SCIENTIFIC ARTICLE

Effects of different pacifiers on the primary dentition and oral myofunctional structures of preschool children

Cristina Giovannetti del Conte Zardetto, MS
Célia Regina Martins Delgado Rodrigues, MS, PhD   Fabiane Miron Stefani, BS
Dr. Zardetto is a teacher and PhD student; Dr. Rodrigues is professor, Department of Pediatric Dentistry; Dr. Stefani is a speech therapist, Medical School, University of São Paulo, São Paulo, Brazil. Correspond with Dr. Zardetto at criszardetto@uol.com.br

Abstract

Purpose: The aim of this study was to evaluate the characteristics of the dental arches and some oral myofunctional structures in 36- to 60-month-old children who sucked a pacifier or did not have this habit.

Methods: Sixty-one children were divided into 3 groups: (1) those who never sucked a pacifier, (2) those who exclusively sucked a physiological pacifier, and (3) those who exclusively sucked a conventional one. A clinical examination was performed on the children to observe the relationship between the arches and their width, as well as the following oral myofunctional structures: lips, tongue, cheeks, and hard palate.

Results: Statistical analysis showed that: (1) the use of both types of pacifiers led to anterior open bite (prevalence of 50% in both groups; P=.001), (2) posterior crossbite was present only on children who had a pacifier-sucking habit, (3) the mean overjet was greater on children who sucked physiological (3.6 mm) or conventional (3.7 mm) pacifiers when compared to those with no sucking habits (1.3 mm; P=.001), (4) intercanine distance of the upper arch was significantly smaller on children who sucked pacifiers (29.6 mm in the physiological group and 29.2 mm in the conventional pacifier group) than those who did not (31.2 mm), and (5) the children who never sucked on a pacifier showed a higher prevalence of normality of cheek mobility (74%; P=.022) and hard palate shape (78%; P=.042).

Conclusions: Children who sucked pacifiers, both conventional and physiological ones, showed higher prevalence of alterations in the relationship of the dental arches and oral myofunctional structures, when compared to those who never sucked a pacifier. (*Pediatr Dent*. 2002; 24:552-560)

The use of teats or objects that resemble mothers' breasts is not a modern practice. The earliest records were found in Roman children's burials from around AD 100, where pottery nipples in the shapes of breasts where found. The present-day pacifier was probably preceded by what was called the "sugar rag." These were made from rags or chamois into which bread crumbs and sugar were placed and then tied in the shape of a nipple. Whenever the child cried, these where moistened and introduced into his or her mouth.[1]

Since birth, infants have a natural sucking instinct or urge[2,3] which is considered the first feeding reflex established.[4] This is essential for an infant's survival, since it allows infants to nurse and cling to their mothers.[2] If this sucking urge is not completely satisfied by breast or bottle feeding, the infant will have a surplus sucking urge which may lead either to frustration or to satisfaction. If the child engages himself in a nonnutritive sucking habit, he or she may satisfy this sucking urge. Otherwise, he or she will be frustrated.[3] Therefore, sucking not only has nutritive significance in infants, but it is also a tremendous source of pleasure, self-gratification, comfort, and soothing relaxation.[6]

According to Seis and Carvalho[7] patients' sucking needs are intense during the first 3 months of life. At approximately the seventh month, it decreases and can be
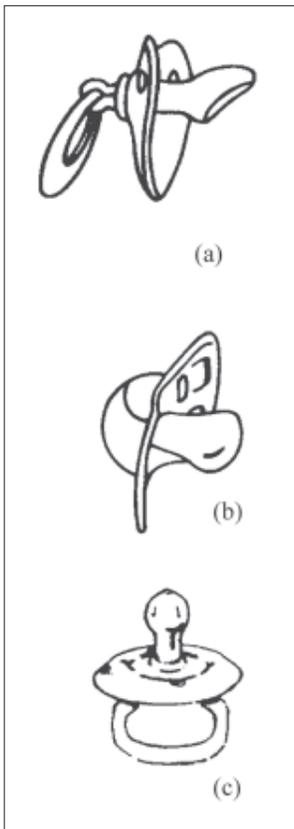
Fig 1a. Physiological pacifier
(Nuk)
Fig 1b. Physiological pacifier
(MAM)
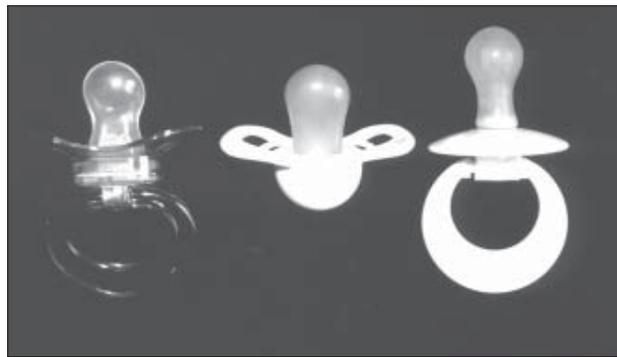Fig 1c. Conventional pacifier
(Lillo)

Fig 2. Physiological (Nuk and MAM) and conventional (Lillo) pacifiers, displayed from left to right

Table 1. Age in Months Among the 3 Groups and Duration of Pacifier Use			
	No sucking habit (N=27)	Physiological pacifier (N=20)	Conventional pacifier (N=14)
Mean age in months	47±8	45±7	46±6
Duration of pacifier use, months mean	None	43±7	45±6

considered unnecessary in the neurophysiological perspective. This occurs because the neuromuscular structures at this stage are being matured and prepared for coordinated eating and drinking activities. Thus, from this age onwards, sucking must gradually be substituted by mastication.

Nowadays, the use of pacifiers is considered socially normal and natural, and this has led to a significant increase in its use. Many researchers have investigated the possible hazards of pacifier sucking on dental arches and occlusion. There are plenty of studies that show the relationship between prolonged oral habits and malocclusion[8-13] as well as alterations in some oral myofunctional structures.[4,5,15-20]

Physiological pacifiers (orthodontic) have existed for more than 50 years. These have a different shape of nipple and shield when compared to the conventional one, as can be observed in Figures 1 and 2. The shield of the conventional pacifier has a convex curvature in relation to the oral structures of the child, while in the physiological pacifier it has a concave curvature that is more suitable to the child's face. The nipple of the conventional pacifier has a "cherry-like" shape and is thicker than the ones of the physiological pacifiers. There are 2 different types of nipple on the physiological pacifiers. Some studies mention that the shape of the physiological pacifier, also known as an orthodontic or functional exerciser, better fits the child's oral structures.[27]

The alterations on the primary dentition most frequently found in children with pacifier sucking habits are the following: anterior open bite,[8-12,15,21-23] posterior crossbite[8,10,11,23] Class II primary canine relationship,[11,12,22] decrease of upper intercanine width,[14,23,24] and increased overjet.[11,14,22]

Among the oral myofunctional alterations associated with pacifier use are lip incompetence,[4,5,14,17,19] lip entrapment,[14] decrease in muscular tonicity of tongue and lips,[5,17,25] and a narrow hard palate.[5,17]

According to Proffit,[26] habits that are maintained for at least 6 hours per day influence posture and alter resting tongue and lip pressures, which, in turn, are capable of affecting the pattern of development and causing malocclusion.

Adair et al[9] compared occlusion of very young children who used orthodontic or conventional pacifiers to a control group, which had no sucking habits. The authors found no clinically significant difference between users of conventional and orthodontic pacifiers with respect to transverse occlusal relationship. On the other hand, a statistically significant difference was observed between the groups regarding open bite and overjet.

Some years later, Adair et al[11] investigated the effects of current and former pacifier use (orthodontic and conventional ones) on the dentition of infants. There was no statistically significant difference between the children who sucked the conventional pacifier and those who used the orthodontic one in relation to overjet and prevalence of posterior crossbite and anterior open bite.

There are few studies, however, that compare the effects of physiological (orthodontic) pacifiers to the conventional ones regarding malocclusion on the primary dentition, and even fewer with regard to oral myofunctional structures. Therefore, the aim of this study was to compare the characteristics of the dental arches and some oral myofunctional structures of children with complete primary dentition who exclusively used the physiological pacifier to those who either solely used the conventional pacifier or were habit free.
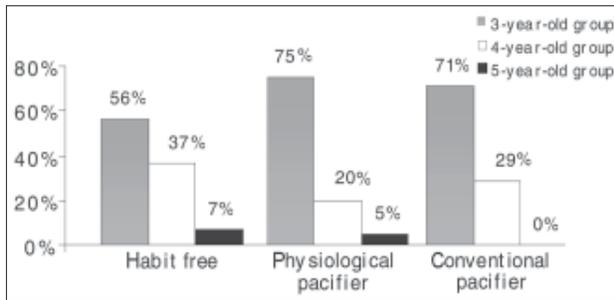
Fig 3. Percent of 3-, 4-, and 5-year-olds who were habit free or who used both types of pacifiers
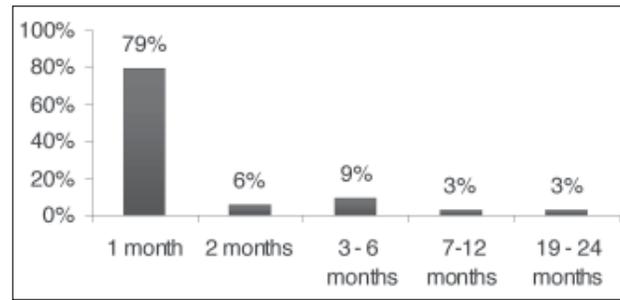

Fig 4. Starting age of pacifier habit for percent of sample

Methods

Before any clinical examination and questionnaire procedures were performed, the research project was reviewed and approved by the Ethics Committee of the Dental School of São Paulo University. A total of 350 questionnaires on oral habits, along with written consent forms, were randomly distributed to mothers of children between the ages of 36 through 60 months in 4 different schools in the city of São Paulo, Brazil. The children chosen to participate in this study needed to meet some requirements: (1) mothers needed to have answered the questionnaire properly and signed the written consent form, (2) children needed to have complete primary dentition and have no dental or development malformation, dental caries, permanent teeth, or digit-sucking behaviors. Also, only those children who only sucked the physiological (orthodontic) or conventional pacifier or did not have nor ever had a sucking habit participated in this investigation. Out of the 250 questionnaires that were properly completed by mothers, 61 children met these requirements and were able to participate in the study. Children were divided into 3 groups according to sucking habits: (1) Group 1—27 children who never sucked a pacifier nor finger (control

Anatomic characteristics	Physiological pacifier (N=20)	Conventional pacifier (N=14)	No sucking habit(N=27)	Significance (P)
Table 2. Chi-square Analysis of Oral Anatomic Characteristics Evaluated in the 3 Different Groups				
Midline shift				
None	55% (N=11)	93% (N=13)	78% (N=21)	.133
To the right side	25% (N=5)	0% (N=0)	15% (N=4)	
To the left side	20% (N=4)	7% (N=1)	7% (N=2)	
Primary canine relationship right side				
Class I	40% (N=8)	29% (N=4)	81% (N=22)	.000*
Class II	60% (N=12)	71% (N=10)	11% (N=3)	
Class III	0% (N=0)	0% (N=0)	7% (N=2)	
Primary canine relationship left side				
Class I	60% (N=12)	43% (N=6)	85% (N=23)	.013*
Class II	40% (N=8)	57% (N=8)	11% (N=3)	
Class III	0% (N=0)	0% (N=0)	4% (N=1)	
Primary molar relationship right side				
Flush	35% (N=7)	57% (N=8)	30% (N=8)	.439
Mesial step	55% (N=11)	29% (N=4)	59% (N=16)	
Distal step	10% (N=2)	14% (N=2)	11% (N=3)	
Primary molar relationship left side				
Flush	35% (N=7)	50% (N=7)	33% (N=9)	.691
Mesial step	50% (N=10)	36% (N=5)	59% (N=16)	
Distal step	15% (N=3)	14% (N=2)	8% (N=2)	
Posterior crossbite				
None	90% (N=18)	79% (N=11)	100% (N=27)	.010*
Right side	5% (N=1)	0% (N=0)	0% (N=0)	
Left side	0% (N=0)	14% (N=2)	0% (N=0)	
Bilateral	5% (N=1)	0% (N=0)	0% (N=0)	
Edge to edge	0% (N=0)	7% (N=1)	0% (N=0)	
Overjet				
0-2mm	42% (N=9)	36% (N=5)	81% (N=22)	.001*
> 2mm	58% (N=11)	64% (N=9)	11% (N=3)	
< 0 mm	0% (N=0)	0% (N=0)	8% (N=2)	
Overbite				
≤ 50% overlap	20% (N=4)	36% (N=5)	63% (N=17)	.001*
> 50% overlap	20% (N=4)	7% (N=1)	30% (N=8)	
Edge to edge	10% (N=2)	7% (N=1)	0% (N=0)	
Open bite	50% (N=10)	50% (N=7)	0% (N=0)	
Anterior crossbite	0% (N=0)	0% (N=0)	8% (N=2)	

*Variables that showed statistically significant difference

group), (2) Group 2—20 children who had been sucking only the physiological (orthodontic) pacifier from the development of this habit up until the examination date, and (3) Group 3—14 who had been sucking only the conventional pacifier since the very development of this habit up until evaluation. All children in both nonnutritional sucking groups were active pacifier users at the time of examination

The term "physiological" pacifier instead of "orthodontic" was used, in agreement with Modesto et al[27] who argued that the terminology "orthodontic" is misleading, since it implies that this type of pacifier may perform some type of dental correction.

Evaluation of the dental arches was performed by a single examiner (CZ), under natural light and with the children sitting down in a school chair in an upright position. The examiner was blind to each child's questionnaire data. Examination was accomplished with mouth mirrors, metal ruler, hand flashlight, and sharp, pointed vernier caliper (Miltex 68-695, Germany). Initially, the intention was to have an impression of each child, but this was not possible because most mothers did not authorize this practice in the written consent form.

The following parameters were recorded:
1. Primary canine relationship, recorded as Class I, II, or III on each side according to Foster and Hamilton.[28]
2. Degree of overbite, recorded as ≤50%, or >50% overlap of the mandibular incisor crown according to Adair et al,[11] open bite (when present, measured in millimeters), or edge to edge.
3. Presence of posterior crossbite, recorded as unilateral or bilateral. Posterior crossbite was considered when reverse buccal overjet on one side of the mouth or both sides was present, according to Adair et al.[11]
4. Amount of overjet in millimeters, measured with a millimetric metal ruler from the buccal surface of the mesial corner of one of the mandibular central incisor to the incisal surface of the ipsilateral maxillary incisor, according to Brunner.[29]
5. Intercanine width of lower and upper arches measured on the cusp tips, according to Bishara et al.[30]
6. Midline shift.
7. Terminal plane relationship of the primary second molars, recorded as flush, mesial step, or distal step on each side, according to Baume.[31]

Examination of some of the oral myofunctional structures was performed by a single, trained speech therapist (FMS) of the Dental School of São Paulo University, according to criteria established by Gomes et al.[16] The examiner was blind to the questionnaire data of all children.

Examination was performed with children sitting on school chairs and not leaning their heads or backs on the chairs. The hard palate, cheeks, lips, and tongue were evaluated. To verify mobility of the lips, tongue, and cheeks, children were asked to perform different and specific exercises for each of these oral structures. The speech therapist

observed how they were performed, if there was symmetry on the muscles while the exercises were performed, and the rhythm of the movements. Muscular tonicity was detected with clinical observation and palpation of the structures. The aspect or morphology was evaluated observing these oral structures. Muscular tonicity was confirmed by mobility exercises. Therefore, all observations made were taken into consideration to determine if the surrounding oral structures were normal or not.

Based on clinical observation and palpation, the speech therapist evaluated the lips, tongue, cheeks, and hard palate, taking into consideration the following criteria:
1. Lips:
   a) Aspect (length, shape, and competence at rest and mobility);
   b) Muscular tonicity (observation and palpation);
   c) Lip mobility. Children were asked to perform some specific exercises with their lips such as blowing kiss, vibrating, blowing out air, and facial mimic.
2. Tongue:
   a) Aspect (shape, size, and the presence of teeth marks on its sides);
   b) Muscular tonicity (observation and palpation);
   c) Mobility. To verify tongue mobility the following exercises were used: making the tongue wide open and then sharp, and placing the tongue inside, outside, up, down, and to the sides.
3. Cheeks:
   a) Muscular tonicity (observation and palpation);
   b) Mobility. Cheek mobility evaluation involved blowing out air and blowing in (inflating). Their symmetry was also observed.
4. Hard palate. Visual aspect of the hard palate was determined as normal, high, or narrow.

The data obtained from both examinations were analyzed using Pearson's chi-squared analysis, ANOVA, reliance interval for the difference between probabilities (for the categorized variables), and Bonferroni intervals (for the difference between mean values of the quantitative variables; $P \leq .05$).

Children with digit sucking were not included in this study because most of the children with this habit had, at some time in their life, sucked a pacifier. The authors' main objective was to compare the alterations on the primary occlusion probably caused by only the conventional or physiological pacifiers.

The questionnaire did not address size of the pacifiers used by the children.

Results

The sample consisted of 37 males (61%) and 24 females (39%). The mean age at the time of examination was 46 months, with a range of 36 to 60 months. The majority of the children (66%) belonged to the 3-year-old group, while the children in the 4- and 5-year-old group were 29% and 5%, respectively. Seventy-one percent and 75% of conventional and physiological
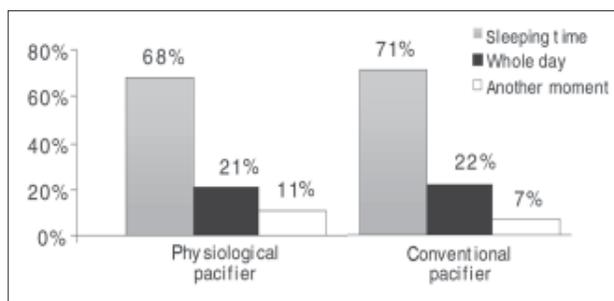
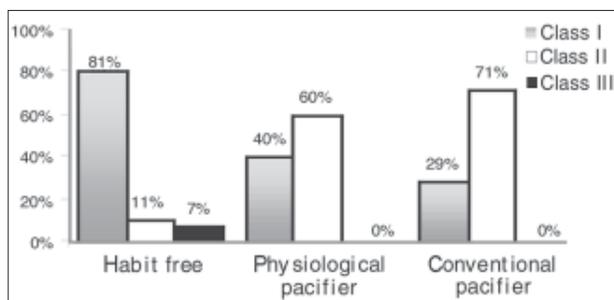Fig 5. Period of day the child used the pacifier

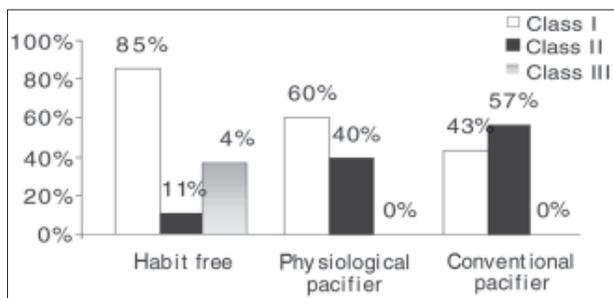Fig 6. Primary canine relationship on the right side according to pacifier-sucking habit

Fig 7. Primary canine relationship on the left side according to pacifier-sucking habit
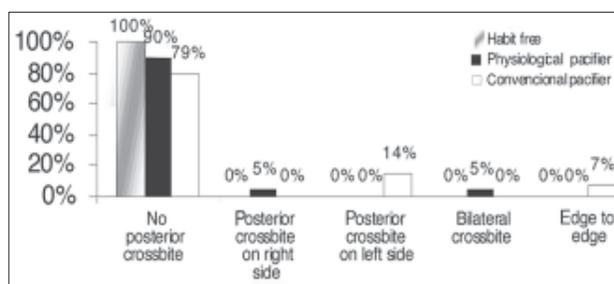

Fig 8. Posterior crossbite according to sucking habit

Table 3. Mean Upper and Lower Intercanine Width and Overjet in Millimeters in the 3 Groups

	No sucking habit (N=27)	Physiological pacifier (N=20)	Conventional pacifier (N=14)
Overjet*	1.3±1.0	3.6±2.3	3.7±1.9
Upper intercanine distance	31.2±1.8	29.6±2.5	29.2±1.7
Lower intercanine distance	25.2±1.8	25.6±1.6	25.2±1.1

Table 4. Mean Open Bite in Millimeters According to Pacifier-sucking Habit

Type of pacifier used	N	Mean	Minimum	Maximum	Median
Physiological	10	5.2±3.0	1.0	10.0	5.0
Conventional	7	6.5±2.1	3.0	8.5	8.0

According to the chi-square analysis, there was a statistically significant difference among the 3 groups evaluated in almost all occlusal characteristics observed, with the exception of midline shift and terminal plane relationship of the second primary molars (Table 2).

A Class I canine relationship on the right and left sides was more common among habit-free children. Meanwhile, a significantly higher percentage of users of physiological and conventional pacifiers had a Class II canine relationship on the right side—60% and 71%, respectively (Figs 6 and 7). Reliance interval analysis showed that there was a significant difference between the probabilities of a Class I canine relationship occurrence on the right side between those with no sucking habit and those who used the physiological or conventional pacifiers.

Posterior crossbite was found only in children who had a pacifier-sucking habit, being slightly more predominant among those in the conventional pacifier group (14%), as compared to those in the physiological pacifier group (10%), although this was not statistically significant (P=.150). There was, however, a statistically significant difference among the children who sucked on the conventional pacifier and the control group (P=.034; Fig 8).

ANOVA indicated statistically significant differences among groups regarding the amount of overjet (mm; P=.000). Bonferroni reliance intervals demonstrated that a statistically significant difference was found among those who had no sucking habits (control group) and those who sucked pacifiers, be they conventional or physiological ones. There was no difference in mean overjet (mm) among the children who sucked the conventional pacifier and those who sucked the orthodontic ones (Table 3).

Anterior open bite was present only in children with pacifier sucking habits, and no statistically significant difference was found between the 2 pacifier-sucking groups. With respect to degree of open bite in millimeters, ANOVA

pacifiers users, respectively, were in the 3-year-old group. Most of the children using pacifiers began this habit in the first month of life (79%). The mean reported length of pacifier use was 43 months for the physiological pacifier and 45 months for the conventional one. The frequency of pacifier use was very similar among both pacifier groups, since 69% of the physiological and 71% of the conventional group reported pacifier use associated with sleeping time (Table 1; Figs 3 and 4).

| Table 5. Pearson's Chi-square Analysis of the Oral Myofunctional Structures of 3 Groups Evaluated				
Anatomic characteristics	Physiological pacifier (N=20)	Conventional pacifier (N=14)	No sucking habit(N=27)	Significance (*P*)
Lips—aspect				
Normal	45% (N=9)	50% (N=7)	70% (N=19)	.772
Not normal	55% (N=11)	50% (N=7)	30% (N=8)	
Lips—tonicity				
Normal	55% (N=11)	43% (N=6)	74% (N=20)	.083
Not normal	45% (N=9)	57% (N=8)	26% (N=7)	
Lips—mobility				
Normal	70% (N=14)	93% (N=13)	82% (N=22)	.272
Not normal	30% (N=3)	7% (N=1)	18% (N=5)	
Tongue—aspect				
Normal	100% (N=20)	100% (N=14)	100% (N=27)	.345
Not normal	0% (N=0)	0% (N=0)	0% (N=0)	
Tongue—tonicity				
Normal	80% (N=16)	79% (N=11)	78% (N=21)	1.000
Hipotonicity	20% (N=4)	21% (N=3)	22% (N=6)	
Tongue—mobility				
Normal	75% (N=15)	86% (N=12)	82% (N=22)	.773
Not normal	25% (N=5)	14% (N=2)	18% (N=5)	
Cheek—tonicity				
Normal	65% (N=13)	64% (N=9)	78% (N=21)	.623
Hipotonicity	35% (N=7)	36% (N=5)	22% (N=6)	
Cheek—mobility				
Normal	35% (N=7)	36% (N=5)	74% (N= 20)	.022*
Only inflates	55% (N=11)	64% (N=9)	22% (N=6)	
Did not do exercise	10% (N=2)	0% (N=0)	4% (N=1)	
Hard palate				
Normal	75% (N=15)	36% (N=5)	78% (N=21)	.042*
Straight	10% (N=2)	43% (N= 6)	7% (N= 2)	
High	10% (N=2)	14% (N= 2)	15% (N=4)	
Narrow and high	5% (N=1)	7% (N=1)	0% (N=0)	

*Statistically significant
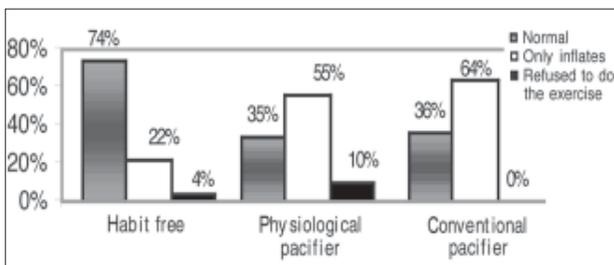
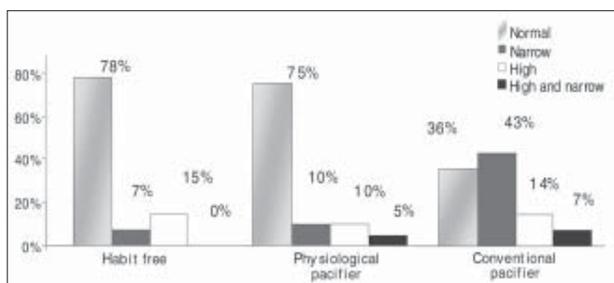Fig 9. Cheek mobility according to sucking habit

Fig 10. Shape of hard palate

also showed that there was no significant difference (*P*=.344) between children who used the conventional pacifier and those who used the physiological one. Table 4 displays the amount of open bite in millimeters in the pacifier habit groups.

ANOVA indicated a difference in intercanine width of the upper arch among the 3 groups that were evaluated (*P*=.004), but no difference on the lower intercanine width (*P*=.628). Bonferroni intervals showed that there was a significant difference between the habit-free (control group) and the pacifier-sucking groups, although no difference was found across the 2 pacifiers subgroups. Table 3 displays the upper and lower intercanine width.

The chi-square analysis was used also to assess oral myofunctional structures and indicated a statistically significant difference among the 3 groups evaluated only with respect to cheek mobility (*P*=.022) and hard palate shape (*P*=.042; Table 5).

It was observed that the probability of having normal cheek mobility was significantly higher among the children who had no sucking habits (control group) than among those who sucked either the conventional or physiological pacifier. No statistically significant difference was detected between the conventional pacifier users and the physiological pacifier users. Reliance intervals showed that there was no significant difference for the probability of having normal palate shape between the control group and the physiological pacifier group (Figs 9 and 10).

Labial tonicity was not statistically significant in the control group (*P*=.083). More than half (74%) of the children in this group had normal labial tonicity, while in the other 2 groups this value was smaller, amounting to 55% for the physiological pacifier group and 43% for the conventional pacifier group.

Discussion

In agreement with many studies performed earlier, children with a pacifier sucking habit in this study showed greater alterations on primary occlusion, such as anterior open

bite,[8-12,15,21-23] posterior crossbite,[8,10,11,23] Class II primary canine relationship,[11,12,22] decrease of upper intercanine width,[14,23,24] and increased overjet[11,14,22] when compared to habit-free children. In relation to the oral myofunctional structures, studies also showed alterations on the shape of hard palate[5,17] and tonicity of lips and tongue.[5,17,25]

In this study, most of the children began pacifier use before 6 months of age, thus, probably before tooth eruption. Duration of pacifier use was very similar among the 2 pacifier groups. It was not possible to assess the exact "hours of pacifier use per day" by the questionnaire. Mothers had difficulty remembering frequency of use in number of hours. Therefore, we estimated pacifier frequency use by analyzing "period of day the child used the pacifier." Frequency of use was also very similar between the 2 pacifier groups, since most of the children used their pacifiers at sleeping time and a smaller number of children used them throughout the whole day. Thus, the differences in degree and the occurrence of malocclusions between the conventional and physiological pacifier groups that were observed in the present study were probably due to the difference in pacifier design rather than difference in hours of use per day, frequency of habit, or starting age. This is in agreement with Adair et al,[9,11] who found no relationship between hours of use per day and any aspect of malocclusion , as well as with Adair et al,[9] who observed that duration of use in months was not related to malocclusion.

This study clearly demonstrated that children in the control group (habit free) had significantly less occurrence and degree of alterations on occlusion and oral myofunctional structures than the ones in the pacifier groups. When these characteristics in the physiological pacifier group and the conventional pacifier group were compared, it was also detected that the incidence and degree of some occlusal alterations were lower in the former group. Hence, the name "orthodontic" pacifier is wrongly used. The more physiologically designed type of pacifier should be named physiological, given that they have a design that is more suitable to the structures of the oral cavity. However, it is important to mention that the physiological pacifier may also bring about some changes on occlusion and surrounding oral structures of preschool children with prolonged sucking habits. These same findings were reported by Adair et al.[9,11] These authors affirmed that when comparison was made between the physiological and conventional pacifier users in relation to mean overjet, mean open bite, occurrence of open bite and posterior crossbite, no clinically significant difference was found. They also mentioned that there seemed to be no advantage of physiological pacifier use over the conventional ones. However, these 2 studies evaluated children who had discontinued their habits and those who were active pacifier users together; meanwhile in this study, only active pacifiers users were included.

Ideally, it would be best if children were only breast-fed and used neither the bottle nor the pacifier. Since this is unrealistic, mothers should be carefully oriented about bottle and pacifier use. Mothers should also be warned about the correct sucking position of the physiological pacifier and the ideal time for discontinuation of nonnutritive sucking habits, which should occur between the second and third year of life.[13,18,33] After this period, nonnutritive sucking is regarded as a prolonged sucking habit.

Though other studies have evaluated the effects of "orthodontic" (physiological) pacifiers on the primary dentition by comparing them to a control group composed of children with no sucking habits and by also comparing them to a group who used conventional pacifier,[9,11] there has been no previous study that also evaluated some oral myofunctional structures across these 3 groups and that studied children who had exclusively used either the physiological pacifier or the conventional one. In this study, all children who at any time sucked both types of pacifiers (conventional and physiological), who started to use one type and then moved on to the other type, who discontinued this sucking habit, and who currently or previously had digit- or finger-sucking habits *did not participate*. Therefore, in the present study, only children who had exclusively used the same type of pacifier since the very development of their nonnutritive sucking habit up until the time of the evaluation were included. This explains the low number of children in each group, but it also provides more accurate information on the effects of pacifier sucking on the primary occlusion and surrounding oral structures.

It is important to note that a Class I canine relationship was more frequent in the control group and a Class II relationship was more frequent in both pacifiers groups. In his study, Ravn[22] found a prevalence of 46% of a Class II canine relationship on both sides among children who had sucking habits. In relation to posterior crossbite, there is no definite agreement among authors. While some found no significant difference between the children with sucking habits and the control group,[9,12,14] other studies showed association between pacifier use and posterior crossbite.[8,10,11,23,24] Adair et al[11] found a posterior crossbite in 16% of the children who used the conventional pacifier and in 13% of the ones who sucked the physiological one; however, in their study, no statistically significant difference was found between the 2 groups.

In this study, ANOVA showed that there was a statistically significant difference between the 3 groups evaluated in mean overjet. The results were similar to the ones that Ravn[22] detected, in which mean overjet prevalence between 0 and 2 mm was higher among habit-free children. Foster and Hamilton[28] stated that a normal overjet should be between 0 and 2 mm. Similar to the results of the present investigation, many studies indicated that the mean overjet in children who had a pacifier sucking habit was higher than the ones who did not have this habit.[9,11,14] Farsi et al[12] noticed that 50% of the children who had a pacifier habit showed a mean overjet equal to or higher than 4 mm.

Adair et al[9] described an interesting fact. They observed a statistically significant difference on the mean

overjet between children who sucked the "orthodontic" (physiological) pacifier (3.04 mm) when compared to the ones with no sucking habit (2.12 mm) or to those who sucked the conventional one (2.63 mm). On the other hand, they did find what was common to several studies: that children with no sucking habits had a lower mean overjet when compared to the ones with a pacifier sucking habit.

A similar pattern was observed in anterior open bite occurrence. Many studies showed that anterior open bite prevalence was significantly higher among children with pacifier habit when compared to habit-free ones.[8-12,21-23] Contrary to the results observed in this study, Adair et al[11] found a higher prevalence of anterior open bite in the children who sucked the conventional pacifier (24%) than in the habit-free group (3%) or orthodontic pacifier group (13%).

The mean anterior open bite observed by Adair et al[11] for the children who used the conventional and orthodontic (physiological) pacifiers were 2.6 and 2.9 mm, respectively. These values were lower than the ones found in this study for the same groups. In both studies, there was no statistically significant difference between the children who sucked the conventional pacifier and those who sucked the physiological one.

The results found in this study for the upper intercanine width are in agreement with those described by Bowden[14] and Larsson,[23] who also found a smaller width among children with a pacifier habit. On the other hand, the lower intercanine width was practically the same across the 3 groups evaluated.

According to Larsson[23] and Øgaard et al,[24] a prolonged pacifier-sucking habit decreases intercanine width of the upper arch and increases it on the lower arch. They explain that this occurs because the tongue stays in a more inferior position in the oral cavity when the child is sucking a pacifier. Øgaard et al[24] also affirmed that one of the most important factors for developing posterior crossbite was the difference between the upper intercanine width and the lower one. Thus, the smaller this difference is, the higher the chances of posterior cross bite occurrence. Larsson[23] warned that the risk of developing posterior crossbite was even higher if this difference was smaller than 3 mm.

In our daily practice, we observe that children with sucking habits have alterations in their lips and swallowing pattern. Very few experimental studies were conducted in this field. Most merely report the alterations of the oral myofunctional structures, and no other study compared these structures in children who used a physiological pacifier to the ones who used the conventional one.

Some authors mentioned that there is an association between a narrow and high hard palate and children with sucking habits.[5,16-18] According to Larsson,[23] this can be explained by the fact that the tongue is forced and remains in an inferior position when the child is sucking a pacifier. Furthermore, the pacifier nipple is pressed against the hard palate by the tongue[16] and the upper teeth in the canine and molar area lack palatal support from the tongue during sucking exercise, decreasing arch width.[23] It is clear that the shape of the hard palate depends on the width of the upper arch. Therefore, if this width decreases, the hard palate becomes narrower and there is less space for the tongue.

When the child inserts the nipple of a pacifier into his or her mouth, it occupies the functional space of the mouth, displaces the tongue to a lower position, and separates the lips.[27] Camargo et al[4] pointed out that the physiological pacifier has a narrower nipple and therefore avoids a greater separation of the upper and lower lips.

Children who have prolonged pacifier-sucking habits often need to have orofacial myofunctional therapy to modify, alleviate, and diminish habits that cause negative impact on the normal growth and development of the orofacial complex. Orofacial myofunctional therapy might provide the pediatric dentist with another method of arresting the abnormal growth pattern associated with excessive habits.[33]

Although not statistically significant, it is important to mention that more than half of the children in the control group had normal lip tonicity, while a smaller percentage of children in the pacifier groups had this characteristic.

It would be ideal if pediatric dentists and orofacial myofunctional therapists shared their knowledge and worked together as a team in research.[33] More studies are necessary in this field, especially the ones regarding alterations on the surrounding oral structures and oral functions.

Conclusions

1. More occlusal and oral myofunctional alterations were detected among children who had pacifier habits, either conventional or physiological, when compared to those with no sucking habits. Children who were pacifier users (physiological and conventional) were significantly more likely to show open bite, posterior crossbite, increased overjet, and alteration in cheek mobility than habit-free children.
2. The prevalence and degree of some alterations were lower in the physiological pacifier group than in the conventional pacifier group.

References

1. Gorelick L. On the use of pacifiers in preventing malocclusions. *NY State Dent J.* 1955;21:3-10.
2. Sim JM, Finn SB. Oral habits in children. In: Finn SB, ed. *Clinical Pedodontics.* 4th ed. Philadelphia, Pa: WB Saunders Company; 1973:370-385.
3. Larsson E, Dahlin KG. The influence and the etiology of the initial dummy- and finger-sucking habit. *Am J Orthod.* 1985;87:432-435.
4. Camargo MC, Modesto A, Coser RM. Uso racional da chupeta. *J Bras Odontopediatr Odontol Bebé.* 1998;1:44-47.
5. Black B, Kövesi E, Chusid IJ. Hábitos bucais nocivos. *Ortodontia.* 1990;23:40-44.

6. Norman RAV. Digit-sucking: a review of the literature, clinical observations and treatment recommendations. *Int J Orofac Myol.* 1997;23(special issue):14-34.

7. Sies ML, Carvalho MP. Uma visão fonoaudiológica em Odontopediatria na primeira infância. In: Correa MSNP. *Odontologia na Primeira Infância.* São Paulo, Brazil: Santos; 1998:39-53.

8. Larsson E. Dummy- and finger-sucking habits in 4-year-olds. *Swed Dent J.* 1975;68:219-224.

9. Adair SM, Milano M, Dushku JC. Evaluation of the effects of orthodontic pacifiers on the primary dentitions of 24- to 59-month-old children: preliminary study. *Pediatr Dent.* 1992;14:13-18.

10. Paunio P, Rautava P, Sillanpää M. The Finnish family competence study: the effects of living conditions on sucking habits in 3-years-old Finnish children and the association between these habits and dental occlusion. *Acta Odontol Scand.* 1993;51:23-29.

11. Adair SM, Milano M, Lorenzo I, Russell C. Effects of current and former pacifier use on the dentition of 24- to 59-month-old children. *Pediatr Dent.* 1995;17:437-444.

12 Farsi NMA, Salama FS, Pedo C. Sucking habits in Saudi children: prevalence, contributing factors, and effects on the primary dentition. *Pediatr Dent.* 1997;19:28-33.

13. Tomita EN, Bijella VT, Franco LJ. Relação entre hábitos bucais e má oclusão em pré-escolares. *Rev Saúde Pública.* 2000;34:299-303.

14. Bowden BD. The effects of digital and dummy sucking on arch widths, overbite, and overjet: a longitudinal study. *Aust Dent J.* 1966;11:396-404.

15. Dadalto ECV. Hábitos de sucção de dedo e/ou chupeta: estudo seccional. Rio de Janeiro; 1989:63. Dissertação (Mestrado em Odontopediatria)–Faculdade de Odontologia da Universidade Federal do Rio de Janeiro. (Summary)

16. Gomes ICD, Proença MG, Limongi SCO. Avaliação e terapia da motricidade oral. In: *Temas de Fonoaudiologia.* 5th ed. São Paulo, Brazil: Loyola; 1993:59-119.

17. Marchesan IQ. Motricidade oral–visão clínica do trabalho fonoaudiológico integrado com outras especialidades. São Paulo, Brazil: Pancast; 1993:71.

18. Soares CAS, Totti JIS. Hábitos deletérios e suas conseqüências. *Rev CROMG.* 1996;2:21-26.

19. Adair SM. Nonnutritive sucking habits in infants and preschool children: a review and recommendations for anticipatory guidance. *Master Clin Pediatr Dent.* 1996;4:14-20.

20. Carvalho MP. A fonoaudiologia e suas relações com a odontopediatria. In: Guedes-Pinto AC, ed. *Odontopediatria.* 6th ed. São Paulo, Brazil: Santos; 1997:855-874.

21. Bowden BD. A longitudinal study of the effects of digit- and finger-sucking. *Am J Orthod.* 1966;52:887-901.

22. Ravn JJ. Sucking habits and occlusion in 3-year-old children. *Scan J Dent Rev.* 1976;84:204-209.

23. Larsson E. Artificial sucking habits: etiology, prevalence and effect on occlusion. *Int J Orofac Myol.* 1994;20:10-26.

24. Øgaard B, Larsson E, Lindsten R. The effect of sucking habits, cohort, sex, intercanine arch widths, and breast or bottle feeding on posterior cross bite in Norwegian and Swedish 3-year-old children. *Am J Orthod Dentofac Orthop.* 1994;106:161-166.

25. Cunha SRT, Corrêa MSNP, Oliveira PML, Schalka MMS. Hábitos bucais. In: Correa MSNP. *Odontopediatria na Primeira Infância.* São Paulo, Brazil: Santos; 1998:561-576.

26. Profitt WR. On the aetiology of malocclusion. *Br J Orthod.* 1986;13:1-11.

27. Modesto A, Vieira AR, Camargo MCF. Avaliação do uso e das características das chupetas utilizadas por crianças do município do Rio de Janeiro. *J Bras Odontopediatr Odontol Bebê.* 1999;2:438-441.

28. Foster TD, Hamilton MC. Occlusion in the primary dentition–study of children at 2-1/2 and 3 years of age. *Br Dent J.* 1969;26:76-79.

29. Brunner V. *Estudo da relação terminal dos segundos molares decíduos (plano vertical, degrau mesial e degrau distal para a mandíbula) e relação incisal (sobremordida e sobressaliência), em crianças caucasóide, na faixa etária de 3 a 6 anos.* São Paulo, Brazil: Tese (Doutorado em Odontopediatria)-Faculdade de Odontologia da Universidade de São Paulo;1990:83.

30. Bishara SE. Jakobsen JR, Treder J, Nowak A. Arch width changes from 6 weeks to 45 years of age. *Am J Orthod Dentofac Orthod.* 1997;111:401-409.

31. Baume LJ. Physiological tooth migration and its significance for the development of occlusion. I. The biogenetic course of the deciduous dentition. *J Dent Res.* 1950;29:123-132.

32. Lindner A, Hellsing E. Cheek and lip pressure against maxillary dental arch during dummy sucking. *Eur J Orthod.* 1991;13:362-366.

33. Haruki T, Kishi K, Zimmerman J. The importance of orofacial myofunctional therapy in pediatric dentistry: Reports of two cases. *ASDC J Dent Child.* 1999; 66:103-109.