INTRODUCTION

Oral habits since long have been the topic of interest to the dentist in general and pediatric dentist and orthodontist in particular. The oral habits range from the simple genetic or nongenetic origin to underlying psychological cause.[1]

A habit is a fixed practice produced by constant repetition of an act. At each repetition, it become less conscious, and if repeated often enough, may be relegated to the subconscious. The digit-sucking habit is the most common oral fixation seen in children. Either the thumb, or one or more fingers may be sucked to varying extents. Its prevalence appears to be increasing, especially in industrialized countries. The prevalence varies and depends on a number of factors, such as the child's age, sex, socio-economic status and racial background.[2]

The etiology behind the initiation of the digit sucking habit in children has been extensively investigated and divergent explanations have appeared in the literature.[2]

According to Mutafchiev et al (1989) most parents detect and then carefully observe the adverse effect of digit sucking and oral breathing habits in their children. Parents, however, often lack the proper knowledge and motivation to cope with the causes of this condition, and fail to request assistance from dentists when necessary.[3]

Thumb sucking is considered part of normal infancy but, if the habit persists in the long term, a dentoskeletal malocclusion can be induced or an existing one can be worsened. Malocclusion may be reversed if a digital habit is recognized early and appropriate intervention measures are taken.[4] A thorough understanding of digit sucking is important in dentistry. Deformation of the occlusion (with or without basal bone displacement) occurs with prolonged digit sucking. Speech, aesthetics and mastication can also be affected. Although digit sucking is often accepted as part of early childhood, the impact of digit sucking becomes more apparent as the individual grows into adulthood. Unfortunately, orthodontic correction also becomes more difficult as an individual grows older.[5]

The American Academy of Pediatric Dentistry (AAPD) suggested that management of an oral habit is necessary at any time the habit is associated with undesirable dentofacial growth or unfavorable effects on child oral health or when there is a possibility that the oral habit will lead to undesirable sequelae in the permanent dentition. The objectives of the treatment are concentrating to decrease or eliminate the habit and reducing potential harmful effects on the dentofacial complex.

The cessation of harmful habits and the re-establishment of normal occlusion are among the key roles played by interceptive orthodontics. For instance, anterior open bite tends to self-correct when the habit is eliminated. Conversely, if not intercepted early, nonnutritive sucking habits can render relatively simple malocclusion treatment extremely complex.[6]

Treatment of thumb sucking mainly depends upon the willingness of the child to stop the habit. The therapy should be advocated to the child as an aid, but not as a punishment and also to provide psychological support to help the child adjust to it. Various therapeutic approaches include counseling the child, reward system, remainder therapy using a habit limiting appliance. If the behavior modification technique fails, then the preferred treatment modality is using the appliance therapy. The literature describes different approaches to intercept finger sucking such as the use of palatal crib which yielded satisfactory results.[6]

Hence these habits, when excessive or are continued past appropriate developmental necessity, can lead to poor dental health, be socially stigmatizing, and inhibit the development of speech clarity. Therefore, habits require a multidisciplinary approach to provide integral care to child patients.[7]

DEFINITIONS AND CLASSIFICATION OF HABITS

In order to successfully change habits, we have to know what we're dealing with. Habits are routine behaviors done on a regular basis. They are recurrent and often unconscious patterns of behavior and are acquired through frequent repetition. Many of these are unconscious as we don't even realise we are doing them.

Definitions of habit given by different authors[8]

William James (1923):

A new pathway of discharge formed in the brain, by which certain incoming currents tend to escape (Psychological view point).

Johnson (1938):

An inclination or aptitude for some action acquired by frequent repetition and showing itself in increased facility to performance and reduced power of resistance.

Maslow (1949):

A formed reaction that is resistant to change, whether useful or harmful, depending on the degree to which it interferes with the child's physical emotional and social functions.

Dorland (1957):

A fixed or constant practice established by frequent repetition

Moyers (1958):

Learned patterns of muscle contraction of a very complex nature.

Buttersworth (1961):

Frequent or constant practice or acquired tendency, which has been fixed by frequent repetition.

Finn (1972):

An act which is socially unacceptable.

Mathewson (1982):

Learned patterns of muscular contractions.

Stedman (1999):

An act, behavioral response practice or custom established in one's repertoire by frequent repetitions of the same act.

Tandon (2001)[9]

A settled tendency in response to a specific cause resulting from repeated learning.

Rao (2005)[10]

Pernicious Oral Habit

Pernicious means "having a harmful effect, especially in a gradual or subtle way".

Habit is defined as "an automatic response to a specific situation acquired normally as the result of repetition and learning. At each repetition the act becomes less conscious and if repeated often enough, may enter the realm of unconscious habit".

When the habit involving the oral cavity becomes fatal that is when the habit causes defects in orofacial structures it is termed as pernicious oral habit

Classification of Oral Habits[8]

1) Morris & Bohana (1969)

a. Pressure habits

Thumb sucking, tongue thrusting

b. Non-pressure habits

Mouth breathing

c. Biting habits

Pencil biting

2) **Earnest Klein (1971)**

a. Intentional (meaningful)

b. Unintentional (empty)

Eg. If a 5 year + old child is left in the care of a baby sitter for 3 months while his parents are away on vacation, he is lonesome and develops feelings of insecurity in the belief that his parents have deserted him. He resorts to thumb sucking which becomes a meaningful habit where there is direct cause and effect ie. habit caused by definite underlying psychological relationship. It becomes an empty habit if it continues after his parents return home. These meaningless habits which have no need for psychological support, can be easily treated by reminder appliances.

3) Brash (1956)

a. Purely muscular

Eg. Tongue thrusting, lip sucking.

b. Combined activity of muscle of jaw, mouth and thumb

eg. Thumb – sucking.

c. Muscular action combined with introduction of passive object into the mouth

Eg. Pencil chewing.

d. Habits in which muscles of the mouth and jaw take no active part, the effect on the position of the teeth are produced by extraneous pressure eg. abnormal pillowing.

e. Functional disturbance eg. Mouth breathing.

4) Sydney Finn (1975)

a. Non-compulsive

Habits which are easily added or dropped from the child's behaviour pattern as he matures. Children appear to undergo continuing behaviour modification which permits them to release certain undesirable habit patterns and form new and more socially acceptable ones.

b. Compulsive

Habits which are acquired and express a deep seated emotional need. "The habit has acquired a fixation in the child to the extent that he retreats to the practice when ever his security is threatened by events". Attempts to correct the habit may cause anxiety because it acts as a comfort when emotional pressures become too much to bear.

Etiology of such compulsive habits may be in:

- Rapid feeding patterns.
- Too little feeding at a time
- Too much tension during feeding
- Bottle feeding
- Insecurity due to lack of affection by mother.

Finn (1987)

a. Primary
b. Secondary ("co varying response" by Johnson & Larson, 1993)

Children often combine primary oral habits, such as thumb and finger sucking, with secondary habits, such as hair pulling.

Frequently the primary habit can be broken by making the secondary habit impossible to perform.

5) William James (1923)

a. Useful habits

eg. nasal breathing, deglutition, correct tongue posture.

b. Non-useful / harmful

eg. mouth breathing, lip biting, lip sucking.

Useful habits include habits of normal function.

Whereas harmful habits include those which exert pressures/stresses against teeth and dental arches.

Abnormal habits which may interfere with the regular pattern of facial growth must be differentiated from the desired normal habits that are a part of normal oropharyngeal function and thus play an important role in craniofacial growth and occlusal physiology.

6) Kingsely (1956)

Based on nature of habit

a. Functional – eg. mouth breathing.
b. Muscular – eg. tongue thrusting, cheek / lip biting
c. Combined muscular habits – eg. thumb & finger sucking
d. Postural habits – eg. chin propping, face leaving on hand, abnormal pillowing.

7) Johnson & Larson (1993) class of Non-nutritive sucking (NNS) habits :

Level	Description
Level I (+/-)	Boy/girl of any age with a habit that occurs during sleep
Level II (+/-)	Boy under 8 years with a habit that Occurs at one sitting during walking hours.
Level III (+/-)	Boy under 8 years with a habit that occurs across multiple sittings during waking hours.
Level IV (+/-)	Girl under 8 years/boy over 8 years with habits that occur at one sitting during waking hours.
Level V (+/-)	Girl under 8 years/boy over 8 years with habits across multiple sittings during waking hours
Level VI (+/-)	Girl over 8 years with habits during waking Hours

(+/- designates willingness of patient to participate in treatment)

8) Classification by Bayardo et al (1996)

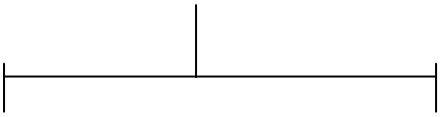
1. Sucking habits
   - digital
   - nursing bottle

- lips
- cheeks
- objects
- atypical deglutition

2. Biting habits
   - oxychophagia (habitual nail biting)
   - bruxism
   - biting body parts
   - biting objects

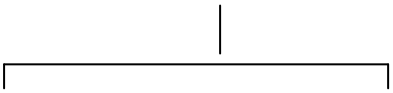
9) Tandon (2001)[9]

Obsessive (deep-rooted)



Non-obsessive

(easily learned & dropped)



Intentional	Masochistic	Unintentional	Functional
or Meaningful	or self-	or empty	habits
eg. nail biting	inflicting	eg. abnormal	eg. mouth
digit sucking	injurious	pillowing,	breathing
lip biting	habit	chin	tongue thrusting
	eg. gingival	propping	bruxism
	stripping		

10) Gurkeerat Singh (2005)

has enlisted the following classifications :

A. According to cause of Habit

a. Physiologic

Those required for normal physiologic functioning.

Eg. nasal breathing, suckling during infancy

b. Pathologic

Those pursued due to pathologic reasons

Eg. mouth breathing due to DNS/enlarged adenoids

B. According to Origin of Habit

a. Retained

Those carried over from childhood into adulthood.

Eg. Thumb sucking, mouth breathing

b. Cultivated/Acquired

Those cultivated during socioactive life of individual

Eg. cigarette smoking.

C. According to patient's awareness of habit

a. Conscious

Involves choice or need, making treatment more difficult and complex

Eg. meaningful thumb sucking.

b. unconscious

Sustained by unconscious behavior.

Simple attenuation of sensory feedback mechanism aids in cessation.

Eg. empty thumb sucking can be cured by reminder appliance.

NUTRITIVE AND NON-NUTRITIVE SUCKING

Therse are essentially 2 forms of sucking[11]

1. **Nutritive form** – which provides essential nutrients (Breast feeding, bottle feeding).

2. **Non-nutritive form** – which provides a feeling of well being, warmth and security. This is probably the earliest sucking habit adopted by infants in response to frustration and to satisfy their urge and need for contact. Children who neither receive unrestricted breast feeding nor have access to pacifier may satisfy their need with alternate activities such as sucking of fingers or other objects (blankets, toys). These NNS habits can soothe infants and young children assist with transitioning to sleep, alienate discomfort of teething provide comfort during stressful episodes.[12]

Rooting and Sucking reflexes are the initial reflexes seen in newborn. So, understanding the processes involved in Nutritive Sucking allows the detection of abnormal conditions as well as to support therapeutic/rehabilitative actions for its correction.

The sucking reflex:

Sucking movements, which are among the earliest coordinated muscle activities, develop during prenatal life. Oral and gag reflexes emerge at 12 to 16 weeks of gestation, slightly earlier than the sucking reflexes which develop at approximately 24 weeks. By contrast, the highly energetic and complex activity of feeding, involving a suck/swallow/breathe cycle, starts to develop much later in prenatal life and is only fully coordinated by 32 to 34 weeks.[13]

Figure 1 Thumb sucking during prenatal period

Coordination of suck, swallowing and breathing during breastfeeding is one of the most intricate processes an infant is required to perform. Efficiency and efficacy of feeding is based on the ability to synchronize all processes while maintaining good cardiovascular stability. Infants are able to suck and swallow, suck and breathe but are unable to breathe and swallow simultaneously.[14]

Suckling or Sucking: Differences between Suckling at the Breast and Sucking at the Bottle

Once an airway has been established, the newborn infant's next physiologic priority is to obtain milk and transfer it into the gastrointestinal system. This is accomplished by two maneuvers: suckling (not sucking, with which it is frequently confused) and swallowing.[14]

The milk ducts of lactating mammals are surrounded by smooth muscle, which contracts to force out the milk. To obtain milk, the infant does not have to suck it from the mother's breast and probably could not do so. Instead, the infant's role is to stimulate the smooth muscle to contract and squirt milk into his mouth. This is done by suckling consisting of small nibbling movements of the lips, a reflex action in infants. When the milk is squirted into the mouth, it is only necessary for the infant to groove the tongue and allow the milk to flow posteriorly into the pharynx and esophagus. The tongue, however, must be placed anteriorly in contact with the lower lip, so that milk is in fact deposited on the tongue.[14]

This sequence of events defines an infantile swallow, which is characterized by active contractions of the musculature of the lips, a tongue tip brought forward into contact with the lower lip, and little activity of the posterior tongue or pharyngeal musculature. Tongue-to-lower lip apposition is so common in infants that this posture is usually adopted at rest, and it is frequently possible to gently move the infant's lip and note that the tongue tip moves with it, almost as if the two were glued together. The suckling reflex and the infantile swallow normally disappear during the first year of life.[14]

As the infant matures, there is increasing activation of the elevator muscles of the mandible as the child swallows. As semisolid and eventually solid foods are added to the diet, it is necessary for the child to use the tongue in a more complex way to gather up a bolus, position it along the middle of the tongue, and transport it posteriorly. The chewing movements of a young child typically involve moving the mandible laterally as it opens, then bringing it back toward the midline and closing to bring the teeth into contact with the food. By the time the primary molars begin to erupt, this sort of juvenile chewing pattern is well established. By this time also, the more complex movements of the posterior part of the tongue have produced a definite transition beyond the infantile swallow.[14]

Nearly all modern infants engage in some sort of habitual non-nutritive sucking-sucking a thumb, finger, or a similarly shaped object. Some fetuses have been reported to suck their thumbs in utero, and the vast majority of infants do so during the period from 6 months to 2 years or later. This practice is culturally determined to some extent, since children in primitive groups who are allowed ready access to the mother's breast for a long period rarely suck any other object.[14]

After the eruption of the primary molars during the second year, drinking from a cup replaces drinking from a bottle or continued nursing at the mother's breast, and the number of children who engage in non-nutritive sucking diminishes. When sucking activity stops, a continued transition in the pattern of swallow leads to the acquisition of an adult pattern. This type of swallow is characterized by a cessation of lip activity (i.e., lips relaxed, the placement of the tongue tip against the alveolar process behind the upper incisors, and the posterior teeth brought into occlusion

during swallowing). As long as sucking habits persist, however, there will not be a total transition to the adult swallow.[14]

The two types of sucking also vary concerning duration, rate, and strength of sucking. Nutritive sucking occurs at a constant rate of one suck per second during breast- or bottle-feeding. Non- nutritive sucking (NNS) occurs at a higher rate of two sucks per second and is believed to satisfy an infant's natural sucking urge or as a means of behavioral state modulation. The differences in development and pattern between the two types of sucking may account for the different effects on craniofacial development.[15]

Older literature on feeding posits that suckling (the front-to-back, wavelike movement of the tongue) changes to sucking (a straight up-and-down movement of the tongue and jaw) at around 3 months of age. A Japanese study of sucking patterns during bottle feeding[16] of previously breastfed and bottle-fed infant showed a transition to a sucking pattern in infants older than age 3 months, but this might have been due to mechanical differences between breast and bottle or the growth of the oral cavity in relation to the static artificial nipple. Electromyography (EMG) studies have confirmed that muscle activation is different between breastfeeding and bottle feeding, with less use of the mentalis and masseter muscles and more use of the buccinator and orbicularis oris muscles in bottle feeding.[17]

Lactation consultants have long been skeptical of the idea that there are two age-dependent forms of sucking at the breast. Our ultrasound suck research has shown that breastfeeding children up to 4 years old use the same sucking pattern reported by Elad and colleagues (2014); Geddes, Kent et al. (2008); and Miller and Kang (2007).

For this reason, the term suckling shall be used to mean the act of feeding at the breast, and the term sucking will be used to describe the oral motor activity that transfers milk, with the understanding that breastfeeding is the biological norm for human beings and normal sucking is the sucking that occurs at the breast.[18]

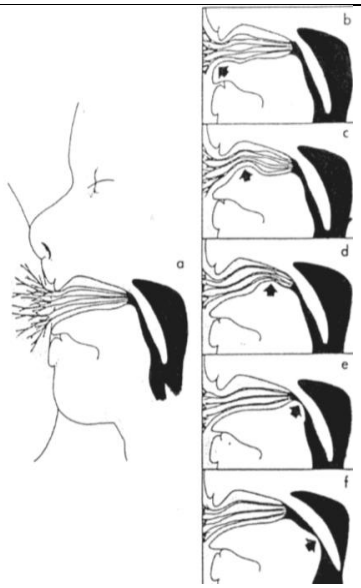


Figure 2 'suck' cycle; the baby is shown in median section. The baby exhibits good feeding technique with the nipple drawn well into the mouth, extending back to the junction of the hard and soft palate.

a. 'Teat' is formed from the nipple and much of the areola. The soft palate is relaxed and nasopharynx is open for breathing. The shape of tongue at back represents its position at rest, cupped around the tip of the nipple.

b. The suck cycle is initiated by a welling up of the anterior tip of the tongue. At the same time the lower jaw, which had been momentarily relaxed (not shown), is raised to constrict the base of the nipple, thereby 'pinching off' milk within the ducts of the teat.

c. The wave of compression by the tongue, moves along the underside of the nipple in a posterior direction, pushing against the hard palate. This roller-like action squeezes milk from the nipple. The posterior portion of the tongue may be depressed as milk collects in the oropharynx.

d. & e. The wave of compression passes back past the tip of the nipple and pushes against the soft palate. As the tongue impinges on the soft palate the levator muscles of the palate contracts raising it to seal off the nasal cavity. Milk is pushed into the oropharynx and is swallowed if sufficient has collected.

e. The cycle of compression continues and ends at the posterior base of the tongue. Depression of the back portion of the tongue creates negative pressure drawing the nipple and its base contents once more into the mouth. This is accomplished by a lowering of the jaw.[19]

Non-Nutritive Sucking:

Non-nutritive sucking is intimately related with two reflexes present in the infant at birth. The rooting reflex is the movement of the infant's head and tongue towards an object touching its cheek. The object is usually the mother's breast, but may also be a finger or pacifier. The disappearance of the sucking reflex does not mean that the infant cannot suckle; at this age of development, the infant has learned to feed and does not need the reflex to obtain nourishment.[20]

The suckling reflex normally disappears during the first year of life. As the diet of the infant changes from liquid to solid foods, there is increased activity in the muscles of mastication and the primary molars are brought into occlusion. The full adult swallow can be observed as early as 3-4 years of age and is usually present by age 9 or 10, but is never achieved in 10%-15% of population. A delay in the normal swallow transition can be expected when a child has a sucking habit.[20]

Non-nutritive sucking in infants is nearly universal and is considered normal. The point at which non-nutritive sucking becomes a habit and is not considered normal is unclear. Numerous studies on the prevalence of thumb and digit sucking indicate that a large majority of newborns suck their fingers but that percentage consistently drops with increasing age. These studies indicate that children spontaneously discontinue non-nutritive sucking sometime between 2 and 4 years of age.[20]

A variety of non-nutritive sucking habits exist, but thumb, digit and pacifier sucking are most common. Children often combine a non-nutritive habit with another repetitive activity. For example, they may suck a thumb while carrying a personal blanket, stuffed toy, or favorite doll. Other children play with their hair or rub an article of clothing. In addition, certain situations and times of day influence the habit. Tired children are more likely to suck their thumb, as are children in new or threatening environments. The effects of non-nutritive sucking on the developing dentition are minor in the child under 3 years of age and are usually limited to changes in incisor position. Some upper or lower incisors become tipped toward the lips, and/or others are prevented from erupting. If these habits persist beyond the time

that the permanent teeth begin to erupt, malocclusion characterized by flared and spaced maxillary incisors, lingually positioned lower incisors (or sometimes labially, with reverse occlusion, depend on sucking technique), anterior open-bite, narrow upper arch, cross-bite, distal occlusion, is the likely result.[20]

According to Warren JJ (2002) there are significant differences in dental arch and occlusal relationships in pacifier users at 24 and 36 months compared with those that had stopped sucking by 12 months. Moreover, by age 2 to 5 years, a significant increase in overjet (>4 mm), open bite, and posterior crossbite in pacifier users was observed.[21]

It is recommended to discourage non-nutritive sucking at 2 years of age, in order to definitively stop the habit by 3 years of age. Beyond 3 years, non-nutritive sucking is implicated in malocclusions.[22]

Figure 3 Thumb sucking

Figure 4 Pacifier sucking

DIGIT SUCKING DEFINITION, CLASSIFICATION, PREVALENCE

Thumb sucking and finger sucking or non-nutritive digital sucking

Definition[8]

1. Thumb sucking habits are often considered within a broad category of habits that include finger sucking. Hence these 2 habits are more generally termed 'digit sucking' habits.

2. Moyers (1958) : Repeated forceful sucking of the thumb with associated strong buccal and lip contractions.

3. Gellin (1978) : The placement of the thumb or one or more fingers in varying depths into the mouth.

Classification[8]

A. Cook (1958): There are 3 patterns :

1. ∝ Group

   Thumb pushes palate in vertical direction and only little buccal wall contractions are displayed.

2. β group

   Strong buccal wall contractions are seen and a negative pressure is created resulting in posterior cross bite.

3. ∂ group

   Alternate positive and negative pressure is created, this has least effect on anterior occlusion.

B. Clinical classification of thumb sucking habit:

   Based on clinical observation thumb sucking thumb sucking can be classified into following 2 types

1. Normal Thumb Sucking- habit during first and second year of life is considered as normal thumb sucking habit.
2. Abnormal Thumb Sucking Habit- persistence of habit beyond the pre-school period is considered as abnormal thumb sucking habit.

C. Subtelny et al (1973) :

   Subtelny has graded thumb sucking into 4 types depending on extent of insertion of thumb into the mouth.

Type A:

It is seen in almost 50% of children.

In this type whole digit is placed inside the mouth, with the pad of thumb pressing over the palate.

Contact of thumb with maxillary and mandibular anteriors is maintained.

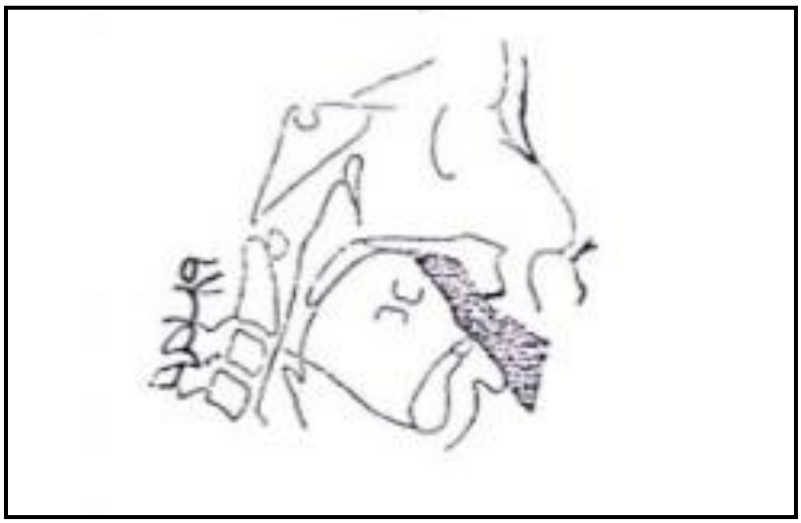


Figure 5 Subtelny classification Type A

Type B:

This type is seen in almost 13 to 24% of children.

In this type, the thumb is placed into the oral cavity without touching the vault of the palate

Contact of thumb with maxillary and mandibular anteriors is maintained.

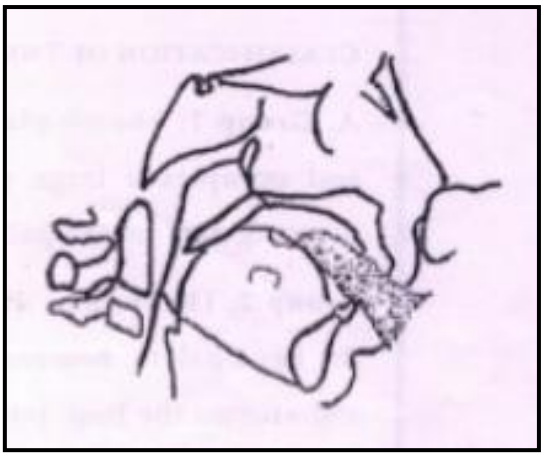


Figure 6 Subtelny classification Type B

Type C:

This type is seen in almost 18% of children.

In this type, the thumb is placed in the mouth just beyond the first joint.

Thumb is in contact with maxillary incisors.

There is no contact with mandibular anteriors.

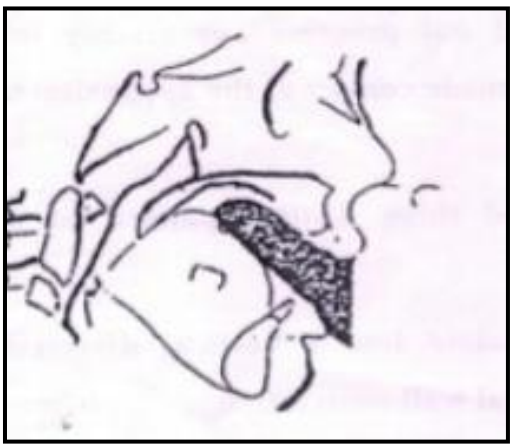


Figure 7 Subtelny classification Type C

Type D:

This type is seen in almost 6%of children.

In this type only little portion of thumb is placed into the mouth.

Figure 8 Subtelny classification Type D

Thumb or Finger-sucking Prevalence:

Different prevalence statistics of thumb-sucking habits have been reported in the literature. The prevalence is higher in developed countries than in developing countries. Larsson (1994) indicated that digit sucking habits in Swedish children have decreased significantly over the years from approximately 30-50% in the 1970s to about half of that in the 1990s. He explained the reason for this decline was the introduction of pacifiers.[23] Larsson, Ogaard and Lindsten (1994) reported that 10-19% of 3-year-old children were finger suckers in Sweden and Norway.[24] Curzon (1974) explained that he did not notice any evidence of thumbsucking when he examined and treated over 1,000 Inuit children in the Canadian Arctic.[25] In an examination of 255 Jordanian children, 1-6 years of age, 14% were thumb-sucking.[26] Farsi and Salama (1997) assessed the prevalence of thumb-sucking in Saudi children and reported a prevalence of 10.46% in a sample of 583 children between the ages of 3 to 5 years.[27]

Kharbanda, Sidhu, Sundaram and Shukla (2003) found in a study of 5,554 Delhi children aged 5-13 years that 0.7% of these children had a thumb-sucking habit; they also found that girls had a greater prevalence of the thumb-sucking habit than boys.[28] In a study of 2,018 Japanese children, between the ages of 3 and 5 years, about 20% were engaged in finger or thumb-sucking habits.[29] While most children quit the finger-sucking habit at school age, some would continue the habit. Egermark-Eriksson (1982) used a cross-sectional survey of 402 children to find that 20% were finger suckers at the age of 7 years, while only 3% engaged in the habit at 11 years and none at 15 years of age still performed this habit. The author used a questionnaire filled out by parents to confirm habit presence or absence. Finger-sucking has been reported to be more prevalent in girls than in boys.[23]

However in a recent longitudinal study, Bishara, Warren, Broffitt and Levy (2006) found no difference between boys and girls (1 and 8 years of age) in their digit-sucking habits.[30] This is consistent with the reports from Bosnjak, Vuievi-Boras, Mileti, Bozi and Vukelja (2002) and Farsi and Salama (1997).[27,31] The incidence of finger-sucking habits is less in children at the stage of the mixed dentition.[30]

Kharbanda o p al (2003) conducted study on 5554 children aged 5-13 years old with the objectives of recording the prevalence of oral habits among North Indian children according to sex. Thumb sucking was relatively less common habit and seen in only 0.7% of children. There were no significant differences between boys and girls for the prevalence of oral habits.[28]

Bhayya Deepak et al (2008) assessed the prevalence of oral habits in 11-13 year old children in Gulbarga city, India. Concluded that prevalence of the oral habit decreased with the increasing age.[32]

Pradeep Vishnoi (2017) checked the age- and gender-wise prevalence of oral habits in the children of 7–16-year-old Indian children. This was a cross-sectional survey involving 1029 (661 males and 368 females) children of age 7–16 years. Prevalence of thumb sucking was (128/12.4%). The male participants showed a greater prevalence rate for the oral habits than the female participants (58.55% vs. 56.25%). There was a significant difference in the age-wise prevalence of oral habits with older children showing greater prevalence of oral habits than the younger ones.[33]

In summary, different reports for the prevalence of the finger-sucking habit have been shown in the literature. This is due to the fact that these habits are surveyed at different ages and because of the use of different methodologies, either longitudinal or cross-sectional studies.

Most of these studies used a parental questionnaire to confirm habit existence and the duration of the child's habit. Overall, there is a decrease in the prevalence of the finger-sucking habit with age.

ETIOLOGY OF DIGIT SUCKING HABIT

Digit sucking is a habit that occurs in childhood and can lead to malocclusion if it persists for a long time. Understanding the cause and available management approaches for habit cessation can lead to more positive outcomes for clinicians, parents and children alike. Increasing clinicians' awareness of the causes and management of digit sucking behaviors can aid in their effective and systematic management, thereby reducing the risk of future malocclusion in some individuals.

Various theories have been proposed by psychologists to explain non-nutritive digit sucking.[34]

Classical Freudian Theory (Sigmund Freud- 1905)

In the early twentieth century, Freud was one of the first mental health experts to popularise a psychoanalytic theory relating to the cause of finger and thumb sucking.

The psychoanalytic theory has proposed that a child goes through various distinct phases of psychological development. In oral phase it is believed that the mouth is the erogenous zone. During this phase the child takes anything and everything to the oral cavity. It is believed that any kind of deprivation of this activity will probably cause an emotionally insecure individual.

He further proposed that, if the sucking needs of the infant were not met during the oral phase of development, the sucking habit would extend into the next developmental phase (Freud, 1953).

Psychoanalysts have defined this as the fixation of a habit. This is in contrast to the term regression, which defines the redevelopment of a previous habit as the result of psychological stress, such as parental divorce (Bishara and Larsson, 2007).

Therefore thumb sucking has the objective of nursing or nourishment.

Freud says attempts to stop the thumb sucking habit will lead to other habits.

Oral drive theory - Sears and Wise (1982)

Their work suggests that strength of oral drive is in part of function of how long a child continues to feed by sucking. Thus it is not frustration of weaning that produces thumb sucking. But rather oral drive, which has been strengthened by the prolongation of nursing.

This theory agrees with Freud's theory that sucking increases the eratogenesis of the mouth.

Rooting Reflex (Benjamin's Theory-1962)

Benjamin suggested that thumb sucking arises from the rooting or placing reflex seen in all mammalian infants. Rooting reflex is the movement of infant's head and towards an object touching his cheeks. The object is usually the mother's breast but may also be a finger or pacifier. This rooting reflex is maximum during 3 months of age and disappears gradually in normal infants around 7-8 months of age.

Learning theory:

Palermo (1956) suggested that thumb sucking arises out of progressive stimulus-and-reward reaction and would spontaneously disappear unless it becomes an attention getting mechanism.

Learning theorists believe that thumb sucking is a learned pattern with no underlying psychological basis.

Recent studies indicate the thumb/ finger sucking is a learned pattern in most patients although deeper emotional disturbance may be the cause in some cases.

Reduction in breast-feeding theory[5]: (Larsson and Dahlin, 1985).

If a sucking need is left unsatisfied during breastfeeding, the infant uses the digits as a substitute. The relationship between breastfeeding, bottle-feeding and digit sucking is a close one, and sucking habits have been linked to the need to satisfy the sucking reflex.The persistence of such sucking habits and the appearance of biting habits, according to Freud have been associated with an arrest in evolution of the psychosexual oral phase, which will represents in a short while. In its initial stage, the

oral habit is a partial solution of a state of displeasure evolving into a habit and the functional and structural problem.[5]

There is some difference of opinion as to whether digit sucking is learned or innate. Usually it starts very early in childhood, being evident within a very short time after birth and there is evidence to suggest that it may begin before birth, but Ayer (1970) presents evidence supporting the theory that prolonged digit sucking is a learned activity.[35]

It may be, therefore, that thumb sucking in early childhood is an innate activity in many children, but prolongation after infancy may be the result of learning.

Some of the etiological factors considered responsible for oral habits include family conflicts, jealousy, school pressure, stress of large city, lack of satisfaction through nourishment, initiation of media activities, irritation associated with tooth eruption, occlusal interference and breathing obstructions.[36]

INFLUENCE OF GENDER

To study by Bayardo et al (1996) showed greater susceptibility of females towards oral habits.[37] Honzick and Mckee (1962) found no gender difference in distribution of sucking habits during infancy. However from 2 years on, digit sucking was found to be stronger, more persistent and more widespread in girls.[38] This was collaborated by Nanda et al which suggested that environmental factors play a more significant role than genetic influences, possibly social and education pressures.[39]

INFLUENCE OF SIBLINGS

The number of siblings in the family played a strong role, as oral habits were more of a problem for the single child group possibly due to over protection, loveliness communication problems.[37]

Hanna (1967), Golden A(1978) found that the later the sibling rank of a child, the greater the chance of having an oral habit.[40,41]

Larsson (1987) found a correlation between number of siblings with same sucking habit, which indicated that parents influence the habit in their offspring.[23] As the no. of siblings increases, attention of parents gets divided. A neglected child may attempt to compensate insecure feelings by sucking.[9]

HEALTH HISTORY

Bayardo et al (1996) showed significant correlation between poor general health and oral habits. There was high association for chronic illness, esp. eye, nose, and throat. Allergies were also highly influential. This affirmed that physical conditions are related to psychological problems.[37]

INFLUENCE OF FEEDING HABITS

Hanna (1967) Traisman & Traisman (1958) found no correlation between thumbsucking and mode of feeding (breast / bottle).[40,42]

Traisman & Traisman (1958) however found that infants who had 30-60min periods of feeding were more likely to form thumb sucking habits than those with average feeding time of 10-25min.[42]

PASSAGE TO SLEEP

Children who sucked their thumbs were less likely to have a caregiver present, as they feel asleep.[43]

CULTURAL FACTORS

NNS is culturally determined to some extent, since children in primitive group who are allowed ready access to the mother's breast for a long period rarely suck any other object.[44]

A survey of the literature on the etiology of thumb sucking reveals many different and conflicting opinions. The possibility of a hereditary factor has been explored and, in this connection, Pearson (1948) contended that there is a familial variation in the need for sucking which predisposes to the habit. Moreover, there is considerable evidence to support this view. Thumb-sucking has been demonstrated in the fetus and observed in newly born babies, presumably before any environmental factor could become effective. Then the habit is frequently encountered in children of the same family but, of this observation, it is only fair criticism to point out that children of the same family are exposed to the same environment which, in itself, may be a cause. Nevertheless, cases often occur where no such environmental cause can be found. Habit does not invariably run in families. In examination of three sets of twins in each set of which one twin had an abnormal sucking habit while the other had not. Therefore, there may be an inherited predisposition to thumb-sucking but that heredity is not the only cause. Another opinion about thumb-sucking that is generally held is that it is an activity imitative of feeding at the breast, and Freud has suggested that it is of sexual origin. However, sexual or otherwise, it is obviously a habit which the

child enjoys. Yet feeding, whether at the breast or not, is indulged in primarily in order to satisfy hunger. Consequently it is suggested that hunger is a cause of thumb-sucking, and' Langford (1939) expressed the opinion that frequently it occurs only when the child is hungry.[45]

Then sometimes it is claimed that even if the thumb-sucking child does not suffer actual hunger his diet may be deficient. In support of this contention Humphreys and Leighton (1950) found definite evidence that mothers of thumb-sucking children had poor health during the time of suckling. They suggested that poor health of the mother results in poorer quality of milk and that this, in its turn, gives rise to a subclinical hunger in the child which may be the cause of the thumb-sucking.[45]

The most detailed investigation into the etiology was made by Levy (1928), who concluded that insufficient food was a sole factor in relatively few cases. He found the commonest cause of the habit was incompleteness of the sucking phase in the feeding act and state that it was more frequent in children fed on a four-hour schedule than in those on an unscheduled feeding regime.[45]

Many other suggestions have been made about the etiology of thumb- sucking, but the essence of them all is that it is a sign of a lack of harmony between the child and his environment. On the one hand the child may be nervously imbalanced or physically subnormal and, in this respect, Salzmann (1943) listed the following disorders as found in thumb-suckers: muscular tics, retarded growth, deficient weight, disordered body functions, unsound sleep, deficient appetite, restlessness, excessive crying, inability to concentrate, and unsocial behavior. On the other hand any upset in

a child's environment may precipitate a thumb-sucking habit. Cooke (1944), for example, stated that weaning, especially if sudden, or painful teething may be causes. Again punishment and excessive parental control, or lack of suitable toys, may all induce him to seek the comfort of his thumb. Indeed, any occurrence which leads the child, rightly or wrongly, to feel neglected or to feel he is not receiving sufficient affection and attention may be a factor. Often the advent of another child, an unhappy atmosphere at home, the loss of a loved one, the untruthfulness of parents (whereby the child loses his confidence in them) all may cause him to find consolation in thumb-sucking.[45]

To sum up, there is a familial variation in the need for sucking which may predispose to thumb-sucking. This accounts for its appearance during the first few weeks of life. Then, in infancy, the most important cause is a lack of sucking activity during feeding. Thereafter the habit is to be regarded as a sign of a disharmony between the child and his environment. Either the child or his environment, or both, may be at fault.[45]

DIGIT SUCKING DIAGNOSIS AND EFFECTS

Dentists who work with children frequently have cause to be concerned about the oral habits among their patients. It is not surprising that such habits develop since the mouth is such an important organ to the child. At birth the neonate's survival depends on instinctive sucking when the lips and tongue are stimulated. Soon after the mouth is used as primary device for exploring the environment. When an object is placed in a baby's hands or within its reach, the first thing it does is put the item into its mouth, almost as it is using the mouth to "see" this new environment. By random movements infants discover their hands and toes and use these to continue stimulation of the mouth and related structures.[46]

Habits grow out of these early developmental stages that are of concern not only to parents but also to the pediatrician, the psychiatrist or psychologist, the pediatric dentist, the orthodontist, and the speech pathologist. As is often the case, the child becomes concerned or even aware of the habit only after one of these specialists

brings it to his attention. Unfortunately specialist tend to view oral habits from different perspectives and to focus on different aspects or complications. It would be best for the child if the different specialist broadened their understanding on oral habits so as to avoid giving confusing and contradictory advice to children and parents.[46]

Factors to be considered while dealing with oral habits[47]

One should not jump into instant diagnosis of any mild deviation of normality as habit. Various factors should be considered before making any relevant diagnosis and subsequent treatment plan if needed.

1. Can the habit be considered normal for any particular age group or stage of development?

   Thumb sucking may be considered normal up to age of 3-4 years

2. Why the child has acquired habit. ?

3. What are the psychological implications of allowing the child to continue the habit or forceful interruption of habit?

   If a habit is being forcefully interrupted e.g. thumb sucking, child may substitute tongue thrusting habit for thumb sucking.

4. Is that habit is harmful or potentially harmful to mouth or relate oral structure?

   It is important to analyze whether habit will or may lead to malocclusion and associated problem. E.g. being a orthodontist it is important that tongue

thrusting habit should be intervened only if it had produced malocclusion or has potential to do so. If tongue thrusting is related to only speech difficulties than only speech therapy is indicated.

5. If habit is harmful, will the damage to mouth and dentition will disappear spontaneously; when habit is discontinued or the deleterious effects will persists?

It is known that if thumb sucking habit is discontinued in its initial phase i.e. in primary dentition there will be no untoward effect on permanent dentition. Reverse of this sequence is also true i.e. sometimes correction of malocclusion will lead to elimination of habit.e.g. in case of simple tongue thrust habit, elimination of anterior open bite will eventually eliminate habit.

6. When is it reasonable to desire that habit be broken?

This highlights very important dimension in management of habit, time. It is wrong for trying to eliminate each and every habit when it is diagnosed first because as already mentioned some habit are part of normal development of child. Thumb sucking especially in first year of life is absolutely normal and essential physiologic activity.

7. What appropriate means to be used to discourage habit?

DIAGNOSIS[34]

1) History-

As during dental appointment a child may seldom indulge in habits so proper history should be taken

- Enquire the feeding pattern and parental care
- Questions regarding the frequency, intensity and duration of habit.
- Presence of other related habits e.g. tongue thrust etc should be evaluated.

2) *Clinical findings*-Various clinical finding say suggest or substantiate the presence of habit e.g.

- Clean pulp of thumb and short nail
- Dento-alveolar pattern i.e. typical flaring of maxillary incisors and collapsed crowded lower anterior
- Excessive /vigorous thumb sucking may cause irritated and reddened palatal rugae area.

Various other clinical features (manifestations) as described earlier may support the diagnosis of digit sucking habit.

Extraoral Examination[34]:

The child may be actively performing the habit. However, this is unlikely during a dental appointment. The thumb is sucked, the index finger may be curled over the bridge of the nose or rolled into a fist with other fingers

Digits

Digits involved in the habit will appear reddened, exceptionally clean, chapped and with a short fingernail ie. clean dishpan thumb.

A fibrous roughened callus may be present on the superior aspect of the finger. The habit is also known to cause deformation of the finger.

Lips

Upper lip may be short and hypotonic in chronic thumb suckers. It may be passive or incompetent during swallowing. The lower lip may be hyperactive, elevated by contraction of orbicularis oris and mentalis between the malposed incisors during swallowing. This increases the overjet and can make for a vicious circle perpetuating the open bite.

Tongue

The tongue is displaced inferiorly in the floor of the mouth and laterally between the posterior teeth. This inferior placement of the tongue may lead to posterior cross bite due to maxillary arch constriction.

Other features: Watch for symptoms of mouth breathing and tongue thrusting especially in children with anterior open bite. Active thumb suckers have high incidence of middle ear infection and enlarged tonsils accompanied by mouth breathing.

Different effects of prolonged sucking habits have been reported in the literature, which include callus formation, irritation eczema and herpetic whitlow of the fingers, digital deformations and increased chance of poison ingestion.[48] In addition, there is an increase in other accessory habits such as hair pulling (Friman & Hove, 1987). Prolonged finger-sucking habits are considered to be socially unacceptable by peers and family. This might prevent the child from socializing with others.[49]

Many parents are aware of the habit and they will often try to seek counselling and treatment to break the habit.[49] There is an agreement among dental professionals that prolonged finger-sucking habits are possible etiologic factors in the development of malocclusion.[15]

INTRA ORAL EXAMINATION

Severe finger or thumb sucking habits where the digit is applied on anterior part of the upper dentition and palate will result in flared maxillary anterior with diastema. Left or right side of the anterior maxillary arch is deformed related to whether the child sucks his right or left thumb. Buccal crossbites and narrow palates occur when children suck their digits with a pronounced constriction of their buccal musculature.[15]

EFFECTS

When the digit is placed in the mouth and sucked a number of changes take place around the teeth that may contribute toward an imbalance of occlusion.[15]

Salzmann (1974) stated that the effects of the sucking habit on the dental arches and the bone including the occlusion of teeth depends on a trident of factors.[50]

- **Duration** indicate the number of years the habit is continued
- **Frequency** denotes how often the habit is practiced. The child who sucks sporadically or just when going to sleep is much less likely to do any damage than one who constantly has his finger in his mouth.

- **Intensity** implied how vigorously the habit is pursued. In some children, the sucking can be heard in the next room, the perioral muscle function and facial contortion are easily visible. In other the thumb sucking habit is little more than a passive insertion of the finger in the mouth with no apparent buccinator activity.

The damage produced also depends on the associated muscle contraction of the lip and cheeks, osteogenic development, the genetic endowment of the child and the state of health of the child. Forces acting on the bony structures to shape them during the developmental stages help in understanding the changes that pernicious oral habits can bring about in the oral architecture.[51]

Some Antagonistic Forces Acting on the Masticatory Apparatus[51]

- Lip – tongue
- Cheeks – tongue
- Eruption of teeth – masticatory muscles masseter, temporalis and medial pterygoid
- Masseter – elasticity of periodontal ligament (particularly of molars and suprahyoid muscles).
- Internal pterygoid – same as masseter in vertical movement.
- External pterygoid in anterior movement – posterior one third of temporalis, suprahyoid group, digastric and muscles of neek.
- External pterygoid in lateral movement – external pterygoid of opposite side

In 1942, Breitner stated that there should be a balance between the forces of the tongue from within the dental arches and compensating action of the lips and cheek musculature. He called this as functional equilibrium.[51]

Buccinator Mechanism:

Muscles are a potent force, whether they are in active function or at rest. A resting muscle still is performing a function that of maintaining posture and a relationship of contiguous parts. The teeth and supporting structures are constantly under the influence of the contiguous musculature. Aberrations of muscle function can and do produce marked malocclusions. The restrictive, guiding role of the buccinator mechanism must be emphasized.

Starting with the decussating fibers of the orbicularis oris muscle, joining right and left fibers in the lips, the buccinator mechanism runs laterally and posteriorly around the corner of the mouth, joining other fibers of the buccinator muscle which insert into the pterygomandibular raphe just behind the dentition. At this point it intermingles with fibers of the superior constrictor muscle and continues posteriorly and medially to anchor at the origin of the superior constrictor muscles, the pharyngeal tubercle of the occipital bone. Opposing the buccinator mechanism is a very powerful muscle the tongue. Balance between these muscle forces is very important. Any deviation in these reflexes or mechanism leads to malocclusion.

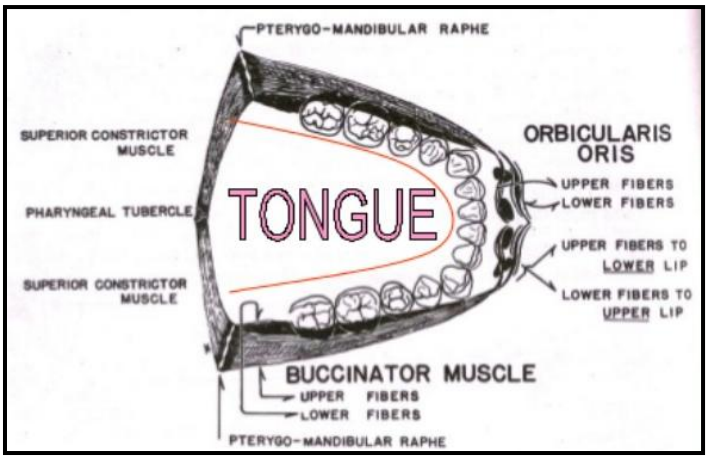


Figure 9 Buccinator mechanism

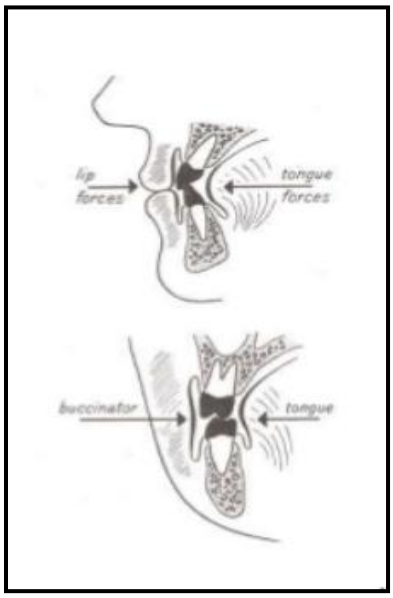


Figure 10 Buccinator mechanism

Types of malocclusion that may develop depends upon a number of variables[51]:

- Position of the digit
- Associated oro-facial muscle contractions
- The position of the mandible during sucking
- The facial skeletal pattern
- Force applied to teeth and alveolar process

Sequelae of thumb sucking[51]:

Theoretically it is possible to draw a very neat sequence attributing a total maxillary protrusion, while the increased pressure from buccinator mechanism activating pterygomandibular raphe just behind the dentition and forcing the maxillary teeth forward.

1. Anterior openbite – In some children the thumb, being held more horizontally, presses the incisors into a position of infraclusion and allows the posterior teeth to elongate into a position of supraclusion. This results in an anterior open-bite. This openbite can lead to tongue thrusting problems and speech difficulties.

2. Proclination and spacing of the maxillary anterior teeth: if thumb is held upward against the palate. Thumb or finger is placed at an angle so that it presses lingually against lower incisors and labially against upper incisors. Prominences of this labially posed incisor make them particularly vulnerable to accidental fractures.

3. Increased overjet: The thumb acting as a lever pressing the maxillary incisors labially and often, at the same time, the mandibular incisors lingually.

4. Mandibular postural retraction may develop if the weight of the hand or arm continuously forces the mandible to assume a retruded position in order to practice the habit. Pressure in the lingual direction causes lingual tipping of mandibular incisors.

5. When maxillary incisors have been tipped labially and an openbite has developed it becomes necessary for the tongue to thrust forward during swallowing in order to effect an anterior oral seal - “compensatory tongue thrusting”.

6. During thumb sucking, buccal wall contractions produce, a negative pressure within the mouth, with resultant narrowing of the maxillary arch – bilateral posterior cross bite may be produced.

7. With these changes in the force system in and around the maxillary complex it is often impossible for the nasal floor to drop vertically to its expected position during growth. Therefore thumb suckers have a narrow nasal floor and high palatal vault.

8. Upper lip becomes hypotonic and lower lip becomes hyperactive. These abnormal muscle contractions during sucking and swallowing stabilize deformation.

9. Compensatory tongue thrust, retained infantile swallowing pattern, abnormal perioral muscle function will assist the thumb sucking in producing the malocclusion.

Persistent sucking habits frequently occur in cases where the oro-muscular behavior or the dental base relation is already unfavorable to the development of good occlusion. In these cases the habit only contributes to a condition that is likely to remain even though the habit ceases. Where the oro-muscular behavior is favorable an

intractable malocclusion is less likely to be produced by the habit and there is a spontaneous improvement once the habit has ceased.

There can be a marked mentalis muscle contraction, which compresses the lower lip inward on swallowing. The lower lip can slip up and make a seal (during the swallow) lingual to the upper anteriors, not labial as is usual. This increases the overjet and can make for a vicious circle perpetuating the openbite and upper labial protrusion. This is because the mentalis contracts on swallowing, flattening the lower lip strongly against the labial surfaces of the lower anterior teeth. At the same time the lower tip may contact the lingual surfaces of upper anteriors with some force during the last of the swallowing spasm. This unequal force generated against the teeth by the perioral musculature may serve to perpetuate the malocclusion long after the original sucking habit has disappeared.

OTHER EFFECTS:

- Risk to psychologic health
- Increased deformation of digit
- Increased risk of speech defects especially lisping

Detrimental effects on occlusion

For the first 3-4 years of life, studies indicate that damage to occlusion is confined largely to anterior segment.[23] These damages are usually temporary, provided the child starts with a normal occlusion. If sucking habits are discontinued before 6 years of age, dental changes are often transitory, whereas those children who stop after 6 years invariably have malocclusions at 12 years. Spontaneous decrease in

open bite and retroclination of upper incisors takes places primarily during the first year after habit cessation.[52]

The prevalence of anterior open bite, maxillary protrusion and distal step molar occlusion are higher in children with finger-sucking habits.[29] The prevalence of open bite malocclusions have shown to increase with continuation of these habits.[30]

Fukuta et al. (1996) stated that the effects of finger-sucking habits appear to be on the anterior region of the dentition before the age of three. He made a recommendation to stop the habit by 3 to 4 years of age.[29] Modeer, Odenrick and Lindner (1982) on the other hand, suggested that the finger-sucking habits should be stopped at a younger age, around 2 years, due to the increase in the incidence of unilateral crossbite malocclusions. The relationship between finger-sucking habits and posterior crossbites in preschool children was examined. The authors suggested that finger-sucking was an aetiological factor in the development of unilateral crossbite malocclusion. However, more effects were found with dummy sucking than with finger-sucking. They stated that another effect of the finger-sucking habit was a reduced overbite in the primary dentition. More effects were found with an increase in intensity (hours/day) and duration of the habit.[53]

Vazquez-Nava et al. (2006) performed a longitudinal study on 1,160 children aged 4 to 5 years old. These children were followed from 4 months of age. Findings revealed that a non-nutritive sucking habit was an important risk factor in posterior crossbite malocclusion. These habits were also significant risk factors in anterior open bite in children younger than 5 years of age. The authors also included allergic rhinitis as a risk factor, alone or together with non-nutritive sucking habits, in the

development of an anterior open bite.[54] Bowden (1966) studied the effects of a prolonged sucking habit on the mixed dentition. He found that the prolonged habit was associated with open bite tendency, skeletal class II dental base relationship, tongue-thrust activities and tongue to lip rest positions. Bowden's sample was taken from the University of Melbourne Child Growth Study where a total of 116 children were followed from the age of 2 to the age of 8 years. However, Bowden did not find an association between the sucking habit and posterior crossbite malocclusion.[55]

In summary, a prolonged finger-sucking habit is a risk factor in malocclusion. The predominant effect of thumb-sucking is anterior open bite malocclusion. A posterior crossbite might be associated with the finger-sucking habit, but it occurs more with prolonged pacifier use. It was found that the longer the habit, the more the associated damage to the primary and permanent dentition.[30]

Other detrimental effects:

Chronic thumb sucking in school age children, which is sometimes associated with strong attachment to an object (eg. blanket, toy) may also reduce peer social acceptance, an important contributor to social development (Friman et al, 1993) His study has shown that school age children consider thumb suckers significantly less intelligent, less attractive, and less desirable as friends.[56]

PACIFIER SUCKING

The newborn infant has a relatively well developed mechanism for suckling, the means of his most important single exchange with the outside world. From it he receives not only his nutriments but his feelings of euphoria, or well being that is so essential in early life.[57]

Searching only for an efficient device for obtaining milk, nipple manufacturers have ignored the basic physiology of suckling.[57]

In breast feeding the gum pads are apart, the tongue is brought forward in plunger like fashion so that the tongue and lower lip are in constant contact, and mandible move up and down rhythmically and forward and backward by virtue of the flat condylar path as the buccinators mechanism alternately contracts and relaxes. The child feels pleasant warmth of the breast not only in the tissues contacting the teat proper, but over an area extending well away from the mouth. The warmth and fondling of mother's body undoubtedly enhance the feeling of euphoria.[57]

The conventional nipples contact only the mucous membranes of the lips (the vermilion border).

The warmth of association conferred by the breast and mother's body is largely lacking, and the physiology of suckling is not duplicated. Because of the poor design the mouth is held open more widely and greater demand is made on the buccinator mechanism. The pumping action of the tongue, the raising and lowering and the rhythmic backward and forward movement of the mandible are reduced. Suckling becomes sucking; and frequently with enlarged hole at the end of the nipple, the child does not have to do much of this. To make the process of getting milk down the child's throat in the shortest possible time even more efficient, the use of a "squeeze bottle" of soft plastic permits the mother to accelerate the flow of the fluid and further reduce the time needed for suckling.[57]

Anderson, W.S. substantiated the observations that breast-fed babies are better adjusted and have less abnormal perioral muscle habits and less retained infantile mechanism.[58]

Balters and his associates in Germany concluded that although other factors were involved, improperly designed rubber nipples and harmful bottle nursing techniques caused many pediatric and orthodontic problems.[57]

The conventional nursing nipple requires the child only to suck. With conventional nipple the milk is more or less squirted into the throat, instead of being brought back by the peristaltic-action like action of tongue and cheeks.[57]

To provide as close a duplicate of the human breast as possible, a nipple was designed which incited the same functional activity as breast feeding. The functionally designed latex nipple largely eliminates the objectionable features of previous non-physiologic counterparts. To satisfy the strong desire of the child to suckle and his dependence on this mechanism for euphoria, an "exerciser" or "pacifier" was developed.[57]

Children who do not have access to unrestricted breast feeding or who are bottle fed may satisfy instinctive sucking urge with a pacifier. There are many sizes and shapes available.[57]

The physiologically designed orthodontic pacifier offers many advantages (according to manufacturer)[57]

- it confirms to the baby's lips
- smooth and adapted contour promotes nasal breathing.
- Flat nipple simulates shape of mother's breast allowing tongue to touch palate in more natural sucking position and improving lip seal.

But it aims that these so called anatomic pacifiers are less harmful have not been substantiated.

Adair et al (1992) showed some minor differences between occlusions of 95 children who used orthodontic or conventional pacifiers. [57]

The influence of the type of feeding (breast/bottle) on acquisition of pacifier and finger habits has been studied.

Some studies correlated bottle feeding with finger sucking whereas some didn't find a relationship. According to Bishara, the long term effects of finger sucking are more important because children tend to maintain this habit up to the age of 7 or more, whereas children using a pacifier stop this habit during the first 5 years of life. Pacifier use is usually introduced by the parents to calm the child (Pannio, 1993) consequently, every time the child is irritated, the pacifier is offered as a form of amusement and the child develops a strong attachment to the sucking object. Lutaif (1999) however, has shown indiscriminate pacifier use as more a need of the parents than the child.[57]

Zardetto et al (2002) pointed out that more occlusal and oral myofunctional alterations are detected among children who have pacifier habits (either conventional or physiologic) than among those with no sucking habits. Pacifier users were significantly more likely to show open bite, posterior cross bite, increased overjet and alteration in cheek mobility than habit free children.[59]

According to Seis and Carvalho patients sucking needs are intense during the first 3 months of life. At the 7^{th} month, it decreases and can be considered unnecessary in the neurohysiological perspective. Because neuromuscular structures at this stage are being natured and prepared for coordinated eating and drinking activities. Thus, from this age onwards sucking must gradually be substituted by mastication.[57]

The alterations on the primary dentition most frequently found in children with pacifier sucking habits are anterior open bite, posterior cross bite, decrease of upper intercanine width, increased overjet.[59]

Among the oral myofunctional alterations associated with pacifier use are lip incompetence, lip entrapment, decrease in muscular toxicity lips, narrow had palate.[57]

Adan et al (1992) found no relationship, however between hours of use per day and duration of use in months with any aspect of malocclusion.[57]

(Soother / Artificial teat)

Dummy sucking (Foster)

Comforter is usually confined to first 3 or 4 years.

It produces some degree of anterior open bite in primary teeth. If the hard ring is held between the teeth, it can produce other tooth malpositions eg. if the ring is held behind lower primary centrals, they may be pushed out. However, these effects seem to be transient.

Physiological (Orthodontic) Pacifiers[57]

These have a different shape of nipple and shield when compared to a conventional one.

The shield of the conventional pacifier has a convex curvature in relation to the oral structures of the child, while the physiological pacifier has a concave curvature that is more suitable to the child's face.

Figure 11 Conventional pacifier

Figure 12 Physiologic (Orthodontic) Pacifier

Modesto et al have argued that the terminology “orthodontic” is misleading, since it implies that this type of pacifier may perform some type of dental correction. They suggested only use of the term “physiological”.

Other aspects of Pacifier use

1) Relationship between pacifier use and sudden infant death syndrome (SIDS) [60]

SIDS is defined as “the sudden death of an infant under 1 year of age which remains unexplained after thorough case investigation, including performance of complete autopsy, examination of death scene, and review of clinical history (Winnger et al, 1991).

Mitchell et al (1993) & L'Hoiretal (1998) and others have published data linking pacifier use with a protective effect against SIDS. The explanations offered include :

- Pacifier use may keep the tongue in a more forward position, reducing possibility of airway occlusion in supine position.
- Pacifiers may prevent an infant from turning to a prove position, keeping the nose off the bed, which has been associated with increased risk for SIDS.
- Pacifiers may decrease arousal threshold.
- Pacifiers may reduce potential for gastro esophageal reflux.

2) The effect of pacifier use on breast feeding [60]

The "nipple confusion" or "sucking confusion" hypothesis suggested by Newman (1990) suggests that early use of a pacifier and/or bottle will cause some infants to adopt a faulty breast feeding technique that leads to early weaving.

However Clements et al (1997) speculated that early use of pacifiers may reflect parental choice to bottle feed.

3) Relationship between pacifier use and acute otitis medial (AOM)[60]

Otitis media is a vial or bacterial infection of the middle ear. Larsson (1971) has reported significantly higher percentage of children with history of AOM among those who had used a pacifier for $\leq$4 years compared to children with digit habits or no NNS habit.

4) Pacifiers as vectors for bacterial and fungal transport[60]

Pacifiers can act as fomites for injection. Pacifier sharing esp. is a risk factor, or the mother cleaning the pacifier by licking it.

Ollila et al (1997) suggested that pacifier use may[61]:

- reduce oral sugar clearance.
- Increase number of receptor sites for microbial adhesion
- Interfere with muscoa in a way that favours candidal colonization.

Dental and skeletal deformity:

The pattern of facial growth and dento-alveolar development is partly determined by genetic factors and partly by environmental factors. Amongst the environmental factors, the pressure exerted by soft tissues of the lips, cheek and the tongue has a major influence in determining the shape of the dental arch, as well as tooth position.[62]

Pacifier-sucking is different from a breast-suckling habit and therefore may alter soft tissue pressures whilst growth is taking place.[63]

- Effects are primarily on the deciduous dentition as most children give up their habits before permanent teeth erupt
- Reduced overbite and anterior open bite
- Reduced maxillary arch width leading to formation of a cross-bite

These forces are thought only to have significant effects on teeth and arch form if they are continued for more than six hours a day. Any duration less than this

does not initiate cellular mechanisms that are required for the alteration of tooth-tissue structure.

'Suckling' involves the child putting both the nipple and areola into the mouth and it is the movement of the lips and tongue that brings about the suckling motion. In dummy 'sucking' the child presses the tongue in a piston-like motion in the direction of the palate to compress the artificial teat.[63]

The prolonged presence of a pacifier in the anterior section of the mouth could theoretically also exert pressures that restrict vertical maxillary development, reduces the overbite and creates an anterior open bite.[63]

Issues related to safety[64]

1. Physical safety

Risks include asphyxiation, gingival damage, lacerations, palatal ulcers.

To avoid triangulation the US consumer product Safety Commission (USCPSC) does not allow pacifiers to be sold with cords attached and warn parents not to attach cords.

Sinkiss et al recommend ventilation holes in pacifier flanges to avoid asphyxiation. And also minimum horizontal and vertical dimensions of 43mm, as well as a grasp ring to facilitate removal.

2) Chemical safety

USCPSC regulations specify that no component of the pacifier may contain more than 20 parts per billion of total volatile N-introsoamines, which are potent

carcinogens. Also, pacifiers may not have sharp points or edges painted with paint containing more than 0.06% lead.

3) Immunologic safety (latex allergy)

Latex allergies related to pacifier use have been reported (Makinen – Kiljunen et al, 1992). Silicone products are available as an alternative.

If a pacifier is going to be used, it is important to make parents aware of the following[64]:

1. It should be of sturdy one piece construction.
2. It should have an easily grasped handle
3. It should have a mouth guard of adequate diameter, with ventilating holes.
4. It should not have any detachable strings or ribbons.
5. It should never be tied around a child's neck or affixed with any material capable of becoming wrapped around the neck.
6. It should be kept clean.
7. It should never be dipped in sugar, honey or other sweetened material to encourage sucking.

MANAGEMENT OF NON-NUTRITIVE SUCKING HABIT

Thumb-sucking should not be treated unless its potential risks outweigh potential benefits. Other than advising parents to be tolerant, treatment is not indicated during infancy or in early childhood because finger-sucking is generally regarded as being harmless. Treatment of thumb-sucking may be justified if the habit is coupled with extreme behaviors such as social withdrawal, intolerance to affection, a resistance to authority, temper tantrums, low self esteem, talk of suicide, an enjoyment in hurting friends and animals, bedwetting, and tics. These are signs of emotional disturbance, and consultation with a psychologist or psychiatrist is recommended.[65]

Overenthusiastic efforts to stop thumb-sucking are harmful. Constant nagging and reprimand cause unhappiness, resentment, and insecurity. Ridicule, teasing, and threats should be avoided, especially considering that most children outgrow the habit

by 5 or 6 years of age. Despairing parents' attempts to stop the habit are usually successful in making the child miserable. Parental disapproval may be sufficient reason for treatment of thumb-sucking because of a lack of tolerance of a behavior perceived as unacceptable.[65]

General considerations and principles of management by AAPD[66]

Oral habits may apply forces to the teeth and dentoalveolar structures. The relationship between oral habits and unfavorable dental and facial development is associational. rather than cause and effect. Habits of sufficient frequency, duration, and intensity may be associated with dentoalveolar or skeletal deformations such as increased overjet, reduced overbite, posterior crossbite, or long facial height. The duration of force is more important than its magnitude; the resting pressure from the lips, cheeks, and tongue has the greatest impact on tooth position, as these forces are maintained most of the time.

Nonnutritive sucking behaviors are considered normal in infants and young children. Some changes resulting from sucking habits persist past the cessation of the habit, it has been suggested that early dental visits provide parents with anticipatory guidance to help their children stop sucking habits by age 36 months or younger.

The identification of an abnormal habit and the assessment of its potential immediate and long-term effects on the craniofacial complex and dentition should be made as early as possible. The dentist should evaluate habit frequency, duration, and intensity in all patients with habits. Intervention to terminate the habit should be initiated if indicated.

Patients and their parents should be provided with information regarding consequences of a habit. Parents may play a negative role in the correction of an oral habit as nagging or punishment may result in an increase in habit behaviors; change in the home environment may be necessary before a habit can be overcome.

Treatment considerations: Management of an oral habit is indicated whenever the habit is associated with unfavorable dentofacial development or adverse effects on child health or when there is a reasonable indication that the oral habit will result in unfavorable sequelae in the developing permanent dentition. Any treatment must be appropriate for the child's development, comprehension, and ability to cooperate.

Habit treatment modalities include patient/parent counseling, behavior modification techniques, myofunctional therapy, appliance therapy, or referral to other providers including, but not limited to, orthodontists, psychologists, myofunctional therapists, or otolaryngologists. Use of an appliance to manage oral habits is indicated only when the child wants to stop the habit and would benefit from a reminder.

Treatment objectives: Treatment is directed toward decreasing or eliminating the habit and minimizing potential deleterious effects on the dentofacial complex.

Basic consideration on which oral habit is being corrected:

REFLEX INVOLVED

The problem is of controlling a physiologic process. Therefore the rationale of therapy must be physiological and not mechanical. At attempt should always be made

to alter the afferent arm of the reflex and this alteration should be thought in terms of muscle relearning. The rationale of therapy is that of conditioning responses not mechanisms. It must be determined whether malocclusion is of primary or secondary concern. Habit should be treated with the help of a psychologist, pediatrician and a physician. The clinical aspect of the problem of thumb sucking may be divided into three phases.[8]

Phase I – Normal and sub-clinically significant sucking[8]

This phase extends from birth to 3 yrs. Most children display a certain amount of thumb and finger sucking during this period, particularly at the time of weaning. Sucking is naturally resolved at the end of phase-I otherwise the use of rubber pacifier towards the end of phase-I is much less harmful from dental point of view than repeated vigorous thumb sucking.

Phase II - Clinically significant sucking[8]

This phase extends from 3 to 6 or 7 yrs of age. Sucking practice during this time deserves more serious attention from the dentist for two reasons.

1. It is a possible indication of clinically significant anxiety.

2. It is best time to solve dental problems, related to digital sucking.

Phase III - intractable sucking[8]

A thumb sucking presenting after the fourth year may be the proof of problems other than simply malocclusion. Such cases require dental and psychological therapy. Consultation with the physician and psychologist may be made in order to develop an integrated approach.

The American Academy of Pediatric Dentistry produced a statement regarding prolonged non nutritive sucking habits. For children over 3 years of age with prolonged non-nutritive sucking habits, the Academy recommends a professional evaluation with the possibility of intervention to break these habits.[67]

Current literature is emerging on timing of habit-breaking. Past literature suggests that habit-breaking with the use of appliances should not start until eruption of the permanent teeth. This recommendation was due in part to the previous opinions that little if any damage is expected in the permanent dentition (Gellin, 1978; Proffit, 2000). In response to these opinions, several organizations including the American Academy of Pediatrics, American Academy of Pediatric Dentistry, American Association of Orthodontics and the American Dental Association have adopted a statement on sucking habits. The statement explains that until permanent teeth erupt in the mouth, habits do not create permanent damage and that any damage is usually reversible once the habit stops.[67]

The recent literature shows that sucking habits have detrimental effects on occlusion, and these effects extend well beyond habit elimination (Warren et al., 2005). The recommendation is now to stop the habit by the age of 3 years.[67]

Before trying to break the habit many authors explained that both parents and children should express their willingness to stop the habit (Cipes, Miraglia, & Gaulin-Kremer, 1986; Proffit, 2000). The treatment usually starts by talking to the child while explaining the potential damage that might occur to their dentition if they continue the habit. Positive reinforcement is also used to encourage parents to reward their child for each day he or she does not perform the habit. A calendar is used to record the

child's progress (Cipes et al., 1986). Wearing gloves during sleep has also been used (Ellingson et al., 2000; Lassen & Fluet, 1978). It is important to note the accessory movement of the other hand that is accompanied by finger-sucking and its importance in habit-breaking e.g., some children like to hold a teddy bear or blanket while performing the habit. In order to stop the sucking-habits these objects should be removed from the child's hand (Friman, 1988; Watson, Meeks, Dufrene, & Lindsay, 2002). All of the previous methods that are used to stop the finger-sucking habit have been reported in the literature with variable success rates (Cipes et al., 1986; Ellingson et al., 2000; Friman, Barone, & Christophersen, 1986).

It is recommended to start with the least invasive methods (e.g., counselling, positive reinforcement, the calendar) before using habit breaking appliances (Schneider & Peterson, 1982; Proffit, 2000).

Preventive measures to discourage the development of sucking habits[9]

1. Motive based approach: The etiology of thumb sucking focuses on a predominant psychological background. Its prevention should be directed towards the motive behind the habit. History serves as important tool for diagnosing the etiology, whether the habit is meaningful or empty.

2. Child's engagement in various activities: Parents when questioned may reveal that the child practices the habit when bored and left to himself, or it could be just before he goes to sleep. In such cases, the parents can be counseled on keeping the child engaged in various activities. This gives little chance for the child to practice the habit. The child can be encouraged to follow his hobbies of interest such as painting or engaging in outdoor activities with his fellow

mates. Proper nursing of the child. These measures can be followed when the parents are working.

3. Parent's involvement in prevention: When the parents are at home they should be advised to spend ample time with the child so as to put away his feeling of insecurity. At night this can again be reinforced by playing soothing music or by telling good bedtime stories till the child falls asleep.

4. Duration of breast feeding: Care should be taken when feeding infants in that the duration of feeding should be adequate so as to enable the child to exhaust his sucking urge and feel wholly satisfied. When pacifiers are to be used, select properly designed pacifier, which will supplement normal functions and deglutition pattern.

5. Proper kinesthetic, neuromuscular gratification activity at this time may well prevent abnormal finger, lip and tongue deforming action later.

6. Mother's presence and attention during bottle feeding: Bottle-fed babies should be held by the mother and enough attention should be given in the process. This will promote a close emotional union between the mother and the baby similar to that seen in breast feeding.

7. Use of a physiological nipple: A physiological nipple should be used for bottle feeding and the size and number of the hole should be standardized to regulate a slow and steady flow of the milk.

8. Use of a dummy or pacifier: Acquiring a digit sucking habit can be prevented by encouraging the child to suck a dummy instead. Dummies are easier to dispense with at an earlier age than is digit sucking.

Thumb-sucking frequently accompanies behaviors such as holding or manipulating favored objects. Removing the favored object has been shown to eliminate thumb-sucking. Take, for example, a child who chronically sucked her thumb during play with her doll. Explaining to the child the association between the two habits and subsequent withdrawal of the doll resulted in elimination of the thumb sucking.[68]

VARIOUS MEASURES USED FOR CORRECTING THE THUMB SUCKING HABIT[9]

Psychological therapy: screen the patient for the underlying psychological disturbances that sustain a thumb sucking habit. once psychological disturbance is suspected, the child is referred to the professional for counseling.

1. Thumb sucking children between 4-8 years of age need only reassurance, positive reinforcement and friendly reminders.

2. Awareness of the habit can be accomplished by emphasizing the positive aaspects of habit cessation. Various aids are employed to bring the habit under the notice of the child such as study models, mirrors etc.

3. Children and parents are informed about existing dentofacial deformities and the long-term risks of a sustained habit. Patients should be presented with

positive mental and visual images of dentofacial ideals expected from habit cessation and subsequent orthodontic treatment.

4. During the treatment adequate emotional support and concern should be provided to the child by the parents.

5. Destructive approaches in the form of nagging, shamming and belittling ought to be strictly avoided.

6. Beta hypothesis:

Dr. Knight Dunlop, a psychologist and past president of the American Psychological Association, made a lifelong study of habits and learning processes and perhaps performed more experiments along this line than any other psychologist. His methods succeeded in curing such habits as nail-biting, thumb sucking, and more serious habits where other methods had failed. The very heart of his system was his finding that effort was the one big deterrent to either breaking a bad habit or learning a new one. Making an effort to refrain from the habit actually reinforced the habit, he found. His experiments proved that the best way to break a habit is to form a clear mental image of the desired end result, and to practice without effort toward reaching that goal. Dunlop found that either "positive practice" (refraining from the habit) or "negative practice" (performing the habit consciously and voluntarily) would have beneficial effect provide the desired end result was kept constantly in mind.

"If a response habit is to be learned, or if a response pattern is to be made habitual, "Dr. Dunlop wrote in Personal Adjustment, "it is essential that the learner shall have an idea of the response that is to be achieved or shall have an idea of the

change in the environment that the response will produce…The important factor in learning, in short, is the thought of an objective to be attained, either as a specific behavior pattern or as the result of the behavior pattern or as the result of the behavior, together with a desire for the attainment of the object."[69]

It is interesting to know that he used to repeatedly make a typographical error in typing the word 'the' as 'hte'. One day, he decided to start typing 'hte' instead of 'the'. And after few days, he serendipitously discovered that his often made typographical error was self corrected! Thus was born the concept of 'negative practice' or 'beta hypothesis. When applied to oral habits, Dunlop suggests that child should be asked to sit in front of a large mirror and asked to suck his thumb observing himself as he indulges in the habit. This procedure is very helpful if the child is asked to do the same at a time when he is involved in an enjoyable activity. The sight of oneself sucking thumb will hamper the pleasure derived from the activity and the child will slowly avoid indulging in the same.[69]

Psychotherapeutic counseling has been used to deal with the thumb-sucking behavior of children 3 to 12 years of age. When counseling was ineffective, behavior modification techniques were used with the objective of improving the parent-child relationship and fostering the child's pride in demonstrating an ability to discard the habit. The children were evaluated every 15 days for 3 months. The program was most effective among children in the 6- to 8-year-old and 9- to 12-year-old age groups. Discontinuance of the habit was found to improve the parent-child relationship.[70]

<u>Reminder therapy:</u> This can be divided into following categories

Extraoral approaches:

1. <u>Aversive therapy:</u> Apply a non-palatal substance to the thumb or finger. For example: Cayenne pepper, quinine, asafetida. Femite composed of denatonium benzoate is a bitter compound which prevents children from sucking their digits on application. It should be applied on the skin and nails and allowed to dry for 10 minutes. A new coat should be applied morning and evening. Till the habit is broken. This is effective only when the habit is not firmly trenched.

Figure 13 Aversive Therapy

2. <u>Thermoplastic thumb</u> was devised by Allen in 1991 where a thermoplastic material was placed on the offending digit. A total of 6 weeks of treatment was required for the elimination of the habit.

Figure 14 Thermoplastic thumb

1. Ace Bandage Approach: Apply a bandage, to the thumb, finger or the entire palm is an at-home program to assist children with nocturnal sucking habits. Children who wish to discontinue the habit and have no psychological contraindications are candidates for this program. The program involves nightly use of and elastic bandage wrapped across the elbow. Pressure exerted by the bandage removes the digit from the mouth as the child tires and falls asleep.

Figure 15 Ace Bandage Approach

2. Cover the palm with socks

3. Use of a long sleeve gown: it has been found that long sleeves in a night gown prevent the child from practicing thumb sucking habit and eventually stop it from recurring. The long sleeves of the gown interfere with the contact of the thumb and oral cavity, thus reminding the child constantly, especially during the nights.

Figure 16 Long Sleeve Gown

4. Explain the child with the help of audio-visual aids, to show that they might develop crooked teeth if the habits are continued.

5. "Do it yourself kit" as advocated by Whitman. By applying a reminder lotion on the thumb and a magic pill (Placebo) to be taken at bedtime. The child is told the pill goes into the stomach, up into shoulder, down the arm into thumbs and then automatically pops out of mouth.

6. Three-alarm system – it is effective in a mature child in the age group of 8 years and above. During the time when the child engages in sucking habit ask him to tie an adhesive tape. When he feels the tape in the mouth it act as first alarm and reminds him to stop. At the same time, elbow of the arm of the offending thumb, is firmly but not tightly wrapped in a two-inch elastic bandage. One pin is placed lengthwise in the medial bend of the elbow. When he sucks, pin mildly jabbing indicates second alarm. If the child continues, elastic bandage will be tightened and his hand falls asleep as a third and final alarm.

INTRAORAL APPROACHES[71]

APPLIANCES

Corrective appliances are indicated only when it can be determined that the child wants to discontinue the habit and needs only a reminder to accomplish the task. The appliance should not be painful or interfere with malocclusion. Instead, it should merely acts as a reminder. The indiscriminate use of habit breaking appliances, when the habit is the result of a deep-seated emotional problem can result in a series of undesirable reactions. Using a reminder appliance to expedite the realignment process will give the child a feeling of success and achievement, which will reinforce the desire to discontinue the habit.

Purpose of habit breaking appliance

1. The appliance renders finger sucking meaningless by breaking the suction. The child may of course place his fingers in the mouth but gets no real satisfaction from it.

2. Prevents finger pressure from displacing the maxillary incisors further labially and prevents the development of openbite or an adaptive and deforming tongue and lip function.

3. The appliance forces the tongue backward, changing its shape during postural resting position from an elongated mass to a wider, more nearly normal tongue. As a result tongue exert more pressure on maxillary buccal segments and the narrowing of the maxillary arch by abnormal swallowing habit is reversed, and the peripheral portions once again overlie the occlusal surface of posterior teeth preventing over eruption of these teeth.

A) Removable appliances

Removable habit breaker is a simple Hawley appliance with a piece of wire embedded in the acrylic resin portion behind the incisors; it can be useful reminder device and has the advantage of allowing the patient to remove it for eating and maintain good hygiene. The disadvantage of this type of appliance are that patient compliance is a major factor and the appliance can be easily misplaced or lost.

Figure 17 Removable Habit Breaking Appliance

B) FIXED APPLIANCES

Fixed habit breakers are advantageous because they do not rely on patient compliance. A fixed device is an intraoral appliance attached to the maxillary teeth by means of two bands fitted to the primary second molars or the permanent first molars. A palatal arch wire soldered to the bands forms the base of the appliance, to which a crib, or some loop is soldered to the anterior portion of the arch, behind the incisors.

Fixed devices serve as reminder and also prevent the patient from putting the palmer surface of digit in contact with palatal gingiva, thus preventing the pleasure of sucking.

Many kinds of fixed habit breaker are available, including the Bluegrass appliance, palatal bar, and quad helix.

Palatal bar: the palatal bar is constructed of two molar bands and a 0.036 inch stainless steel wire to serve as the base of the appliance. A shield or crib made of 0.030-inch wire is adapted to the deepest anterior part of the palate, separating the thumb or finger from the soft tissue. A short vertical extension in the front serves as a reminder.[71]

Palatal cribs of various designs have been used successfully to overcome digit-sucking habits and are designed to prevent both the comfortable positioning of the digit against the palate and any associated tongue thrust, thereby allowing the natural force of the lips to correct an anterior open bite.

Several minor problems have been reported with the use of palatal cribs. Children with palatal cribs may be initially upset regarding the appliance and experience difficulty eating sticky and hard foods. These are usually accommodated within three to four weeks.

Transient changes in speech, such as slurring and lisping, are corrected once the appliance is removed at the completion of treatment, if not during the active treatment stage.

Palatal irritation following insertion of the appliance has been reported in some children and may reflect poor fabrication. Loss or loosening of palatal cribs has also been reported in a small minority. The risk of dental caries and lack of patient cooperation may contraindicate the use of appliance therapy in some children.[47]

Figure 18 Palatal Bar

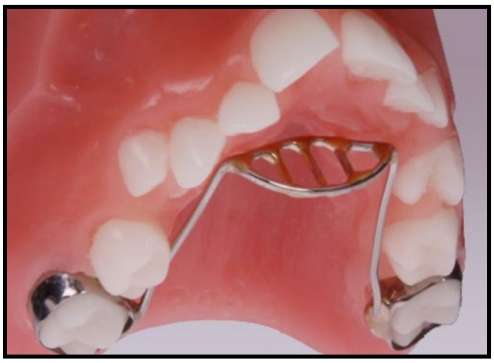


Figure 19 Palatal Bar with Reminder

The Hay rake is a fixed appliance designed to discourage thumb sucking by adding spurs to a metal crib placed in the anterior portion of the palate.

Figure 20 Hay Rakes

Some children need additional help to stop the habit and in that case habit-breaking appliances are indicated. Graber (1958) reported 92% success with fixed appliance therapy.[72] One of the fixed appliances used to break the habit is the palatal crib appliance.[73] This appliance is effective in habit-breaking; however, the negative emotional reactions and effects on speech and eating are evident.[74] There are many disadvantages to the use of the palatal crib appliance in habit-breaking e.g., tongue irritation, difficulty to maintain good oral hygiene and self-inflected trauma.[62] The success of habit-breaking appliances is usually assessed by asking the parents and the child about the history of habit-breaking with positive reinforcement to the child for stopping the habit. This is done at each follow-up appointment.

Blue Grass Appliance: Haskell (1991) introduced this appliance for the children with a continued thumb sucking habit which is affecting the mixed or permanent dentition. The idea came from the equine industry, where a bit with copper rollers is used to distract irritable horses.

It consists of a modified six-sided roller machined from Teflon to permit purchase of the tongue. This is slipped over a 0.04 stainless steel wire soldered to molar orthodontic bands. This appliance is placed for 4-6 months. Instructions are given to turn the roller instead of sucking the digit. Digit sucking is often to stop immediately.[75]

Figure 21 Bluegrass Appliance

Modified Bluegrass appliance: Stainless steel wire (0.9mm) adapted over the palate extending from either side of molars. 3 mm acrylic beads made in laboratory using dental monomer and polymer. Later, beads inserted into stainless steel wire over palatal rugae area. No contact established by beads with palatal tissues. The wire soldered to molar bands by protecting the beads. The appliance cemented using luting cement. The patient instructed to roll the bead with tongue whenever he/she feels like sucking his/her thumb.

Figure 22 Modified Bluegrass Appliance

It encourages neuromuscular stimulations by using multiple beads as per what was the principles of Castillo-Morales.[76]

Between 4–6-year-old children can be Instructed to play with the beads with the tongue immediately after placement. This allows the child to accept the appliance

and learn the neuromuscular activity to normalize the tongue position. When a spinning roller is placed in close proximity to the tip of the tongue, "fascinating" response is quickly implemented due to neuromuscular and sensitive nature of tongue. Since Teflon rollers are not in contact with palatal tissues, children can roll them with their tongues. Within few days, the tongue establishes new non harmful habit of playing with roller. Hence, this appliance works through counter conditioning response to the original conditioned stimulus for thumb sucking.[77,78]

Direct relationship between age and time of appliance placement has been observed. The younger the patients are, the more quickly and completely the tongue position becomes normalized and the lesser the time required for cessation of the habit is. Limbrock et al. suggested the appliance design even for toddler group to 12 year old child. Cessation of habit was reported on very 1st day in toddlers, whereas it takes few weeks in case of 10–12-year-old children. Hence, in early mixed detention or even in younger group, appliance could be used comfortably.[76]

The BG appliance has been shown to be a successful appliance for thumb or fingersucking habit-breaking. Greenleaf and Mink (2003), in a retrospective study, showed a 93% success rate of the BG appliance in breaking the finger-sucking habit. The history of habit breaking was confirmed by the patient and/or parents and was recorded in the patient's chart. In that study, the treatment was marked as successful when the child had stopped the habit and was not engaging in it at each follow-up appointment until the end of treatment. However, the authors did not state if a long-term follow-up was performed after appliance removal. It is important to know whether a long-term habit-breaking is achieved.[79]

In their retrospective study, Greenleaf and Mink (Greenleaf & Mink, 2003) included 30 out of 41 patients presenting for treatment of a thumb-sucking habit at the University of Kentucky Paediatric Dental Clinic over a period of 7 years. Of the excluded 11 subjects, 6 were still in active treatment, while 5 did not present for follow-up. The total time for habit cessation was 12.3 weeks ± 12.2 weeks. Greenleaf and Mink (Greenleaf & Mink, 2003) suggested that the use of the BG can serve as "a neuromuscular stimulant for the tongue" which they claimed might be used for speech therapy.[79]

Quad Helix:. The quad helix is a fixed expander that is applied during primary or mixed dentition for transverse expansion of the maxillary arch. A combination of quad helix and habit controller soldered to the anterior part of the helix can be useful in patients who have thumb sucking habits and also need palatal expansion. The quad helix alone, without a habit controller also can prevent thumb sucking.

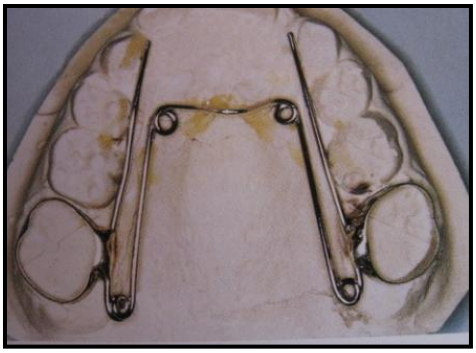


Figure 23 Quad Helix

Modified quad helix appliance: A modified quad helix crib appliance fabricated with 0.036 inch stainless steel wire. Anterior component of the quad helix modified to form cribs, which are continuous with the anterior helices and the

posterior component retained the conventional design. The expansion arms extended up to the primary canine region.[80]

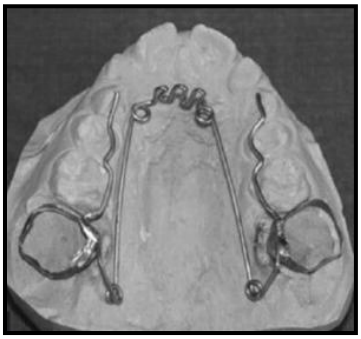


Figure 24 Modified Quad Helix

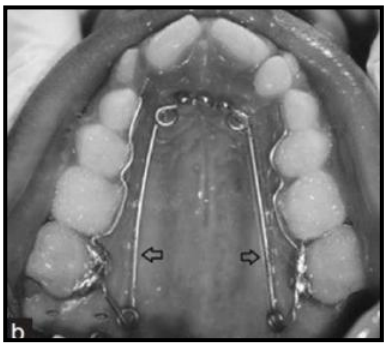


Figure 25 Modified Quad Helix

Bandaids, mittens, socks, and tape placed over the fingers or hands are of questionable value in discouraging thumb-sucking. Variously designed dental appliances constructed to assist the child who wants to stop a thumb habit have been shown to be quite effective, however, even for an intense thumb-sucking habit. Such appliances remind the child to be conscious of the habit. A palatal bar fixed to the molars that does not interfere with the occlusion is used with a "hayrake" that breaks the seal that sucking creates. Similar appliances that the patient can remove may be fabricated. Lingual spurs attached to maxillary incisor bands also act as a reminder appliance.[81,82]

Current strategies[34]:

Thumb-home concept:

This is the most recent concept. In this a small bag is given to the child to tie around his wrist during sleep and it is explained to the child that as the child sleeps in his home, the thumb will also sleep in its house and so the child is restrained from thumb sucking habit.

Thumb sucking book-

"The Little Bear who Sucked His Thumb" is a book directed at children, for children. The book has been written and illustrated by Dr.Dragan Antolos, an experienced dentist with a special interest in thumb sucking habits in children. He deals first-hand in management of dental, social, and functional problems which can arise with persistent thumb sucking. The book and chart are a non-invasive and effective strategy for stopping thumb sucking, and have received positive support from psychiatrists, speech pathologists and pedodontic societies. He is very mindful that parents and practitioners should not place pressure on children to stop as this is only met with resistance and can entrench the problem.

Dr. Dragan Antolos, "It is important to balance the psychological benefits of thumb sucking with the negative impact it has on developing, permanent teeth. If you read books to your child and your child is a thumb sucker, "The Little Bear who Sucked His Thumb" is a book you should have. The child will relate to the story and it will deliver a positive message without pressure. The book empowers parents to proactively encourage their child to stop sucking on their own terms, when they are ready. I am totally against unremovable restraining aids placed on children's thumbs

to forcefully prevent children thumb sucking, especially in young toddlers. If your child is a thumb sucker between the ages of two and seven, then The Little Bear who Sucked his Thumb is a simple, inexpensive and effective way to help your child address the habit."

Oliver is a little bear with a thumb sucking habit. Initially Oliver finds it comforting and fun, but soon decides it is a time to stop his thumb sucking.

This proves to be more difficult than Oliver had first though. So off he goes into the woods, so seek out a mystical dragon, who is sure can help. The dragon shows Oliver how, with determination, and little help, he can stop his thumb sucking.

The book is beautifully illustrated with characters that will appeal to both boys and girls. As well as stand-alone story, The Little Bear who sucked his Thumb is especially useful to parents with children that have a thumb sucking habit. It addresses the problem in a fun and non-threatening way. The wall charts can be personalized with your child's name, helping to further motivate them, and in conjunction with the book, find the desire to stop sucking their thumb.

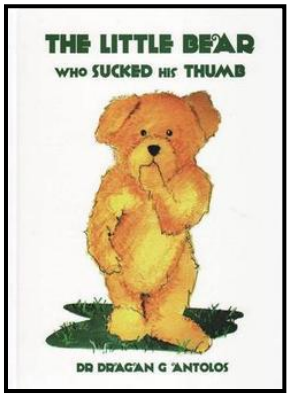


Figure 26 Thumb Sucking Book

Use of hand puppets: Currently the use of hand puppets is gaining popularity. These help in eliminating thumb sucking.

Figure 27 Hand Puppets

My special shirt: This helps in minimizing the damage of the finger sucking by providing a number of tools to address the habit in a phased manner.

Figure 28 Special Shirt

CONCLUSION

Oral habits in children usually initiate as normal reflex which may be pleasant or unpleasant. Most habits disappear when child reaches school. In rare instances habit is no longer a habit, but may be the result or the cause of physical or psychological problem. If these habits are practiced with more frequency, and for longer duration, the muscle imbalance of the growing dental structures will cause malocclusion, facial mal development and speech. Attempts must be made to pin point the cause and treat it to break the habit. Habits, both good and bad are patterns of behavior which are actively learnt by the child. Teaching of good habits to children and elimination of bad one is one of the important skills for the parent to learn.

NNSH may be considered normal till certain stage of the child's development. These may or may not be related to the emotional status of the child. If the habit is causing a malocclusion or other pathologic process, it is privilege and responsibility of the dentist to work with the child and parents toward a resolution of the problem.

Since oral habits adversely affect dentoalveolar system, more attention to control and prevent them is required, so the duty of dentists is not only tooth repair and modification of dentoalveolar changes, but also, he has to have enough knowledge about prevention and treatment of disorders caused by oral habits. This point is considerable that most parents who spend their time with their children are not aware of the harmful oral habits and their bad effects. Dentists should provide parents with information about different types of oral habits, etiology of habits especially with emphasis on role of stress in development of them and ways to manage and treat habits at home.

Parents should be educated about benefits of the exclusive breast feeding in the first 6 months of age on mixed dentition. The activity of non-nutritive sucking should be diagnosed in a timely manner in order to reduce the development of posterior cross bite, anterior open bite, and Class II molar relationship.

Dental practitioners who care for children should provide anticipatory guidance and ensure timely detection of sucking habits. When necessary, referral to appropriate specialists for treatment should be arranged.

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