

# Effect of the education interval and method on improving Patients' plaque control ability

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## 교습 간격 및 방법이 치면세균막 관리능력 향상에 끼치는 영향

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**Objectives:** This study aimed to evaluate the effect of oral health education interval and toothbrushing instruction, the difference between the demonstration-only method and the demonstration with chairside practice toothbrushing instruction method, and the effect of initial patient plaque control ability on the plaque index.

**Methods:** Patients (n=60) were randomly assigned to receive a 1-week, 2-week, or 3-week interval of oral health education and toothbrushing instruction. Each group was further subdivided into the demonstration-only group and the demonstration with chairside practice group. Patients were categorized as having "good", "fair", or "poor" initial plaque control ability, based on the Turesky modification of the Quigley-Hein plaque index (TQHI). Patients attended five sessions during which they received oral health education and toothbrushing instruction of the modified Bass technique. Plaque evaluation was performed at each visit using the TQHI.

**Results:** The plaque index tended to improve from the first visit to the fifth visit, but there were no significant differences between the 1-week, 2-week, and 3-week education interval. The demonstration with the chairside practice group showed significantly greater improvements in the plaque index, compared to the demonstration-only group. In the good, fair, and poor plaque control ability groups, the plaque index improved gradually from the first to the fifth visit. When plaque control was poor, the improvement in the plaque index increased to a greater degree after oral health education and toothbrushing instruction.

**Conclusions:** The results of this study may be helpful for suggesting appropriate individualized oral hygiene management methods to improve plaque control ability.

**Key Words:** Dental plaque, Dental plaque index, Oral health education, Toothbrushing instruction

## Introduction

Periodontal disease results from chronic bacterial infection caused by supragingival and subgingival plaque. Plaque is an acquired soft deposit that develops on the teeth, gums, and other structures in the oral cavity. The development and pro-

gression of periodontal diseases can be prevented by methods that control plaque formation<sup>1)</sup>. In addition, these measures can improve overall oral health and decrease an individual's need for restorative treatments in dental clinics<sup>2-4)</sup>.

Regular toothbrushing suppresses the formation of plaque and has a major role in preventing periodontal disease<sup>5)</sup>. To

date, various toothbrushing techniques have been developed that combine many different brush movements, and several studies have been conducted to investigate their effects<sup>6-8)</sup>. However, there are no overwhelming differences in plaque removal among the various available toothbrushing methods. The modified Bass technique efficiently eliminates plaque on lingual surfaces where plaque easily accumulates and inflammation is more likely to occur. Thus, this technique is recommended to patients who require cleaning of the gingival sulcus<sup>8,9)</sup>.

To eliminate plaque efficiently, it is desirable for patients to learn the importance of toothbrushing to maintain and improve their oral health and to learn the correct brushing method involved in one of the available techniques. Therefore, the importance of oral health education and toothbrushing instruction cannot be overemphasized. Oral health education involves teaching patients about oral health, and encouraging patients to develop a positive attitude towards toothbrushing and to form good habits that promote oral health during daily life. Oral health education aims to motivate patients to set realistic goals for changing their oral health behaviors and to guide and sustain these new behaviors<sup>10)</sup>.

Self-care is important to maintain good oral health. For self-care, methods are needed that encourage patients to follow an oral hygiene management method provided by dentists or dental hygienists. Calley et al.<sup>11)</sup> achieved better results with patient-oriented oral hygiene management methods in which patients have a major role and active role in comparison to methods that were suggested from the care providers' point of view. Jönsson et al.<sup>12)</sup> also report that patients with an individually tailored oral health educational program have more positive effects on plaque removal than their general counterparts.

To date, the investigations of the factors influencing the outcomes of oral health education and toothbrushing instruction have focused on oral health education media and the individuals being studied<sup>10,13)</sup>. However, few studies have been performed on factors such as the education interval and its

relationship with patient plaque control ability. This study aimed to evaluate the effect of the oral health education interval and toothbrushing instruction, the difference between the demonstration-only method and the demonstration with chairside practice-toothbrushing instruction method, and the effect of initial patient plaque control ability on the plaque index.

## Materials and Methods

### 1. Study participants

This study was conducted in accordance with the Helsinki Declaration and with the approval of the Ethics Committee of Chosun University Dental Hospital at Gwangju, South Korea (approval number, CDMDIRB-1428). The study participants of this prospective study were patients of Chosun University Dental Hospital who had visited the department of periodontology for the first time and volunteered to participate in a clinical test on improving their plaque control ability. Patients who were taking cyclosporine, nifedipine, or phenytoin, which induces gingival enlargement and influence the formation of plaque, and patients who had a physical disability that could affect oral hygiene management were excluded. All patients participated voluntarily and the objects and methods of this study were explained verbally and through written consent forms.

### 2. Groups

Sixty patients (18 men and 42 women) were selected. Their mean age was 50.2 years (range, 20-72 years). The patients were randomly assigned into three groups with different oral health education intervals (i.e., 1 week, 2 weeks, 3 weeks) and toothbrushing instruction (Table 1). The groups that received toothbrushing instruction were further randomly divided into (1) the demonstration-only group in which the investigator demonstrated the modified Bass technique in the patients' mouths and (2) the demonstration with chairside practice group in which the investigator demonstrated the

**Table 1.** Sex ratio, mean age, and initial plaque control ability of the 1-week, 2-week, and 3-week education interval groups

Education interval	Sex		Mean Age (y)	Initial Plaque Control Ability			Total
	M	F		Good	Fair	Poor	
1 week	6	14	49.4	0	16	4	20
2 week	7	13	50	1	16	3	20
3 week	5	15	51.4	2	15	3	20
Total	18	42	50.2	3	47	10	60

All data are presented as the number, unless otherwise denoted. F, female; M, male.

**Table 2.** The number of patients in the subgroups divided by education interval and education method

Education interval	Education Method		Total
	Demonstration	Demonstration with Chairside Practice	
1 week	10	10	20
2 week	10	10	20
3 week	10	10	20
Total	30	30	60

modified Bass technique and the patients then practiced the technique with a toothbrush in their mouths (Table 2).

### 3. Education method

The patients had not undergone any oral health education or toothbrushing instruction before the clinical testing. The patients were examined five times. Thus, the total clinical testing period of the 1-week, 2-week, and 3-week education interval groups were 5 weeks, 10 weeks, and 15 weeks, respectively.

At the first visit, all labial (i.e., buccal) and palatal (i.e., lingual) surfaces of the upper and lower teeth were disclosed by using a disclosing agent (GUM Red-Cote tablets; Sunstar Group, Lausanne, Switzerland) and the extent of plaque formation was evaluated. Oral health education and toothbrushing instruction of the modified Bass technique were then conducted consecutively. Residual teeth were divided into four sectors and subgingival curettage was applied to one sector at a time. Throughout the clinical testing period, all patients were supplied with an identical toothbrush (E-TBI#412; Hana Dental, Seoul, Korea) that had four rows of flat plane mild stiffness bristles. The patients were instructed to bring the supplied toothbrush to each visit and to use it to perform the demonstrated method during their daily toothbrushing routine. Other oral hygiene management devices such as dental floss and interdental brushes were prohibited to exclude any factors that may have affected the results, and to observe only the effect of the toothbrushing instruction using the modified Bass toothbrushing technique. The contents of oral health education included explaining the etiology and progression of periodontal disease and the importance of toothbrushing to maintain and improve oral health.

At the second, third, and fourth visits, plaque formation was evaluated. The patients were motivated through further instruction on toothbrushing. Subgingival curettage was applied to each of the four tooth sectors. At the fifth visit, plaque formation was evaluated.

### 4. Measurement of plaque

The same examiner, who was a periodontist, performed all clinical measurements throughout the course of the study. Plaque formation was assessed by the Turesky modification of the Quigley-Hein Plaque Index (TQHI)<sup>14</sup>. The plaque area on the crown of the tooth was evaluated without addressing plaque thickness. A score of 0 to 5 was assigned to each facial and lingual nonrestored tooth surface. A score of “0” indicated no plaque; “1” indicated separate flecks or a discontinuous band of plaque at the gingival margin; “2” indicated a thin continuous band of plaque up to 1 mm at the gingival margin; “3” indicated a band of plaque that was wider than 1 mm but covered less than one-third of the gingival third of the tooth surface; “4” indicated plaque covering more than one-third but less than two-thirds of the tooth surface; and “5” indicated plaque that covered two-thirds or more of the tooth surface. All teeth, except the third molars, were assessed. An index for the entire mouth was determined by dividing the total score by the number of surfaces examined.

### 5. Statistical analysis

Paired *t* tests were used to analyze the intragroup differences in the plaque index, based on the number of visits during each education interval. One-way analysis of variance (ANOVA) and the Tukey *post hoc* test were used to analyze the intergroup differences in the plaque index between each education interval. Repeated measures ANOVA was used to analyze the intergroup differences in the plaque index between each education method. The patients were categorized into three groups, based on their initial plaque control ability: “good” (i.e., TQHI, 0.00–1.66), “fair” (i.e., TQHI, 1.67–3.32), or “poor” (i.e., TQHI, 3.33–5.00). In the analysis of plaque control ability, paired *t* tests and the Wilcoxon signed rank test were used to analyze the intragroup differences in the plaque index, based on the number of visits during each interval. SPSS software (SPSS 20.0; IBM, Chicago, IL, USA) was used for all statistical analyses. The level of significance was set at  $P < 0.05$ .

## Results

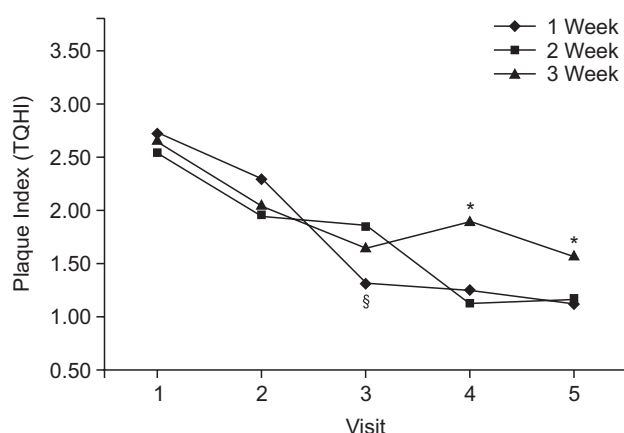
### 1. Education interval

Intragroup analysis showed that the plaque index in the 1-week education interval group tended to improve gradually from the first visit to the fifth visit. In addition, there was a statistically significant difference between the first visit and the second, third, fourth, and fifth visits.

**Table 3.** Changes in the mean plaque index at the first, second, third, fourth, and fifth visits during the 1-week, 2-week, and 3-week education interval

Mean Plaque Index		Visit				
		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>
Education interval	1-week (n=20)	2.72 (0.89)	2.30 (0.73)*	1.32 (0.32)*	1.25 (0.36)*	1.13 (0.26)*
	2-week (n=20)	2.55 (0.58)	1.95 (0.36)*	1.85 (0.29)*	1.13 (0.23)*	1.16 (0.30)*
	3-week (n=20)	2.67 (0.56)	2.04 (0.49)*	1.65 (0.38)*	1.89 (0.45)*	1.57 (0.40)*

The plaque index is presented as the mean (standard deviation). \*Indicates a statistically significant difference between the first visit and the second, third, fourth, and fifth visits, as measured by the paired *t* test ( $P<0.05$ ).

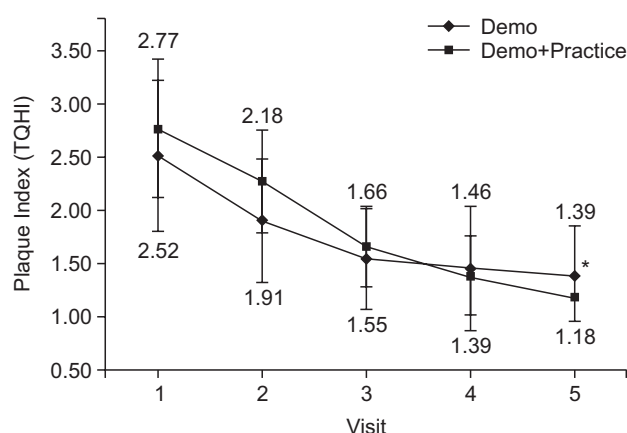


**Fig. 1.** Mean plaque index of 1-week, 2-week, and 3-week education interval groups at the first, second, third, fourth and fifth visits. § Indicates a statistically significant difference between the 1-week interval and the 2-week interval or 3-week interval, as measured by one-way analysis of variance (ANOVA) ( $P<0.05$ ). \*Indicates a statistically significant difference between the 1-week or 2-week interval and the 3-week interval, as measured by one-way ANOVA ( $P<0.05$ ). TQHI, Turesky modification of the Quigley-Hein Plaque Index.

In the 2-week education interval group, the plaque index tended to improve from the first visit to the fourth visit. There was a statistically significant difference between the first visit and the second, third, fourth, and fifth visits.

In the 3-week education interval group, the plaque index tended to improve from the first visit to the third visit. There was a statistically significant difference between the first visit and the second, third, fourth, and fifth visits (Table 3).

Intergroup analysis using repeated measures ANOVA showed no statistically significant differences between the 1-week and 2-week intervals ( $P=0.993$ ), the 2-week and 3-week intervals ( $P=0.135$ ), or the 1-week and 3-week intervals ( $P=0.166$ ). Tukey *post hoc* tests indicated that a 1-week education interval could significantly improve the plaque index in comparison to the 2-week or 3-week education interval at the third visit. At the fourth visit and fifth visit, the 3-week education interval showed significantly less effective



**Fig. 2.** The change in the mean plaque index at the first, second, third, fourth, and fifth visits in the demonstration-only group (n=30) and the demonstration with chairside practice group (n=30). \*Indicates a statistically significant difference between groups, as measured by the *t* test ( $P<0.05$ ). TQHI, Turesky modification of the Quigley-Hein Plaque Index.

improvement in the plaque index in comparison to the 1-week and 2-week education interval (Fig. 1).

## 2. Education method

Repeated measures ANOVA showed a statistically significant difference between the demonstration-only group and the demonstration with chairside practice group ( $P<0.05$ ). The demonstration with chairside practice group showed more effective improvement in the plaque index than the demonstration-only group, particularly at the fifth visit (Fig. 2).

## 3. Plaque control ability

In the group assessed as having good initial plaque control ability, the plaque index tended to improve from the first visit to the fifth visit. There was also a statistically significant difference from the third visit onwards, compared to the first visit. In the group assessed as having fair initial plaque control ability, the plaque index tended to improve from the first visit to the fifth visit; there was a statistically significant difference

**Table 4.** Changes in mean plaque index at the first, second, third, fourth, and fifth visits, according to initial plaque control ability

		Visit					Changes in the Mean Plaque Index (1 <sup>st</sup> -5 <sup>th</sup> visit)
		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	
Plaque control ability	Good (n=3)	1.40 (0.26)	1.37 (0.33)	1.07 (0.54)*	0.87 (0.28)*	0.85 (0.28)*	0.55
	Fair (n=47)	2.53 (0.48)	2.07 (0.47) <sup>§</sup>	1.62 (0.42) <sup>§</sup>	1.41 (0.49) <sup>§</sup>	1.29 (0.39) <sup>§</sup>	1.24
	Poor (n=10)	3.62 (0.24)	2.45 (0.72)*	1.72 (0.29)*	1.66 (0.42)*	1.39 (0.25)*	2.23

The data are presented as the mean (standard deviation). \*Indicates a statistically significant difference between the first visit and the second, third, fourth, and fifth visits, as measured by the Wilcoxon signed rank test ( $P < 0.05$ ). <sup>§</sup>Indicates a statistically significant difference between the first visit and the second, third, fourth, and fifth visits, as measured by the paired *t* test ( $P < 0.05$ ).

from the second visit onwards, compared to the first visit. In the group assessed as having poor initial plaque control ability, the plaque index similarly tended to improve from the first visit to the fifth visit; there was a statistically significant difference from the second visit onwards, compared to the first visit. The analysis of the relationship between plaque control ability and the amount of change in plaque index showed that the lower the patient's initial plaque control ability, the greater was the amount of change in plaque index (Table 4).

## Discussion

To date, several studies have compared the Bass technique with other toothbrushing methods. For example, Gibson et al.<sup>15)</sup> compared plaque removal between the Bass technique and the roll brushing technique, and reported that the Bass technique was more effective on tooth surfaces that are adjacent to lingual and labial gingival tissue. However, Robinson<sup>16)</sup> report no statistically significant difference between the Bass method and the scrub method in plaque removal. Plaque accumulates easily on lingual surfaces; thus, this area is vulnerable to gingivitis<sup>17,18)</sup>. Many investigators report that the modified Bass technique effectively removes plaque from lingual surfaces. Bergenholtz et al.<sup>9)</sup> report that the Bass technique is superior to the roll and scrub methods in removing plaque from lingual surfaces. The results of previous studies suggest that the modified Bass technique shows no statistically significant difference in plaque removal in comparison to other methods, although it is effective in lingual areas where plaque easily accumulates and gingivitis is likely to occur. Therefore, the current study provided instruction on toothbrushing using the modified Bass technique.

In the present study, the TQHI was used to evaluate plaque because it is easy to learn and highly reproducible because of its five-point classification scale<sup>19)</sup>. The TQHI also measures plaque on cervical areas where the modified Bass

technique effectively removes plaque. Furthermore, the TQHI does not measure interproximal surfaces, although it is compatible with the Rustogi-modified Navy Plaque Index (RMNPI), which is more complex and sensitive for assessing the effect of toothbrushing<sup>20)</sup>.

In the current study, only one session of oral education and toothbrushing instruction led to statistically significant improvements in the plaque index, regardless of whether the education interval was 1 week, 2 weeks, or 3 weeks. Under continuous instruction, the degree of improvement tended to increase further. Jo et al.<sup>21)</sup> also report that the ability of patients to reduce plaque formation gradually improved from the first visit to the fifth visit through toothbrushing instruction. Schlueter et al.<sup>22)</sup> report that after a 2-week interval during which patients were provided with verbal instructions and a video that demonstrated the modified Bass technique, there was a statistically significant improvement in the plaque index at the second visit, compared to the first visit. In addition, the degree of improvement at the third visit was even greater, which was similar to the results of the present study. Ashkenazi et al.<sup>23)</sup> report that the education interval and the number of education sessions affected patient compliance with dental preventive measures because the patients received oral health education and toothbrushing instruction and repeated motivation when they visited the dental clinics. With regard to the education interval, no studies were found that compared the toothbrushing education interval, which can effectively improve plaque index during periodontal treatment. Ower<sup>24)</sup> did not clarify the number of education sessions associated with the improvement in plaque control ability, but did recommend a short education interval. In the current study, the 1-week education interval showed a statistically significant difference in the improvement of the plaque index, compared to the 2-week and 3-week interval at the third visit. The 3-week interval was likewise less effective than the 1-week or 2-week interval at the fourth and fifth visits.



Many studies have assessed the effect of a demonstration during instruction on toothbrushing. Acharya et al.<sup>25)</sup> report that oral health education (e.g., information on the composition of plaque, its impact on oral hygiene, and the importance of plaque removal) and a demonstration of the scrub method in a patient's mouth decreased the gingival index and the plaque index and effectively managed gingival health. In addition, Renton-Harper et al.<sup>26,27)</sup> report that demonstration was more effective than written instructions for improving plaque index because visual-based instruction is superior to verbal instruction. In addition, Hodges et al.<sup>28)</sup> showed that the most effective method for toothbrushing instruction was verbal instruction combined with a demonstration on a model<sup>29)</sup> or a presentation of images concerning toothbrushing instruction<sup>26,27)</sup>; the demonstration helped to teach toothbrushing motions whereas the verbal instruction helped to deliver new information. Ashkenazi et al.<sup>30)</sup> report that oral health could be improved by toothbrushing instruction with a demonstration on a model or in a patient's mouth, followed by the patient practicing in his or her own mouth while a demonstrator indicated mistakes.

The current study compared a demonstration-only group with a demonstration with chairside practice group, and evaluated the effect of these different education methods on the plaque index. From the first visit to the third visit, the demonstration-only group had a greater improvement in the plaque index than the demonstration with chairside practice group; however, the difference was not statistically significant. Throughout the study, demonstration with chairside practice more effectively improved the plaque index, compared to demonstration only.

In terms of the plaque control ability in the fair group and poor group, there was a statistically significant difference in plaque index from the second visit onwards, compared to the first visit. The good group had a statistically significant difference from the third visit onwards, compared to the first visit. These results indicate that a statistically significant improvement in plaque index was not achieved by a single education session in patients with a good initial degree of plaque control ability; plaque index section from 1.40 of the first visit to 1.37 of the second visit did not allow statistically significant improvement by single session in such patients. This finding indicates it takes time to acquire a certain degree of plaque control ability.

In the current study, the patients participated voluntarily, and thus were likely to be interested in oral hygiene and motivated in oral hygiene management. Therefore, it can be as-

sumed that the degree of improvement in the plaque index was relatively high in this study.

One limitation of this study is that, although there was a statistically significant difference in the improvement of the plaque index between the demonstration with chairside practice group and the demonstration-only group (especially at the fifth visit), it is unclear whether the same trend would have continued after the fifth visit. Future research should investigate the effect of the number of education sessions on plaque control ability. Furthermore, the patients in this study were only divided into two groups in accordance with the education method. Further research such as a "no toothbrushing" instruction group would be helpful to assess further the effect of education methods on improving the plaque index.

## Conclusion

The plaque index tended to improve gradually from the first visit to the fifth visit in all patients. A 1-week education interval improved the plaque index faster than a 2-week or 3-week education interval. The 3-week education interval showed less effective improvement in the plaque index. Demonstration with chairside practice was an effective method of toothbrushing instruction. The lower the patient's plaque control ability, the higher was the amount of change in the plaque index after oral health education and toothbrushing instruction. The results of this study may be helpful in suggesting appropriate oral hygiene management methods for individual patients to improve plaque control ability.

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