Preventive effects by intensive restorative treatment against caries in children

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The caries preventive effect of intensive treatment of existing caries was studied in children less than 7 years old living in a district without a dentist. The methods consisted of intensive restorative treatment provided by a pediatric dentist in three stages as follows: Stage I (n=70), two years before initiation of intensive treatment; Stage II (n=80), at initiation of long-term intensive treatment, and Stage III (n=92) three years after initiation of intensive dental treatments. The results were that experience and severity of dental caries and secondary caries rates were significantly lower in stage III than in stage I or II in six year olds. Between-meal consumption of snacks containing sugar and plaque prevalence both were less in stage III than in others. In conclusion, intensive treatment of caries in young children was associated with prevention both primary and secondary caries.
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INTRODUCTION

In Japan, where drinking water is not fluoridated, heightened social awareness of dental health and individual daily dental health practices may be the key to caries prevention.[1-9] As part of the community-based public health services, dental examinations are provided to infants, 18-month-olds, 3-year olds and school aged children. During these examinations the importance of self-care and other dental health concerns is stressed. In addition to those provided as part of public health services, periodic dental examinations[10-13] are being initiated in the offices of dental practitioners during infancy and childhood. Since educational efforts alone have limited effectiveness, enhancement of practical dental services has been advocated. An example of the effectiveness of intensive caries treatment for children in a limited district has been reported.[14] Several reports have suggested that intensive caries treatment not only improves the treated tooth rate, but also decreases the incidence of subsequent caries.[14,15] In the present study we attempted to determine whether intensive caries treatment was effective in preschool children, not only for secondary prevention as reported by Leavell and Ciark,[16] but also for primary prevention.

METHODS AND SUBJECTS

Subjects included children under 7 years old living in Shirakawa village, Oono-Gun, in the Gifu prefecture of Japan. The village population was approximately 1900 from 1996 through 1998, the time of this study Shirakawa village is a district without a dentist. By definition of the Japanese Ministry of Health and Welfare, a population of more than 300 people without a full-time dental clinic within a four km radius of the center of the district, or ready access to other full-time clinics, are considered to be without a dentist. A dentist traveled from a neighboring town to perform necessary treatment once per week; however, residents rarely consulted this dentist. Less than 20% of the population underwent dental treatment.[17,18] Most patients that consulted the dentist were advanced in age, and infant patients were few.

During the past 18 years, regular dental examinations and individual dental education has been provided to preschool children (4-months to 6 years-old) four times per year by us as volunteer activities, but has had no obvious effect on the prevention of deciduous

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Table 1. Subject age categories in each stage

Age (yrs)	Stage I			Stage II			Stage III		
	male	female	Total	male	female	Total	male	female	Total
< lyr.	0	0	0	2	0	2	4	4	8
1 to < 2yr.	0	0	0	0	0	0	8	7	15
2 to <3vr.	0	10	10	11	9	20	12	6	18
3 to <4vr.	1	6	7	8	10	18	7	7	14
4 to < 5yr.	2	1	3	8	4	12	10	5	15
5 to < 6yr.	5	12	17	9	9	18	9	10	19
>6 yr. old	10	14	24	5	5	10	1	2	3
Total	27	43	70	43	37	80	31	41	92

caries. Our report suggested that the cause of the failure of our prevention was due to the custom to intake some foods and beverages with sugar under 3 years of age.

This strong custom was difficult to change.[18]

Therefore, we hypothesized that we could improve oral health in children under 7 years old through intensive dental restorative treatment. Some pediatric dental specialists performed the intensive treatment during four-weeks, twice a year for 3 years (6 treatments in total).

The three stages were selected for the convenience of the evaluation process and occurred as follows:

Stage I: at two years before the initiation of intensive treatment;

Stage II: just prior to the initiation of intensive treatment; and

Stage III: at three years after initiation of intensive dental treatments.

The numbers of subject in each stage were as follows:

Stage I included 27 boys and 43 girls, 70 children in total;

Stage II included 43 boys and 37 girls, 80 in total; and

Stage III included 51 boys and 41 girls 92 in total Table I.

Since all of the subjects resided in the same district there was partial overlap in the composition of subjects in the three stages.

The same dentist performed all three evaluations for dental caries with adequate light, a standard oral mirror and a blunt probe (diameter, 0.5 mm) while the subjects were seated in a chair. Assistants were present to record findings, position the subjects, as well as to manage the behavior. The teeth of the subjects were not brushed or professionally cleaned prior to the examination. No radiographic examinations were performed. Diagnosis of caries was based on the detection of carious lesions at the cavitation stage. Demineralization was recorded as CO (Figure 1).

To establish the caries experience of each subject from the oral examination, we used the frequency of patients without caries (caries-free), def index, def tooth rate, def distribution, and the modified caries seventy index (Figure 1).[19] The def is based on the number of deciduous teeth in the mouth that are decayed, extracted due to caries, or filled. We decided extracted tooth by oral examination three times in a year. The quality of restorative treatment was evaluated by the use of the secondary caries rate. Secondary caries, which reflect caries around luted restorations, manifest one of the major reasons for failure of restoration.

We determined the dental caries experience of primary tooth at each stage. To avoid overlap among subjects, who might have been present in more than one stage, statistical analysis was limited to comparisons status of dental caries between stage I and III for subjects in the third year of life and for subjects in the sixth year of life.

The Oral Hygiene Index (OHI) by Greene and Vermillion[20] was used to assess the status of plaque on upper and lower incisors. We distributed questionnaires for completion by parents of subjects just before initiation of treatment and 6 weeks after initiation. Questions addressed frequency of between-meal snacks containing sugar and frequency of tooth brushing.

For subjects aged 18 months, and those at 3 years, parental questionnaires also included life habits (identity of primary caregiver, frequency of beverage consumption, snack habits, consumption of foods containing sugar and toothbrushing habits) that are considered particularly important to contributine to oral health. The x^2 test and Student's t-test were used for the statistical evaluation of differences among stages with significance accepted at the 5% level ($p<0.05$).

Table 2. Experience and severity of dental caries by stage

Indices	Stage I		Stage II		Stage III	
	No.	mean ±SD	No.	mean±SD	No.	mean±SD
Def tooth rate	70	21.51±23.25	80	18.64±28.66	91	1.52±4.39
d distribution		62.46%		61.05%		9.40%
e distribution		0.37%		0.19%		1.81%
f distribution		37.17%		38.76%		88.78%
def index	70	4.04±4.07	80	3.28±4.79	92	0.28±0.80
Secondary caries rate	38	24.35±29.74	34	29.08±34.66	40	2.38±7.96
Caries severity index	70	10.36±10.51	80	3.27±14.72	91	0.81±2.22

d. decayed, e. extracted, f, filled.

Table 3 Caries-free subjects and subjects completing treatment

Subjects	Stage I		Stage II		Stage III	
	No.	%	No.	%	No.	%
caries-free	11/70	15.7	17/80	18.6	43/92	46.7
completing treated subjects	31/70	44.3	51/80	61.1	88/92	95.7

RESULTS

Details of the six treatments of caries over 3 years are as follows. The treated subjects had a mean age of 52.8 months and 51.50% were over 4 years old. The mean number of treatments per subject was 2.5. The mean number of teeth treated per participant in treatment program was 5.6. Composite resin fillings were used for 291 teeth (50.8% of those treated): preventive sealants for 181 teeth (31.6%), vital pulp amputation and preformed stainless steel crown placement for 36 teeth (6.3%) and extraction of 43 teeth (7.5%).

Experience and severity of dental caries in each stage are shown in Table 2. The Stage III subjects had lower def tooth indices, def tooth rates, modified caries severity indices, and secondary caries rates when compared to other stages. As for the distribution of def findings, the frequency of d (decayed) was decreased and the frequency of f (filled teeth) was increased, in stage III. The frequency of caries-free subjects in stage III was higher than in other stages (Table 3).

The experience and severity of dental caries among subjects in the third year of life is shown for each stage in Table 4. Although no significant difference was attained.

The def index, def tooth rate, and modified caries severity index were lower in stage III than in stage II or I. The experience and severity of dental caries among subjects in the sixth year of life by stage, is shown in Table 5. The def index, def tooth rate modified caries severity index, and secondary caries rate, stage III were significantly lower ($p<0.0l$ to <0.05) than the stage I. If one examined def distribution the frequency of d was significantly less ($p<0.01$), while the frequency of f was significantly greater ($p<0.01$), in stage III when compared to stage I.

The fraction of subjects with a plaque level 0 was 58.7% in stage I. In stage II, it was 54.3% and 82.8% in stage III. Stage III included a larger fraction with plaque level 0 than the other two stages.

In the analysis of consumption of foods with sugar between meals, we found that this represented 50.0% in stage II and a slightly lower frequency of 37.5% in stage III. Frequency of tooth brushing only once a day was 88.9% in stage II and 50.0% in stage III.

Table 4. Caries experience and severity in the third year of life by stage

Indices	Stage I No.	Stage I mean±SD	Stage II No.	Stage II mean±SD	Stage III No.	Stage III mean±SD	Statistical Significance Between stages I & IIII
def tooth rate	19	5.82±10.33	20	2.69±8.61	17	1.00±2.67	NS
d distribution		85.71%		75.00%		40.00%	NS
e distribution		0.00%		0.00%		0.00%	NS
f distribution		14.29%		25.00%		60.00%	NS
def index	19	1.05±2.01	20	0.45±1.39	18	0.17±0.51	NS
Seconday caries rate	1	0.00	1	0.00	3	0.00	NS
Caries severity Index	19	2.7±5.17	20	1.35±4.31	17	0.50±1.48	NS

d. decayed, e. extracted, f, filled.

Table 5. Caries experience and severity in the sixth years of life by stage

Indices	Stage I No.	Stage I mean±SD	Stage II No.	Stage II mean±SD	Stage III No.	Stage III mean±SD	Statistical Significance Between stages I & IIII
def tooth rate	17	27.63±23.01	18	28.31±24.09	19	3.80±7.19	III<I; p<0.01
d distribution		53.07%		53.82%		7.64%	III<I; p<0.01 NS
e distribution		0.00%		0.00%		0.00%	NS
f distribution		46.93%		46.17%		90.32%	III<I; p<0.01
def index	17	5.18±3.97	18	5.06±4.30	19	0.68±1.25	III<I; p<0.01
Seconday caries rate	15	21.85±29.39	14	26.38±30.9	17	4.28±11.55	III<I; p<0.05
Caries severity Index	17	13.48±10.82	18	15.93±14.47	19	1.95±3.29	III<I; p<0.01

d. decayed, e. extracted, f, filled.

DISCUSSION

Promotion of dental health in preschool children and school pupils in Japan has largely depended on informing parents of the results of dental screening, and upon dental health education intended to increase awareness in children and the parents. These preventive methods appeal to reason and ultimately depend on parental value and lifestyle. Changing attitudes and behavior requires time and persistence and must take place within a limited portion of a child's life.[12,3] Children in the district studied and others are likely to be exposed to risk factors for a high incidence of caries before public attitudes regarding dental health are improved. In the district studies, children tended to have many untreated teeth and a high incidence of secondary caries because of time and economic constraints, as well as limited accessibility to a dental clinic within the range of access.[14] Prior to the availability of intensive dental treatment, infants and children underwent dental examinations three times a year and received individual guidance on dental health behavior, as well as fluoride applications Most of the working-age population in this area makes their living from agriculture or tourism. As a result the number of dual-income families is large. Grandparents, who care for grandchildren, are often indulgent, and display a negative attitude regarding dental health.[21]

The age at which dental health care is initiated is important. Milgrom has stated that the primary prevention of early childhood caries (ECC) will fail unless efforts begin in the prenatal period and addresses the dental health of both mother and child.[22]

Morinushi *et al.*,[23] have reported that continuous oral health guidance beginning at less than 3 years of age is

more effective than guidance started after three years of age. In this district, however, marked behavioral changes in home dental care by early dental health education with fluoride applications and the maintenance of low caries incidence had not been successful. We therefore performed restorative treatment of caries twice a year during 2-week periods, aiming to motivate children and parents and to win their trust.

We achieved a marked decrease in experience and severity of dental caries, as well as the number of untreated teeth by providing restorative treatment involving an average of 5.6 deciduous teeth per participant. However, significant differences were not consistently demonstrated in children less than 3 years of age, because children of this age generally have a low incidence of caries and few teeth requiring restorative treatment. In the sixth year of life, significant differences between stage I and III were demonstrated.

Few reports have considered the relationship between restorative treatments of caries as a mode of primary prevention of new caries Morinushi *et al*.[14,18,24] reported that the decay pattern for nursing bottle caries was changed in response to the community dental health program, which included treatment of caries. These authors reported that there was relationship with improved control of intake of beverages containing sugar. They also suggested that continuous oral health guidance was more effective for caries control in children less than 3 years of age than for older children.[23] The change in response to our community dental health program, which included treatment of caries, support these observation.

The mechanism linking restorative treatment to decreased incidence of caries is associated with a decrease in the number of caries-associated bacteria in saliva *(Streptococcus mutans* and Lactobacillus*)* observed immediately following conventional dental restorative treatment.[25] Petti *et al*.[15] also reported that the incidence of new caries decreased following restorative treatment because of a decrease in the numbers of S*treptococcus mutans.* The present study was not designed to address this issue. However, in another study we sampled saliva (Dentocult SM strept.mutans% and Denteult LB®; Orion Diagnostica, Finland) and confirmed that complete restorative treatment markedly reduced numbers of S. *mutan.s* and Lactobacillus for at least 3 months.[26] Therefore, we believe that one of the factors associated with the preventive effect in this study was a decrease in number of caries-related bacteria by restorative treatment.

Another factor in decreasing incidence of caries may have been increased awareness of dental health concerns on the part of the parents of treated children. Deposition of dental plaque, intake of sugar-containing between-meal snacks and frequency of tooth brushing all improved after the intensive treatment for three years. Intensive caries treatment for promotion of preschool dental health could lead to effective primary prevention of caries in preschool children, as well as for secondary prevention, as reported by Leavell and Clark.[16]

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