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Controlling cariogenic bacteria by the regular check-up system

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Abstract Regular check-ups are important for reducing the risk factors of dental caries. Through regular check-ups, clinicians empirically know that the incidence of the new dental caries was suppressed. However, the effects of the regular check-up system have not been thoroughly evaluated. Our primary concern was to evaluate the efficacy of the regular check-up system with professional preventive care for preventing dental caries. In this study, we evaluated attitudes toward regular check-ups. Five hundred and thirteen patients who visited one dental office in Japan from 1981 to 2000 and who were under 12 on the first visit were examined for dental caries, salivary mutans streptococci, and Lactobacilli to obtain baseline values and the values for the more recent visit analyzed in this study. Salivary mutans streptococci and Lactobacilli were counted using Dentocult SM and Dentocult LB. Most of the risk factors, particularly the salivary levels of the mutans streptococci, were reduced by regular check-ups in this study. There was a greater risk reduction in particular for the salivary levels of mutans streptococci in patients undertaking regular check-ups. Reduced salivary levels of Lactobacilli were also observed. However, the changes between the groups in the attitude toward regular check-ups were not statistically significant. This result indicates that most of the risk factors investigated in this study could be reduced by regular check-ups, particularly the levels of mutans streptococci, which has been suggested to be a strong etiology of dental caries.

Key words
Lactobacilli,
Mutans streptococci,
Regular check-up system,
Risk factors

Introduction

It has been suggested that regular check-ups for dental caries effectively reduce the incidence of dental caries[1,2)]. The current national guidelines for preventing dental caries emphasize the importance of regular check-ups[3,4)]. However, compliance and attitude toward preventing dental caries are not evaluated at these check-ups.

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The risk factors of dental caries have been classified into three main categories—teeth, substrate, and oral micro flora[5)]. Characteristics of micro flora, such as the oral levels of mutans streptococci (*Streptococcus mutans* and *Streptococcus sobrinus*) and Lactobacilli, were suggested to be the most important risk factors[6,7)]. These bacteria have been evaluated for the effects of the caries preventive programs. It has been suggested that salivary levels of the mutans streptococci can be reduced by using anti-microbial drugs[8)]. However, in the conventional regular check-ups and treatment for preventing

dental caries, professional tooth cleaning and application of fluoride have sometimes been used and sometimes not used[9–11]. These strategies suppressed the incidence of dental caries. However, whether or not major risk factors such as salivary levels of these bacteria could be reduced was uncertain.

This study investigates the efficacy for the prevention of dental caries by regular check-ups with the professional preventive care and effect of the compliance with regular check-ups. It also investigates whether or not the salivary levels of the mutans streptococci and Lactobacilli could be reduced by the regular check-ups without using anti-microbial drugs.

Materials and methods

Subjects and evaluation method

The caries risks were evaluated for all the patients at one of the private dental office in Japan that participated, using the methods described by Petersson *et al.*[12] Two thousand one hundred and thirty-two patients under the age of 20 visit the private dental clinic for professional preventive programs since 1980 when this dental office opened. At 1981, this private dental office began to construct the database for the management of the patient's data, especially for the oral conditions and risks for the dental caries and periodontal disease.

Of these patients, 448 patients who visited the dental office from 1981 to 2000 and who were under 12 years of age at the first visit were examined for dental caries and salivary mutans streptococci and Lactobacilli to obtain baseline values and the values for the most recent visit analyzed in this study. Before the examination, informed consent was obtained to use the data of the oral conditions and the results of the saliva test for the construction of the data base and the possibility to use the data for publication. The examination of the dental caries was carried out by the dental hygienist, then checked again by the dentist and both dental hygienist and dentist had the clinical experience more than 10 years.

The Salivary mutans streptococci and Lactobacilli were counted using commercially available mutans streptococci and Lactobacilli evaluation kits, Dentocult SM and Dentocult LB (Orion Diagnostica Co. Ltd., Epsom, Finland). The results of this test were categorized according to the manufacturer's instructions.

Regular check-ups and preventive treatment

During a regular check-ups, dental plaque, one of the risk factors for dental caries[9,10], is controlled by the dentist or dental hygienist by professional tooth cleaning. Fluoride is then applied by the dentist or dental hygienist[6]. The risks of micro flora are reduced through this intervention to control dental plaque.

In a professional care program, the dentist or dental hygienist cleans the tooth surfaces by hand brushing and dental floss. 2% APF-containing paste (Fluorident gel, Stone Pharmaceuticals, Philadelphia, USA) is applied to the tooth surface by the toothbrush then indicated for the patients to bite a cotton roll for 5 min. Then, patients rinsed out one or twice and prohibited not to rinse for 30 min.

Fissure sealant or scaling to remove the dental calculus is performed if necessary. In addition, instructions regarding diet and using the fluoride containing toothpaste (950 ppm) are provided.

Statistical analysis

Prior to the analysis, the patients were classified into groups of regular attendees, irregular attendees, and those who never attended regularly, according to their compliance with the regular check-ups. The criteria were designated as follows. Regular attendees were present for regular check-ups every three months after the caries treatment was finished, irregular attendees included patients who understood the importance of regular check-ups but who occasionally missed their regular check-ups. The remainders were patients who visited the dental office only when they were experiencing dental problems. These patients were advised to attend the dental office regularly; however they were never attended without experiencing dental problems. The data of these patients used in this study as check-ups were the data at the attended dental office when experiencing dental problems. The number of patients who developed new dental caries during the check-up periods and the mean number of incidences of new dental caries were calculated for each group. The baseline characteristics of these groups were checked by the one-way ANOVA. Logistic regression analysis was then used to evaluate the attitude for the regular check-ups, to calculate the crude odds ratios and the adjusted odds ratios associated 95% confidence intervals. The results were adjusted by factors that had co-relation

Table 1 Incidence of the new dental caries in this study

		Percentage of subjects with new dental caries	*P*-value	Number of new dental caries (mean ± SD)	*P*-value
	n	% (n)		Number of teeth	
Total	448	30.4% (136)	0.006	0.76 ± 1.54	<0.001
Regular check-ups	273	25.6% (70)		0.47 ± 0.98	
Irregular check-ups	72	30.6% (22)		0.86 ± 1.51	
No check-ups	103	42.7% (44)		1.45 ± 2.34	

Percentage of subjects with new dental caries and the mean number of new dental caries classified by their compliance with regular check-ups. *P*-values were calculated by the Chi-square test for the percentage of subjects with new dental caries and two-way ANOVA for the mean number of the new dental caries.

Table 2 Baseline characteristics of the subjects participating in this study

(A)

	Regular check-ups	Irregular check-ups	No check-ups	Total	*P*-value
n	271	69	97	437	
Mean age at first visit	8.82 ± 2.84	10.47 ± 3.75	11.36 ± 3.78	9.67 ± 3.39	<0.001
Mean treatment periods	1.19 ± 1.45	1.24 ± 1.23	1.25 ± 1.42	1.21 ± 1.42	0.931
Mean follow up periods	3.61 ± 1.98	3.03 ± 1.84	2.43 ± 1.96	3.27 ± 2.01	<0.001
dft at baseline	0.74 ± 1.74	2.08 ± 3.21	3.27 ± 4.22	1.55 ± 2.95	<0.001

(B)

	Crude odds ratio	95% CI	*P*-value	Adjusted odds ratio	95% CI	*P*-value
Age at first visit	1.056	0.993–1.123	0.084			
Follow-up periods	1.061	0.973–1.157	0.179			
dft at baseline	1.090	1.029–1.115	0.004			
Irregular check-ups	1.091	0.624–1.909	0.760	1.147	0.586–2.246	0.689
No check-ups	2.250	1.382–3.662	0.001	2.358	1.241–4.482	0.009

(A) shows the baseline characteristics for each group for the attitude of regular check-ups. *P*-values were calculated by one-way ANOVA. Statistically significant differences were observed in each group except for the treatment periods.
(B) shows the results of the crude and adjusted odds ratios from logistic regression analysis.

with the baseline characteristics in each group.

The relative risk reduction (RRR) and absolute risk reduction (ARR) were calculated. The numbers needed to treat (NNT) for the regular check-ups was then calculated using the inverse of the absolute risk reduction.

To determine the attitude for the regular check-ups and to evaluate whether salivary cariogenic bacteria were reduced or not, the methods of Friedman were used to check the difference of the salivary levels of the mutans streptococci and Lactobacilli in each group. *P*-values less than 0.05 were considered statistically significant.

Results

Sixty-five (12.9%) of the 513 patients dropped out. The main reasons were as follows: relocation 29 subjects (44.6%), and cancelled the check-ups and never come to the dental office 25 subjects (38.5%). The demographics of the patients who participated in this study were as follows. There were 297 males (45.5%) and 356 females (54.5%), the mean age at the first visit was 5.77 ± 3.10, the distribution was less than 5 years old: 224 (50%), 5–10 years old: 182 (40.6%), 11 or 12 years old 42 (9.4%) and the mean follow-up period was 4.22 ± 2.25 years.

Table 1 shows the percentage of subjects with

Table 3 NNT for the regular check-ups

	RRR	ARR	NNT
Regular check-ups vs. No check-ups	40.0	17.1	5.9
Regular check-ups vs. Irregular check-ups	16.1	12.2	8.2

Relative risk reduction, absolute risk reduction and numbers needed to treat (NNT) for the attitude of the regular check-ups. NNT was calculated by the inverse of the absolute risk reduction.

Table 4 Changes in the salivary levels of the mutans streptococci evaluated by Dentocult SM

(A)

	First visit		Treatment finished		Check-ups		
Level	n	%	n	%	n	%	*P*-value
0	30	11.0	39	14.3	74	27.1	<0.001
1	41	15.0	45	16.5	51	18.7	
2	78	28.6	81	29.7	77	28.2	
3	124	45.4	108	39.6	71	26.0	

(B)

	First visit		Treatment finished		Check-ups		
Level	n	%	n	%	n	%	*P*-value
0	6	8.2	5	6.5	6	7.8	0.399
1	12	16.5	14	19.4	17	23.4	
2	26	36.4	30	41.9	29	40.6	
3	28	38.9	23	32.3	20	28.1	

(C)

	First visit		Treatment finished		Check-ups		
Level	n	%	n	%	n	%	*P*-value
0	8	7.8	16	15.3	17	16.0	0.038
1	16	15.6	12	11.5	17	16.0	
2	37	35.6	42	40.3	40	38.7	
3	42	41.1	34	32.7	30	29.1	

Table 4 shows the results of number and percent of subjects for the changes in salivary levels of the mutans streptococci on each visit. (A) indicates the regular attendees, (B) irregular attendees, and (C) no check-ups. Data were analyzed by Friedman Test. A statistically significant reduction of the salivary levels of mutans streptococci was observed in regular check-up patients.

new dental caries and the mean number of new dental caries, classified by their attitude toward regular check-ups. The result clearly illustrates that regular check-ups reduce the incidence of new dental caries. This result was found statistically significant by one-way ANOVA.

Baseline characteristics of the patients in each group are shown in Table 2-A. Statistically significant differences were found in mean age of the first visit, mean follow-up periods and baseline dft between each group. Patients were divided into two groups depending on whether they had new dental caries or not, and only the baseline DMFT was correlated with the incidence of dental caries (data not shown).

We performed logistic regression analysis to investigate the odds ratios of the attitude towards

Table 5 Changes in the salivary levels of the Lactobacilli evaluated by Dentocult LB

(A)

	First visit		Treatment finished		Check-ups		
Level	n	%	n	%	n	%	*P*-value
0	119	43.6	126	46.2	189	69.2	<0.001
1	55	20.1	47	17.2	36	13.2	
2	56	20.5	58	21.2	30	11.0	
3	43	15.8	42	15.4	18	6.6	

(B)

	First visit		Treatment finished		Check-ups		
Level	n	%	n	%	n	%	*P*-value
0	25	34.2	30	41.9	33	46.0	0.009
1	18	24.4	17	24.1	18	25.4	
2	18	24.4	17	24.1	16	22.2	
3	12	17.1	7	9.7	5	6.4	

(C)

	First visit		Treatment finished		Check-ups		
Level	n	%	n	%	n	%	*P*-value
0	48	46.5	48	46.8	55	53.8	0.006
1	13	12.7	9	8.5	20	19.4	
2	25	23.9	26	25.6	23	22.3	
3	17	17.0	20	19.2	5	4.5	

Table 5 shows the number and percent of subjects with changes in salivary levels of the Lactobacilli at each visit. (A) indicates regular attendees, (B) irregular attendees, and (C) no check-ups. Data were analyzed by Friedman Test.

regular check-ups for the incidence of new dental caries. The crude odds ratio was 0.524 for regular check-ups, 1.091 for irregular check-ups and 2.250 for no check-ups for the incidence of new dental caries. The odds ratios were then adjusted by the age of first visit and the baseline dft. The odds ratio for regular check-ups subsequently became 0.553 and that for no check-ups became 2.358. These odds ratios also were statistically significant (Table 2-B).

By using these data and the attitude toward regular check-ups, we calculated the relative risk reduction (RRR), absolute risk reduction (ARR), and number needs to treat (NNT). As shown in Table 3, the NNT for the regular attendees and no check-ups was 5.9, and that for regular attendees and irregular attendees were 8.2.

We next conducted a Friedman test to check the association of the attitude toward regular check-ups and salivary levels of cariogenic bacteria, such as mutans streptococci and Lactobacilli. As shown in Table 4, the salivary levels of mutans streptococci in regular attendees were reduced, and the difference was statistically significant. Levels were especially reduced in the check-up periods. Statistically significant reduction was found in the salivary levels of mutans streptococci in the group of no check-ups. Specifically, it was reduced between the first visit and the treatment completion. However, a slight difference was found in the check-up periods. Salivary levels of Lactobacilli tended to be reduced in all groups (Table 5).

Discussion

Recently, the prevalence and incidence of the dental caries has declined remarkably in Western countries; the same tendency has been observed in Japan. However, some populations are still affected

by dental caries. For population strategies, water fluoridation effectively suppresses dental caries. However, even in such an environment, dental caries could not be completely suppressed. In this respect, regular check-ups and professional preventive dental care based on risk assessment are still necessary. Some reports have evaluated the effects of regular check-ups[13–15]. However, the compliance or attitude was not totally evaluated in these studies, and these studies used only the increment of DMFT of tooth mobility for the outcomes of the regular check-ups. Our results also demonstrated that the increment of new dental caries has a statistically significant relation with the attitude for regular check-ups. In this study, we calculated the NNT for the attitude of the regular check-ups. Rijkom *et al.*[16] previously found that fluoride gel treatment suppressed new dental caries in 6- to 15-year-old children. The NNTs of the fluoride gel treatment were 18 in a population with a caries incidence of 0.25 DMFS per year and 3 in a population with a caries incidence = 1.5 DMFS per year (treatment duration 1 year). In our preventive programs, fluoride gel was applied regularly. Our results of the NNT were included in the 95% confidence intervals of the results of Rijkom *et al.* Furthermore, if we classified patients with the criteria described above, the NNT for the incidence of new DMFS were 0.25. However, in our preventive programs, NNT was 5.9 or 8.2. This may be because our preventive programs included not only fluoride application but professional tooth cleaning or instruction on dietary habits. This total program may thus be reflected in the results.

Treasure[17] reviewed the effects of the preventive programs evaluated by NNT using fluoride or anti-microbial drugs. Two studies on fluoride gel application were available. One study shows the NNT was 18, and the other that it was 2. For fluoride varnish, NNTs were 11 to 8. Our NNT results were more effective than those of other studies. This may be because the population in our study visited the private dental office for regular check-ups and preventive programs. In Japan, regular check-ups are not covered by insurance. The awareness of health promotion may thus affect the results. In our results, the salivary levels of the mutans streptococci and Lactobacilli had statistically significant differences when observed by groups for the attitude towards check-ups. For the baseline values, the difference may result from the number of decayed caries. It is well known that many mutans streptococci and Lactobacilli exist in the decayed caries lesions[18,19]. There were no statistically significant differences for mutans streptococci in the groups when the treatment was finished, and reductions of mutans streptococci were observed in each group. This may also result from effective treatment for dental caries that is the reservoir of the mutans streptococci and Lactobacilli. However, the attitude toward check-ups affected the salivary levels of these bacteria. Neither mutans streptococci nor Lactobacilli could be eradicated by the preventive programs we used since we normally don't use anti-microbial drugs. The attitude toward regular check-ups reflected health promotion and may have affected the results.

In conclusion, our results suggest that most of the risk factors investigated in this study could be reduced by regular check-ups, particularly the levels of mutans streptococci and Lactobacilli that have been suggested to be a strong etiology of dental caries.

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