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Relationship between gingival health and dental caries in children aged 7-12 years

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Abstract: The purpose of this study was to investigate the relationship between gingival health and dental caries in elementary school children in Japan. The subjects were 474 children aged 7 to 12 years who attended dental check-ups at an elementary school. The Oral Rating Index for Children, which consists of five categories (+2, +1, 0, -1, -2), was used to rate the findings of the gingival health examination. The dental examination was performed using the WHO caries diagnostic criteria for DMFT. Children were divided into three groups: a healthier group (H-group) made up of those scoring +2 (excellent) or +1 (good), an equivocal group (E-group) made up of those scoring 0, and a gingival less-healthy group (L-group) made up of those scoring -2 (very poor) or -1 (poor). Overall percentages for the H-group, E-group and L-group were 48.3 %, 21.5 % and 30.2 %, respectively. The number in the L-group increased with increasing age. The mean scores of the DT and DMFT in the H-group were significantly lower than those in the L-group ($p < 0.01$ and $p < 0.05$, respectively). The results suggest that oral hygiene instruction should be given to children in order to motivate self-care, not only to avoid dental caries but also to prevent gingivitis. (J. Oral Sci. 42, 151-155, 2000)

Key words: gingivitis; DMFT; oral self-care; elementary school children.

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Introduction

The most common oral diseases, dental caries and periodontal disease, could well be seen as behavioral diseases, because the adoption of healthy behavior is crucial for their control (1). Oral hygiene practices are those employed personally or professionally to prevent the establishment of pathogenic flora and their products that cause diseases in the oral cavity. The ultimate objective is to prevent disease initiation, progression, or recurrence (2). For oral health promotion, one of the most effective practices is self-care performed by individuals themselves. Children who consciously try to maintain good oral health do in fact practice good health behavior, and thus a gingival condition reflecting a consistent commitment and ability to perform appropriate oral health activities (tooth brushing and flossing) would be correlated with the incidence of other dental conditions, such as the prevalence of dental caries.

Elementary school provides an effective forum for the delivery of health promotion programs. Schools have access to a large number of children and their teachers. Health promotion activities, including health education, can be integrated into the regular curriculum. School boards, administrators and teachers play important roles as decision makers, since they control the content of the curriculum, participation in health promotion activities and compliance with health regimens. Finances, manpower, public acceptance, attitudes of policy-makers and facilities are reported as the five most frequently mentioned barriers to program development (3).

Okada et al. (4) developed an Oral Rating Index for Children (ORI-C) as a system for screening children's gingival health and oral hygiene status. The system has the following characteristics: 1) requires a very short time

to make a judgment (approximately 10 seconds), 2) is easy to understand by children and school teachers, 3) is readily available for screening gingival health status, and 4) uses standardized color photos. This scoring system is recommended for use in large-scale population surveys and as an educational and motivational method to improve children's gingival health status.

The purpose of this study was to investigate the relationship between gingival health status and dental caries in elementary school children.

Materials and Methods

Four hundred and seventy-four children (255 boys and 219 girls) in attendance at an elementary school in Hiroshima, Japan, were enrolled in this study. Consent to a dental check-up was obtained from both the participants and their parents. All elementary school children aged 7 to 12 years were examined with the exception of those children who were absent from school. The oral examination took place on location at the school in November 1996. The ORI-C as previously described (4) was employed for the assessment of the gingival condition of the children. The ORI-C uses a set of standard photographs to illustrate each level of the scale in order to maintain consistent standards. The ORI-C scores were recorded by a pediatric dentist (MO) with 12 years experience. The examination was performed using natural light, with children seated in a chair. Each child's gingival health care level was judged and recorded according to an ordinal scale from -2 (very poor) to +2 (excellent). Next, each child was dentally examined by three well trained pediatric dentists (SK, YK, HI) using the WHO caries diagnostic criteria for DMFT (5). Between these three pediatric dentists, the percentage of agreement was more than 90 % for the inter-examiner reproducibility of the DMFT index. The dental examinations took place with the subjects in a supine position using an artificial light, a dental explorer and a dental mirror. To investigate the relationship between gingival condition and caries experience/prevalence, children were classified into three groups: a gingival healthier group (H-group) made up of those scoring +2 (excellent) or +1 (good), an equivocal group (E-group) made up of those scoring 0 and a less healthy group (L-group) made up of those scoring -2 (very poor) or -1 (poor). Mann-Whitney U-test was used for analysis of the DT, FT and DMFT scores for the three groups. Standard computer programs (StatView 4.02, Abacus Concepts, Inc., Berkeley, CA, U.S.A.) were used for the statistical analyses.

Results

Table 1 shows the number and the percentage distribution of children in each of the three groups according to the ORI-C scores by age. For the whole sample, the percentages of the H-group, E-group and L-group were 48.3 %, 21.5 % and 30.2 %, respectively. The percentages of children in the H-group aged 7, 8, 9, 10, 11 and 12 years were 61.4 %, 50.0 %, 44.2 %, 52.2 %, 44.7 % and 42.1 %, respectively. The percentages of the children in the E-group aged 7, 8, 9, 10, 11 and 12 years were 27.1 %, 23.3 %, 23.4 %, 17.4 %, 12.6 % and 27.4 %, respectively. The percentages of the children in the L-group aged 7, 8, 9, 10, 11 and 12 years were 11.4 %, 26.7 %, 32.5 %, 30.4 %, 42.7 % and 30.5 %, respectively.

Table 1 Number and percentage distribution of gingival status of elementary school children in each of the three groups by age

		Number (%)		
Age(yr)	N	H-group	E-group	L-group
7	70	43(61.4)[a)]	19(27.1)	8(11.4)
8	60	30(50.0)	14(23.3)	16(26.7)
9	77	34(44.2)	18(23.4)	25(32.5)
10	69	36(52.2)	12(17.4)	21(30.4)
11	103	46(44.7)	13(12.6)	44(42.7)
12	95	40(42.1)	26(27.4)	29(30.5)
Total	474	229(48.3)	102(21.5)	143(30.2)

H-group: ORI-C score of +2 or +1, E-group: ORI-C score of 0, L-group: ORI-C score of -2 or -1, a): number (%)

Table 2 lists the mean scores for the DT, FT, DMFT, the care index and percentage of caries free by gingival status and by gender. The mean scores for the DT, FT, and DMFT in boys were 0.63, 1.19 and 1.82, respectively. The mean values for the care index and percentage of caries free were 61.1 % and 40.4 %, respectively. The mean scores for the DT, FT, and DMFT in girls were, 0.88, 1.93 and 2.80, respectively. The mean value of the care index and the percentage of caries free were 67.5 % and 27.9 %, respectively. The mean score for the DT of girls in the H-group was significantly lower than that in the L-group ($p < 0.05$). The mean scores for the FT and DMFT of the boys' H-group were significantly lower than that in the girls' ($p < 0.01$).

Table 3 shows the mean scores for the DT, FT, DMFT, the care index and the percentage of caries free by age.

Table 2 Caries prevalence, caries experience and gingival status of elementary school children by gender

Subgroup	ORI-C	N	DT	FT	DMFT	FT/DMFT (%)	DMFT=0 (%)
Boys	H	128	0.51±1.10[a)]	1.09±1.62	1.60±2.00	63.0	42.2
	E	51	0.76±1.64	1.06±1.43	1.82±2.17	59.0	39.2
	L	76	0.75±1.17	1.43±1.75 **	2.18±2.13 **	60.0	38.2
	Subtotal	**255**	**0.63±1.25**	**1.19±1.63**	**1.82±2.09**	**61.1**	**40.4**
Girls	H	101	0.57±1.29	1.99±2.16	2.56±2.40	73.0	31.7
	E	51	0.92±2.18 *	1.82±2.05	2.73±2.95	63.0	25.5
	L	67	1.30±2.81	1.93±2.06	3.22±3.40	63.0	23.9
	Subtotal	**219**	**0.88±2.08**	**1.93±2.10**	**2.80±2.87**	**67.5**	**27.9**
Total	H	229	0.54±1.19	1.49±1.93	2.03±2.23	68.0	37.6
	E	102	0.84±1.92	1.44±1.80	2.27±2.61	61.0	32.4
	L	143	1.01±2.11	1.66±1.91	2.67±2.85	62.0	31.5
	Subtotal	**474**	**0.74±1.69**	**1.53±1.89**	**2.27±2.53**	**67.0**	**34.6**

Mann-Whitney U-test; statistical significance, *: $P<0.05$, **: $P<0.01$
H: ORI-C score of +2 or +1, E: ORI-C score of 0, L: ORI-C score of -2 or -1, a): mean±standard deviation

Overall the mean scores in the DT, FT and DMFT were 0.74 (range: 0.40-1.16), 1.53 (0.19-2.64) and 2.27 (0.60-3.80), respectively. The mean values for the care index and the percentage of children who were caries free were 67 % (25.0 %-77.2 %) and 34.6 % (16.8 %-68.6 %) overall. For the whole sample, the mean scores for the DT in the H-group, E-group and L-group were 0.54, 0.84 and 1.01, respectively. The mean scores for the FT index in the H-group, E-group and L-group were 1.49, 1.44 and 1.66, respectively. The mean score for the DMFT in the H-group, E-group and L-group were 2.03, 2.27 and 2.67, respectively. The mean scores for the DT and DMFT in the H-group were significantly lower than that in the L-group ($p < 0.01$, $p < 0.05$, respectively). The care index among the three groups ranged from 61 % to 68 %. The percentages of caries-free children in the H-group, E-group and L-group were 37.6 %, 32.4 % and 31.5 %, respectively. The mean scores for the DT of the 7-year old and 12-year old groups within the H-group were significantly lower than that in the L-group ($p < 0.05$).

Discussion

In Japan, periodic oral health examinations, including gingival examinations, are performed in elementary and secondary schools near the beginning of each academic year. These oral examinations are done at school, not at a dental clinic. In actual practice, the number of children, the available dental staff, medical costs, etc. usually limit the time devoted to gingival examination. Currently, school dentists, who are usually part-time dentists, are instructed to record only obvious cases of gingivitis and these only as "gingivitis present" As a result, little emphasis is placed on gingival health. From the clinician's view point, it seems that he/she is not just faced with a single tooth, the shape of the bone around a tooth surface, pocket depth, etc., but also with the variety of variation in the patients' levels of self-care (6).

We investigated gingival health in elementary school children using ORI-C scores. In our study, oral hygiene education, such as tooth brushing and flossing instructions, were needed in approximately 30 % of children (L-group). Overall, our study showed that gingival condition worsened in proportion to age. The percentage of children with poor gingival condition was highest at the age of 11 years. This result was similar to that of Hugoson et al. (7), in which the percentage of tooth surfaces with gingivitis was higher among 10-year-olds than among any other age group between 3 to 15-years in both 1973 and 1978. In a review by Matsson (8), it was suggested that factors predisposing to gingival inflammation might include tooth eruption and puberty. Peretz et al. (9) also suggested that during the mixed dentition stage of children, exfoliation and eruption of teeth might impair oral hygiene measures and might result in increased dental plaque and gingivitis. Gingivitis becomes more chronic and more frequent with increasing age (10). Gingival reactivity increases gradually

Table 3 Caries prevalence, caries experience and gingival status of elementary school children by age

Subgroup	ORI-C	N	DT		FT	DMFT	FT/DMFT (%)	DMFT=0 (%)
7 year	H	43	0.26±0.62[a)]	*	0.28±0.85	0.53±1.01	37.5	72.1
	E	19	0.42±0.90		0.05±0.23	0.53±0.90	16.7	68.4
	L	8	1.13±1.36		0.00±0.00	1.13±1.36	0.0	50.0
	Subtotal	**70**	**0.40±0.84**		**0.19±0.69**	**0.60±1.03**	**25.0**	**68.6**
8 year	H	30	0.70±1.70		0.63±1.22	1.33±2.23	41.0	50.0
	E	14	0.43±0.51		0.38±0.77	0.79±0.80	31.0	42.9
	L	16	0.56±0.73		0.38±1.02	0.94±1.18	26.0	43.8
	Subtotal	**60**	**0.60±1.28**		**0.51±1.07**	**1.10±1.73**	**34.4**	**46.7**
9 year	H	34	0.44±0.86		1.12±1.47	1.56±1.62	67.0	38.2
	E	18	0.44±0.70		1.39±1.72	1.83±1.76	65.0	33.3
	L	25	0.60±1.15		1.24±1.69	1.84±2.21	66.0	52.0
	Subtotal	**77**	**0.49±0.93**		**1.22±1.59**	**1.71±1.84**	**66.2**	**41.6**
10 year	H	36	0.56±0.91		1.86±1.66	2.42±1.66	74.0	19.4
	E	12	1.33±2.84		1.33±1.50	2.67±2.77	59.0	25.0
	L	21	0.95±1.63		1.19±1.44	2.14±2.10	55.0	28.6
	Subtotal	**69**	**0.81±1.61**		**1.57±1.58**	**2.38±2.00**	**66.2**	**23.2**
11 year	H	46	0.61±1.18		2.00±1.87	2.61±2.32	74.0	26.1
	E	13	0.62±0.87		2.54±1.66	3.15±2.19	84.0	23.1
	L	44	1.11±3.10		2.34±2.05	3.45±3.44	79.0	20.5
	Subtotal	**103**	**0.83±2.19**		**2.21±1.92**	**3.04±2.85**	**77.2**	**23.3**
12 year	H	40	0.70±1.59	*	2.83±2.62	3.53±2.75	79.0	20.0
	E	26	1.54±3.00		2.50±2.10	4.04±3.39	72.0	7.7
	L	29	1.45±1.90		2.52±2.01	3.97±2.93	63.0	20.7
	Subtotal	**95**	**1.16±2.16**		**2.64±2.29**	**3.80±2.97**	**72.2**	**16.8**
Total	H	229	0.54±1.19	**	1.49±1.93	2.03±2.23	68.0	37.6
	E	102	0.84±1.92		1.44±1.80	2.27±2.61	61.0	32.4
	L	143	1.01±2.11		1.66±1.91	2.67±2.85	62.0	31.5
	Subtotal	**474**	**0.74±1.69**		**1.53±1.89**	**2.27±2.53**	**67.0**	**34.6**

Mann-Whitney U-test; statistical significance, *: $P<0.05$, **: $P<0.01$

H: ORI-C score of +2 or +1, E: ORI-C score of 0, L: ORI-C score of -2 or -1, a): mean±standard deviation

from early childhood to adulthood (11) and thus more attention should be paid to the oral self-care of children, including gingival self-care, in order to maximize it at an early age.

With increasing age, there was generally an increase in experience of dental caries. The result of our study indicated that caries experience and caries prevalence increased in proportion to age. Children with good gingival condition had lower DT and DMFT indices than those with poor gingival condition. Gingival condition was related not to past caries experience (FT) but to the current prevalence of caries (DT). The effect of this on the value of the DT created a significant difference in the DMFT between the H and L groups. This suggested that oral cleanliness might be related to gingivitis and dental caries.

There has been little epidemiological study on the relation between the degree of oral hygiene and gingivitis and dental caries in children. Ratka-Kruger et al. (12) reported that in 4- and 5-year old children there was clearly a correlation between the degree of oral hygiene and caries and gingivitis. In our study, the care index for children was relatively high (67.0 %) and the percentage of caries-free children decreased in proportion to age. Durward and Wright (13) reported that the care index in adolescents ranged from 40 % to 63 %. It is important for children not only to be treated for dental caries and gingivitis but also for them to achieve good self-care for preventing these conditions.

In conclusion, the results of our study suggested that oral hygiene instruction should be given to children beginning

in their early school years in order to motivate self-care to prevent not only dental caries but also gingivitis. Although the presence of gingivitis cannot be used to predict periodontitis, management of gingivitis in elementary school children should be recommended.

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