

The effect of an oral hygiene instruction intervention on plaque control by orthodontic patients

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Orthodontic therapy is recently becoming more popular. The numerous orthodontic components, however, encourage the accumulation of dental plaque on teeth, increasing the risk of caries and periodontitis. In order to reduce these problems, we designed a study to investigate the effects of an oral hygiene instruction intervention program. Fifty-seven patients with fixed orthodontic appliances were divided randomly into a trial (n=29) and a control group (n=28). Plaque and gingival indices were recorded for each patient. First, a patient's teeth were stained with a disclosing agent. Patients in the trial group underwent oral hygiene instruction immediately after the first recording was completed. The plaque and gingival indices were again recorded on two subsequent visits at intervals of 3 weeks, and intensive oral hygiene instruction was again given to patients in the trial group. In the control group, a patient's teeth were stained, and the plaque and gingival indices were recorded, but no oral hygiene instruction was given to those patients. Paired t-test was used to analyze differences in the plaque and gingival indices between the trial and control groups. We found that both the plaque and gingival index scores were significantly lower during the test period for the trial group than for the control group. We concluded that oral hygiene instruction can lead to the efficient control of dental plaque accumulation in patients with fixed orthodontic appliances. (*J Dent Sci*, 2(1) : 45-51, 2007)

Key words: dental plaque, oral hygiene instruction, orthodontic treatment.

Orthodontic therapy has recently become more popular¹. Orthodontic treatments may provide patients with an improved esthetic facial appearance, a well-functioning occlusion, and the desire, interest, and the possibility of maintaining the dentition in a good condition for most of their lives after treatment². Ideally, orthodontic treatment can be a caries-preventive measure in itself³, in that tooth movement may relieve crowding or other conditions that hinder oral hygiene efforts. However, any orthodontic treatment represents a serious invasion of the oral

environment. The numerous orthodontic components encourage the accumulation of dental plaque and the proliferation of cariogenic and periodontopathic microorganisms, increasing the risk of caries and periodontitis^{4,5}. Plaque accumulates on brackets and some of the resins used to bond them, even in subjects practicing good oral hygiene⁶. Rapid demineralization has been documented to have occurred around orthodontic appliances after placement for only 1 month⁷. The formation of demineralization spots increases the risk of caries⁴. In other words, fixed orthodontic appliances expose teeth to a cariogenic environment for a relative long time, increasing the risk of caries⁸. The margins of orthodontic bands usually run along proximal to the subgingival area. Plaque accumulation in the subgingival band margins can be a factor in the development of periodontal

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diseases⁹. This periodontal condition may persist even after the orthodontic treatment has concluded¹⁰.

Orthodontists and dental hygienists are all too familiar with the oral hygiene problems that may be initiated by fixed appliances: massive initial lesions and even more-advanced enamel loss following removal of the wires and brackets¹¹. Therefore, a high standard of oral hygiene is essential for patients undergoing orthodontic treatment¹². Effective oral hygiene programs are needed to help prevent caries and periodontal diseases in orthodontic patients.

In order to reduce these clinical problems, we designed a study which investigates the effects of an oral hygiene instruction intervention program for orthodontic patients. We attempted to determine whether an oral hygiene instruction intervention influenced the oral hygiene condition of patients. The purpose of this study was to improve the oral hygiene condition of patients by instructing them on how to maintain their oral health during orthodontic treatment, so as to prevent problems caused from orthodontic treatment such as demineralization, caries, and periodontal diseases, by repeated motivation and instruction in oral hygiene care and by using economical and convenient cleaning instruments.

MATERIALS AND METHODS

Subjects

The participants in this study were patients who visited the Orthodontic Clinic of Kaohsiung Medical University Hospital, Taiwan. They were treated with fixed orthodontic appliances, and each subject had at least 20 permanent teeth present in the mouth. The study group consisted of 57 orthodontic patients selected consecutively for 6 months. They were randomly separated into a trial ($n = 29$) and a control group ($n = 28$).

Assessments of the oral hygiene status

The oral hygiene condition was evaluated for each patient by plaque and gingival indices. A recording method was adopted instead of an epidemiology survey, and it was modified for a clinical evaluation during routine appointments.

The plaque index system developed by Heintze et al.¹³ was used to record the plaque status of these orthodontic patients. First, all buccal and lingual

surfaces of bonded teeth were stained with a disclosing agent. Three sites were recorded on each tooth: cervical, i.e., gingival to the bracket; central, i.e., mesial and distal to the bracket; and occlusal, i.e., coronal to the bracket. The presence or absence of plaque at each site was recorded. The findings were weighted in accordance with their accessibility to tooth cleaning: occlusal as 1, i.e., easily accessible; cervical as 2, i.e., accessible with some difficulty; and central (under the orthodontic wire) as 3, i.e., poorly accessible. To establish the presence of plaque as a percentage, the number of sites affected by plaque was multiplied by the weighting factor and divided by the number of teeth present. Banded teeth were not counted, nor were third molars in the complete dentition, as the latter were rarely banded. Buccal and lingual surfaces were respectively used to calculate the buccal plaque index and lingual plaque index. The average plaque index was the sum of the buccal plaque index and lingual plaque index.

The gingival index system was modified from the method developed by L oe¹⁴: healthy gingiva was recorded as 0, redness as 1, redness with probing bleeding as 2, and spontaneous bleeding as 3. Each tooth was divided into buccal and lingual surfaces and then these were separated into mesial, middle, and distal parts. In other words, the gingival index for each tooth was record for 6 parts. Adding the gingival indices from all buccal sites and then dividing by the number of teeth produced the average buccal gingival index. The lingual gingival index was calculated in the same manner as the buccal gingival index. The average gingival index was the sum of the buccal gingival and lingual gingival indices.

Oral hygiene instruction

After the teeth were stained with a disclosing solution, we showed patients where the dental plaque was and explained how it formed, its components, and possible tooth damage. The exact content of the explanation was tailored to the age of the patient. We then showed them how to use a toothbrush, and let the patient practice the brushing technique, then directly corrected their efforts.

The oral hygiene instruction included a judgment of the results after using the disclosing solution, using an orthodontic toothbrush, a single-tufted brush, an interdental brush, and dental floss. We paid particular attention to cleaning instruction of areas where

patients had not cleaned well. We offered them cleaning instruments such as an orthodontic toothbrush, a single-tufted brush, an interdental brush, and dental floss, and told them to bring these instruments at each visit to improve their techniques of oral hygiene care.

The trial group received the oral hygiene instruction immediately after the baseline recording, while in the control group, the baseline conditions were recorded with no oral hygiene instruction given during the first appointment. The two subsequent appointments were at intervals of 3 weeks. Repeated motivation and instruction in oral hygiene care were given to patients in the trial group. After the third recording, the control group was also given oral hygiene instruction.

Data analysis

A paired t-test was performed on all tested variables to evaluate intra-group differences from the baseline and inter-group differences at each observation. A p value of < 0.05 was considered statistically significant. All data were analyzed with the SAS statistical package¹⁵. Besides comparing the buccal plaque and buccal gingival indices, we also analyzed and compared the lingual plaque and lingual gingival indices and the overall oral hygiene condition, and we discuss differences by gender and age group.

RESULTS

Among 57 participants, the distributions of number, gender, and age were similar between the trial and control groups ($p>0.05$). There were 17 adults at least 20 years old and 11 adolescents younger than 20 years in the control group. The average ages of the adults and adolescents in the control group were 24.4 ± 2.4 and 13.3 ± 3.1 years, respectively. There were 15 adults and 14 adolescents in the trial group, and the average ages were 25.1 ± 4.2 and 13.7 ± 3.1 years, respectively. In adolescents, the average ages between the control and trial groups did not show a statistical difference ($p>0.05$). In adults, the average ages between the control and trial groups also showed no statistical difference ($p>0.05$).

Baseline recordings of the plaque, buccal plaque, lingual plaque, gingival, buccal gingival, and lingual gingival indices showed no statistical differences

between the 2 groups ($p>0.05$, Table 1). In the paired comparisons, there was a statistically significant difference between the trial and control groups in the second and third recordings versus the baseline recording ($p<0.001$). This shows that the oral hygiene instruction intervention significantly decreased the plaque and gingival index scores in the trial group.

In intra-group paired comparisons between genders, a negative change was revealed in the trial group (Table 2). Patients in the trial group showed no significant changes in oral hygiene condition by gender ($p>0.05$). This reveals that after the oral hygiene instruction intervention, the index in males and females decreased to the same extent, and there was no significant difference between genders.

The average score of each index gradually decreased in the trial group regardless of the age group (Table 3). A comparison of adults and adolescents in the trial group showed no significant difference for each index ($p>0.05$), except that adolescents had significantly smaller gingival and lingual gingival indices than adults ($p<0.05$). However, the paired comparisons between adults and adolescents in the trial group showed no significant differences in the average change of each index ($p>0.05$). This reveals that the influence of the oral hygiene instruction intervention on different age groups did not statistically differ.

DISCUSSION

What was the influence of the oral hygiene instruction intervention on the oral health of patients treated with fixed orthodontic appliances? The results of this study revealed that a comprehensive oral hygiene care program helped patients control plaque, decrease gingival inflammation, and maintain their oral health status. The effect did not differ by gender or age group.

Davies et al.¹⁶ indicated that although orthodontically treated patients have lower plaque and gingival index scores than did an untreated control group after a 3-year follow-up, the difference was ascribed more to greater awareness of oral hygiene (i.e., more related to behavioral factors) than to the orthodontic therapy itself. McGlynn et al.¹⁷ and Boyd¹⁸ respectively used a behavioral self-management program and a self-monitoring plaque control program to improve the oral health of patients.

Table 1. Comparison of changes in indices between the trial and control groups

	Visit 1	Visit 2 vs. 1	Visit 3 vs. 1
Plaque index			
Trial	7.20 ± 1.23	-2.78 ± 1.86	-3.47 ± 1.60
Control	6.34 ± 2.00	0.23 ± 1.17	0.69 ± 1.27
<i>p</i> value of the 2-sample <i>t</i> -test	0.0541	< 0.0001	< 0.0001
Buccal plaque index			
Trial	3.91 ± 0.77	-1.47 ± 1.22	-1.87 ± 0.86
Control	3.49 ± 0.99	0.27 ± 0.59	0.55 ± 0.79
<i>p</i> value of the 2-sample <i>t</i> -test	0.0813	< 0.0001	< 0.0001
Lingual plaque index			
Trial	3.29 ± 0.71	-1.31 ± 0.89	-1.60 ± 0.92
Control	2.85 ± 1.14	-0.04 ± 0.70	0.14 ± 0.59
<i>p</i> value of the 2-sample <i>t</i> -test	0.0795	< 0.0001	< 0.0001
Gingival index			
Trial	6.09 ± 1.30	-3.27 ± 2.20	-3.99 ± 1.60
Control	5.34 ± 1.51	-0.07 ± 0.65	-0.01 ± 0.84
<i>p</i> value of the 2-sample <i>t</i> -test	0.0504	< 0.0001	< 0.0001
Buccal gingival index			
Trial	3.08 ± 0.58	-1.62 ± 1.13	-1.88 ± 0.89
Control	2.71 ± 0.94	0.00 ± 0.40	0.09 ± 0.48
<i>p</i> value of the 2-sample <i>t</i> -test	0.0770	< 0.0001	< 0.0001
Lingual gingival index			
Trial	3.00 ± 0.84	-1.65 ± 1.17	-2.11 ± 0.90
Control	2.63 ± 0.68	-0.07 ± 0.44	-0.02 ± 0.51
<i>p</i> value of the 2-sample <i>t</i> -test	0.0691	< 0.0001	< 0.0001

The results indicated that as long as there were detailed oral hygiene instructions and communication of the required information, significant improvements in the oral health status of patients could be achieved. The intensive hygiene supervision during orthodontic treatment produced a significant improvement in gingival health. With proper maintenance, orthodontic appliances need not lead to detrimental effects on the gingival tissue¹⁹. Schwaninger and Vickers-Schwanger¹¹ demonstrated the importance of good oral hygiene during and after orthodontic treatment. One's attitude toward oral hygiene contributes to the future of one's own dentition. They emphasized that correcting malocclusion is important, but the result is lost in a few years because of periodontal disease or caries if patients have not been given sufficient

instruction in oral hygiene care. However, if patients learn to practice effective plaque control, they can keep their teeth for all or most of their lives.

Orthodontic treatment is acceptable in patients with periodontal diseases. Adults with reduced but healthy periodontal tissues are not at greater risk for periodontal breakdown or tooth loss during orthodontic treatment than adults with normal periodontal tissue or adolescents. Boyd et al.¹⁹ found that even in patients with periodontal diseases before orthodontic treatment, their periodontal health condition would be the same as general patients during and after treatment if they paid attention to oral hygiene care and followed periodontal conditions at regular times during orthodontic treatment.

A preventive program including instructions and

Table 2. Comparison of changes in indices between male and female groups

	V1 trial	V2 - V1 trial	V3 - V1 trial
Plaque index			
Female	7.27 ± 1.21	-3.16 ± 1.94	-3.47 ± 1.68
Male	7.10 ± 1.30	-2.24 ± 1.67	-3.46 ± 1.54
p value of the 2-sample t-test	0.7368	0.1853	0.9909
Buccal plaque index			
Female	3.92 ± 0.80	-1.69 ± 1.29	-1.87 ± 0.94
Male	3.89 ± 0.76	-1.15 ± 1.09	-1.86 ± 0.78
p value of the 2-sample t-test	0.9183	0.2296	0.9922
Lingual plaque index			
Female	3.35 ± 0.68	-1.47 ± 0.96	-1.60 ± 0.92
Male	3.22 ± 0.78	-1.10 ± 0.78	-1.60 ± 0.96
p value of the 2-sample t-test	0.6398	0.2623	0.9917
Gingival index			
Female	6.01 ± 1.23	-3.33 ± 2.21	-4.12 ± 1.36
Male	6.18 ± 1.42	-3.19 ± 2.30	-3.82 ± 1.96
p value of the 2-sample t-test	0.7425	0.8728	0.6521
Buccal gingival index			
Female	3.06 ± 0.47	-1.67 ± 1.09	-1.99 ± 0.78
Male	3.12 ± 0.73	-1.56 ± 1.22	-1.74 ± 1.04
p value of the 2-sample t-test	0.8190	0.8011	0.4866
Lingual gingival index			
Female	2.95 ± 0.85	-1.66 ± 1.24	-2.13 ± 0.82
Male	3.06 ± 0.79	-1.64 ± 1.11	-2.08 ± 1.04
p value of 2 sample t-test	0.7186	0.9702	0.8946

practice in oral hygiene techniques and meticulous prophylaxis stimulates individuals to adopt proper oral hygiene habits, may resolve gingivitis, and prevent the progression of periodontal disease and caries²⁰. Treatment in patients with orthodontic appliances is long-term work, and the appliance needs to be adjusted at regular intervals. It is the responsibility of the orthodontist to involve patients in a systematic program of preventing caries and periodontal disease, by focusing on the removal of plaque and elimination of cariogenic and periodontopathic microorganisms.

In fact, in addition to the effect shown by tooth cleaning instruments, recognition and motivation in patients themselves play an important role in oral hygiene care. So communication of the required information, establishing concepts of oral health

conditions in patients, and maintaining a good relationship between the orthodontist and patient can help and support the performance of a planned oral hygiene program.

Hobson et al.²¹ investigated the oral hygiene advice that orthodontists gave to patients undergoing routine orthodontic treatment. They found that all orthodontists gave advice on tooth brushing, 89.5% gave dietary advice, and 84% suggested that patients to use disclosing tablets. A fluoride rinse was recommended by 73% and a chlorhexidine mouthwash by 41.9% of orthodontists. Many orthodontists advocate appropriate oral hygiene measures, but the efficacy of such methods is determined by the patient's motivation. Therefore, orthodontists require skills in behavioral management.

Table 3. Comparison of changes in index values between the adult and adolescent groups

	Visit 1	Visit 2 vs. 1	Visit 3 vs. 1
Plaque index			
Age < 20 yr	7.55 ± 1.51	-2.85 ± 0.51	-3.66 ± 1.76
Age ≥ 20 yr	6.87 ± 0.81	-2.72 ± 0.49	-3.29 ± 1.46
p value of the 2-sample t-test	0.1512	0.8558	0.5520
Buccal plaque index			
Age < 20 yr	4.17 ± 0.76	-1.40 ± 1.33	-1.93 ± 0.86
Age ≥ 20 yr	3.65 ± 0.72	-1.53 ± 1.15	-1.81 ± 0.89
p value of the 2-sample t-test	0.0720	0.7873	0.7055
Lingual plaque index			
Age < 20 yr	3.38 ± 0.90	-1.45 ± 1.12	-1.73 ± 1.05
Age ≥ 20 yr	3.21 ± 0.49	-1.19 ± 0.62	-1.49 ± 0.80
p value of the 2-sample t-test	0.5485	0.4577	0.4975
Gingival index			
Age < 20 yr	5.53 ± 0.93	-3.04 ± 2.13	-3.63 ± 1.40
Age ≥ 20 yr	6.59 ± 1.39	-3.48 ± 2.32	-4.33 ± 1.76
p value of the 2-sample t-test	0.0220	0.697	0.2503
Buccal gingival index			
Age < 20 yr	2.92 ± 0.61	-1.59 ± 1.13	-1.68 ± 0.83
Age ≥ 20 yr	3.24 ± 0.52	-1.65 ± 1.17	-2.07 ± 0.92
p value of the 2-sample t-test	0.1430	0.9017	0.2358
Lingual gingival index			
Age < 20 yr	2.61 ± 0.49	-1.45 ± 1.03	-1.95 ± 0.73
Age ≥ 20 yr	3.36 ± 0.91	-1.83 ± 1.28	-2.25 ± 1.04
p value of the 2-sample t-test	0.0112	0.4007	0.3794

We concluded that the oral health conditions of patients with fixed orthodontic appliances can be improved by proper communication of the required information and repeated motivation and oral hygiene instruction. A high standard of oral hygiene is essential for patients undergoing orthodontic treatment. This study also found that general oral hygiene care and convenient cleaning instruments can produce a good effect, so clinical practitioners should not ignore the importance of oral hygiene instruction.

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