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Artificial Sucking Habits: Etiology, Prevalence and Effect on Occlusion

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Active digit-sucking results in 1) reduced vertical growth of the frontal parts of alveolar process which creates an anterior open bite; 2) proclination of the upper incisors as a result of the horizontal force created by the digit; 3) anterior displacement of the maxilla for the same reason; 4) anterior rotation of the maxilla, resulting in an increased prevalence of posterior crossbite in the deciduous dentition; and 6) proclination or retroclination of the lower incisors which seems to be due to the strength of the tightness of the lower lip and tongue activity during sucking. When the sucking habit stops, the anterior open bite will correct itself spontaneously, due to increased growth of the alveolar processes, provided that the patient is still growing. If the lip activity and the lip/teeth relationship is normal, the upper incisors will upright themselves, and sometimes, due to the anterior displacement of maxilla, become somewhat retroclined. The skeletal effect of the sucking habit will remain.

Improper use of a pacifier can create quite disastrous effects on the occlusion, if, for instance, the child has the shield inside the lower lip or is biting into the shield. Otherwise, the effect of the pacifier is limited to the vertical and the transversal plane. The anterior openbite is normally more obvious and visible earlier in pacifier-suckers than in digit-suckers. As in digit-suckers, the open bite is associated with tongue-thrust during swallowing. Also in pacifier-suckers, the open bite will correct itself spontaneously when the habit stops despite the tongue-thrust. Sucking a pacifier is more clearly related to a posterior crossbite in the deciduous dentition than is digit-sucking. When the pacifier is in the child's mouth, the teat occupies the upper part of the anterior and middle part of the mouth thus forcing the tongue to a lower position. In the upper jaw, the teeth in the canine area lack palatal support from the tongue during the sucking activity of the cheeks. This reduces the arch width and increases the risk of a transversal malrelation between the upper and lower arches. The low tongue position widens the lower jaw in the same area thus enhancing the probability of the development of a posterior cross-bite.

INTRODUCTION

It has been suggested (Larsson, 1985) that there are three different types of sucking habits: pacifier-sucking, digit-sucking and unrestricted breast-feeding or non-nutritional suckling. Unrestricted breast-feeding or suckling means sucking on the mother's breast for comfort, physiological contact, and satisfaction of the sucking urge, but not primarily to get milk. This behavior could be considered the genuine physiological sucking habit, different from pacifier and digit-sucking which, for the purpose of this presentation, are referred to as artificial sucking habits.

Artificial sucking habits are most common in modern Western cultures. According to Zadic et al. (1977) 95 percent of children investigated in Jerusalem developed an artificial sucking habit. Prevalence of 80-90 percent have been reported in several studies (Heckman, 1964; Modeer et al., 1982; Larsson, 1983; Larsson et al., 1992). Opinions about the cause of these high and increasing prevalences are varied and often based on personal observations and general assumptions.

In a recent review paper, Larsson wrote that *Breast-feeding mammals in early infancy can be divided into two different groups, continual or spaced feeders. Continual feeders are most primates, bats and marsupials, as well as those whose infants follow them. Spaced feeders are those that leave their infants in nests, such as tree shrews and rabbits. Continual feeders receive more diluted milk, with lower fat and protein content. They suck slowly but often as they are either clinging on the mother or in close proximity. Spaced feeders receive more concentrated milk and suck quickly but less often.*

Higher primates, such as apes, chimpanzees and humans who live traditionally, are continual feeders. They have frequent but brief nursing periods, normally until 3 - 4 years of age. For instance, the !Kung Sans living in the Kalahari dessert have a traditional society. They are continual feeders. The child suckles several times an hour. According to Konner and Worthman (1980) they suckle on average every 13th minute during the daytime. They sleep with the mother and also suckle several times during the night, often without waking the mother. The !Kung San infants are not able to cling so the mother uses a sling, which gives her maximal non-restrictiveness, leaving her arms and legs free. It allows skin-to-skin contact between mother and infant and keeps the infant on the mother's hip, allowing it to see what the mother sees. The infant has constant access to the mother's breasts, which are uncovered, and feeds whenever he or she likes.

Corresponding reports have been given from the Zinacantecos of highland Chiapas in southeastern Mexico (Brazelton, 1977), the Kolla people in the mountains of New Britain in Papua, New Guinea (Lindrud and Lindrud) and from Zaire (Silow).

Artificial sucking habits are not mentioned in the reports on the !Kung people and probably do not exist or are extremely rare (Kolata, 1974; Konnor, 1977; Konnor and Worthman, 1980; Shostak, 1976). Brazelton (1977) states that among the Zinacantecos *breast was used as a pacifier in every way* and the artificial sucking habits were extremely rare.

This author concludes: Throughout evolution, higher primates have been continual feeders. This was also true for humans. Following agricultural and industrial development, humans became spaced feeders but so far have not succeeded in eliminating the infants sucking urge. This offers an explanation of the etiology of artificial sucking habits.

PACIFIER-SUCKING

During recent decades pacifier-sucking has increased greatly in Sweden. Today about 70 percent of all young infants develop a pacifier-sucking habit (Fig 1).

It should be kept in mind that the pacifier is in the child's mouth before the eruption of the teeth. The pacifier, as well as the digit, does not create the anterior open bite, normally associated with the habit. It does hinder the full eruption of the incisors and the vertical growth of the alveolar process (Larsson and Ronnerman, 1981).

Normally the habit has stopped by 3 - 4 years of age. In those rare cases when the child still

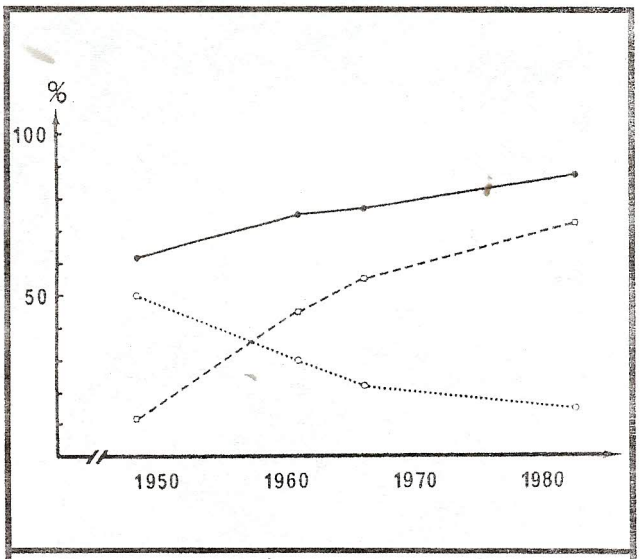

Fig. 1: The development of pacifier - (-----) and digit-sucking (•••••)habits in Sweden according to Klackenberg (1949) and Larsson (1971, 1975, 1983). The solid line represents the total number with artificial sucking habit.

sucks at the time of the eruption of the permanent incisors, the anterior open bite can be quite striking. It is the author's experience that children with these anterior open bites typically swallow with a tongue thrust.

When the sucking habit ceases, incisal contact is usually established in a rather short time. Among 9 year olds, who at one time had been pacifier-suckers, there was no difference in overbite compared to children with no earlier sucking habit (Larsson, 1972). Among 16 year olds, no incisal contact was three times as common among previous non-suckers as among previous pacifier/dummy-suckers (Table 1) (Larsson, 1978).

Atypical use of the pacifier can have a negative effect on the occlusion. Sometimes, the child discovers an atypical way of using the pacifier. About one third of all pacifier-suckers, for instance suck their pacifiers sometimes with the shield partly inside the lower lip. (Fig. 2a). This can cause disastrous effects on the dentition and affect the thin marginal bone of the anterior part of the mandible (Fig 2b, c). In rare cases, asymmetric use of a pacifier can have remarkable effects on the occlusion. The author has come across a young pacifier-sucker referred for medical care because of a presumed growth disturbance in the anterior part of the mouth. A large diastema can also be aggravated by the use of a pacifier (Fig 3).

Pacifier-sucking is more common today than some fifteen-twenty years ago (Fig 1), but persists longer (Larsson, 1985; Larsson et al., 1992) and often occurs outdoors when the child is playing. It seems as if the pacifier has been accepted as a part of the child's clothing, with which it is often matched in color. Sometimes the pacifier is tied to the child's clothes or some part of the baby carriage with a piece of string or a telephone cord. The author has observed parents tying a piece of cloth to the ring of the pacifier. Several pacifiers are sometimes tied together, giving the child a choice of which one to suck, while the others are hanging outside the mouth. In this situation, the extra-oral weight of the pacifiers can act as a lever, creating an effect on the dentition similar to that of digit-sucking (Larsson, 1978).

Several studies have revealed an increased prevalence of posterior crossbite in the deciduous dentition in Swedish pacifier-suckers (Larsson, 1975; Modeer et al, 1982; Kohler et al., 1973),

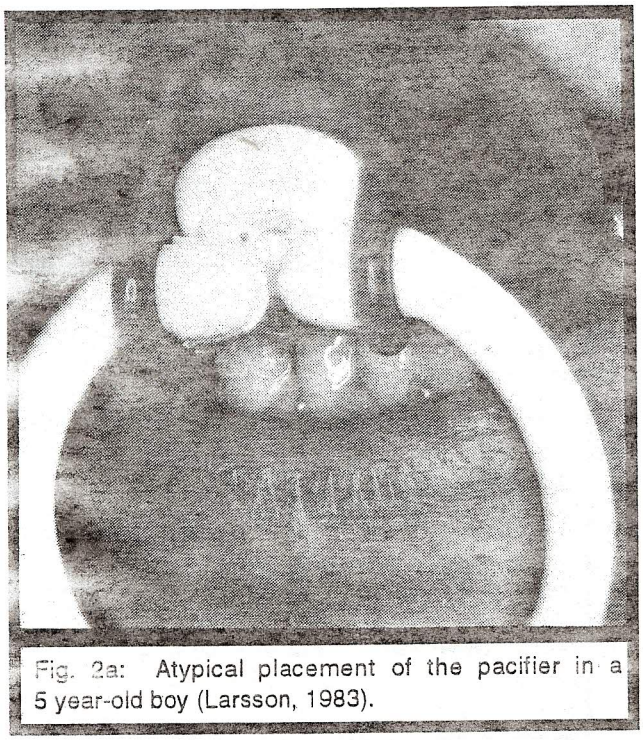

Fig. 2a: Atypical placement of the pacifier in a 5 year-old boy (Larsson, 1983).

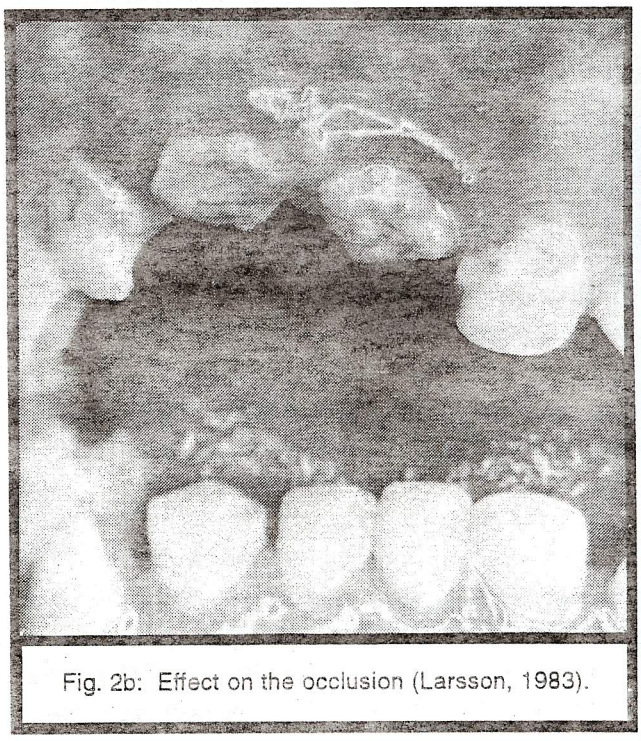

Fig. 2b: Effect on the occlusion (Larsson, 1983).

	Digit - suckers	Pacifier- suckers	Controls
n	51	44	39
Neutral bite	71	96	85
Postn.occl Cl.II:1	29	2	5
Postn.occl.Cl.II:2		2	2
Prenormal bite			8
Unilateral crossbite	8		2
Bilateral crossbite	6	5	5
Posterior lingual crossbite		5	
No incisal contact	6	5	18
Traumatized or lost teeth	10	7	2
Teeth extracted for orthodontic reasons	67	11	35
Treatment need 0	18	32	21
Treatment need 1	35	41	44
Treatment need 2	37	27	31
Treatment need 3	8		5
Treatment need 4	2		
Cl. II:1 treatment with headgear	24		3
Cl. III treatment			10

1 pat. noted for operative correction
1 pat. treated with full band and Cl. III traction
1 pat. head-cap/chin-cap
1 pat. Bensow plate

Table 1

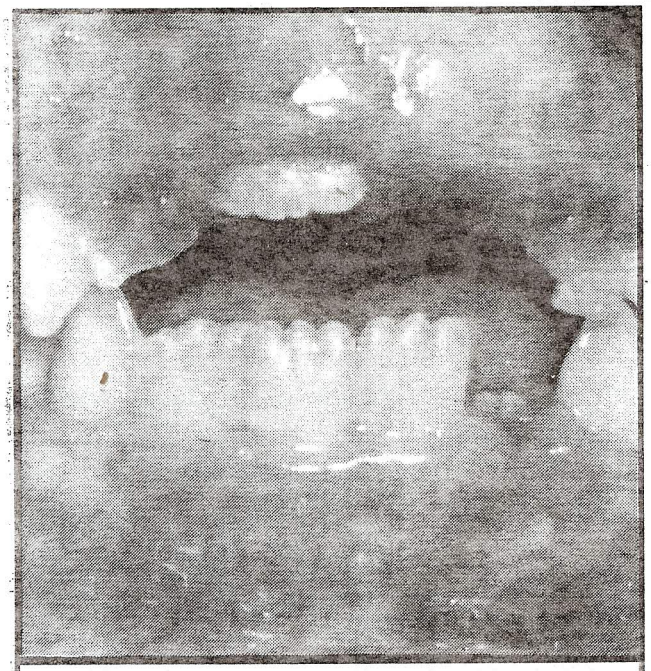

Fig. 2c: Spontaneous improvement after stopping the habit (Larsson, 1986).

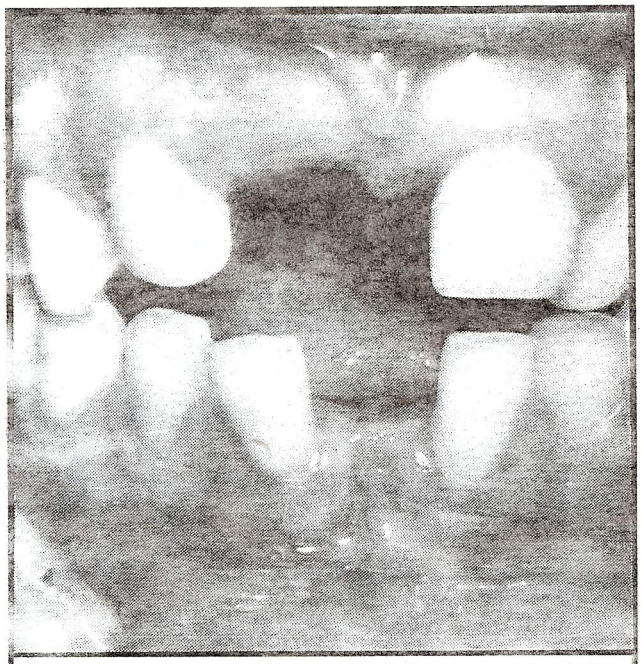

Fig. 3: Diastema in the lower jaw, aggravated by the use of a pacifier.

especially girls (Ogaard et al., 1994), but also in Danish children (Kisling et al., 1976; Kristensen, 1992). Larsson has also noted that the prevalence among 3 - 4 year old pacifier-suckers from the county of Skaraborg in southwestern Sweden is increasing. Between the years of 1975 and 1990 the prevalence of posterior crossbite in these children rose from 13 to 20 percent. Especially high is the figure for the girls, 26 percent. However, a comparison between Swedish and Norwegian 3 year-olds (Larsson et al, 1992; Ogaard et al, 1994), showed an almost normal prevalence of crossbite among Norwegian pacifier-suckers, high prevalence in Swedish non-suckers compared to the Norwegians. The Swedish children had significantly narrower jaws with or without sucking habits. In medieval skulls with intact deciduous dentition, no crossbites were recorded.

A comprehensive statistical analysis of the intercanine arch widths in the Swedish and Norwegian 3 year-olds showed that the development of a posterior crossbite was significantly correlated to a narrowing of the upper jaw. This had also been shown by Modeer et al. (1982). Lindner and Helsing (1991), registered increased muscle activity in the canine area in young pacifier-suckers. Ogaard et al (1994), also registered a significant correlation between the development of posterior crossbite and an increase in the mandibular intercanine arch widths.

In several studies (Larsson, 1986; Ogaard et al., 1994; Lindsten et al.) the following hypothesis about the relation between the pacifier-sucking habit and cross-bite has been suggested: For many children the pacifier has become a natural part of the oral environment. The pacifier is in the child's mouth most of the time during the day and often throughout the night. The pacifier is not often sucked, but simply stays in the mouth passively. When playing, for instance, it is a good way for the parents to prevent the child from putting objects into the mouth. Most children are so used to the pacifier that they are capable of speaking intelligibly with it in the mouth (Lindsten, et al.) When the teat of a pacifier becomes almost a natural part of the mouth, changes will occur in the surrounding tissues. The tongue has to take a lower position in the anterior part of the mouth. In this way, the palatal support of the upper deciduous canines and the first molars against the pressure of the cheeks is reduced. The tongue will also exert increased lateral pressure

on the lower canines and the first molars (Fig 4). The lack of palatal support from the tongue will result in a narrower upper arch, and the pressure of the tongue will widen the lower arch. Both these changes in equilibrium act to create a transversal disharmony in the canine region, which will increase the risk of a posterior crossbite developing.

According to Proffit (1986), a pressure against the teeth has to exist for at least 6 hours per 24 hours to result in tooth movement. Differences in hours per day with the pacifier in the mouth, rather than sucking intensity, could probably explain why some children develop a posterior crossbite more often than others.

The effect of pacifier-sucking on the occlusion has been studied in 3 year-old (Ogaard et al, 1994) and 4 year-old pacifier-suckers and in former pacifier-suckers at 4 years of age (Larsson, 1975), and 9 years of age (Larsson, 1972) and at 16 years of age (Larsson, 1978) compared to children with no earlier sucking habit. The studies of the 9 and 16 year-olds included lateral cephalometric x-rays. In the 16 year-old former pacifier-suckers, there was a reduction in anterior facial height and in the inclination of the mandibular plane, compared with the control group, indicating an anterior rotation of the mandible. A tendency towards increased prognathism as well as proclination of the incisors was recorded. A similar trend was observed in the 9 year-old group.

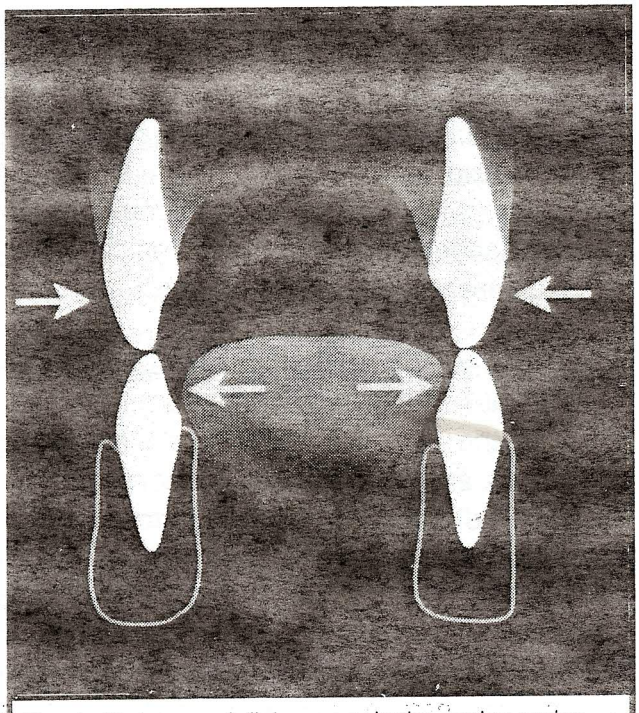

Fig. 4: Transversal disharmony in the canine region.

The need for orthodontic treatment in the 16 year-old former pacifier-suckers was less compared to children with no previous pacifier-sucking habit, and particularly compared to previous digit-suckers (Table 1). Indeed, the arches of previous pacifier-suckers were well developed and crowding was rare. It might be speculated that the muscle activity caused by pacifier-sucking during early childhood could be of some beneficial influence on the development of the arches, as well as promoting the slight anterior rotation of the maxilla and the mandible.

The main reason, from the orthodontist's point of view, for accepting pacifier-sucking is that it reduces the number of children, who develop a digit-sucking habit (Larsson and Dahlin, 1985; Larsson, 1985). If children are forced to break the sucking habit at too young an age, there is a risk that they will develop a digit-sucking habit instead (Larsson, 1971; 1985). This risk is greater for girls (Larsson, 1971). Therefore, one should have good reasons for trying to break a pacifier-sucking habit.

Those dealing with pacifier-sucking, should attempt to prevent the child from using the pacifier incorrectly. Many of the problems described above can be controlled by educating the parents. Today many children have the pacifier in their mouth almost full-time. In these cases, it should be pointed out that pacifier-sucking is a substitute for non-nutritive feeding or unrestricted breast-feeding and not a physiological part of the baby's growth. The need for physical contact between mother and the baby should also be stressed.

Pacifier-sucking does not normally indicate a case for orthodontic treatment. In almost all cases the anterior open bite will close spontaneously when the habit terminates. If the

difference between the upper intercanine arch widths and that of the lower arch falls below 3 mm, the risk of a posterior crossbite is high and the parents should be encouraged to reduce the pacifier-sucking time. If a unilateral crossbite develops in combination with a forced lateral guidance of the mandible, this should be treated immediately by grinding the primary dentition to adjust the occlusion.

In those rare cases, in which it is decided to try to break a pacifier-sucking habit, the following method is recommended. The therapist, the child and the parents decide to break the habit on a special day some months ahead. A suitable day to choose is the last school day before a holiday. The child selects 4 - 5 small presents for the parents to buy. On the appointed day the child brings all his/her pacifiers to the therapist. As an encouragement, the child receives one of the presents bought earlier, every day during the first few days.

DIGIT-SUCKING

The prevalence of digit-sucking in young children has decreased greatly in Sweden during recent decades; from 50 percent in the late forties (Klackenberg, 1949) to about 30 percent twenty years later (Larsson, 1971) and today about half that number (Larsson, 1983); Larsson et al., 1992). The main reason for this change is the increase in the proportion of children who start sucking a pacifier.

Digit-suckers, especially girls, have greater difficulty breaking their habit than those who suck a pacifier. Of those who start digit-sucking, 50 percent will still retain the habit at the age of 7 years. As a result of the reduced prevalence of initial digit-sucking, the number of children with a prolonged digit-sucking habit has also diminished.

In a young child, the effect of a digit-sucking habit is normally not as obvious as that of pacifier-sucking. There is a lack of firm incisal contact but, less frequently, an anterior open bite. In the permanent dentition, the effect on the vertical dimension can be sometimes quite severe. The anterior open bite is mainly caused by reduced alveolar growth (Larsson and Ronnerman, 1981), but the maxilla also rotates anteriorly (Larsson, 1972). As in pacifier-suckers, the open bite is typically associated with tongue-thrust swallowing. A spontaneous correction of the open bite will take place when the sucking habit ceases (Larsson, 1978). The alveolar processes seem to accelerate in growth and the incisors in both jaws erupt until incisal contact has been established. In 16 year-old children, who had been digit-suckers until at least 9 years of age, lack of incisal contact of the lower incisors was actually considerably lower than in corresponding children with no earlier sucking habit (Larsson, 1978). If incisal contact cannot be obtained because of a retruded or overjet relationship, the open bite often will end up as a deep bite with givgival contact. However, in the author's experience, in those rare cases when the sucking habit is prolonged beyond the pubertal growth spurt, the open bite will usually not correct itself spontaneously.

Asymmetric use of a digit can create quite disastrous effects on the alveolar processes and dentition (Fig 5).

In the anteroposterior direction, the effect of digit-sucking in a young child is not especially noticeable. Often there is only a slight spacing in the incisor region and a slightly increased overjet. This effect increases with age and, in the permanent detention, the effect of continued digit-sucking is usually quite obvious.

It is useful to distinguish between two types of digit-sucking: Typical thumbsucking or sucking with the ventral side of the fingers facing the palate and the maxillary incisors; and sucking with the dorsal side of the fingers upwards. In the latter case the finger or fingers lie passive and the effect should be similar to that of pacifier-sucking. This type of finger-sucking is comparatively uncommon. In the former case, sucking of the thumb or one or more of the other fingers with the

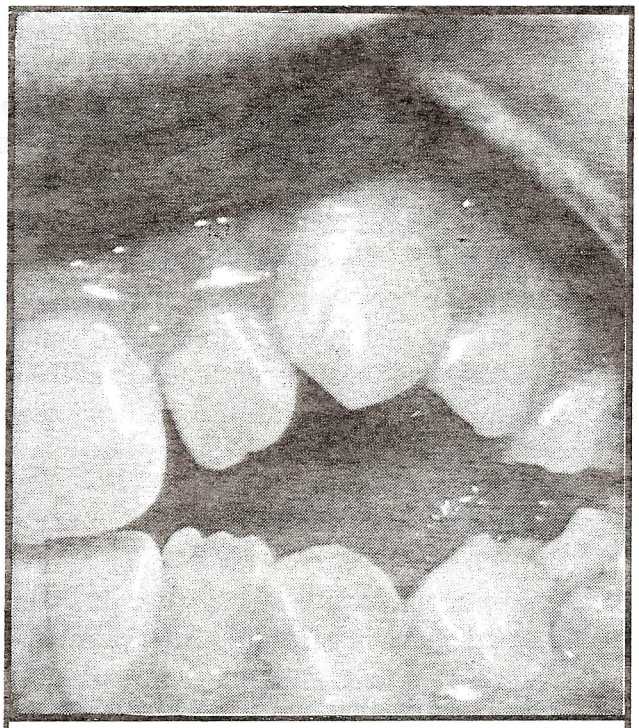

Fig. 5: Dental effect of asymmetric digit-sucking.

ventral side towards the palate, the digit will form a lever, the longer part of which consists of a part of the digit, the wrist and the forearm. The force produced by this lever may be divided into horizontally and vertically directed components. As in the case of pacifier-sucking, the vertically directed component of the force obstructs vertical growth of the maxilla and the alveolar process. The horizontally directed component affects the horizontal growth of the maxilla and also the inclination of the maxillary incisors. The result is that the maxillary dental arch becomes lengthened, the anterior teeth of the upper arch become anteriorly displaced and the maxillary incisors become protruded and proclined. A strained and incomplete closure of the lips is observed often in these cases. The risk of traumatic dental injury is increased.

When the digit-sucking habit stops, the proclination of the upper incisors will diminish as a result of the lip pressure if the lip function is normal. In some cases with protruded upper incisors and active lips, the proclined upper incisors can end up as retroclined, showing a tendency to a Class II, division 2 relationship. Therefore when the sucking habit stops, the overjet will be close to normal in most cases (Larsson, 1972; 1978). The lengthening and the anterior displacement of the maxilla will remain. This is probably the main reason why underjet is uncommon among digit-suckers. The soft tissue contour, therefore, is more convex in previous digit-suckers than in children without a previous sucking habit (Fig 6).

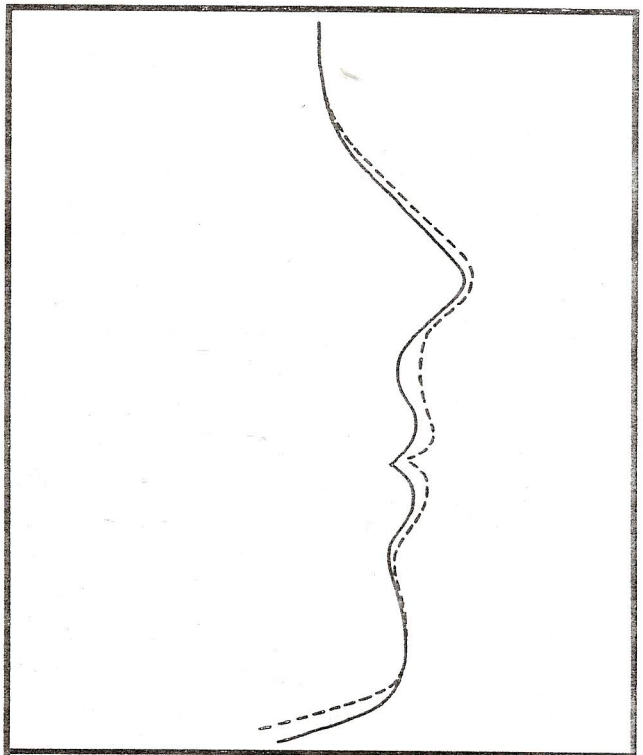

Fig. 6: Average soft tissue contour of thirty-seven 16 year-old previous digit suckers compared with children without earlier sucking habit.

Digit-sucking is associated with an increased prevalence of posterior cross-bite in the deciduous detention. The mechanism is probably the same as for pacifier-suckers. However, the prevalence is not as high as for the pacifier-suckers. The author has been unable to document a corresponding effect of either digit or pacifier-sucking in the permanent dentition. However, an effect in the canine/premolar area is plausible if the habit continues when these teeth are under eruption. Moore (1994) registered an increased lower intercanine arch width in 10 - 16 year-old digit-suckers, however the difference was not statistically significant.

In orthodontic and pedodontic textbooks, prolonged digit-sucking is often said to cause retroclination of mandibular incisors, often in combination with a distal displacement of the mandible (Moyers, 1973). However, cephalometric studies have shown that the mandibular incisors often procline in digit-suckers (Backlund, 1963; Larsson, 1972). Moore (1994) found that the range and standard deviation for lower incisor angulation were much larger for digit-suckers compared to non-digit-suckers. This indicates that while on average, there was no difference, digit-sucking could be associated with either a retroclination of the lower incisors or a proclination. Larsson et al. wrote : *In some children with a prolonged thumbsucking habit, the mandibular incisors are retroclined. However, a proclination of the lower incisors is more common.* In a study he compared children with a continuing digit-sucking habit and proclination of the lower incisors (ILi/ML >97 degrees) cephalometrically and clinically. *In the group with retroclined mandibular incisors the inclination between the thumb and the mandibular incisors was significantly smaller and the lower lip significantly thinner than for the other group. A tendency to earlier loss of deciduous molars was also registered.* Larsson concludes: *The results give some support to the following hypotheses. In a few thumbsucking children, the lower incisors erupt more upright than normal. The reason for this may be early loss of deciduous molars, a tight lower lip, and/or increased perioral muscle activity. As a result of the changed direction of incisor eruption, the angle between the mandibular incisors and the thumb will be sharp which will increase the lingually directed force caused by the thumb on the incisors.*

The effect of digit-sucking on the occlusion has been studied in 3, 4, and 9 year-old digit-suckers and in 16 year-old children who had sucked until at least 9 years of age. The development of the dentition of those children has been compared to that of non-suckers as well as of previous dummy-suckers. The effect of a prolonged digit-sucking often is considerable and the need for orthodontic treatment is often high.

Attempts to stop a digit-sucking habit should be made when the patient has a Class II molar relationship or is developing in that direction. In cases with a pre-normal skeletal pattern (prognathic) the digit-sucking habit can be beneficial for dental development (Larsson, 1978). From an orthodontic perspective, an anterior open bite is no reason for interfering with a digit-sucking habit unless the habit seems likely to continue through puberty, in which case spontaneous correction is doubtful (Larsson and Ronnerman, 1981).

There are, of course, psychological reasons for stopping a sucking habit. A 10 year-old digit-sucker is normally embarrassed because of the habit and is anxious to hide it from friends. If sucking occurs during sleep, for instance, this may interfere with social activities such as staying overnight with friends.

If a patient wants to stop a digit-sucking habit and its effect is limited to the anterior part of the dentition, a removable plate with a palatal crib can be used. The author uses this appliance only when the child has stopped sucking during the daytime and has difficulty avoiding the habit during sleep. The acrylic should be removed from the palatal plate to the incisors to allow them to retrocline when the sucking habit ceases.

Often, the digit-sucking habit is associated with a Class II skeletal and molar relationship, which will worsen the longer the habit continues. In these cases, the author uses a headgear, which will make the sucking more difficult and reduce the protruding effect of the habit on the maxilla. Often, the sucking will continue in spite of the headgear, but probably to a lesser degree and with a less harmful effect on the occlusion. When the sucking habit stops, usually the proclination of the upper incisors will diminish provided that lip closure is normal. If not, or to accelerate this retroclination, a frontal elastic can be fixed to the facebow.

If the overjet is large, so that incisal contact cannot be established when the open bite closes, the mandibular incisors may overerupt and within a few months cause a deep bite with gingival contact. In these cases, it is a good idea to stop the mandibular incisors at a suitable level with a biteplane, an activator or some sort of fixed appliance until the overjet is reduced.

Editorial Note: Sweden does not yet have orofacial myologists, who can motivate most children to stop sucking habits without intra-oral appliances (Hanson & Barrett, 1988; Van Norman, 1985).

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