

# Changes in Oral Environment Status According to the Use of Mouthwash in Incremental Dental Care Program

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## Abstract

**Background/Objectives:** This article aims to investigate changes in oral environment status according to whether to use mouthwash among oral hygiene products in an incremental dental care program conducted by dental hygienists as oral care specialists.

**Methods/Statistical analysis:** Among visitors to the clinical dental hygiene laboratory of D University in B city, only 45 visitors who continued to visit and participate in the dental care program once a week for four weeks were selected as final subjects of research. For statistical analysis, SPSS 25.0 for Windows, SPSS Inc., Chicago, IL., USA was used.

**Findings:** There were differences in the pre-post change of halitosis according to the experience of using mouthwash ( $p < .004$ ). There were differences in dental plaque index between before and after care among the group with the experience of using mouthwash ( $p < .017$ ). And there were differences of pre-post changes in dental plaque index according to whether mouthwash was used or not ( $p < 0.47$ ). From these findings, it was found that "in case of having the experience" of using mouthwash, changes in oral health behavior and dental plaque index were the effects of using mouthwash as an adjuvant method for maintaining clean oral hygiene status in the dental hygiene care program.

**Improvements/Applications:** It was found from the incremental dental care program that the use of mouthwash is effective in lowering the rate of dental plaque formation or reducing bacteria. Therefore, it is deemed that it will be helpful in improving periodontal disease to popularize more the use of mouthwash and also use extensively adjuvant products for oral care (dental floss, interdental brush, water toothpick).

**Keywords:** Mouthwash, Dental plaque index, Oral environment management, Incremental dental care, Dental hygienist

## 1. Introduction

The dental hygienist is a qualified professional dental hygiene educator, clinician, as well as a therapist who has a collaborative relation with a dentist. This profession uses preventive, educational, and therapeutic techniques in order to promote and maintain the optimum oral health status for individuals and groups in terms of oral disease control [1]. The dental hygiene process is a framework for dental hygienist' evaluating patients generally and providing individualized treatment, and is the basic of dental hygiene work that can be conducted by the dental hygienist as a specialist [2]. In the late 1980s, the US dental hygiene world started to develop dental hygiene theories based on nursing process in order to establish the identity of dental hygiene, and announced a framework for dental hygiene practice, and published the four-staged Standard of Applied Dental Hygiene Practice consisting of assessment, planning, implementation, and evaluation. After then, in 1995, the component stages of dental hygiene care (incremental dental care) were defined by Mueller-Joseph and Peterson as the five consecutive relationships of dental hygiene assessment, dental hygiene diagnosis, dental hygiene plan, dental hygiene implementation, and dental hygiene evaluation [3]. The dental hygiene care, that is, the incremental dental care is a framework for clinical practice provided to allow dental hygienists to assess and properly judge subjects for the purpose of reducing, removing, and preventing the causes or influencing factors of oral health problems [4]. In addition, dental hygiene process allows dental hygienists as specialists, who can satisfy patients' needs, to grasp the overall status of patients' oral cavities as well as their actual oral health problems according as dental hygienists judge individuals' health behaviors by systematic approach. The performance of this evidence-based practice enables dental hygienists to identify and remove causes affecting individuals' oral health conditions, and consequently, subjects come to be able to maintain the optimum oral health.

Oral disease is bacterial infectious disease, and is one of main causes of tooth loss. Most of main bacteria causing oral disease exist in subgingival plaque, and if infection continues or the antimicrobial responses of the host weaken while plaque is not removed, gingivitis progresses to periodontitis. That is, if gingivitis continues to progress, the ratio of Streptococcus within

subgingival paradental cysts reduces in terms of bacteriologic composition, and the ratios of *Capnocytophaga gingivalis* and *Bacteroides intermedius*, which are black-pigmented bacteroides, increase together with the increase of anaerobic bacteria, this leads to the progression to periodontitis [5]. To prevent the oral disease or suppress the progression of periodontal disease, physical methods such as toothbrushing and the use of dental floss or chemical methods such as antibiotics and mouthwash may be used. Among them, it has been reported that mouthwash is effective in reducing plaque by suppressing or destroying the activity of bacteria in saliva [6]. That is, mouthwash suppresses bacterial activity within oral cavity, and also can help in the prevention and treatment of oral disease through anti-inflammatory action [7]. According to results of the 2017 survey on the status of oral health and tooth brushing in Korea, it was found that among oral hygiene products, the use of mouthwash was highest with 43.9%, followed by dental floss of 35.6%, interdental brush of 31.1%, and tongue cleaner of 19% [8]. According as Koreans' living standards recently rise and their interest in oral health and the prevention of oral disease increases, mouthwash is widely used as an oral hygiene product that can be conveniently used in busy modern society and it may be said that it has been popularized. Modern people's needs and interest in mouthwash is increasingly spreading according as mouthwash is known today for its efficacy for the removal of halitosis and the whitening of tooth as well as the prevention of oral disease and the management of oral environment [9].

This study intends to investigate changes in oral environment status according to whether to use mouthwash among oral hygiene products in the incremental dental care program implemented by dental hygienists as oral care specialists.

## 2. Materials and Methods

### 2.1. Subjects of research

This study was carried out with those who visited the clinical dental hygiene laboratory of D University in B city from September 13, 2018 to November 30, 2018. A questionnaire survey was conducted, with the subjects being informed of the need for the study, the purpose and methods of the study, the guarantee of anonymity, and matters about voluntary participation in the study. And the final subjects of the study were 45 persons.

### 2.2. Research Methods

The number of subjects was analyzed by G\*power program. The sample size to maintain the significance level of 0.05 in t-test, the effect size of 0.8, and the power of 0.8 was a total of 52, with 26 for each group, but a total of 60 subjects were selected by convenience sampling, in consideration of dropouts of 10%. 24 subjects of the experimental group and 21 subjects of the control group were finally analyzed, excluding those who failed to participate in the dental hygiene process regularly. Education about correct tooth brushing and proper dental hygiene was conducted through incremental dental care, for the oral health of patients with gingivitis and periodontitis, who visited a total of four times, once a week. In the process of conducting the incremental dental care program, it was attempted to identify dental plaque index, halitosis, changes in oral health behavior, and changes in oral pollution.

### 2.3. Statistical analysis

For the statistical analysis of data in this study, SPSS 25.0 for Windows, SPSS Inc., Chicago, IL., USA was used, and statistical testing was conducted at the significance level of 0.05. Statistical methods used for analysis are as follows: Frequency analysis was conducted for age classification by the gender of subjects and the subjects' oral hygiene characteristics; and t-test and ANOVA was carried out to investigate and compare changes in oral health behavior, halitosis, dental plaque index, and oral environment pollution according to the use of mouthwash, and the statistical significance level was 0.05.

## 3. Results

### 3.1. General characteristics

As for the subjects' age distribution by gender, below 25 was 65.6% and 25 and above was 46.2% among males, and 34.4% and 53.8% among females, respectively.

**Table 1. Age classification by gender**

Category	N(%)		
	Below 24	25 and above	Total
Male	21 (65.6)	6 (46.2)	27 (60.0)
Female	11 (34.4)	7 (53.8)	18 (40.0)
Total	32 (71.1)	13 (28.9)	45 (100.0)

### 3.2. The subjects' oral health characteristics

As for the subjects' oral health characteristics, in the case of interest in oral health, the response rate was high in 'Moderate' with 51.1%, and that of 'Interested' was 26.7%. In the case of the period of regular scaling, the response rate was high in 'Not get scaled' with 44.4% and that of 'Only when I feel uncomfortable' was 26.7%. In the case of the existence of experience of oral health education, 'Not sure' was 42.4% and 'Have experience' was 26.7%. The subjects who had experience of using mouthwash were 60.0%, and those who had no experience were 40.0%. In the case of the frequency of using mouthwash, 'Don't use' was 53.3%, and 'Use every day' was 28.9%.

**Table 2. Oral hygiene characteristics**

Category		N (%)
Interest in oral health	Interested	12 (26.7)
	Moderate	23 (51.1)
	Indifferent	10 (22.2)
Regular scaling	Within one year	13 (28.9)
	Only when I feel uncomfortable	12 (26.7)
	Not get scaled	20 (44.4)
Experience of oral health education	Have	12 (26.7)
	Have none	14 (31.1)
	Not sure	19 (42.2)
Experience of using mouthwash	Have	27 (60.0)
	Have none	18 (40.0)
Frequency of using mouthwash	Every day	13 (28.9)
	Only if necessary	8 (17.8)
	Not use	24 (53.3)
Total		45 (100.0)

### 3.3. Oral environment status according to the use of mouthwash

#### 3.3.1. Changes in oral health behavior (OHB) according to the use of mouthwash

As for changes in oral health behavior according to the experience of using mouthwash, in the case of 'Have,' oral health behavior was 10.70 points before incremental care and 13.00 points after care ( $p < .001$ ), and in the case of 'Have none,' it was 10.44 before care and 13.7 after care ( $p < .001$ ), and thus there were differences in the changes. As for the frequency of using mouthwash, there were differences in changes in oral health behavior in the case of 'Use' every day and 'Not use,' and there was also pre-post difference in the case of 'Use only if necessary' ( $p < .048$ ). There was no change in oral health behavior according to the existence of the experience of using mouthwash and the frequency of use.

**Table 3. Changes in oral health behavior(OHB) according to the use of mouthwash**

Category		Changes in oral health behavior		Mean±s.d
		Before	After	t(p)
Experience of use	Have	10.70±2.35	13.00±1.96	6.158 (.001)
	Have none	10.44±1.72	13.27±2.08	6.269 (.001)
t(p)		-.915(.366)		
Frequency of use	Use every day	10.00±2.73	12.76±2.12	4.382 (.001)
	Only if necessary	11.25±2.49	13.12±2.53	2.511 (.048)
	Not use	10.70±1.51	13.29±1.78	7.847 (.001)
F(p)		.588(.576)		

#### 3.3.2. Halitosis according to the use of mouthwash

As for the halitosis according to the experience of using mouthwash, 'in the case of having experience,' the measurement of halitosis was 78.56 before incremental care and 72.41 after care and 'in the case of having no experience' as well, the measurement was 81.44 before care and 79.00 after care, showing a little difference in change but no significant difference between before and after care;

however, there was significant difference because there were changes in halitosis according to the experience of use ( $p < .004$ ). As for the frequency of using mouthwash, in the case of responding with 'Use' every day, the measurement increased a little from 71.77 before care to 76.00 after care; however, in the case of responding with 'Not use,' the measurement showed a small difference between 73.54 before care and 74.08 after care, and in the case of responding with 'Use only if necessary,' the measurement decreased a little from 77.38 before care to 73.00 after care, but showed no significant difference. There was no change in halitosis according to the frequency of the use of mouthwash.

**Table 4. Changes in the degree of halitosis according to the use of mouthwash**

Category		Mean±s.d		t(p)
		Before	After	
Experience of use	Have	78.56±13.61	72.41±13.01	.963 (.345)
	Have none	81.44±14.19	79.00±19.17	-.516 (.613)
t(p)		-.306(.004)		
Frequency of use	Use every day	71.77±16.43	76.00±15.34	.990 (.341)
	Only if necessary	77.38±16.18	73.00±10.12	-.639 (.543)
	Not use	73.54±14.40	74.08±18.26	.147 (.894)
F(p)		.597(.555)		

### 3.3.3. Dental plaque index according to the use of mouthwash

As for the halitosis according to the experience of using mouthwash, 'in the case of having experience,' the measurement of halitosis was 78.56 before incremental care and 72.41 after care and 'in the case of having no experience' as well, the measurement was 81.44 before care and 79.00 after care, showing a little difference in change but no significant difference between before and after care; however, there was significant difference because there were changes in halitosis according to the experience of use ( $p < .004$ ). As for the frequency of using mouthwash, in the case of responding with 'Use' every day, the measurement increased a little from 71.77 before care to 76.00 after care; however, in the case of responding with 'Not use,' the measurement showed a small difference between 73.54 before care and 74.08 after care, and in the case of responding with 'Use only if necessary,' the measurement decreased a little from 77.38 before care to 73.00 after care, but showed no significant difference. There was no change in halitosis according to the frequency of the use of mouthwash.

**Table 5. Changes in dental plaque index according to the use of mouthwash**

Category		Mean±s.d		t(p)
		Before	After	
Experience of use	Have	54.78±17.46	42.92±21.42	-1.987(.017)
	Have none	49.46±19.02	46.51±22.31	-.454(.656)
t(p)		-1.734(.047)		
Frequency of use	Use every day	55.38±21.50	42.07±24.76	-2.526(.035)
	If necessary	55.78±15.61	52.66±22.04	-.564(.590)
	Not use	47.43±16.36	45.23±20.02	-.631(.535)
F(p)		.536(.592)		

### 3.3.4. Oral pollution (ATP) according to the use of mouthwash

As for the oral pollution according to the experience of using mouthwash, in the case of 'having experience,' the measurement was 5.19 before incremental care and 5.23 after care; and in the case of 'having no experience,' the measurement increased a little from 5.29 before care to 5.30 after care, which, however, was not statistically significant. There was no change in oral environment pollution between before and after the use of mouthwash. As for the frequency of using mouthwash, in the case of responding with 'Use every day,' the measurement was 5.14 before care and 5.34 after care, and in the case of responding with 'Not use' as well, the measurement increased a little from 5.25 before care to 5.27 after care. In the case of responding with 'Use only if necessary,' the

measurement showed the tendency of decreasing a little from 5.35 before care to 5.28 after care, but showed no significant difference. There was no change in oral environment pollution according to the frequency of using mouthwash.

**Table 6. Oral environment pollution according to the use of mouthwash**

Category		Mean±s.d		t(p)
		Before	After	
Experience of use	Have	5.19±.33	5.23±.30	1.102 (.280)
	Have none	5.29±.31	5.30±.35	.096 (.925)
t(p)		.685(.490)		
Frequency of use	Use every day	5.14±.43	5.34±.28	1.632 (.129)
	Use only if necessary	5.35±.24	5.28±.38	-.578 (.581)
	Not use	5.25±.26	5.27±.32	.260 (.797)
F(p)		.195(.823)		

## 4. Discussion

The purpose of this study was to investigate changes in oral environment status according to the use of mouthwash in the incremental dental care. The incremental dental care is conducted for the purpose of reducing, removing and preventing by dental hygienists the causes or influencing factors of oral health problems, and this study intended to analyze the effects of mouthwash on the control of dental plaque, the major cause of oral disease.

In the treatment of periodontal disease, the establishment of improved oral hygiene in patients, surgical or non-surgical scaling techniques, root planing, gingival curettage, and excisional new attachment procedure have been used for the regeneration of periodontal tissues[10]. As additional therapy, systemic antibiotics have been used, and a study about the effects of mouthwash containing antibacterial anti-plaque formulations on periodontal treatment was reported[11]. The dental plaque, which causes disease, can be removed by mechanical or chemical methods. Of course, the most basic method for removing oral bacteria is the mechanical method; however, under environment or conditions where it is difficult to remove plaque effectively, adjuvant products should be used additionally. Together, additional effects can be expected from the use of mouthwash that chemically suppresses the growth of bacteria in the mouth[12]. Yun[13] demonstrated that in case of subgingival cleaning with saline solution, C31G, benzothonium chloride, or tetracycline, the depth of paradental cyst, gingival index, plaque index, gingival sulcus bleeding index, and the clinical index of gingival recession generally improved, and that the ratio of polymorphonuclear leukocytes significantly decreased. You et al[14]. showed that bacteria didn't grow in all of the undiluted solutions of mouthwash used in the study, and that Product 1 and Product 2, which were mixed with CPC, showed antimicrobial activity at relatively low concentrations when they were diluted. This study compared the differences of changes in oral health behavior, halitosis, dental plaque index, and oral environment pollution according to the existence of experience of using mouthwash in the weekly incremental care program. Differences of changes in oral health behavior were observed between before and after care according to the frequency of using mouthwash as well as the existence of experience of using mouthwash. And it was found that there were the differences of changes in halitosis between before and after care according to whether mouthwash was used or not ( $p < 0.004$ ), and that there were also differences in dental plaque index ( $p < .047$ ). These findings showed similar results to the expected effects of the previous study. While there are adjuvant products that assist oral hygiene care, such as dental floss, interdental brush and tongue cleaner, it is deemed that the findings become grounds that besides the physical removal of plaque, the control of dental plaque by means of mouthwash is effective for oral environment management.

The limitations of this study are as follows: First, it is difficult to control all external factors such as the systemic situation and food intake of the subjects who participated in the incremental dental care program. Second, although there were differences in oral environment changes according to whether mouthwash was used, it is difficult to distinguish exactly whether the differences were caused by mouthwash or ingredients of mouthwash. Despite these limitations, this study confirmed that the use of mouthwash in incremental dental care is partially effective in improving periodontal disease, and thus it is deemed that the concept of incremental dental care will have to be settled and the use of mouthwash together with various oral adjuvant products will have to be popularized in the future for the improvement of periodontal disease.

## 5. Conclusion

This study was conducted to investigate the changes of oral environmental status according to the use of mouthwash in incremental dental care, and comparatively analyzed differences in oral health behavior, the degree of halitosis, dental plaque index, and oral environment pollution. The final subjects of the study were 45, and as a result of analyzing the differences of oral environment status according to the experience and frequency of using mouthwash in the weekly incremental dental care program, the following conclusion was obtained.

1. As for the general characteristics of the subjects, the number of males was more with 60.0% in terms of gender, and "below 25" accounted for 71.1% in terms of age.

2. As for the subjects' oral hygiene characteristics, 'Moderate' was high with 51.1% in terms of interest in oral health; 'Not get scaled' was high with 44.4% in terms of regular scaling; the case of having experience of oral hygiene education was 26.7%; the case of having experience of using mouthwash was 60.0%; and the case of responding with 'Not use' was 53.3% in terms of the frequency of using mouthwash.

3. There were differences in changes of oral health behavior between before and after care according to the existence of experience of using mouthwash, and there were also differences between before and after care in terms of the frequency of using mouthwash. There were differences in changes of halitosis between before and after care according to the existence of experience of using mouthwash ( $p < .004$ ), the dental plaque index showed differences between before and after care among the group with the experience of using mouthwash ( $p < .017$ ), and it was found that there were differences in dental plaque index between before and after care according to whether mouthwash was used or not ( $p < .047$ ).

As a result of the overall analysis of this study, it is deemed that the use of mouthwash in incremental dental care is a suitable adjuvant method for maintaining clean oral hygiene status.

## 6. References

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