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Mun S-J, Chung W-G, Min S-H, Park J-K, Kim C-B, Kim N-H, Seo H-Y, Chang S-J. Reduction in dental plaque in patients with mental disorders through the dental hygiene care programme.

Reduction in dental plaque in patients with mental disorders through the dental hygiene care programme

Abstract: *Objective:* To develop a dental hygiene care programme based on the specific needs of patients with mental disorders and to suggest practical guidelines to improve the oral health care of these patients. *Methods:* A total of 73 patients with mental illness participated in the study. The patients were randomly classified into three groups and followed over 12 weeks at 4-week intervals. A newly designed dental hygiene care programme using flash-based video, brochures and a toothpick method was implemented by five dental hygienists. Plaque index, stimulated saliva, subjective oral dryness and dental caries activity were analysed as outcome variables. *Results:* Results showed that the dental plaque index significantly decreased after each session ($P < 0.0001$) in all three groups, and significant differences were found between groups ($P = 0.036$). Patients' oral dryness decreased significantly, but stimulated saliva and dental caries activity did not improve. *Conclusion:* The results of this study suggest that the dental hygiene care programme, which made use of a short, 10-min flash-based video and brochures every 4 weeks, was effective in reducing the dental plaque index of patients with mental disorders.

Key words: dental hygiene care; mental illness; oral health; plaque index

Introduction

Mental disorders such as depression and anxiety disorders have been rapidly increasing over the past several decades. In a survey conducted in 2006, the lifetime prevalence rate of mental illnesses in Korea was 12.6% and then increased to 14.4% in 2010 (1). The lifetime prevalence rate of mood disorders, including depression, was 7.5% of the total population, which has also shown an increasing trend over the past 10 years (1). According to the Korean National Health Insurance Corporation, the number of patients with mental and behavioural disorders increased from 1.34 million in 2001 to 1.81 million in 2006 (an increase of 35%); consequently, health insurance costs increased by 93%, reaching 863 billion Korean Won (about 798 million dollars) (2).

The medications typically used to treat mental illnesses, such as serotonin reuptake inhibitors, atypical antidepressants and tricyclic antidepressants, can often result in common oral illnesses, including xerostomia, dysgeusia and glossitis (3–6). In particular, xerostomia decreases the self-cleansing effect of saliva. Because xerostomia causes

dryness and discomfort in the mouth, it tends to increase sugary drink intake, smoking and alcohol intake, all of which negatively affect oral health (7). According to a study by the National Evidence-based Healthcare Collaboration Agency, antidepressant treatments have serious adverse effects on oral health (8).

Personal hygiene and oral hygiene self-care practices in patients with mental disorders can affect disease development. Such patients often do not care for themselves properly because they lack confidence and interest (9, 10). Additionally, because of the lack of knowledge and awareness regarding oral health, such patients do not receive timely treatment or examinations (9). Furthermore, the high cost of dental treatment is often a prohibitive factor (11).

Indeed, it has been reported that the average Decayed, Missing, and Filled Teeth (DMFT) index for patients with a mental disorder is 7.10, indicating a higher rate of dental caries and worse oral and periodontal health compared with the general population (12). Studies from other nations have also reported weak oral health in patients with mental disorders (7, 11, 13–18). Moreover, patients taking medications for mental illness have a lower non-stimulated salivary flow and more frequently experience subjective symptoms of xerostomia (6). These symptoms are worse in patients who have been treated with medications over a longer period (7).

For these reasons, patients with mental illness have a higher risk of oral diseases such as multiple dental caries, periodontal diseases and glossopyrosis. To address this problem, a differentiated oral management programme that focuses on providing motivation for behavioural change in patients with mental disorders is necessary (10, 13). Indeed, the toothbrushing rate is much lower in patients with mental disorders (75%) than in the general population (96%) (11). The development of a strategy to improve the knowledge, attitude and behaviour of patients with mental disorders towards oral health is critical in order for these patients to learn and practice proper oral healthcare habits.

Oral healthcare education is very important in preventing oral diseases in patients with mental disorders (4). In addition to oral healthcare education through various media, the prescription of artificial saliva to relieve xerostomia and routine oral healthcare examinations by a specialist every 3 months are also necessary techniques for maintaining good oral health in this population. To maximize the effects, it has been highly recommended that a caretaker participates in the process of dental hygiene education (4). Unfortunately, there exists little empirical evidence regarding interventions to improve the oral health of patients with mental disorders (19), and the importance of oral health for these patients has been ignored (20).

In Korea, aside from a few studies in the 1990s examining the oral health status of inpatients with mental disorders that suggested the need for an oral healthcare programme (12), few studies have assessed the oral health of such patients. Therefore, there is a critical need for the development of an effective oral healthcare education programme.

Accordingly, the purpose of this study was to elucidate the effects of a newly designed dental hygiene care programme on dental plaque in patients with mental disorders and to suggest practical guidelines to improve oral health care for these patients.

Methods

Study subjects

Study subjects were adult patients undergoing medication treatment for schizophrenia, schizoaffective disorder, bipolar disorder, depression and organic mental disorder and who had at least one normal tooth in each sextant. Patients were excluded based on the following criteria: significant pathological manifestations in the oral tissues, fixed orthodontics, pregnancy, the inability to communicate, visual or auditory disabilities, or the inability to complete all follow-up assessments. Patients with alcohol addiction or those who could not participate in inpatient care were also excluded.

Subjects included 23 patients who participated in the daytime programme of a mental health centre in Gangwon Province and 69 inpatients at a nearby psychiatric hospital. They were given serial numbers consecutively and randomly allocated to three groups, separately. They were assessed over 12 weeks at 4-week intervals. Data from a total of 73 subjects were analysed. We excluded four subjects who met the exclusion criteria and 15 subjects who were unable to continue with the study (Fig. 1).

Procedures

Pilot test

To understand the characteristics of subjects and to develop appropriate educational materials and questionnaires, three researchers participated in mental health centre programmes for the participatory observation of the subjects for a half-day period every week for 10 weeks from 23 November 2011 to 1 February 2012 before the start of the study. During the participatory observation period, the researchers simply observed potential subjects in the mental health programmes and tried to establish rapport with them without making any verbal or behavioural suggestions about the study.

A pilot test was conducted to confirm the best procedure to measure the outcomes of the study, examine the content and wording of questionnaires and develop the study design. Five subjects from the mental health centre were recruited for the pilot test. Based on the results of the pilot study, difficult words or items were simplified for greater understanding among the patients. Dental caries activity tests and dental plaque tests were conducted to determine whether the outcomes were measurable and to verify the procedure appropriate for the study.

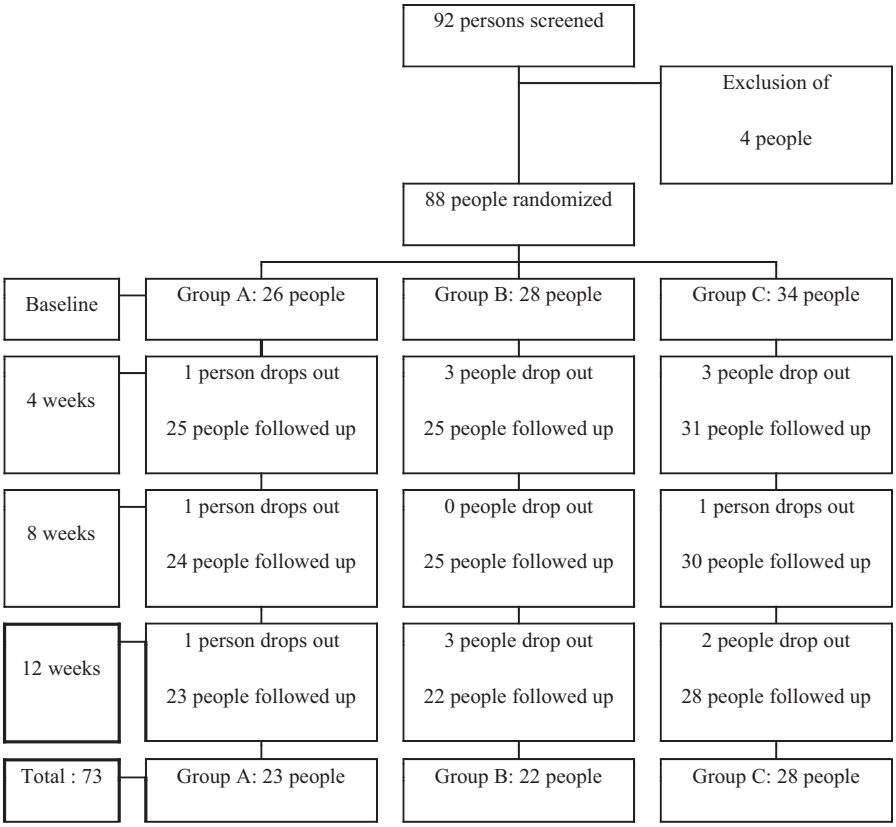

Fig. 1. The participant selection process.

Development of educational media

We developed a brochure and a flash-based video to educate subjects. For the educational materials, the necessary training information, photographs, videos and scenarios for each session were submitted to an educational media specialist to create the brochure and the video. The video was <10 min in length because subjects had difficulty maintaining a longer attention span. Important educational points, such as toothbrushing techniques and alleviation of xerostomia, were repeated at least twice. Information was selected by the researchers based on previously established oral hygiene education materials (9, 21, 22) and was submitted to specialists for review, including a psychiatrist, the head of nursing at a psychiatric hospital and professors at a department of dental hygiene.

Examiner training

Before conducting the study, examiner training was completed once a week for 3 weeks to establish baseline plaque index measurements for all researchers. Five examiners conducted the study from 13 February 2012 to 31 May 2012. We examined the agreement test for the plaque index. The kappa value among the examiners was >0.7, indicating a high level of agreement (23).

Examination guidelines for measuring salivary flow, conducting the dental caries activity test and the subjective survey, and demonstrating correct tooth-brushing technique were developed based on the pilot test. These guidelines were distributed to examiners for educational purposes. Based on the guidelines, a simulated examination was conducted.

Dental hygiene care programme

Subjects were classified into three groups (groups A, B and C) for the dental hygiene care programme. Group A received oral healthcare education using the flash-based video programme and underwent two practice sessions of professional tooth-brushing using the toothpick method during the second and third sessions. A toothbrushing technique using the toothpick method with a two-line bristle toothbrush was demonstrated, with all subjects using the same type of toothbrush. Group B received the same flash-based material as group A, and all three groups, including group C, received brochures that contained the same material that was shown in the video.

The flash-based video, which was <10 min in length, was interactive in order to allow subjects to follow along by observing the monitor and clicking when necessary. An educator assisted with computer operation if subjects were unable to use the computer themselves. They were educated over 12 weeks at 4-week intervals (Fig. 2).

The information covered in the educational material focused on knowledge of oral health, attitude about oral health and

self-management of behavioural changes. Subjects were allowed to review the material using the brochure, which contained the same information.

Measurements

We used the Patient Hygiene Performance index (PHP index, Podshadely and Haley, 1968) to assess the plaque index (24). Dental plaque was measured on one representative tooth per sextant on a total of six tooth surfaces. The adjacent tooth was measured if the chosen tooth was unavailable for measurement. The tooth surface was divided into five areas, and each area received a score of 1 or 0 for the presence or absence of dental plaque, respectively. The total score was divided by the number of teeth observed, leading to a minimum score of 0 and a maximum score of 5. The plaque index was assessed every 4 weeks for a total of four measurements.

We measured stimulated salivary flow to determine the extent of xerostomia. Stimulated salivary flow was measured by collecting saliva in a conical tube, which was produced after the subject chewed on paraffin for 5 min. Subjective oral dryness was measured using a total of nine survey questions. After excluding one question based on factor analysis, the rest of the eight questions were scored, giving a minimum score of 0 and a maximum score of 8.

The dental caries activity test was conducted using Cariview® and Dentocult LB®. Cariview® is a dental caries activity test that measures the acid production of the microorganisms that form dental plaque. Dental plaque was collected using a sterilized cotton swab, which was stirred into growth media and cultured for 48 h at 37°C before adding the indicator. Using a colorimetric analysis, the activity was converted to a score between 0 and 100, with 100 indicating the highest level of dental caries activity. Growth on Dentocult LB®, which detects Lactobacillus, was assessed by collecting the saliva from the stimulated salivary flow test. The saliva was spread on growth medium, grown at 37°C for 96 h, and visually assessed for colony formation. Results were scored on a 0–3 scale according to guidelines provided by the company. The xerostomia and dental caries activity tests were conducted on the first and the last days (week 12) of the programme (Fig. 2).

Statistical analysis

The general characteristics of the subjects were analysed using a chi-square test. Repeated-measures ANOVA was carried out to examine changes in the dental plaque index after each session. Changes in salivary flow, subjective oral dryness and changes in Cariview® and Dentocult LB® test scores were analysed using paired *t*-tests. SPSS statistics program, version 20 (SPSS Inc; Chicago, IL, USA) was used for analyses. Results at $P < 0.05$ were considered significant.

Ethics approval of research

This study was approved by the Yonsei University Wonju College of Medicine Institutional Research Ethics Review Board (Registration number 2011-40, approval date: 19 October 2011).

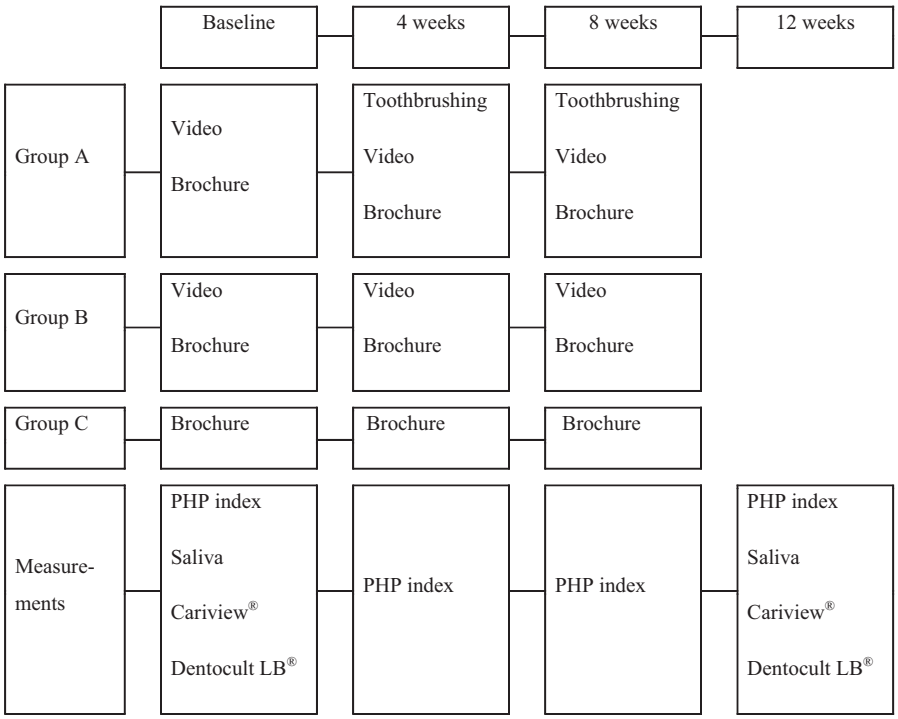

Fig. 2. Experimental design.

Results

General characteristics

Seventy-three patients completed the 3-month dental hygiene care programme: 23 in group A, 22 in group B and 28 in group C. The general characteristics of the study subjects are listed in Table 1. These general characteristics did not significantly differ between the groups. The majority of subjects (89%) were schizophrenic.

Results of plaque index measurements

At baseline, the groups did not differ on the dental plaque index. For all three groups, the dental plaque index significantly decreased after each session ($P < 0.0001$), and significant differences were found between the groups ($P = 0.036$). The rate of score change after 12 weeks was 41.9% in group A, 50.1% in group B and 30.1% in group C. Changes in the dental plaque index for each group are shown in Table 2 and Fig. 3.

Results of the xerostomia tests

Results of the xerostomia test after 5 min of stimulation did not differ between the groups before or after the programme. However, there was a trend of increased saliva production in all three groups after four sessions (Table 3).

No significant differences in subjective oral dryness questionnaire scores were found among the groups before and after the intervention, but scores decreased significantly in all three groups after the intervention (Table 4).

The change of score after four sessions adjusted for the baseline yielded no significant difference between the groups.

Acid production of oral bacteria and the lactobacillus test

For the oral bacteria acid production test, group A showed an increase in dental caries activity after the fourth session. For the Lactobacillus test, no significant differences were observed among the groups, but small decreases occurred within groups A and B (Table 5). The change in score after four sessions adjusted for the baseline yielded no significant difference between the groups.

Discussion

Patients with mental disorders often have weaker focus, memory and attention span and have difficulty with communication than the general population. Motivation is also difficult to achieve for these patients as it is challenging for them to make logical decisions regarding treatment plans. Furthermore, the fear of dental treatment can be an obstacle for achieving adequate oral health care (9). Although it has been reported that teaching patients with mental disorders proper toothbrushing techniques can lead to improvement in oral hygiene, the oral health of these patients regressed after 1 month, suggesting that a continuous toothbrushing educational programme and individualized educational programmes, rather than collective programmes, are needed (12).

The results of our study show that the dental plaque index significantly decreased in all three groups when educational

Table 1. **General characteristics of participants**

Characteristics	Group A	Group B	Group C	Total	*P*-value
n	23 (100)	22 (100)	28 (100)	73 (100)	
Gender†					
Male	9 (39.1)	12 (54.5)	15 (53.6)	36 (49.3)	0.497
Female	14 (60.9)	10 (45.5)	13 (46.4)	37 (50.7)	
Location†					
Mental health centre	7 (30.4)	7 (31.8)	5 (17.9)	19 (26.0)	0.452
Hospital	16 (69.6)	15 (68.2)	23 (82.1)	54 (74.0)	
Age‡					
20–29 years	2 (8.7)	1 (4.5)	1 (3.6)	4 (5.5)	0.063
30–39 years	3 (13.0)	7 (31.8)	2 (7.1)	12 (16.4)	
40–49 years	10 (43.5)	9 (40.9)	10 (35.7)	29 (39.7)	
50–59 years	8 (34.8)	2 (9.1)	11 (39.3)	21 (28.8)	
60–65 years	0 (0)	3 (13.6)	4 (14.3)	7 (9.6)	
Health insurance‡					
Medical insurance	3 (13.0)	2 (9.1)	4 (14.3)	9 (12.3)	0.908
Medical care	20 (87.0)	20 (90.9)	24 (85.7)	64 (87.7)	
Mental illness‡					
Schizophrenia	22 (95.7)	19 (86.4)	24 (85.7)	65 (89.0)	0.408
Schizoaffective disorder	0 (0)	0 (0)	1 (3.6)	1 (1.4)	
Bipolar disorder	0 (0)	1 (4.5)	1 (3.6)	2 (2.7)	
Depression	1 (4.3)	0 (0)	2 (7.1)	4 (4.1)	
Organic mental disorder	0 (0)	2 (9.1)	0 (0)	2 (2.7)	

All the values in the table are presented as *n* (%).
†Chi-square test.
‡Fisher's exact test.

Table 2. **Changes in PHP index by group**

				P-value		
	Group A	Group B	Group C	Within group	Between group	Interaction
Baseline	3.56 ± 0.68	3.45 ± 0.43	3.32 ± 0.54	<0.0001*	0.342	0.036*
4 weeks	3.00 ± 0.87	2.71 ± 0.86	2.70 ± 0.68			
8 weeks	2.68 ± 0.99	2.23 ± 0.88	2.68 ± 1.06			
12 weeks	2.07 ± 1.06	1.72 ± 0.84	2.32 ± 1.00			

All the values in the table are presented as mean ± SD.
Repeated-measures ANOVA, *$P < 0.05$.

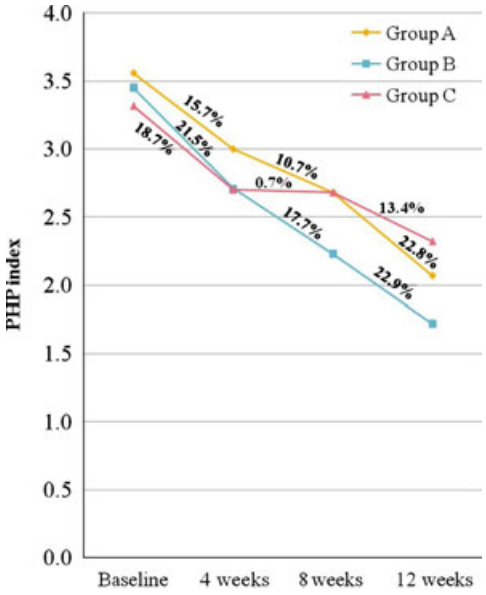

Fig. 3. Changes in PHP index by group.

Table 3. **Changes after 5 min of saliva stimulation by group**

	Group A	Group B	Group C	Total
Baseline	3.30 ± 2.58	2.95 ± 2.26	3.65 ± 2.82	3.33 ± 2.56
12 weeks	3.71 ± 3.69	3.22 ± 2.32	4.15 ± 3.81	3.73 ± 3.36
P-value	0.414	0.629	0.339	0.177

All the values in the table are presented as mean ± SD.
Paired *t*-test.

Table 4. **Changes in subjective oral dryness scores**

	Group A	Group B	Group C	Total
Baseline	2.91 ± 2.61	3.32 ± 2.82	3.22 ± 2.59	3.15 ± 2.64
12 weeks	2.39 ± 2.57	2.45 ± 2.24	2.67 ± 2.22	2.51 ± 2.31
P-value	0.168	0.189	0.118	0.015*

All the values in the table are presented as mean ± SD.
Paired *t*-test, *$P < 0.05$.

brochures, a flash-based educational video or both media types were used and when proper toothbrushing techniques were demonstrated or shown on video. The index decreased continually in the two groups that received video training, whereas this decrease was smaller in the group that received only the brochure.

Although professional tooth brushing was implemented in group A, there was no effect of the toothpick method in group A. The toothpick method removed more plaque from proximal tooth surfaces than the Bass method (25). In this study, the plaque index was measured first, and then the subjects received professional tooth brushing by the toothpick method. This sequence would not have changed the effect of professional tooth brushing on subjects' plaque index. The most important factor in oral health education for patients with mental disorders is effective behavioural changes. Previous studies have also focused on this area. Evaluating the effect of electric toothbrush use (26) or providing rewards for oral cleaning (10) has been suggested interventions. Additionally, it has also been shown that combining motivational interviews with normal oral healthcare education effectively decreases dental plaque in patients with mental illness (21), indicating that psychiatric treatment should be considered simultaneously with specific oral hygiene education to motivate behavioural change. In this study, a flash-based educational video <10 min in length, which consisted of interesting pictures and narration, was effective in maintaining the attention of subjects. In addition, the subjects were examined periodically at four-week intervals, which may have increased motivation for oral hygiene care.

Medications for mental disorders can lead to various adverse effects on oral health. Specifically, xerostomia can lead to difficulties in eating and pronunciation and can cause many serious oral diseases (3–6). Xerostomia occurs normally in seniors, and easy periodic mouth exercises that seniors can follow have been shown to significantly improve non-stimulated salivary flow and subjective xerostomia (27). Furthermore, oral care by specialists, including toothbrushing, gargling and lubricant application, can improve difficulties in swallowing, chewing, xerostomia, pain and sensitivity (28). In the present study, we implemented an oral massage technique in groups A and B that was similar to mouth exercises and sugar-free xylitol candies to increase salivary flow and improve xerostomia symptoms. We were not able to observe the effects of these measures because our study focused on improvements in dental plaque. However, we did observe a trend of increasing salivary flow in some cases and

Table 5. **Change in the acid production of oral bacteria and Lactobacillus**

	Group A	Group B	Group C	Total
Cariview®				
Baseline	62.61 ± 7.94	63.99 ± 13.10	66.00 ± 12.65	64.35 ± 11.5
12 weeks	68.55 ± 7.59	70.08 ± 6.64	66.55 ± 8.97	68.24 ± 7.93
P-value	0.022*	0.083	0.793	0.012*
Dentocult LB®				
Baseline	2.20 ± 0.95	1.95 ± 0.83	1.59 ± 1.10	1.90 ± 0.99
12 weeks	1.95 ± 1.15	1.65 ± 0.75	1.73 ± 1.16	1.77 ± 1.03
P-value	0.135	0.163	0.451	0.231

All the values in the table are presented as mean ± SD.
Paired *t*-test, $^*P < 0.05$.

improvements in subjective symptoms such as discomfort from dryness of the mouth during chewing or swallowing. Future studies should focus on xerostomia symptoms as outcome measures.

To assess dental caries activity, we measured the acid production of oral bacteria and the level of Lactobacillus, which is one of the bacteria that produces acid and causes dental caries. Although we observed a trend of increasing acid production after 12 weeks and a decrease in Lactobacillus in groups A and B, these differences were not significant. The colorimetric test and the Lactobacillus test are used as indicators of dental caries (29, 30). In our study, the average tooth decay index was 4.7, and we believe that bacterial activity did not decrease, as we did not treat these decayed teeth. In the future, changes in dental caries activity should be observed using active improvements in oral health.

Oral healthcare education and improved access to dental treatment are necessary to advance the oral health of patients with mental disorders. The oral care of inpatients is still not considered an important issue, and nurses working in psychiatric hospitals listed their shifts, the lack of patient cooperation and the lack of educational facilities as reasons for difficulties with patient oral care (31). The development of educational media for the oral healthcare education of patients with mental disorders and evidence-based oral care guidelines for staff training such as the nurses are required. Furthermore, measures to effectively improve the oral health of patients with the help of oral care specialists, such as dental hygienists, in patients who may face difficulties, such as patients with systematic disorders or psychiatric inpatients, should be developed. In addition, educational and institutional support is needed for the caretakers of mentally ill patients and should be provided to ensure oral health promotion and increased wellness.

Our study has several limitations. First, this study was conducted in patients with mental disorders in a small area of Gangwon Province. Second, we did not adjust for the type and severity of the mental disorder, the type of medication or length of treatment, or the length of inpatient care. In future studies, these must be considered, as they may influence the results. Furthermore, long-term evaluation is required to determine the proper frequency of programme implementation.

Conclusion

In conclusion, a dental hygiene care programme using a short, 10-min, flash-based video and brochures every 4 weeks was effective in reducing the dental plaque index of patients with mental disorders. However, we failed to confirm improvements in xerostomia symptoms or dental caries activity. This study suggests that the reduction in the dental plaque index in dental caries activity through concurrent dental treatment is very important for dental hygiene improvement in patients with mental disorders. Future studies are needed to develop a systematic approach to alleviate xerostomia, which is the most serious oral problem in patients with mental disorders.

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