



Republic of Iraq
Ministry of Higher Education
And Scientific Research
University of Baghdad
College of Dentistry



THUMB SUCKING AND MALOCCLUSION

A Project Submitted to

The College of Dentistry, University of Baghdad, Department
of Pedodontics' and Preventive Dentistry in Partial Fulfillment
for the Bachelor of pediatric dentistry

By

Mustafa Safaa Hamza

Fifth Grade

Supervised by

Lecturer. Heba N. Yassin

(B.D.S, M.Sc.)

2022 A.D.

1443 A.H.

Certification of the Supervisor

I certify that this project entitled "thump sucking and malocclusion " was prepared by the fifth-year student Mustafa Safaa Hamza under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the bachelor's degree in pediatric Dentistry

Lect. Heba N. Yassin

Date

ACKNOWLEDGEMENT

First of all, I thank "Allah" almighty for granting me the will and strength to accomplish this research and I pray that his blessings upon me may continue throughout my life.

Deep thanks to Assist. **Prof. Dr.Raghad Abdulrazzaq AL Hashimi** ,Dean of the College of Dentistry-University of Baghdad for his support to accomplish this review.

Deep thanks to Prof **Dr.Ali I. Al-Bustani** , the associate dean for scientific affairs

I would like to thank Assist. **Prof. Dr. Ahlam Taha**, Head of the Department of Pedodontics and Preventive Dentistry for his Kindness and help.

I am indeed internally thankful to my supervisor **Lect. Heba Yassin** for her continuous guidance, generous advice, and without their encouragement and wise supervision; the present dissertation would not see the light of the day.

My great appreciation and thanks to all teaching staff in Department of Pedodontics and Preventive Dentistry. Finally, to all those whom I forgot to mention their names for their kind efforts helping me to compose this review of literature.

DEDICATION

I'd like to dedicate this project to my beloved **father** and to my beloved **mother** without both I would never make it to this point.

To all **my friends**, thank you for being always there for me with all you love and support.

CONTENT

SUBJECT	PAGE N.
INTRODUCTIONS	1
REVIEW OF LITERATURE	3
Définition	3
Sucking development	3
Types of sucking	4
prevalence of thump sucking	5
Types of thumb sucking	5
. Etiology of thumb sucking	6
Type of feeding	6
Child gender	8
Family structure	8
Child birth rank	8
Mother's age	9
Genetic background	9
Parental education	9
Socioeconomic status	9

Adverse effects of thumb sucking	10
Malocclusion	10
Anterior open bite	10
Increased Overjet	11
Posterior crossbite	11
Deep palate	12
Manangement	12
Before age four	12
Four To six-year age	12
Reframing	13
Reward therapy	13
Reminder therapy	14
The school age years	14
Treatment of malocclusion	15
Anterior openbite	16
Posterior cross bites	16
CONCLUSION	19
REFERENCES	20

LIST OF FIGURES

Figure 1. Subtelny's classification of sucking	6
Figure 2. Reward therapy in treating thumb sucking	14
Figure 3. sharp and blunt rake appliance	15
Figure 4. Spring-loaded bite block in treating anterior open bite	16
Figure 5. modified quad helix appliance	17
Figure 6. modified quad helix appliance with soldered cribs	18

INTRODUCTION

Thumb sucking habit makes up the majority of the bad oral habits (Jabur and Nisayif, 2007). If these habits are stopped by five years of age, they do not alter the position of the permanent teeth, but if prolonged beyond this age, it can lead to malocclusion by impeding mandibular growth which leads to the lingual inclination of the lower anterior teeth and increased the overjet, also it may result in an anterior open bite; posterior crossbite; deep palate (Dimberg et al., 2013; Suhani et al., 2015; Obayes,2021); onycholysis (Sechi et al., 2021); finger eczema (Oloyede and Okpokowuruk, 2021), and speech defects (Gutierrez and Carugno, 2020).

Thumb sucking not only damages the mouth's structures but also serves as a vector for the propagation of infectious disease (Obayes, 2021). As a result, identifying and assessing the abnormal habits and their consequences should be done as soon as possible to limit the potential adverse effects on health (Muhammad et al., 2020).

Emotional stress is one of the major causes that exacerbates bad oral habits, it's usually seen as the way that a person reacts with or recovers from stress (Almutairi et al., 2021).

Occlusion is the relationship between the maxillary and mandibular teeth when the individual bites on his teeth (Ferro et al., 2017), and it is not only related to teeth contact but rather includes the continuous interactions between teeth and their supporting structures; neuromuscular system; temporomandibular joints (TMJs) and the craniofacial skeleton (Shen et al., 2021). The essential constituent of thorough oral health care for all children is the establishment of a functional and aesthetically appealing occlusion (Majorana et al.2015).

Malocclusion is the presence of any teeth and jaw malalignment that results in esthetic or functional problems and is caused by either hereditary factors which cannot be prevented or environmental factors such as bad oral habits which are of primary interest to orthodontists because they may affect the normal development of occlusion and compromise treatment prognosis (Cirulli et al., 2015; Anand et al., 2021).

The impact of habits on malocclusion is determined by cellular resistance; the facial pattern of the individual, and elements related to the habit directly, such as severity; repetition, and duration (Corrêa et al., 2016).

Different methods of management are present including counselling the child; reframing; a reward system and reminder therapy with a habit breaker appliance (Neha et al., 2021).

Aims of the study

The aim of this review is to study the etiology, prevalence, types and methods of management for thumb sucking habit.

REVIEW OF LITERATURE

1. Definition

Thumb sucking has been defined as repetitive forceful sucking of the thumb accompanied by contraction of the buccal and lip muscles. It is a type of non-nutritive sucking that is considered normal in the first 2-3 years of life but can cause irreversible damage if it continues beyond this age (Shetty et al., 2015).

2. Sucking development

Sucking is a process that occurs throughout the oral developmental stage in which the sucking response is first elicited by touching the lips at 13 weeks of gestational age and terminates between one and three and a half years of age. It is thought to be the infant's first ordered muscle activity, which aids in breastfeeding (Jyoti and Pavanalakshmi, 2014). At 18 to 24 weeks of gestation, actual sucking begins, which is characterized by a posterior-anterior tongue movement during which the posterior movement is predominant (Miller et al., 2003). There is probably no substantial further maturation of sucking between 26 and 29 weeks of gestation (Lau and Schanler, 2000; Lau and Kusnierczyk, 2001).

It had been well accepted that effective and reliable nutritive sucking is dependent on the coordinated actions of sucking; swallowing; breathing and esophageal functioning, all of these mechanisms in what is known as the 'nutritive sucking pathway' working together to ensure that a milk bolus is transported quickly and safely from the oral cavity to the stomach (Lau, 2014). There is some difference in sucking process between infants and adults, the jaws open and the lips press tightly in infants while the maxillary and mandibular teeth are locked together, the tongue is positioned on the hard palate, and lips are relaxed in adults. The infant to adult transfer is based on long-term alterations in the oropharyngeal muscle activation that are not related to weaning (Feștilă et al., 2014).

Suction and expression are the main aspects of mature sucking (Lau, 2006), Suction is the negative intraoral pressure caused by the soft palate closing the nasal passages, the lips tightening on the breast or bottle nipple, and lowering of the mandible, milk is pulled into the mouth when there is no air penetrated the oral cavity, similar to sipping through a straw. Expression is the action of pressing the nipple of breast or bottle against the hard palate with the tongue to discharge milk into the mouth, comparable to hand-milking a cow (Lau, 2016).

3. Types of sucking

Sucking can be divided into two types: Nutritive sucking delivers the nutrients and non-nutritive sucking brings a sense of comfort and security (Hasan, 2021), and involves sucking fingers; pacifiers, or other items; yet, it is tolerated until three years of age without creating orofacial deformities; however, the persistence after this age can increase the risk of developing unfavorable occlusion as it associated with craniofacial abnormalities (Feștilă et al., 2014..).

Non-nutritive sucking is linked to two reflexes that are inborn in the child. The rooting reflex in which the infant's head and tongue moving toward any object that touches his cheek. Typically, this object is the mother's breast, although it could also be a finger or a pacifier. Around the age of seven months, the rooting reflex in healthy newborns ceases. The sucking reflex evokes milk from the nipple and lasts when the child reaches the age of 12 months. The absence of the sucking reflex does not imply that the infant is unable to suck; at this stage of development, the infant has learned to feed and does not require the reflex for nutrition (Feștilă et al., 2014 ; Al Assadi and Al Dahan, 2015; Taha, 2019).

When babies are upset, they suck to soothe themselves, it's also a way for them to explore, and in some cases, sucking may just be a way for them to pass the time, but many children recognize that the habit is an infantile mechanism, they find it difficult to break because it becomes a joyful

habit over time, and they may also use it just to get their parents' interest (Green, 2010; Sanadi and Rebial, 2018; Hasan, 2021).

4. Prevalence of thumb sucking

The prevalence varies depending on a variety of characteristics including age of the child, gender, social situation, and ethnic origins. It varies with the culture; while it is prevalent in western society, it is unusual among Eskimos (Chopra et al., 2015). According to Al Assadi and Al Dahan (2015), the prevalence of nonnutritive sucking habits was higher in girls, and this can be explained by the fact that girls have more emotional issues than boys, therefore they are more likely to develop this practice (Niemelä et al., 2000).

5. Types of thumb sucking

Thumb sucking was divided into four categories by Subtelny and Subtelny (1973), based on the locations of fingers' insertion and mandibular incisors as shown in (figure 1).

Type A: Is the most common and it is represented by 50%. The entire digit is put into the mouth, with the thumb pad compressing against the palate and thumb contact with the maxillary and mandibular anterior sustained.

Type B: Constitute about 24%. The thumb is inserted into the mouth without contacting the palate's vault, while contact with the maxillary and mandible anterior is sustained.

Type C: It form about 18%. The thumb is inserted into the mouth further than the first joint, touching the hard palate, and only the maxillary anterior is in contact with the thumb.

Type D: Is accounted 6%. In this type which only the tip of the thumb is inserted into the mouth.

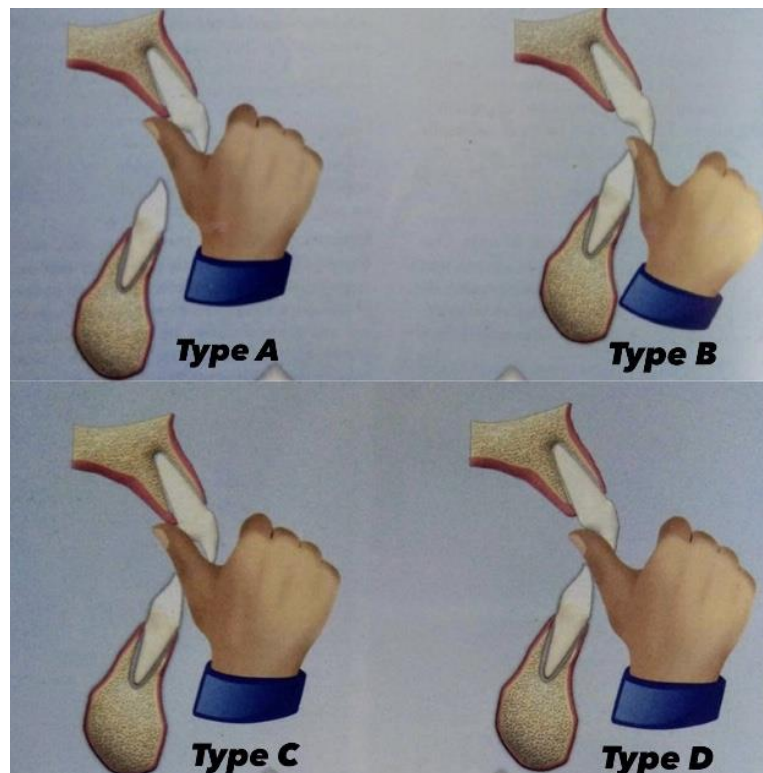


Figure 1: Subtelny's classification of thumb sucking (Al-kinane, 2019).

According to Shahraki et al., (2012) Thumb sucking had 2 types:
1) Active thumb sucking in which the muscles exert a lot of force during sucking, and if this habit is continued for a long time, it will affect the location of the permanent teeth and the form of the mandible.

2) Passive thumb sucking in this situation, the child places his finger in the mouth without applying force to the teeth or mandible, so the habit will not result in dentofacial deformities.

6. Etiology of thumb sucking

There are many factors that attributed to the development of thumb sucking habit such as:

6.1 Type of feeding

Exclusive breastfeeding is recommended by the World Health Organization (WHO) from birth to 6 months of age, and it is supplementary until age 2 years of age to prevent early malnutrition; minimize the rate of infant morbidity and mortality rates (Sankar et al., 2015; Victora et al., 2016); providing infants with the iron supplies they need (Maguire et al., 2013) and increase cognitive performance (Horta et al., 2015).

There is also considerable evidence that exclusive breastfeeding promotes the infant's immune system and emotional well-being (Rollins et al., 2016). Breastfeeding also aids in the development of the stomatognathic system (Sánchez et al., 2010), which is the collection of organs, structures, and nerves that are responsible for sucking, swallowing, chewing, speaking, and breath (Castro et al., 2012).

The mother's breast works as a biological orthodontic appliance (Page, 2001) during sucking, the infant places the tongue appropriately within the mouth and performs a real breast "milking." (Sakalidis et al., 2013). The arches, cheeks, and tongue all move in harmony, and the mouth's neuromuscular activities grow reasonably (Rollins et al., 2016). Another benefit of breastfeeding is lowering the child's likelihood of developing nonnutritive sucking habits (Narbutytė et al., 2013) because insufficient breastfeeding may lead to apparent emotional confusion and frustration lead to inappropriate replacement of nipple by digit or pacifier (Mobbs et al., 2016).

The mechanism of sucking in bottle feeding is completely different from that occurred in breastfeeding (Viggiano et al., 2004; Gomes et al., 2006); as it requires less vigorous muscle action, which means less mouth exercise, and hence does not assist mandibular growth to the same amount as breastfeeding (Chen et al., 2015). Reduced oral activity can result in underdeveloped muscles, improper

lip and tongue posture, and the development of detrimental oral habits, all of which can contribute to malocclusion development (Romero et al., 2011), so inadequate breastfeeding and inappropriate bottle-feeding may increase the frequency of these nonnutritive sucking habits, which are linked to the development of malocclusions (Narbutytė et al., 2013).

6.2 Child gender

Girls have a higher prevalence of thumb sucking than boys, maybe due to an emotional factor found in girls (Santos et al., 2009; Padure et al., 2012, Garde et al., 2014).

In contrast, Bosnjak et al., (2002) discovered that there is no statistical difference in the prevalence of thumb sucking habit between boys and girls.

6.3 Family structure

The child's environment becomes essential for the emergence of habit since it can generate a sense of pleasure and well-being (Canut, 2005). As a result, the family structure is linked to this phenomenon, as a less secure family setting leads to a child's need to escape less stable situations by developing para functional habits (Murrieta-Pruneda et al., 2011).

6.4 Childbirth rank

The impact of this factor on the development of non-nutritive sucking habits, such as thumb sucking is questionable: while some studies found that the first child in the family was associated with a longer habit, this may be explained by that the presence of siblings will reduce the attention on the first one so the child express the feeling of stress by thumb sucking habit (Warren and Bishara, 2002), others found that the last child born in the family was more likely to develop thumb sucking which may be due to the presence of sibling whom need a lot of care and interest by their mothers (Maguire,2000), however, Almonaitienė et al.

(2013) found that there was no link between the rank of child birth and the development of thumb sucking.

6.5 Mother's age

Some studies mentioned that there was a strong relationship between the maternal age and her personality toward the habit because older mothers were more concerned as they are more skillful, had a greater awareness, and had just enough maturity to deal with these issues, while Chopra et al. (2015) claimed that there was no such relationship. However, according to Warren et al., (2000) older maternal age was linked to prolonged nonnutritive sucking habits including thumb sucking.

6.6 Genetic background

The genetic basis for finger sucking action that remains beyond the third birthday concluded from a study performed on monozygotic and dizygotic twins (Onyeaso, 2004), whereas Ooki in (2005) reported that the genetic effect on the development of finger sucking still till the age of 12 years. Also Obayes (2021) stated that the family history had a high significant difference on the study group due to genetic predisposition of thumb sucking habit.

6.7 Parental education

The level of parental education is the most important factor in determining the quality of their children's oral hygiene practices. Some of them were aware of the potential implications of bad oral habits, which can lead to dental abnormalities and necessitate orthodontic treatment (Lala et al., 2020) while Warren et al., (2000) reported that the children of parents with a higher degree of education were more likely than other children to adopt long-term nonnutritive sucking habits. However, Obayes (2021) demonstrated there is no relation between parents' education and development of thumb sucking habit.

6.8 Socioeconomic status

There was also a link between socioeconomic situation and non-nutritive sucking habits, by which more children from high socioeconomic classes indulging in certain non-nutritive sucking habits than children from low classes (Taylor and Cook, 1989). The proportion of children from various socioeconomic classes who indulge in non-nutritive sucking habits did not differ significantly (Chukwumah et al., 2018).

7. Adverse effects of thumb sucking

Thumb sucking habit may produce different adverse effects including the following:

7.1 Malocclusion

Malocclusion is characterized as "a growth and development irregularity primarily of the muscles and jaw bones during childhood and adolescence, probably due to early childhood habits." It has been linked to the combination of hereditary and environmental influences (Silva and Manton, 2014).

The changes happened since the muscles attempt to accommodate the force generated throughout thumb-sucking. Thumb-sucking causes pressures to be applied to the tissues of the oral cavity, resulting in an imbalanced muscle tone in which the buccinator muscle creates negative pressure on the jaw, narrowing the dental arches, producing constriction in the maxilla, and improper facial development (Miyarsih et al., 2020).

Thumbs also apply pressure to the palate, causing the palate to become deeper and the upper anterior teeth to shift to the labial side, and the lower teeth to the lingual side (Chhabra and Chhabra, 2020).

The characteristic features of malocclusion in thumb sucking are as the following:

7.1.1 Anterior open bite

The loss of vertical contact between the maxillary and mandibular anterior teeth is caused by a variety of factors (Nielsen, 1991), dental open bite caused by mechanical obstruction of the vertical growth of the incisors and alveolar structure while skeletal relationships are normal whereas the skeletal open bite caused by a vertical discrepancy in skeletal components which is represented by short mandibular ramus, increased posterior dentoalveolar height, and increased lower anterior facial height and gonial angle in addition to the transverse discrepancies may that may occur (Grippaudo et al., 2013).

Other characteristics are incompetent lips; convex profile; a prominent labial inclination of the anteriors, and crowding (Zecca et al., 2016). As a result, an anterior open bite is a leading source of masticatory and speech impairment, as well as significant esthetic concerns for those who experience it (Farronato et al., 2013).

7.1.2 Increased overjet

According to Pădure et al. (2012), thumb-sucking behavior was a significant etiological factor for the development of class II division 1 malocclusion.

Several authors believed that thumb sucking increased the occurrence of overjet because of the lengthening and the advancement of the front portion of the maxillary arch (Al-Dawoody, 2004; Kato et al., 2009). Thumb sucking also resulting in lingual inclination of lower incisors and labial inclination of upper incisors (Kamdar and Al-Shahrani, 2015).

7.1.3 Posterior crossbite

Al-Dawoody (2004) stated that posterior crossbite in thumb suckers evolved because of a reduction in the width of the maxillary arch and increase in the

mandibular arch width which caused by the displacement of tongue position by the thumb.

7.1.4 Deep palate

Thumb sucking leads to a reduction in the width of the palate and increasing in the length of the maxillary arch which results in the development of the deep palate (Shetty et al., 2015; Zameer et al., 2015).

8. Management

Management can be classified according to age:

8.1 Before four years of age

Parents should get dental education to prevent thumb sucking development which includes feeding the child once he is hungry and letting him eat as much as he wants, as well as naturally feeding the child, breastfeeding is regarded as the best technique of nutrition and malocclusion prevention. In addition to the use of physiologically developed nipples instead of traditional nipples during bottle-feeding (Majorana et al., 2015).

If one recognizes the concept that the thumb sucking habit will normally stop by the age of four, and the effects on the occlusion will most likely be temporary, even though self-correction of malocclusion can be expected because the pattern is normal and the skeletal malformation is mild, then direct intervention before this age is questionable. Furthermore, the child's level of comprehension makes any of the intervention approaches difficult to implement (Avery and McDonald, 2010, Tanaka et al., 2013).

8.2 Four to six-year age group

Some children at this age may benefit from psychological ploys and reward systems to assist them to stop the habit. Explanations that are appropriate for the

child's age, establishing psychological stability for children who lack parental care, interest, and affection. Parents must encourage their children to participate in activities like playing outside and purchasing new toys to redirect their focus away from the habit's repetitive actions (Avery and McDonald, 2010; Muhammad et al., 2020).

8.2.1 Reframing

Reframing has been recognized and confirmed to be one of the most widely used behavior guidance strategies in pediatric dentistry (Nuvvula and Kamatham, 2013). It is founded on the idea that the content of any event is determined by the frame in which it is viewed. When the frame shifts, the content shifts as well, affecting the person's response and behavior. It can be accomplished via altering the situation's meaning or background (Bandler and Grinder, 1982).

8.2.2 Reward therapy

Reward therapy is a contract made between a child and his or her parent or between a child and a dentist. If the child stops performing the habit for a certain period, he or she will be rewarded. The reward does not have to be costly, but it should be unique enough to encourage the child. He is instructed to record the frequency of thumb sucking occurrence and to his success in breaking the habit. A reduction in the frequency of practicing the habit suggests that the child is making progress and will most likely stop it. For a better outcome, the parents should be instructed to ignore the habit and not mention it to the child (Muhammad et al., 2020).

A timed reward system might be beneficial. In the first month, a star is placed on a calendar for each day the child does not indulge in the habit. If the calendar has 28 stars (i.e., two "bad" days permitted), the child receives a gift selected by the parent. In the second month, the target is 29 stars to earn a reward. The calendar for the third month should be filled with stars. If the child stops thumb-

sucking habit for three months, there is a high probability that the habit will be broken and occlusal development will improve (Avery and McDonald, 2010), as shown in (Figure 2).

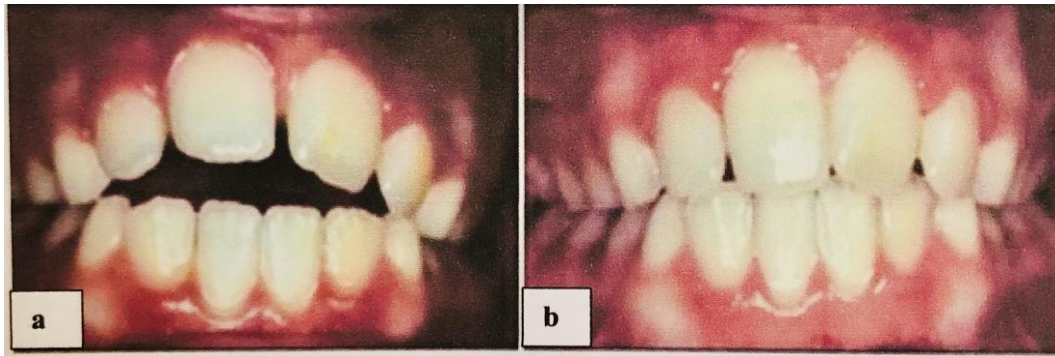


Figure 2: Reward therapy in treating thumb sucking (Avery and McDonald, 2010). (a) Constriction and anterior open bite in an 8-year-old child with a thumb-sucking habit. (b) Self-correction of the open bite 9 years of age after the child was discontinued the habit through a positive rewards system.

8.2.3 Reminder therapy

Incorporate the negative reinforces such as gloves, bandages, and bitter sating medicines, adhesion tapes, thumb guards, and long sleeve gowns placed directly on the problematic thumb may sometimes cause the habit to cease but some of these techniques have drawbacks. Clinical trials have revealed that a better solution has a limited effect (Alemran, 2000), additionally, the usage of adhesion tapes on the fingers may obstruct blood circulation, resulting in excessive sweat and illness (Shetty et al., 2010), however, these methods are more effective with children who demonstrate a willingness to stop the habit and just require a little assistance-the "reinforces" are used as reminders, not as punishment (Avery and McDonald, 2010).

8.3 The school-age years

Although reward approaches may succeed in some children aged six years and older, the chronic habit may be so established that successful cessation with

such approaches is doubtful. That would be the child who has "tried and tried to stop," but seems to be unable to do that.

Direct appliance therapy is frequently required due to the transition of the permanent incisors and the persistent nature of the habit, not only to eliminate the habit but also to facilitate appropriate tooth eruption and alignment by affecting the acquired muscular patterns (Avery and McDonald, 2010).

Various dental appliances are present since a long time such as sharp rakes, blunt rakes as shown in (Figure 3); lingual spurs, vertical cribs, palatal bars, horizontal cribs, Graber appliances, and bluegrass appliances. While many of these appliances have been considered harsh and brutal (Moore, 2008), the palatal crib appliance is effective in the treatment of thumb sucking (Sayin et al., 2006; Berger and Janisse, 2013; Asiry, 2015).

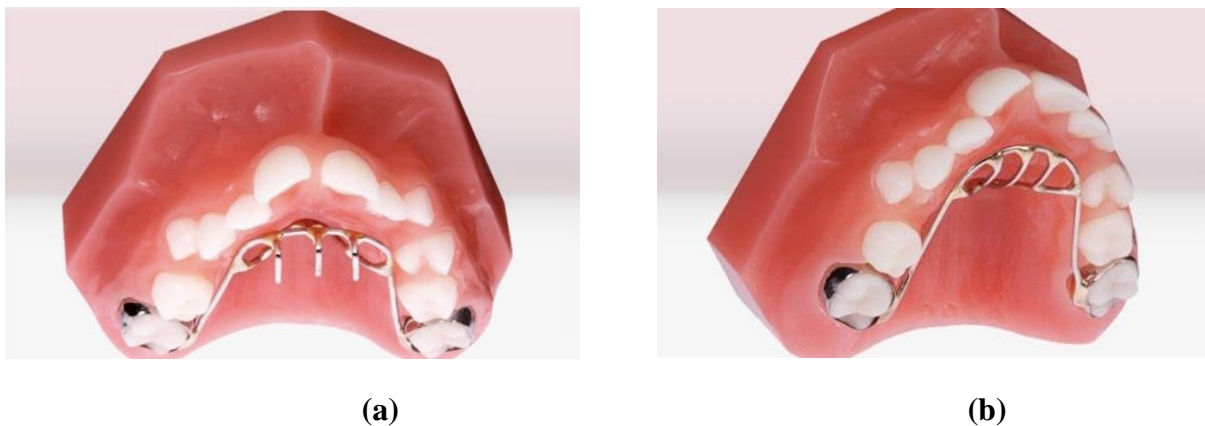


Figure 3: sharp and blunt rake appliance (Clover and Hobson, 2013).

(a) Sharp rake. (b) Blunt rake

9. Treatment of malocclusion

Treating malocclusion caused by thumb sucking is mostly depends on the child's desire to give up the habit. Various appliances have an effect specific characteristic, more than one appliance is usually recommended for the elimination of habit and correction of related malocclusion (Vinay et al., 2013),

however, this therapeutic strategy is costly and time-consuming (Kulkarni and Lau, 2010).

9.1 Anterior open bite

The mixed dentition is the best time to start treatment; if the malocclusion is treated during the deciduous dentition, it will return due to continuous growth changes. When the open bite is coupled with skeletal characteristics such as an increased mandibular plane angle, anterior face height, and extruded posterior teeth, molar intrusion is indicated to redirect the growth of the maxilla and rotate the mandible upward and forward (Doshi and Bhad, 2011).

Many methods have been proposed to influence this earlier developmental pattern, but just posterior bite blocks have been shown to be effective in promoting condylar growth and mandibular forward rotation (Barbre and Sinclair, 1991).

Iskan et al. (1992) and Akkay and Haydar (1996) recommended using a spring-loaded bite-block to intrude the posterior teeth as shown in (Figure 4).

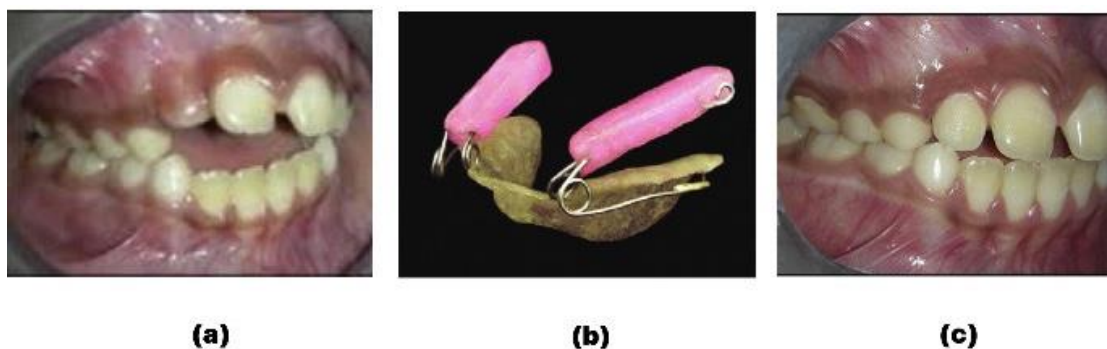


Fig 4: Spring-loaded bite block in treating anterior open bite (Doshi and Bhad, 2011). (a)Preoperative anterior open bite (b) Appliance design (c) Eight-month post treatment intraoral photographs.

9.2 Posterior crossbite

Uncorrected posterior crossbite, especially the unilateral type, may cause temporomandibular joint disorders, asymmetry in the skeletal patterns, soft-tissue profile changes, and teeth attrition (Binder, 2004).

Cozza et al. (2000) described a modified quad helix appliance with soldered cribs attached to the front portion as a habit-breaker. It has proven to be successful, with positive dental outcomes and patient cooperation. However, the development of a modified quad-helix appliance with a roller has eliminated the crib system's drawbacks since it is positioned on the most anterior surface of the palate, causing no difficulty in speech and eating (Greenleaf and Mink, 2003, Neeraja et al., 2010, Chhabra and Chhabra, 2012, Diwanji et al., 2013).

The quad-helix appliance's helices also aid to remind the child not to put the thumb in the mouth (Pinkham et al., 2005). Furthermore, the roller in the modified quad-helix design has a synergistic impact in retraining the child to stop sucking, correction of the posterior crossbite was accomplished by gradual activation of the modified quad-helix appliance (Zameer et al., 2015).



Figure 5: modified quad helix appliance in treating thumb sucking and its malocclusion (zameer et al., 2015).



Figure 6: modified quad helix appliance with soldered cribs attached to the front portion as a habit breaker. (zameer et al., 2015)

CONCLUSION

Thumb sucking habit produces deleterious effects on the occlusion of children such as anterior open bite; posterior crossbite; increased overjet and provide a way for the spread of infectious diseases. So that parents should be instructed to monitor their child if he indulged in the habit to intervene and stop it as soon as possible. If the child still having the habit beyond 4 years of age, the parents should consult the psychiatrist and orthodontist for management before the development of the adverse effects, however, if the adverse effects are developed they will be self-corrected with management at an earlier age since the growth patterns are still normal.

When thumb sucking leads to the skeletal discrepancy, treatment during the mixed dentition is the best time to influence the developmental pattern.

Psychological management plays a very important role in the success of dental treatment, as a result, the clinician's understanding of child psychology, and knowledge of behavior management techniques, Is crucial.

REFERENCE

1. Al-Assadi, A.H. and Al-Dahan, Z.A., (2015). Prevalence of Pacifier Sucking Habit and Its Effect on Occlusion in Children Aged 1-5 Years in Baghdad City. *Journal of Baghdad College of Dentistry*, 27(4), 143-146 [Online]. Available at: <https://platform.almanhal.com/Files/Articles/84298>
2. Al-Dawoody, A.D., (2004). Finger sucking habit: Prevalence, contributing factors and effect on occlusion. *Al-Rafidain Dental Journal*, 4(2), 135-142 [Online]. Available at: https://rden.mosuljournals.com/article_165152.html
3. Alemran, S.E., (2000). A new method in reminder therapy technique for ceasing digit sucking habit in children. *The Journal of clinical pediatric dentistry*, 24(4), 261-263. [Online]. Available at: <https://europepmc.org/article/med/11314408>
4. Almonaitienė, R., Balčiūnienė, I. and Tutkuvienė, J., (2013). Prevalence of oral habits and their impact on facial parameters in Lithuanian children 4 to 9 years of age. *Medicinos Teorija Ir Praktika*, 19, 31-8
5. Almutairi, A.F., Albeshar, N., Aljohani, M., Alsinanni, M., Turkistani, O. and Salam, M., (2021). Association of oral parafunctional habits with anxiety and the Big-Five Personality Traits in the Saudi Dental Journal, 33(2), 90-98. [Online]. Available at: <https://www.sciencedirect.com/science/article/pii/S1013905219310788>
6. Anand, K., Menka, K., Maloth, S., Nayak, S.C., Chowdhary, T. and Bhargava, M., (2021). Analyzing the role of malnourishment in malocclusion: A cross-sectional study. *Journal of Pharmacy and Bioallied Sciences*, 13(5), 452. [Online]. Available at: <https://www.jpbonline.org/article.asp?issn=09757406;year=2021;volume=13;issue=5;page=452;epage=455;aulast=Anand>

7. Asiry, M.A., (2015). Anterior open bite treated with Myofunctional Therapy and palatal crib. *J Contemp Dent Pract*, 16(3), 243-7. [Online]. Available at: <https://www.thejcdp.com/doi/JCDP/pdf/10.5005/jp-journals-10024-1669>
8. Avery, D.R. and McDonald, R.E., (2010). *McDonald and avery dentistry for the child and adolescent-E-book*. Elsevier Health Sciences. 10th ed., 437-440
9. Bandler, R., Grinder, J. and Andreas, S., (1982). *Neuro-linguistic programming™ and the transformation of meaning*. Utah: Real People. 1-4
10. Berger, J. and Janisse, F., (2013). Treatment options for anterior open bite. *Ontario Dentist*, 90(5), 30-5
11. Binder, R.E., (2004). Correction of posterior cross bites: diagnosis and treatment. *Pediatric dentistry*, 26(3), 266-272. Borrie, F.R., Elouafkaoui, P. and Bearn, D.R., (2013). A Scottish cost analysis of interceptive orthodontics for thumb sucking habits. *Journal of orthodontics*, 40(2), 145-154. [Online]. Available at: <https://www.tandfonline.com/doi/abs/10.1179/1465313312y.000000002>
12. Bošnjak, A., Vucicevic-Boras, V.A.N.J.A., Miletic, I., Bozic, D. and Vukelja, M., (2002). Incidence of oral habits in children with mixed dentition. *Journal of oral rehabilitation*, 29(9), 902-905. [Online]. Available at: <https://onlinelibrary.wiley.com/doi/abs/10.1046/j.1365-2842.2002.00925.x>
13. Canut, J. (2005). *Ortodoncia clínica terapéutica*. 2nd ed. Barcelona. Masson
14. Castro, M.S.J.D., Toro, A.A.D.C., Sakano, E. and Ribeiro, J.D., (2012). Evaluation of oral functions of the stomatognathic system according to the levels of asthma severity. *Jornal da Sociedade Brasileira de Fonoaudiologia*, 24, 119-124 [Online]. Available at: <https://www.scielo.br/j/jsbf/a/wg4NmfNPckXhh66BtgT837P/abstract/?format=.html&lang=en>

15. Chen, X., Xia, B. and Ge, L., (2015). Effects of breast-feeding duration, bottle-feeding duration and non-nutritive sucking habits on the occlusal characteristics of primary dentition. *BMC pediatrics*, 15(1), 1-9. [Online]. Available at: <https://link.springer.com/article/10.1186/s12887-015-03641>
16. Chhabra, N. and Chhabra, A., (2020). Evaluation of the efficacy of the modified bluegrass appliance in cessation of thumb-sucking habit: an in vivo study with 12 months follow-up. *Medicine and Pharmacy Reports*, 93(2), 190 [Online]. Available at: [/https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7243892](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7243892)
17. Chopra, A., Lakhanpal, M., Singh, V., Gupta, N., Rao, N.C. and Suri, V., (2015). The habit of digit sucking among children and the attitude of mothers towards the habit in India. *TMU J Dent*, 2(1), 1-4 [Online]. Available at: [.http://www.tmujdent.co.in](http://www.tmujdent.co.in)
18. Chukwumah, N.M., Kolawole, K.A., Folayan, M.O., Oyedele, T.A., Oziegbe, E.O., Onyejaka, N., Agbaje, H.O. and Oshomoji, V., (2018). Non Nutritive Oral Habits, Age, Sex, Socioeconomic Status and Infant Feeding Practices in Children in Sub-Urban Nigeria. *IOSR Journal of Dental and Medical Sciences*. 3(17), 07-12 [Online]. Available at: www.iosrjournals.org.
19. Cirulli, N., Ballini, A., Cantore, S., Farronato, D., Inchingolo, F., Dipalma, G., Gatto, M.R. and Alessandri Bonetti, G., (2015). Mixed dentition space analysis of a southern italian population: new regression equations for unerupted teeth. *J Biol Regul Homeost Agents*, 29(2), 515-20. [Online]. Available at: <https://www.scijournal.org/impact-factor-of-j-biol-reg-homeos-ag.shtml>
20. Corrêa, C.D.C., Bueno, M.D.R.S., Lauris, J.R.P. and Berretin-Felix, G., (2016), March. Interference of conventional and orthodontic nipples in system .stomatognathic: systematic review. In *CODAS* (Vol. 28, 182-189)

21. Cozza, P., Giancotti, A. and Rosignoli, L., (2000). Use of a modified Quad Helix in early interceptive treatment. *Journal of clinical orthodontics: JCO*, 34(8), 473-476. [Online]. Available at: <https://www.jco> (<https://www.jco/>)-
.online.com
22. Dimberg, L., Lennartsson, B., Söderfeldt, B. and Bondemark, L., (2013). Malocclusions in children at 3 and 7 years of age: a longitudinal study. *The European Journal of Orthodontics*, 35(1), 131-137 [Online]. Available at <https://academic.oup.com/ejo>
23. Diwanji, A., Jain, P., Doshi, J., Somani, P. and Mehta, D., (2013). Modified bluegrass appliance: a nonpunitive therapy for thumb sucking in pediatric patients a case report with review of the literature
24. Doshi, U.H. and Bhad, W.A., (2011). Spring-loaded bite-blocks for early correction of skeletal open bite associated with thumb sucking. *American journal of orthodontics and dentofacial orthopedics*, 140(1), 115-120. [online].
./Available at <https://www.ajodo.org>
25. Ferro, K.J., Morgano, S.M., Driscoll, C.F., Freilich, M.A., Guckes, A.D., Knoernschild, K.L., McGarry, T.J. and Twain, M., (2017). The glossary of prosthodontic terms.
26. Feștilă, D., Ghergie, M., Muntean, A., Matiz, D. and Șerbanescu, A., (2014). Suckling and non-nutritive sucking habit: what should we know?. *Clujul medical*, 87(1), p.11. [Online]. Available
at:<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4462418>Fisher, J.E. and O'Donohue, W.T. eds., (2006). *Practitioner's guide to evidence-based psychotherapy*. New York: Springer.
27. Garde, J.B., Suryavanshi, R.K., Jawale, B.A., Deshmukh, V., Dadhe, D.P. and Suryavanshi, M.K., (2014). An epidemiological study to know the prevalence of deleterious oral habits among 6 to 12 year old children. *Journal of*

international oral health: JIOH, 6(1), p.39. [Online]. Available at:

[.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3959135](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3959135)

28. Gomes, C.F., Trezza, E., Murade, E. and Padovani, C.R., (2006). Surface electromyography of facial muscles during natural and artificial feeding of infants. *Jornal de pediatria*, 82, 103-109. [Online]. Available at:

<https://www.scielo.br/j/jped/a/GK5NdW7hdNj4VrxRTdcyN8G/?lang=en>

29. Green, S.E., (2010). Confirmational study: a positive-based thumb and finger sucking elimination program. *International Journal of Orofacial Myology*, 36. [Online]. Available at: <https://ijom.iaom.com/journal>

30. Grippaudo, C., Oliva, B., Greco, A.L., Sferra, S. and Deli, R., (2013). Relationship between vertical facial patterns and dental arch form in class II malocclusion. *Progress in orthodontics*, 14(1), 1-7. [Online]. Available at: <https://progressinorthodontics.springeropen.com/articles/10.1186/2196-1042-14-43>

31. Hasan, A.A., (2021). Assessment of Children with Thumb Sucking Habit in . Babylon City. *Indian Journal of Forensic Medicine Toxicology*, 15(1), p.2627 .[online]. Available at: <http://www.ijfmt.com>

32. Horta, B.L., Loret de Mola, C. and Victora, C.G., (2015). Long-term consequences of breastfeeding on cholesterol, obesity, systolic blood pressure and type 2 diabetes: a systematic review and meta-analysis. *Acta paediatrica*, 104, 30-37

33. Jyoti, S. and Pavanalakshmi, G.P., (2014). Nutritive and non-nutritive sucking habits effect on the developing oro-facial complex; a review. *Dentistry*, 4(3), 1-4

34. Jabur, S.F. and Nisayif, D.H., (2007). The effect of bad oral habits on malocclusions and its relation with age, gender and type of feeding.

Mustansiriya Dent J, 4(2), 152-6. [Online]. Available
.https://www.iasj.net/iasj/download/42b4ba2cf9ba3628

35. Kamdar, R.J. and Al-Shahrani, I., (2015). Damaging oral habits. Journal of international oral health: JIOH, 7(4), p.85. [Online]. Available at:
.https://europepmc.org/article/med/25954079

36. Kato, M., Watanabe, K., Kato, E., Hotta, H. and Daito, M., (2009). Three dimensional measurement of the palate using the semiconductor laser: On the influences of the palate of maxillary protrusion with finger sucking. Pediatric Dental Journal, 19(1), 25-29. [Online]. Available at:
.https://www.jstage.jst.go.jp/article/pdj/19/1/19_1_25/_article/-char/ja

37. Lala, S., Al Kurdi, S. and Kouchaji, C., (2020). Oral Health Knowledge, Awareness and Associated Practices of Pre-school Children's Parents in Damascus, Syria: a cross-sectional study [online]. Available at
.https://www.researchsquare.com/article/rs-32897/v1

38. Lau, C., (2006). Oral feeding in the preterm infant. NeoReviews, 7(1), 19
27[Online]. Available at:
.https://neoreviews.aappublications.org/content/7/1/e19.short

39. Lau, C., (2014). Interventions to improve oral feeding performance of preterm infants. Perspectives on Swallowing and Swallowing Disorders
(Dysphagia), 23(1), 23-45

40. Lau, C., (2016). Development of infant oral feeding skills: what do we know?-. The American journal of clinical nutrition, 103(2), 616S-621S.
[Online]. Available at:
https://academic.oup.com/ajcn/article/103/2/616S/4564718?login=true

41. Lau, C. and Kusnierczyk, I., (2001). Quantitative evaluation of infant's nonnutritive and nutritive sucking. Dysphagia, 16(1), 58-67

42. Lau, C.H.A.N.T.A.L. and Schanler, R.J., (2000). Oral feeding in premature infants: Advantage of a self-paced milk flow. *Acta Paediatrica*, 89(4), 453-459. [Online]. Available at: <https://onlinelibrary.wiley.com>
43. Maguire, J.A., (2000). The evaluation and treatment of pediatric oral habits. *Dental Clinics of North America*, 44(3), 659-vii. [Online]. Available at: <https://pubmed.ncbi.nlm.nih.gov/10925776>
44. Maguire, J.L., Salehi, L., Birken, C.S., Carsley, S., Mamdani, M., Thorpe, K.E., Lebovic, G., Khovratovich, M., Parkin, P.C. and TARGeT Kids! collaboration, (2013). Association between total duration of breastfeeding and iron deficiency. *Pediatrics*, 131(5), e1530-e1537
45. Majorana, A., Bardellini, E., Amadori, F., Conti, G. and Polimeni, A., 2015. Timetable for oral prevention in childhood-developing dentition and oral habits: a current opinion. *Progress in orthodontics*, 16(1), 1-3. [Online]. Available at <https://progressinorthodontics.springeropen.com>
46. Miller, J.L., Sonies, B.C. and Macedonia, C., (2003). Emergence of oropharyngeal, laryngeal and swallowing activity in the developing fetal upper aerodigestive tract: an ultrasound evaluation. *Early human development*, 77(1), 61-87. [Online]. Available at: <https://www.journals.elsevier.com/early-human-development>
47. Miyarsih, R., Sutardjo, I. and Al-Supartinah, A.S., (2020). The influence of thumb-sucking habit towards anterior open bite on Javanese girls aged 67 years-old in Ngaglik District, Sleman, and Yogyakarta. *Journal of Dentomaxillofacial Science*, 5(1): 45-47. [Online]. Available at <https://jdmfs.org/index.php/jdmfs>
48. Mobbs EJ, Mobbs GA, Mobbs AED., (2016). Imprinting, attachment and displacement: a mini review of early instinctual behavior in newborn infant influencing breastfeeding success. *Acta Paediatr*; 105:24-30

49. Muhammad, N.I., Laishram, H. and Hassan, M.S.D., (2020). Nursing • Mother's Awareness and Intervention towards Thumb Sucking Habit, Prevention and Management among Children in Kano State of Nigeria. [Online]. Available at: <https://www.iosrjournals.org>
50. Murrieta-Pruneda, J.F., Bello, R.I.A., Silva, L.E.P., Juárez-López, L.A., Vieyra, C.L., Ocampo, A.F.M., Murillo, V.Z. and Rebolledo, M.G.S., (2011). Prevalence of non-nutritive buccal habits in a group of preschool children in Nezahualcoyotl City, México. *Boletín Médico del Hospital Infantil de México*, 68(1), 26-33. [Online]. Available at: <https://www.elsevier.es/en-revista-boletin-medico-del-hospital-infantil-201>.
51. Narbutytė, I., Narbutytė, A. and Linkevičienė, L., (2013). Relationship between breastfeeding, bottle-feeding and development of malocclusion. *.Stomatologija*, 15(3), 67-72. [Online]. Available at: <https://sbdmj.com>
52. Nielsen, I.L., (1991). Vertical malocclusions: etiology, development, diagnosis and some aspects of treatment. *The Angle Orthodontist*, 61(4), 247-260
53. Niemelä, M., Pihakari, O., Pokka, T., Uhari, M. and Uhari, M., (2000). Pacifier as a risk factor for acute otitis media: a randomized, controlled trial of parental counseling. *Pediatrics*, 106(3), 483-488
54. Neha, P., Sukhdeep, S. and Dhirja, G., (2021). Reframing the Behavior and Breaking the Thumb Sucking, Tongue Thrusting Habit in a 6 Years Old Child: A Case Report. *Annals of the Romanian Society for Cell Biology*, 25(6), 7561-7569
55. Obayes, N.M., (2021). Impact of Thumb Sucking and Nail Biting on Oral Health Status and Malocclusion among 6-10 years old children in Hilla City. (MSC dissertation, College of Dentistry. Impact of Thumb Sucking and Nail

Biting on Oral Health Status and Malocclusion among 6-10 years old children
.Hilla City/Iraq)

56. Oloyede, I.P. and Okpokowuruk, F.S., (2018). Impact of Exclusive Breastfeeding on Digital Sucking in Children Attending the Children's Outpatient Department of University of Uyo Teaching Hospital, Uyo. *Int J .Pediatr Res*, 4, p.036

57. Ooki, S., (2005). Genetic and environmental influences on finger-sucking and nail-biting in Japanese twin children. *Twin Research and Human Genetics*, .8(4), 320-327. [Online]. Available at: <https://www.cambridge.org>

58. Onyeaso, C.O., (2004). Oral habits among 7-10 year-old school children in Ibadan, Nigeria. *East African medical journal*, 81(1), 16-21 [Online]. Available at: <https://www.ajol.info/index.php/eamj>

59. Pădure, H., Negru, A.R. and Stanciu, D., (2012). The Class II/1 anomaly of hereditary etiology vs. Thumb-sucking etiology. *Journal of medicine and life*, 5(2), p.239. [Online]. Available at: <https://medandlife.org>.

60. Page, D., 2001. Breastfeeding is early functional jaw orthopedics (an introduction). *Functional Orthodontist*, 18(3), 24-27. [Online]. Available at: [.https://www.worldcat.org/title/functional-orthodontist](https://www.worldcat.org/title/functional-orthodontist)

61. Rollins, N.C., Bhandari, N., Hajeebhoy, N., Horton, S., Lutter, C.K., Martines, J.C., Piwoz, E.G., Richter, L.M., Victora, C.G. and Group, T.L.B.S., (2016). Why invest, and what it will take to improve breastfeeding practices?. *The lancet*, 387(10017), 491-504 [Online]. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S0140673615010442>

62. Romero, C.C., Scavone-Junior, H., Garib, D.G., Cotrim-Ferreira, F.A. and Ferreira, R.I., (2011). Breastfeeding and non-nutritive sucking patterns related to the prevalence of anterior open bite in primary dentition. *Journal of Applied Oral Science*, 19, 161-168 [Online]. Available at

<https://www.scielo.br/j/jaos/a/fccSMGFjKvnmwdD6VyBWxXs/abstract/?format=html&lang=en>

63. Sakalidis, V.S., Williams, T.M., Garbin, C.P., Hepworth, A.R., Hartmann, P.E., Parch, M.J. and Geddes, D.T., (2013). Ultrasound imaging of infant sucking dynamics during the establishment of lactation. *Journal of Human Lactation*, 29(2), 205-213. [Online]. Available at: <https://journals.sagepub.com>

64. Sanadi, R. and Rebial, M., (2018). A Study on Assessing the effectiveness of Nurse Teaching Programme on Knowledge and Attitude regarding Thumb Sucking among the Mothers of under-five children in selected rural areas of Belgaum, Karnataka. *Asian Journal of Nursing Education and Research*, 8(3), 349-356 [online]. Available at <https://www.indianjournals.com>

65. Sánchez-Molins M, Grau Carbó J, Lischeid Gaig C, Ustrell Torrent JM., (2010). Comparative study of the craniofacial growth depending on the type of lactation received. *European journal of paediatric dentistry*, 11(2), 87-92., (2010). Comparative study of the craniofacial growth depending on the type of lactation received. *European journal of paediatric dentistry*, 11(2). 87-92 [online]. Available at: <https://europepmc.org/article/med/20635843>

66. Sankar, M.J., Sinha, B., Chowdhury, R., Bhandari, N., Taneja, S. , Martines, J. and Bahl, R., (2015). Optimal breastfeeding practices and infant and child mortality: a systematic review and meta-analysis. *Acta paediatrica*, 104, 3-13. [Online]. Available at: <https://onlinelibrary.wiley.com>

67. Santos, S.A.D., Holanda, A.L.F.D., Sena, M.F.D., Gondim, L.A. and Ferreira, M.Â.F., (2009). Nonnutritive sucking habits among preschool aged children. *Jornal de pediatria*, 85(5), 408-414. [Online]. Available at: <https://www.scielo.br/j/jped/a/GhStBqHDmZMm6fCxWM6KxNx/?format=pdf&lang=pt>

68. Sayin, M.O., Akin, E., Karaçay, S. and Bulakbaşı, N., (2006). Initial effects of the tongue crib on tongue movements during deglutition: a Cine Magnetic .resonance imaging study. *The Angle orthodontist*, 76(3), 400-405
69. Sechi, A., Patrizi, A., Leuzzi, M., Chessa, M.A. and Neri, I., (2021). Concomitant onychomadesis and skin rash in a 3-year-old child affected by hand, foot, and mouth disease. *Indian Journal of Dermatology*, 66(1), p.106. [Online]. Available at: <https://www.ncbi.nlm.nih.gov>
70. Shen, Y.F., Wei, M.C., Li, H.P., Pan, Y.H., Hong, H.H., Chen, C.C., Kuo, S.B., Ho, C.Y., Chang, C.T. and Huang, Y.F., (2021). Vertical dimension of occlusion related to mandibular movement during swallowing, *biomedical journal*, 44(2), 217-222 [Online]. Available at: [.https://www.sciencedirect.com/science/article/pii/S2319417019305281](https://www.sciencedirect.com/science/article/pii/S2319417019305281)
71. Shetty, R.M., Dixit, U., Hegde, R. and Shivprakash, P.K., (2010). RURS'elbow guard: An innovative treatment of the thumb-sucking habit in a child with Hurler's syndrome. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 28(3), p.212 [Online]. Available at: <https://www.jisppd.com>
72. Shetty, R.M., Shetty, M., Shetty, N.S. and Deoghare, A., (2015). Three alarm system: revisited to treat thumb-sucking habit. *International journal of clinical pediatric dentistry*, 8(1), p.82 [Online]. Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4472878>
73. Silva, M. and Manton, D., (2014). Oral habits-part 1: the dental effects and management of nutritive and non-nutritive sucking. *Journal of Dentistry for Children*, 81(3), 133-139. [Online]. Available at: [.https://www.ingentaconnect.com](https://www.ingentaconnect.com)
74. Suhani, R.D., Suhani, M.F., Muntean, A., Mesaros, M. and Badea, M.E., (2015). Deleterious oral habits in children with hearing impairment. *Clujul*

Medical, 88(3), p.403. [Online]. Available at:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4632903>

75. Tanaka, O.M., Guariza-Filho, O., Carlini, J.L., Oliveira, D.D., Pithon, M.M. and Camargo, E.S., (2013). Glossectomy as an adjunct to correct an open-bite malocclusion with shortened maxillary central incisor roots. *American Journal of Orthodontics and Dentofacial Orthopedics*, 144(1), 130-140. [Online].

Available at: <https://www.sciencedirect.com/science/article/abs>

76. Taylor, V.J. and Cook, P.A., (1989), April. The prevalence of dummy sucking in 2 socioeconomic groups in Leeds. In *Journal of Dental Research* (Vol. 68, No. 4, 567-567). [Online]. Available at:

<https://journals.sagepub.com/home/jdr>

77. Viggiano, D., Fasano, D., Monaco, G. and Strohmer, L., (2004). Breast feeding, bottle feeding, and non-nutritive sucking; effects on occlusion in deciduous dentition. *Archives of Disease in Childhood*, 89(12), 1121-1123

78. Warren, J.J. and Bishara, S.E., (2002). Duration of nutritive and nonnutritive sucking behaviors and their effects on the dental arches in the primary dentition. *American Journal of Orthodontics and Dentofacial Orthopedics*, 121(4), 347-356. [Online]. Available at:

<https://www.sciencedirect.com/science/article/abs/pii>

79. Warren, J.J., Levy, S.M., Nowak, A.J. and Tang, S., (2000). Non-nutritive sucking behaviors in preschool children: a longitudinal study. *Pediatric Dentistry*, 22(3), 187-191 [Online]. Available at:

<https://www.aapd.org/publications/journals/pediatric-dentistry-journal>

80. Zameer, M., Basheer, S. N., Reddy, A. & Kovvuru, S. K. (2015). A Single Versatile Appliance for Habit Interception and Crossbite Correction. *Case reports in dentistry* 2015. [Online]. Available at:

<https://www.hindawi.com/journals/crid/2015/607545>

81. Zecca, P. A. Fastuca, R., Beretta, M., Caprioglio, A. & Macchi, A. (2016). Correlation assessment between three-dimensional facial soft tissue scan and lateral cephalometric radiography in orthodontic diagnosis. *International Journal of Dentistry*, 2016. [Online]. Available at: <https://www.hindawi.com/journals/ijd/2016/1473918>.