PEDIATRIC DENTAL JOURNAL 15(1): 64–71, 2005

A study on non-nutritive sucking habits in young Japanese children —Relationships among incidence, duration, malocclusion and nursing behavior—

Nobuya Ozawa, Sakumitsu Hamada, Fumiko Takekoshi and Hisaaki Shinji

Division of Pediatric Dentistry, Department of Craniofacial Growth and Development Dentistry,
Kanagawa Dental College
82 Inaoka-cho, Yokosuka, Kanagawa 238-8580, JAPAN

Abstract Purpose: The purpose of the present study was to investigate the non-nutritive sucking habits of 18-month-old and 42-month-old children in order to determine the best method of advice to stop sucking habits.
Method: We examined the present situation of oral habits, the time of commencement and the time of discontinuation of the habits, the condition of occlusion, and the nursing behavior during the first 3 months from birth in the subjects.
Results: The incidences of finger sucking and pacifier sucking habits in the 18-month-old children were 25.6% and 16.9%, respectively, and the incidences of the habits in the 42-month-old children were 27.2% and 16.8%, respectively. Most cases of the finger sucking habit continued until after 3 years of age, but the pacifier sucking habit was discontinued before 42 months of age. Open bite or maxillary protrusion was found in 70.7% of the 42-month-old children with persistent non-nutritive sucking habits but in only 6.8% of the 42-month-old participating children who had broken their sucking habits. We examined the correlation between non-nutritive sucking habits and nursing behavior. The incidence of oral habits was significantly higher in bottle-fed children than in breast-fed children. Pacifier sucking was more prevalent in children with a short breast feeding duration than in children with a normal feeding duration.
Conclusion: The incidence of finger sucking is higher than that of pacifier sucking in Japan. Malocclusion caused by a sucking habit is more frequent in pacifier suckers than in finger suckers. The incidence of oral habits is higher in bottle-fed children than in breast-fed children.

Key words
Finger sucking,
Malocclusion,
Nursing behavior,
Pacifier sucking,
Sucking habit

Introduction

Finger sucking has been regarded as an inane behavior for infants to collect information from the environment[1]. However, if the finger sucking habit persists for a long period of time, lip and tongue musculatures develop disharmonically, and secondary habits, such as tongue thrusting, will be acquired even after discontinuation of finger sucking[2,3]. The situation is similar in the case of a long-term pacifier sucking habit[4–6]. Starr[7] and Johnson *et al.*[8] had suggested that pacifier sucking could be effective for preventing the development of a finger sucking habit[7,8], but Klackenberg[9] and Traisman[10] reported that the development of a finger sucking habit can not be prevented by pacifier sucking. Recently, Johnson *et al.*[8] reported that the number of cases of finger sucking were decreased in Western Europe although the pacifier sucking habit was increased.

Received on September 21, 2004
Accepted on December 10, 2004

Table 1 Types and incidences of oral habits at 18 and 42 months of age

		18-month-old children (n = 254)		42-month-old children (n = 232)	
Type of oral habit	Sex	Experience group (n = 39) n (%)	Persistence group (n = 82) n (%)	Experience group (n = 48) n (%)	Persistence group (n = 74) n (%)
Finger sucking	M	5 (2.0)	31 (12.2)	4 (1.7)	31 (13.4)
	F	3 (1.2)	26 (10.2)	4 (1.7)	24 (10.3)
Pacifier sucking	M	20 (7.9)	9 (3.5)	18 (7.8)	2 (0.9)
	F	9 (3.5)	5 (2.0)	18 (7.8)	1 (0.4)
Pacifier to finger*	M	0	1 (0.4)	1 (0.4)	1 (0.4)
	F	0	2 (0.8)	0	1 (0.4)
Finger to pacifier**	M	1 (0.4)	2 (0.8)	1 (0.4)	0
	F	0	1 (0.4)	0	0
Other oral habits	M	0	5 (2.0)	2 (0.9)	10 (4.3)
	F	1 (0.4)	0	0	14 (6.0)

*: Transition from pacifier sucking to finger sucking **: Transition from finger sucking to pacifier sucking
The difference between sexes was not statistically significant at 18 and 42 months of age ($P = 0.21$ and $P = 0.67$, respectively).

The incidence of sucking habits were recognized differences each other areas[2–4,7], and the habits appear to be strongly dependent on life-style[11–14].

There is a correlation between oral habits and malocclusion of deciduous dentition; 40% of the causes of malocclusion were found to be related to oral habits[15]. It has been reported that the incidence of malocclusion in children with oral habits was 74.0%, while the incidence was only 25.1% in children without any oral habit[16]. Many studies that oral habits, bottle feeding, breast feeding and nursing duration have an influence on the deciduous dentition has already been reported[10,11,17–22].

At the time of dental health check ups for infants, many questions about the method of using a pacifier or a finger sucking habit were asked and the bad influence of sucking habits were explained. As there are a little information about pacifier sucking habit in this country, the content of instructions how to take measures to cope with the situation of the habit for a guardian is insufficient. In addition, in order to the bad effects of oral habits have been emphasized, guardians correspond inadequately to the problem of the habit. Consequently, oral habits may persist or transform into other habits, such as nail biting.

To know about various things of oral habit such as the frequency, the onset and discontinued time were important for us to talk with parents correctly, therefore in this study the incidence of non-nutritive sucking habits of pre-school children was investigated.

Subjects

The subjects of this study were 508 pre-school children living in the northern part of Yokosuka City, 50 km from Tokyo. The ages of the subjects ranged from 18 to 42 months. Four hundred ninety-eight of the 508 children visited the Yokosuka Public Health Center for oral examinations during the period from August 1996 to March 1997. Twelve of those 498 children were subsequently excluded because their parents could not be interviewed. Therefore, a total of 486 children participated in the present study.

Survey methods

The survey was conducted under the supervision of a pediatric dentist with 15 years of clinical experience. Occlusion was assessed in each of the children, and their parents were interviewed about their children's oral habits. Questions were asked about the type of habit, onset, duration, the time of discontinuation and nursing behavior. Conditions of occlusion were classified as normal overbite, deep overbite, maxillary protrusion, open bite, anterior cross bite, and cross bite of single or double teeth. Oral habits were classified as finger sucking, pacifier sucking, transition from finger sucking to pacifier sucking, and transition from pacifier sucking to finger

Table 2 Ages at which oral habits started and were discontinued

	18-month-old children				42-month-old children			
	Finger sucking		Pacifier sucking		Finger sucking		Pacifier sucking	
Age (month)	started (n=59) n (%)	discontinued (n=8) n (%)	started (n=41) n (%)	discontinued (n=27) n (%)	started (n=50) n (%)	discontinued (n=8) n (%)	started (n=39) n (%)	discontinued (n=36) n (%)
0–3	32 (54.2)		24 (58.5)	5 (12.2)	26 (52.0)		25 (64.1)	3 (7.7)
4–6	17 (28.8)		12 (29.3)	7 (17.1)	10 (20.0)		12 (30.8)	3 (7.7)
7–9	2 (3.4)	3 (5.1)		3 (7.3)	2 (4.0)		2 (5.1)	3 (7.7)
10–12	5 (8.5)	4 (6.8)	4 (9.8)	6 (14.6)	5 (10.0)	1 (2.0)		13 (33.3)
13–15	2 (3.4)	1 (1.7)		2 (4.9)	1 (2.0)	1 (2.0)		1 (2.6)
16–18	1 (1.7)		1 (2.4)	4 (9.8)	1 (2.0)	2 (4.0)		4 (10.3)
19–24								6 (15.4)
25–30					1 (2.0)	2 (4.0)		1 (2.6)
31–36					3 (6.0)	2 (4.0)		1 (2.6)
37–42					1 (2.0)			1 (2.6)
Unknown	6		2		13			

sucking. Nail biting and towel sucking were classified as other oral habits. The onset of the oral habit was defined as one month after the beginning of either prolonged oral habit or a prolonged use of a pacifier.

Statistical analysis

The data were analyzed using statistical software (SPSS version 10.0 for Windows, SPSS Japan Inc., Tokyo, Japan). The chi-square test was used to evaluate differences between finger suckers, pacifier suckers and children without oral habits concerning nursing behavior and breast feeding duration. The observed significance level of each test, *i.e.*, probability (P), was calculated for each comparison. Probability levels of $P<0.05$ were considered statistically significant.

Results

Data were obtained from 95.7% of the children, including 254 18-month-old children and 232 42-month-old children. The types and incidences of oral habits in the 18-month-old and 42-month-old children are listed in Table 1. The incidences of oral habits in the 18-month-old and 42-month-old children were 47.6% and 52.6%, respectively. The oral habit persisted in 32.3% of the 18-month-old children and 31.9% of the 42-month-old children at the time of oral examination. The finger sucking habit containing both experienced and persistent groups was the highest frequency in incidence, 25.6% among the 18-month-old and 27.2% among the 42-month-old children. Twenty-two point four percentage of the 18-month-old and 23.7% of the 42-month-old children continued finger sucking habit. Pacifiers used by 16.9% of the 18-month-old children and 16.8% of the 42-month-old children in the experienced and persistent groups. Only 5.5% of the 18-month-old children and 1.3% of the 42-month-old children continued to use pacifier suckers until the time of oral examination. Although, no significant difference ($P>0.947$) was found between incidences of finger sucking in 18-month-old children and 42-month-old children in the persistent group, a significant difference ($P>0.006$) was found between the percentage of 18-month-old and 42-month-old children in the persistent group who used a pacifier. The prevalence of other oral habits in the 42-month-old children was 11.2%, higher than the prevalence of 2.4% in the 18-month-old children.

The time of beginning and the time of discontinuance of finger sucking are summarized in Table 2. Twenty-one children were excluded from data because their parents were not able to clearly identify

Table 3 Comparison between deciduous teeth occlusion and oral habits at 18 months of age

	Experienced group		Persistent group		
Occlusion	Finger sucking (n=8) n (%)	Pacifier sucking (n=29) n (%)	Finger sucking (n=57) n (%)	Pacifier sucking (n=14) n (%)	Non oral habit (n=133) n (%)
Maxillary protrusion	2 (25.0)	3 (10.3)	16 (28.1)	2 (14.3)	
Open bite		1 (3.4)	8 (14.0)	7 (50.0)	1 (0.8)
Deep bite	4 (50.0)	10 (34.5)	14 (24.6)	1 (7.1)	59 (44.4)
Anterior cross bite		3 (7.7)	6 (10.6)	1 (7.1)	31 (23.3)
Cross bite*		1 (3.4)			2 (1.5)
Normal bite	2 (25.0)	11 (37.9)	13 (22.8)	3 (21.4)	40 (30.1)

*: Cross bite of single of double teeth

Table 4 Comparison between deciduous teeth occlusion and oral habits at 42 months of age

	Experienced group		Persistent group		
Occlusion	Finger sucking (n=8) n (%)	Pacifier sucking (n=36) n (%)	Finger sucking (n=55) n (%)	Pacifier sucking (n=3) n (%)	Non oral habit (n=110) n (%)
Maxillary protrusion	1 (12.5)	2 (5.6)	21 (38.2)	2 (66.6)	5 (4.5)
Open bite			17 (30.9)	1 (33.3)	1 (0.9)
Deep bite	2 (25.0)	8 (22.2)	5 (9.1)		41 (37.3)
Anterior cross bite	1 (12.5)	1 (2.8)	3 (5.5)		8 (7.3)
Cross bite*	1 (12.5)	3 (8.3)	1 (1.8)		4 (3.6)
Normal bite	3 (37.5)	22 (61.1)	8 (14.5)		51 (46.4)

*: Cross bite of single of double teeth

their children's actual situation. A finger sucking habit started predominantly during the first 6 months of life, and the incidences were 83.1% in the 18-month-old children and 72.0% in the 42-month-old children. The pacifier sucking habit also began during the first 6 months of life, and the incidences were 87.8% in the 18-month-old children and 94.9% in the 42-month-old children. However, approximately half of pacifier suckers had discontinued their habit by the age of 12 months.

The conditions of occlusion in the 18-month-old finger suckers are shown in Table 3. Maxillary protrusion or open bite was observed in 42.1% of finger suckers and in 64.3% of pacifier suckers in the persistent group. Rates of both maxillary protrusion and open bite were significantly higher than those in the non-suckers ($\chi^2=93.60$, $P<0.001$). The incidence of maxillary protrusion and open bite in pacifier suckers in the experienced group was significantly lower than that in the pacifier suckers in the persistent group ($\chi^2=11.41$, $P<0.01$).

The conditions of occlusion in the 42-month-old children are shown in Table 4. The incidence of maxillary protrusion or open bite in finger suckers in the persistent group was 69.1%, much higher than that in the 18-month-old children. All of the children who persisted in pacifier sucking (persistent group) showed maxillary protrusion or open bite. Among the children who had experienced oral habits, there was only one child with maxillary protrusion in the finger sucking group and there were only two children with maxillary protrusion in the pacifier sucking group.

In both the 42-month-old and 18-month-old children, maxillary protrusion or open bite was significantly more frequent in finger suckers than in

Table 5 Relationship between feeding behavior and oral habits at 3 months after birth

Oral habits	Breast feeding (n = 96) n (%)	Mix feeding (n = 95) n (%)	Bottle feeding (n = 55) n (%)
Finger sucking	20 (20.8)	28 (29.5)	17 (30.9)
Pacifier sucking	14 (14.6)	13 (13.7)	15 (27.3)
Other oral habits	0 (0.0)	4 (4.2)	2 (3.6)
No oral habit	62 (64.6)	50 (52.6)	21 (38.2)

Table 6 Relationship between duration of breast feeding and sucking habits

Breast-fed duration (months)	Finger sucking (n = 65) n (%)	Pacifier sucking (n = 42) n (%)	No oral habit (n = 133) n (%)
0	17 (26.2)	15 (35.7)	21 (15.8)
1–3	15 (23.1)	10 (23.8)	27 (20.3)
4–6	14 (21.5)	9 (21.4)	33 (24.8)
>6	19 (29.2)	8 (19.0)	52 (39.1)

Table 7 Relationship between method of feeding and sucking habits at 18 months of age

Oral habits	Regular feeding (n = 152) n (%)	Irregular feeding (n = 92) n (%)
Finger sucking	40 (16.4)	24 (9.8)
Pacifier sucking	31 (12.7)	11 (4.5)
Other oral habits	5 (2.0)	1 (0.4)
No oral habit	76 (31.1)	56 (23.0)

The differences between methods of feedings were not statistically significant ($P = 0.191$).

non-suckers ($\chi^2 = 78.0$, $P < 0.001$).

In order to determine the relationship between non-nutritive sucking habits and nursing behavior at 3 months of age, the parents of 18-month-old children were interviewed, and the results are shown in Table 5. The rates of breast feeding, mixed feeding and bottle feeding were 39.0%, 38.6% and 22.4%, respectively. The incidence of oral habits was highest in the bottle-fed children and lowest in the breast-fed children. The incidence of oral habits was significantly higher in the bottle-fed children ($\chi^2 = 10.7$, $P < 0.030$) than in the breast-fed and mixed-fed children.

The relationship between breast feeding duration and incidence of oral habits is summarized in Table 6. Children with sucking habits and children without any sucking habit were compared. No correlation was found between finger sucking habit and breast feeding duration ($\chi^2 = 3.60$, $P < 0.058$). The incidence of pacifier sucking was higher in children with a short duration of breast feeding ($\chi^2 = 9.60$, $P < 0.014$).

The relationship between the method of feeding and oral habits at 18 months of age is shown in Table 7. The incidence of finger sucking habit was higher than the incidence of other oral habit in both the regular and irregular feeding. There was no significant difference between the method of feedings and oral habits.

Discussion

Since finger sucking and pacifier sucking habits are discouraged for parents in Japan, they often ask to dentists to avoid the development of these habits. However, the first oral examination is usually performed during a health check-up for 18-month-old children at a health center. Since parents try to make their children stop sucking habits without knowledge of the process of child mental development, their actions may lead to the persistence of oral habits. Previous studies[3,23] have shown that the incidences of finger sucking and pacifier sucking in Australia are 26.7% and 37.1%, respectively, and that those in Sweden are 30.2% and 44.8%, respectively. However, more recently, the incidences of finger sucking and pacifier sucking in Australia have been reported to be 18.2% and 61.5%, respectively[24]. A recent study has also shown that the incidences of finger sucking in Swedish and Norwegian children is about 10–19% that the incidences of pacifier sucking in Swedish and Norwegian children are 70.3% and 50.0%, respectively[13]. And the incidence of finger sucker decreased from 30% at 1961 to 18% at 1991, the incidence of pacifier sucker increased from 45% at 1961 to 70% at 1986. Johnson[17] suggested that the recent decrease in the incidence of finger sucking may be due to the increase in the incidence of pacifier sucking. In Zimbabwe, the incidence of finger sucking was estimated to be 2%, while pacifier sucking habit was not observed at all[18]. In Lapland, the incidences of finger sucking and pacifier sucking were estimated to be 36.5% and 12.1%, respectively[25]. In Saudi children, the incidences of finger sucking and pacifier sucking were estimated to be 10.49% and 37.90%, respectively[11]. Thus, the incidence of both sucking habits varies from one population to another. The incidence of finger sucking in the present study is similar to that in Western countries 30 years ago, but the incidence of pacifier sucking is much lower. The incidence of pacifier sucking in Japan was 8.13% in 1960[26] and 9.0% in 1978[27]. The incidence of pacifier sucking in the present study was 16.9%, suggesting that there is a tendency of increase in this habit in Japan. However, in another recent study, the incidence of pacifier sucking was found to be only 1.6%[28]. Thus, the incidence of pacifier sucking varies from one population to another, even within Japan.

Klackenberg[9] reported that the finger sucking habit could not be discontinued by pacifier sucking. Traisman[10] reported that the incidence of finger sucking was high in children using a pacifier and that the pacifier sucking habit transformed easily to the finger sucking habit after the discontinuation of pacifier sucking.

In the present study, transition from finger sucking to pacifier sucking was observed in children whose parents attempted to stop their finger sucking by using a pacifier. On the other hand, transition from pacifier sucking to finger sucking was observed in children who were instructed and forced to discontinue pacifier sucking at a young age. Some of the children in the finger sucking group chose finger sucking even though a pacifier was offered to them by their parents. The use of a pacifier has been recommended by many researchers to prevent the development of a finger sucking habit[17,24,29,30], and we also suggest that a finger sucking habit can be prevented by using a pacifier. However, further investigation is required to determine the optimal timing and the best method for discontinuation of pacifier sucking.

The relationships between oral habits and primary dentition have been examined in many studies[10,15,16]. Brandhorst[15] considered oral habits to be one of the local risk factors of malocclusion. He concluded that 25% of cases of malocclusion are due to oral habits, and he reported that 12% of cases of early loss of primary teeth and 3% of cases of prolonged retention of primary teeth are associated with oral habits. Johnson[31] reported that 12.2% of children with malocclusion had a finger sucking habit. Among cases of malocclusion due to a finger sucking habit, it was found that the open bite was corrected in many cases if finger sucking ceased by 4 to 5 years of age[32]. In contrast, Johnson reported that 62.5% of cases of open bite did not show any self-healing even after discontinuation of finger sucking by 5 years of age[31]. It was recommended in those reports that sucking habits should be broken during infancy. Graber[33] reported that the risk of permanent change in a condition of occlusion increases if the finger sucking habit is prolonged until 3 years of age. The change in occlusion is reinforced by the peri-oral musculature. Normal swallowing becomes difficult, tongue thrusting occurs, and maxillary protrusion as well as deformation of the dental arch persists. Other studies have suggested that open bite and maxillary protrusion will be collected by discontinuing the finger sucking habit if tongue and labial functions are normal[34,35]. In our study, open bite and maxillary

protrusion were more frequent tendency in persistent group children than in experimental group children at the 18 and the 42 months of age and open bite were more frequent in the pacifier suckers than in the finger suckers at the 18 months of age. These problems were less frequent in the habit experienced group than in the habit persistent group. None of the children showed open bite and only a small number of children showed maxillary protrusion in the experimental group at 42 months of age. In cases in which oral habits were discontinued by the age of 42 months, malocclusion appeared to heal naturally. However, few finger suckers broke the habit of finger sucking, and about 70% of children in the persistent group with a finger sucking developed open bite and/or maxillary protrusion at 42 months of age. Therefore, control of the onset of an oral habit is important. There are many parents and family members who punish their children to try to make them break oral habits without considering the process of mental development.

In some studies, no correlation was found between nursing behavior and oral habits[9,19,21]. However, it was found in another study that the percentage of finger suckers in bottle-fed or mixed-fed children was higher than that in breast-fed children[36]. Other studies have shown that finger suckers were less frequent in breast-fed children than in bottle-fed or mixed-fed children if the breast feeding duration was sufficiently long[5,20]. Although no correlation between breast feeding duration and incidence of finger sucking habit was found in this study, the prevalence of pacifier sucking was higher in children with a short breast feeding duration. In order to avoid emotional dissatisfaction of nursing infants, adequate information and advice for parents are essential.

Conclusions

1. In the present study, the incidence of finger sucking in Japanese was similar to that in Western countries 30 years ago, but the incidence of the pacifier sucking was much lower.
2. Open bite and maxillary protrusion were significantly more frequent in pacifier suckers than in finger suckers.
3. Analysis of the correlation between nursing behavior and non-nutritive sucking habits showed that the percentage of bottle-fed children with oral habits was higher than the percentage of breast-fed children with oral habits, while suckers were observed more frequently when the breast feeding duration was short.

Acknowledgments

The author appreciates the help given by staff of the public health center in Yokosuka during data collection. This research was supported by a Grant-in-Aid Scientific Research (C), from the Japanese Ministry of Education, Science, Sports and Culture (No. 11672064, 1998–2000).

References

1) Annunciation, N.F.: Plasticity of the nervous system. *Int J Orofacial Myology* **21**: 53–60, 1995.
2) Graber, T.M.: Thumb- and finger-sucking. *Am J Orthod* **45**: 258–264, 1959.
3) Bowden, B.D.: A longitudinal study of digit and dummy sucking. *Aust Dent J* **11**: 184–190, 1966.
4) Kohler, L. and Holst, K.: Malocclusion and sucking habits of four-year-old children. *Acta Paediatr Scand* **62**: 373–379, 1973.
5) Larsson, E.: Dummy- and finger-sucking habits in 4-year-olds. *Swed Dent J* **68**: 219–224, 1975.
6) Modeer, T., Odenrick, L. and Lindner, A.: Sucking habits and their relation to posterior cross-bite in 4-year-old children. *Scand J Dent Res* **90**: 323–328, 1982.
7) Starr, P.H.: Psychiatric aspects of thumb sucking as it relates to dental malocclusion. *Wash Univ Dent J* **22**: 4, 1955.
8) Johnson, E.D. and Larson, B.E.: Thumb-sucking: classification and treatment. *ASDC J Dent Child* **60**: 392–398, 1993.
9) Klackenberg, G.: Thumbsucking: frequency and etiology. *Pediatrics* **4**: 418–423, 1949.
10) Traisman, A.S. and Traisman, H.S.: Thumb- and finger-sucking: a study of 2,650 infants and children. *J Pediatr* **52**: 566–572, 1958.
11) Najat, M.A.F., Fouad, S.S. and Cert, P.: Sucking habit in Saudi children: prevalence, contributing factors and effects on the primary dentition. *Pediatr Dent* **19**: 28–33, 1997.
12) Ogaard, B., Larsson, E. and Lindsten, R.: The effect of sucking habits, cohort, sex, intercanine arch widths, and breast or bottle feeding on posterior crossbite in Norwegian and Swedish 3-year-old children. *Am J Orthod Dentofacial Orthop* **106**: 161–166, 1994.
13) Larsson, E., Ogaard, B. and Lindsten, R.: Dummy- and finger-sucking habits in young Swedish and Norwegian children. *Scand J Dent Res* **100**: 292–295, 1992.
14) Larsson, E., Ogaard, B. and Lindsten, R.: Rearing of Swedish, Norwegian and Norwegian Sami children. *Scand J Dent Res* **101**: 382–385, 1993.

15) Brandhorst, O.W.: Promoting normal development by maintaining the function of the deciduous teeth. *J Am Dent Assoc* **19**: 1196–1203, 1932.
16) Calisti, L.J.P., Cohen, M.M. and Fales, M.H.: Correlation between malocclusion, oral habits and socio-economic level of preschool children. *J Dent Res* **39**: 450–454, 1960.
17) Johnson, E.D. and Larson, B.E.: Thumb-sucking: Literature review. *J Dent Child* **60**: 385–391, 1993.
18) Larsson, E.F. and Dahlin, K.G.: The prevalence and the etiology of the initial dummy- and finger-sucking habit. *Am J Orthod* **87**: 432–435, 1985.
19) Hanna, J.C.: Breast feeding versus bottle feeding in relation to oral habits. *J Dent Child* **34**: 243–249, 1967.
20) Yarrow, L.J.: The relationship between nutritive sucking experience in infancy and non-nutritive sucking in childhood. *J Genet Psychol* **84**: 149–162, 1954.
21) Backland, E.: Facial growth and the significance of oral habits, mouth breathing and soft tissues for malocclusion: A study on children around the age of 10. *Acta Odontol Scand Suppl* **36**: 9–139, 1963.
22) George, V., Constantin, O. and Elias, B.: Profile of non-nutritive sucking habits in relation to nursing behavior in pre-school children. *J Clin Pediatr Dent* **22**: 133–136, 1998.
23) Larsson, E. and Jarvheden, B.: Dummy- and finger-sucking habits with special attention to their significance for facial growth and occlusion. 2. Background variables. *Swed Dent J* **64**: 781–788, 1971.
24) Cerny, R.: Thumb and finger sucking. *Aust Dent J* **26**: 167–171, 1981.
25) Curzon, M.J.E.: Dental implications of thumb-sucking. *Pediatrics* **54**: 196–200, 1974.
26) Takimoto, K., Akiyama, K. and Hosomi, K.: Feeding and its relationship to malocclusion in children. Part 1. Relationship between feeding and habit. *J Jpn Orthod Soc* **19**: 134–140, 1960. (In Japanese)
27) Kurosu, K., Fukuta, O., Yoshioka, T. and Emi, Y.: A study of the psychosomatic odontology on the oral habits: The condition of the appearance, life environment and its influence on the oral habits of children. *Jpn J Pediatr Dent* **16**: 123–136, 1978. (In Japanese)
28) Saijyo, T., Yonezu, T. and Machida, Y.: Oral-habits prevalence and its relation to occlusion in children 18 months to 5 years of age. *Shikwa Gakuho* **98**: 137–149, 1998. (In Japanese)
29) Larsson, E.: The prevalence and aetiology of prolonged dummy and finger-sucking habits. *Eur Orthod* **7**: 172–176, 1985.
30) Christensen, J.R. and Fields, H.W. Jr.: Non-Nutritive Sucking. Pediatric Dentistry, Second edition. WB Saunders, Philadelphia, 1994, pp. 205–208.
31) Johnson, L.R.: The status of thumb-sucking and finger-sucking. *J Am Dent Assoc* **26**: 1245–1254, 1939.
32) Lewis, S.J. and Lehman, I.A.: Observation on growth change of the teeth and dental arches. *Dent Cosmos* **71**: 480–499, 1929.
33) Graber, T.M.: The finger sucking habit and associated problems. *J Dent Child* **25**: 145–151, 1958.
34) Popovich, F. and Thompson, G.W.: Thumb- and finger-sucking: Its relation to malocclusion. *Am J Orthod* **63**: 148–155, 1973.
35) Larsson, E.: Dummy- and finger-sucking habits with special attention to their significance for facial growth and occlusion. 5. Improvement of malocclusion after termination of the habit. *Swed Dent J* **65**: 635–642, 1972.
36) Levy, D.M.: Finger sucking and accessory movement in early infancy. *Am J Psychiatry* **7**: 881–918, 1928.