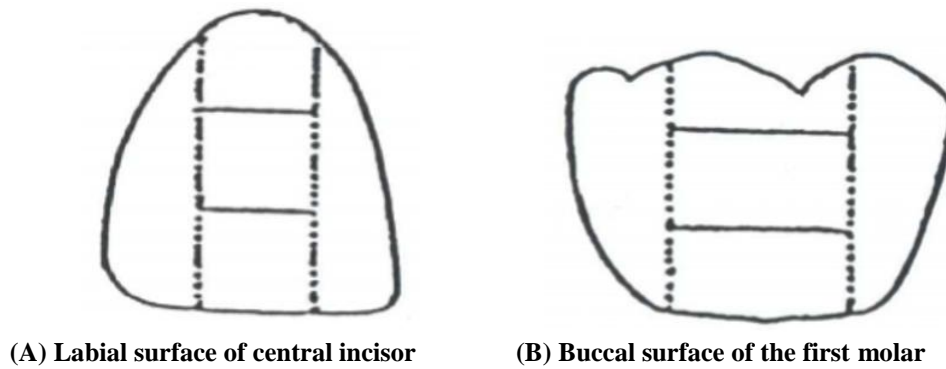


Figure 3. The designated teeth for the oral environment management ability index test



**Figure 4. Oral environment management ability index (PHP index) of central incisor and first molar tooth surface division**

### **Analysis method**

The collected data were analyzed using the IBM SPSS Statistics 22 statistical program. The analysis method is as follows: The questionnaire filled out by the test subjects was cross-analyzed, and the O'Leary index and the oral environment management ability index (PHP index) values of the test subjects were analyzed using the corresponding sample T-test. The criterion for determining statistical significance was  $p < 0.05$ .

### **Results and Discussion**

#### **General characteristics**

Research subjects were 45(90%) of 20-22 years old, 4(8%) of 23-25 years old, 1 (2%) of 26-28 years old with 20-22 years old being the most, and 48 females (96%) which was much more than 2 men (4%).

Perio was the highest with 56%, followed by other toothpastes not listed in the questionnaire, followed by Median with 12%, and followed by 2080 with 10%.

On average, people who brush their teeth three times a day were found to brush their teeth longer on average than those brush their teeth once or twice a day. The average of the subjects in their 20s brushing teeth per day was 24% at 2 times, 70% at 3 times, and 6% at 4 times or more in Table 1.

Average time to brush teeth was 2 (6%) with less than a minute, 12 (24%) with between one to two minutes, 15 (30%) with between two to three minutes, and 21 (42%) with more than 3 minutes.

**Table 1: General characteristics**

Sort	Variable	N	%
Gender	Male	2	4
	Female	48	96
Age	20~22	45	90
	23~25	4	8
	25~28	1	2
Dentifrice	Median	6	12
	Perio	28	56
	2080	5	10
Number of teeth brushing per day	Others	11	22
	2 times	12	24
	3 times	35	70
Average time to brush teeth	4 times and more	3	6
	Less than 1 min.	2	4
	More than 1 min.	12	24
	More than 2 min.	15	30
	More than 3 min.	21	42
Total		50	100

**Comparison of the average of O’Leary PCR for removal rate of tooth surface bacteria with or without dentifrice**

O’Leary PCR average comparison was performed to confirm the effect of removing the tooth surface bacterial membrane according to the use of dentifrice. As a result of brushing the teeth using a dentifrice, the average was 10.3, and the result of brushing without using a dentifrice was 11.1. Both groups had statistically significant differences. in Table 2.

**Table 2. Comparison of the average of O’Leary PCR for removal rate of tooth surface bacteria with or without dentifrice**

	M	SD	N	P-value*
Used dentifrice	10.3	8.5690	50	<0.001
Not used dentifrice	11.1	8.4524	50	<0.001

The most basic and effective way to manage the tooth surface bacterial membrane is brushing teeth, and the other auxiliary method is to use oral aids and hygiene products. Toothbrushing is an oral environment management method to prevent oral disease, and aims to remove tooth surface bacteria. When brushing the teeth, it is common to use a toothpaste as an auxiliary agent to effectively remove the tooth surface bacterial membrane and the colored tooth surface (Jung S. I *et al.*, 2006). Dentifrice is an auxiliary detergent used to effectively wipe the surface of teeth during the process of brushing teeth. In other words, the cleaning agent cleans and polishes the tooth surface. Currently, the most commonly used cleaning agent is sodium lauryl sulfate (SLS), which is a representative surfactant with strong irritation. According to a recently reported study (CM Healy *et al.*, 1999; Herlofson BB *et al.*, 1994) it was reported that SLS, a surfactant included in the dentifrice, causes irritation of oral tissues and dry mouth. Therefore, this study was to confirm the effect of the use of dentifrice. In order to confirm the effect of removing the tooth surface bacterial membrane according to the use of a dentifrice, it was not shown in the previous table, but the average of the group using dentifrice was 10.3 and the average of the group without dentifrice was 11.1. As a result of this study, the removal of the tooth surface bacterial membrane was effective even in the group that did not use a dentifrice, which is thought to be effective in preventing disease by reducing irritation caused by the dentifrice in case of oral disease or inflammation. These results were found to be the same in the results of the PHP average comparison, and it is thought that when correct tooth brushing is performed correctly, oral health can be maintained through effective removal of the tooth surface bacteria even if no dentifrice is used.

As a limitation of this study, a sample of university students attending some areas of Busan was sampled, but there were relatively many female students in their twenties. Therefore, there is a limit to generalizing the results of this study to the overall opinion, and it is believed that there will be an effect on the experimental results due to the difference in tooth brushing method and strength, and the difference in oral conditions. Therefore, even if the tooth brushing was performed without including a dentifrice, there was no difference from the effect of removing the tooth surface bacterial when using a dentifrice. In the follow-up study, it is necessary to analyze the types and characteristics of dentifrice, determine the exact method of brushing teeth, and set a certain time and intensity to derive and analyze more specific results.

## **Conclusion**

In order to find out how much the tooth surface bacterial membrane can be removed by performing the rotation method according to the presence or absence of a dentifrice, the following

conclusions were obtained by experimenting a comparative study on the effect of removing the tooth surface bacterial membrane.

1. By O'Leary PCR, the average of 10.3 was found in the group that brushed teeth containing dentifrice, and the average was 11.1 in the group that brushed teeth without dentifrice. ( $p < 0.05$ )
2. As for the PHP index, an average of 0.5 for one group of tooth brushing with dentifrice, and 0.6 for a group without tooth brushing, showing no significant difference. ( $p > 0.05$ )

In this study, it was thought that tooth brushing with a rotation method including a dentifrice would result in a better effect of removing the tooth surface bacterial membrane, but the experimental results showed that the average of the group using a detergent was 10.3, and the removal rate was similar to 11.1 in the group without dentifrice. Even brushing the teeth without a dentifrice, it was found that the tooth surface bacterial membrane was effectively removed. Therefore, it is judged that tooth brushing that does not contain a dentifrice has the same effect of removing tooth surface bacteria as using a dentifrice.

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