Case Report

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LIP SUCKING AND LIP BITING IN THE PRIMARY DENTITION: TWO CASES TREATED WITH A MORPHOLOGICAL APPROACH COMBINED WITH LIP EXERCISES AND HABITUATION

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ABSTRACT

Lip sucking and lip biting in the primary-dentition period can cause the upper incisors to tip labially and the lower incisors to collapse lingually with the lower lip wedged between the upper and lower anterior teeth. The resulting lip incompetence further aggravates maxillary protrusion. Thus, there is a causal relationship between lip sucking/lip biting and maxillary protrusion. Orofacial myologists provide lip training to activate the flaccid upper lip and raise the child's awareness to help stop the sucking or biting of the lower lip, sometimes using an oral screen.

Two primary-dentition cases with lip sucking and lip biting were treated with a functional appliance (F.A.), resulting in the elimination of the habits in 5 to 6 months along with the improvement of the overjet, overbite and facial profile. The authors prioritize myofunctional therapy (MFT) when treating open bite cases with tongue thrust in the primary dentition. However, the treatment of maxillary protrusion due to lip sucking and lip biting is approached differently with priority given to morphological improvement to create an oral environment that makes lip sucking and lip biting difficult, which is complimented with lip exercises and habituation. This combined approach was found to be effective in breaking the lip-sucking and lip-biting habits.

Keywords: lip sucking, lip biting, functional appliance (F.A.), orofacial myology

INTRODUCTION

Oral habits are said to account for 15 to 25% of acquired malocclusions. Surveys on oral habits in children from birth to 6 year olds conducted by the pedodontic departments of 3 dental schools in Japan (Yokoi, Yamauchi, Suzuki, Fukuta & Kurosu, 1986; Sakai, 1985; Ohmori, 1977) revealed that the mean lip sucking and/or lip biting rates for all the age groups ranged between 2.2 and 4.8% (Table 1).

Hanson & Barrett (1988, p.324-325) state that lip biting is a "relatively infrequent habit, at least to a pathological extent". They divide lip habits into 3 types; lip biting, lip licking and lip sucking. They attribute lip biting to certain types of stress, lip licking primarily to mouth breathing and occasionally to chronic nervousness, and lip sucking to transfer from thumb sucking.

Maroto, Gonzalez & Lajardin (1998, p.207) describe lip sucking as a habit to which professionals pay less attention but which appears in all ages with a certain frequency.

Effects of lip sucking and lip biting on the dentition and jaws have also been discussed in the literature. According to Moffatt (1963, p.145), "sucking of the cheek and lips is less common than thumb sucking, but if practiced long enough may contribute towards malocclusion." In the same article, he writes: "Lip sucking is frequently observed, the resulting malocclusion depending upon whichever lip is sucked. When the upper lip is sucked, the upper incisors become locked lingually to the lower incisors. When the lower lip is sucked, the result may be twofold with

Table 1. Incidences of lip sucking and/or lip biting by age from questionnaires conducted by pedodontic departments

	0year	1year	2year	3year	4year	5year	6year	Total
School of Dentistry, Aichi-Gakuin University n = 4,159	10.0	2.3	1.8	1.5	3.4	2.5	2.0	2.2
School of Dentistry at Tokyo, The Nippon Dental University n = 4,243	0.0	2.6	3.7	5.9	6.5	2.4	0.0	4.1
Tsurumi University, School of Dental medicine n = 863		2.5		4.7	7.0	5.1	4.9	4.8

[%]

Table 2. Case 1 - Cephalometric analysis

Measurements		Initial examination (4Y4M)	Before end of active treatment (5Y3M)	After active treatment (6Y6M)	Final record-taking (9Y10M)
SNA	[°]	82.8	82.3	78.8	81.2
SNB	[°]	75.8	75.7	74.2	78.3
ANB	[°]	7.0	6.6	4.6	2.9
FMA	[°]	23.4	25.5	25.5	22.3
IMPA	[°]	90.2	99.4	105.4	105.2
FMIA	[°]	66.3	55.1	49.0	52.5
U1 - SN	[°]	107.9	94.7	99.0	102.0
A-B plane	[°]	-11.6	-11.3	-6.9	-5.6
Y-axis	[°]	65.6	65.1	66.0	65.6
Occlusal Plane	[°]	13.5	14.7	16.2	16.0
Interincisal Angle	[°]	132.5	133.0	122.9	123.7
Overjet	[mm]	8.5	4.8	4.5	2.0
Overbite	[mm]	4.1	2.1	1.7	1.5

* Measured to $\frac{A}{A}$ ** Measured to $\frac{A}{1}$

the upper incisors tipping labially and the lower incisors tipping lingually." Although the authors have not seen sucking of the upper lip, it appears that either lip can be involved. As Graber (1961, p.232) observed, "the abnormal structural relationship and oral habits associated with maxillary protrusion can lead to lack of lip contact (short, hypofunctional upper lip), cushioning of the lower lip lingual to the upper incisors, hyperactive mentalis and orbicularis oris muscles, and tongue function and position. These effects contribute to constriction of the upper arch, protrusion and labial tipping of the upper incisors, and flattening of the lower anterior segment." Moyers (1988, p.551) says: "In Class II, Division 1 cases, the lip habits frequently are severe and that their treatment should not be started until the incisors have been positioned correctly. Some lip habits are then self-correcting, but the hyperactive mentalis muscle remains." The authors agree that morphological improvement holds a key to the breaking of these habits.

Hanson & Barrett (1988, p.325) state that "lip sucking is frequently referred to in dentistry as a mentalis habit, since contracture of the mentalis muscle in positioning the lower lip may result in overdevelopment and a characteristic button chin." They find it "generally impossible to even begin procedures for mouth closure until this habit is disrupted: the instant that the mouth closes, the lower lip darts between the teeth." Barrett & Hanson (1974, p.277) refer to lip sucking as "by far the lesser of two evils" when compared to tongue sucking. Interestingly, he points out that "many reported cases of lip sucking turn out to be illusory; the habit is assumed on the basis of dental malocclusion or lip development and function inherent in some types of abnormal swallowing." An indicator of genuine lip sucking is "a constantly chapped and discolored lower lip outlined by an angry red semicircle dipping down toward the

mentalis." Peterson (1982, p.367) also states that "...lip sucking can be identified with the red, inflamed, and chapped area below the vermilion border." Owman-Moll & Ingervall (1984, p.12) hint that "...lip incompetence may contribute to maxillary protrusion by reducing the restricting pressure from the lips to the teeth, along with its unesthetic consequence of short lips."

These observations clearly indicate that lip sucking and lip biting can lead to malocclusion, eversion of the upper lip and lip incompetence. In addition, mandibular growth may be restricted, possibly resulting in morphological problems such as mandibular retrognathism and low mandibular angle with a deep bite, as the authors observed in their patients with lip sucking and/or lip biting. The authors thus recognize the need for elimination of lip sucking and lip biting in the primary dentition. These habits may adversely affect the child's speech and psychological development, as well as the growth and development of the dentition and jaws.

Lip sucking and lip biting have been dealt with as two different habits, but are clinically difficult to distinguish as these habits are often practiced together. The habit of sucking the lip between the upper and lower anterior teeth is classified as "lip sucking", and that of biting the lip with the upper and lower anterior teeth as "lip biting". In the authors' opinion, however, the two habits are inseparable and are referred to as such in this paper. Although the lower lip appears to be the main player in lip sucking and lip biting, it is essentially a mentalis habit with contracture of the mentalis muscle. The intensity and frequency of these habits influence the degree of labial tipping of the upper incisors, interdental spacing, upper lip protrusion and labial tipping of the lower incisors. The eversion of the upper lip and resulting lip incompetence due to flared upper incisors may further accentuate the protrusive tendency with age, making the

upper incisors more susceptible to trauma from fall or collision.

Parents may be concerned with the child's lip sucking and biting in the primary dentition. However they often remain unaware of the need for treatment until overt symptoms of maxillary protrusion appear after eruption of the permanent incisors. Then they visit a pedodontist or an orthodontist seeking treatment for the first time. For this reason, it is rare to see children in the primary-dentition period presenting with maxillary protrusion from lip sucking and biting even in orthodontic offices. This paper introduces a treatment approach using F.A. for these children with emphasis on morphological improvement to create an occlusal environment that makes it difficult to suck or bite the lower lip. This is assisted with lip exercises and habituation, that is, awareness-raising to help the children break these habits. This combined approach prioritizing morphological correction allows elimination of lip sucking and lip biting in 5 to 6 months and achievement of better treatment results.

CONVENTIONAL APPROACH TO TREATMENT OF LIP SUCKING AND LIP BITING

The standard approach to lip sucking and lip biting taken by orofacial myologists has been to call the child's attention to the behavior of inserting the lower teeth under the upper incisors, provide lip training and use habit breakers such as an oral screen or an oral shield. However, it is difficult to have 4 or 5-year-olds comply with the use of an oral screen, often resulting in a lack of efficacy of the treatment. In addition, maxillary protrusion is often so severe that an oral screen remains unstable in the mouth producing little effect. Because of this difficulty, lip sucking and lip biting in the primary dentition are usually placed under observation at regular intervals, and subjected to training or orthodontic treatment in the mixed dentition with an increased severity of maxillary protrusion.

The orthodontic appliances used at this time include a lip bumper to keep out the lower lip, a bite plane to correct deep bite, headgear to reduce maxillary protrusion, and a 2x4 appliance for partial orthodontic correction.

Hanson & Barrett (1988) point out that in a few patients, lip biting persists to the point of habit formation with a detrimental effect on tooth alignment, though it is usually among the less difficult habits to break. "Once the causes and effects have been explained to the patient, it remains only to call up to consciousness the instances of habitual occurrence" (Hanson & Barrett, 1988, p.324). Peterson (1982, p.368) writes: "Resolving of the overjet malocclusion may serve to diminish the frequency of a lip habit. If additional treatment becomes necessary, however, an approach to lip habits may involve self-discipline not to perform the habit or the use of a habit-breaking appliance. One such appliance is the lip bumper, whose purpose is to make the practice of drawing the lower lip between the anterior teeth more difficult and thus reminding the child of the habit." Owman-Moll & Ingervall (1984, p.22) state that "...an oral screen generates forces to reduce the labial tipping of upper incisors in a manner similar to other types of appliances strengthening the lips at the same time." They also suggest that "...oral screen therapy may have the side effect of flaring the lower incisors, which is desirable in some cases but not in others." Sclare (1957) refers to the influence of the lips on dentition as a factor contributing to certain types of malocclusion. He says that "it is possible to move teeth into almost any position, but that the forces of nature will move them back into a state of equilibrium if their positions are not in harmony with their environment" (Sclare, 1957, p.402). Maroto, Gonzalez & Lajardin (1998, p.210) propose "...the use of appliances that prevent the lip insertion between the dental arches for treatment of lip sucking." They list "...the activator, the lip bumper and the oral screen as the most frequently used appliances...",

however they present no case report on the use of these appliances. They also suggest that "...the practice of some exercises or functional myotherapy of the lower lip by the upper lip may help to solve the lip-sucking problem." Moffatt (1963) introduces the use of a band with a sharp labial spur on a mandibular incisor tooth, which is worn for 3 to 4 months and is activated slightly every 2 weeks.

The methods of treating lip sucking and lip biting that have been described in the literature can be summarized as follows: Remind the child of the sucking or biting behavior to help him stop the habit. Strengthen the orbicularis oris through lip exercises to retrocline the upper incisors. Use an oral screen as a lip exerciser or a reminder of the habit. Use an orthodontic appliance such as a lip bumper, F.A. and a headgear in the mixed dentition.

Before the eruption of the 6-year molars, there are a limited number of appliances available for treatment of maxillary protrusion resulting from lip sucking and lip biting, among which F.A. is well-accepted by 4 to 5-year olds. In fact, the authors obtained favorable results using F.A. in combination with lip exercises and behavioral modification in the two cases to be presented here.

USE OF F.A.

There are two possible approaches to treatment of maxillary protrusion induced by lip sucking and lip biting in the primary dentition. One is to eliminate the habit by correcting function. The other is morphological correction to create an environment that will discourage the child to practice the habit.

The common treatment modalities utilized by orofacial myologists include lip exercises (lip pulls, cotton roll, lip massage, button pull, and lip puffer with warm water), habit reminders, and the use of appliances such

as an oral screen and the lip exerciser designed by Zickefoose (1999, 1980). From an orthodontist's perspective, lip sucking and lip biting cannot be ignored as etiologic factors of malocclusion since they influence the dentition, jaws and soft tissues. If early treatment with a simple orthodontic appliance helps correct the protrusion associated with the lip habits in the primary dentition, this would eliminate the need for more complicated and cumbersome orthodontic procedures later in the mixed dentition. The correction of the upper and lower incisor relationship for morphological improvement in the primary dentition may also allow early elimination of these habits, which would be of value from the standpoint of preventive orthodontics as well. In the treatment of maxillary protrusion due to lip sucking and lip biting, therefore, the approach prioritizing morphological correction will serve to create an occlusal environment conducive to lip exercises and habituation and facilitate the adaptation of the orofacial muscles.

F.A. is worn in the evening and at bedtime. During daytime when the appliance is not worn, the patient undergoes lip training to reminded of the lower lip sucking and to activate the upper lip. Although children generally find it easy to wear F.A., mouth-breathers with allergic rhinitis, enlarged tonsil, etc. may be unable to wear it. F.A. physically prevents its wearer from sucking the lower lip, serving as a habit reminder to assist in habit breaking (Havold, 1974; Graber, Rakosi & Petrovic, 1997).

F.A. allows the improvement of overjet and overbite relationship of the incisors in a relatively short period. The appliance unlocks the mandible from a growth-suppressed, retruded position due to lip sucking and lip biting, thereby stimulating its growth. F.A. can also open the bite by elongating lower posterior teeth if so adjusted, and expand the upper and lower arches laterally at the same time with an expansion screw built into the appliance. F.A. is known to cause flaring of the lower

incisors, which can be utilized to correct the inclination of linguallly tipped lower incisors. Thus, F.A. therapy is recommended as it allows facial profile improvement, lip closure and harmony of the orofacial muscles through morphological improvement.

CASE 1

A 4 year 4 month old girl presented with lip sucking, lip biting and maxillary protrusion, which were recognized during a dental examination in kindergarten (Fig.1).

Fig.1 Case 1 - Lip biting scenes

She began to sleep biting the lower lip at around nine months of age when weaned from breast milk. She kept biting the lower lip all day from one year of age to about two years of age. In the subsequent years, she sucked the lower lip for 30 minutes before falling asleep. She was breast-fed until nine months old. Weaning began at around six months of age. She seldom used a nursing bottle and never used a pacifier. No other habits or nasopharyngeal conditions were noted. Her family consisted of her parents, younger brother, and herself. The father had maxillary protrusion and the mother had crowding.

In the frontal view, the face was almost symmetrical, and the habit of sucking and biting the lower lip was noted. In profile, the upper lip was protrusive, while the chin was retruded with mentalis strain upon lip closure. Her intraoral findings included a marked overjet, a deep bite with the lower incisors biting into the palata, and labially tipped upper deciduous incisors. Her occlusal relationship was of mesial step

type with 8.5mm of overjet and 4.0mm of overbite. There was no midline deviation. Cephalometric analysis revealed labial tipping of the upper deciduous central incisors, mandibular retrognathism and low mandibular angle (Fig. 2).

DIAGNOSIS, TREATMENT GOALS AND TREATMENT PLAN

The case was diagnosed as maxillary protrusion with a deep bite due to lip sucking and biting. The treatment plan was to perform Phase I orthodontic treatment of the primary dentition, followed by observation in the mixed dentition and, if necessary, full-appliance therapy in the permanent dentition. The objectives of Phase I treatment were to reduce the overjet and stimulate forward growth of the mandible, as well as to remind the child of the habit by keeping the lower lip out of the mouth, through the use of F.A.

COURSE OF TREATMENT

F.A. was worn to reduce the flaring of the upper deciduous central incisors and to stimulate forward mandibular growth in Phase I (Fig. 3). The construction bite of F.A. was prepared to create about 3mm of anterior open bite and unforced forward positioning of the mandible. F.A. was adjusted every 2 to 3 months. The child was instructed to wear the appliance at nighttime and as much as possible while at home during the day. Maxillary protrusion was improved in 5 months, resulting in complete elimination of lip sucking and lip biting. F.A. was then left in place as a retainer to facilitate myofunctional adaptation to the new, post-treatment mandibular position. Another F.A. with expansion screws was fabricated for transverse development of the upper and lower arches to create spaces for permanent teeth in the buccal segments in the mixed dentition. The patient is currently under observation.

Fig. 2. Case 1 - Intraoral photographs

Initial examination
age 4Y4M

End of active treatment
5Y1M

Final record-taking
10Y1M

Fig. 3 Case 1 - Functional Appliance

TREATMENT RESULTS

The case is near the completion of the permanent dentition. Molar relationship is now Angle Class I with 2.0mm of overjet and 1.5mm of overbite. Cephalometric comparison at the start and prior to the end of F.A. treatment revealed changes in the SNB angle from 75.8° to 75.7°, the ANB angle from 7.0° to 6.6°, Mand. pl. from 90.2° (to LA) to 99.4° (to L1), and UA-SN from 107.9° to 94.7°.

The elimination of lip sucking and lip biting and stimulation of forward mandibular growth in Phase I resulted in favorable jaw and incisor relationships and a good forward growth of the mandible. The lip protrusion and soft tissue profile were improved at the same time. The patient and parents were satisfied with the facial improvement, and the parents were pleased with the child's improved self-image (Fig. 4, 5) (Table 2).

CASE 2

A 4 year 6 month old boy presented with lip sucking, lip biting and maxillary protrusion (Fig. 6). He has been constantly sucking the lower lip since shortly after birth. The minute the mother pulled the lower lip out from between the upper and lower incisors, the lip went back in for sucking. He was bottle- and breast-fed from birth to seven months of age and only bottle-fed from seven months of age to twelve months of age. Weaning was initiated at twelve months of age. He used a nursing bottle from birth but never used a pacifier. He had no other habits or nasopharyngeal conditions. His family comprised three members, his parents and himself. The mother had maxillary protrusion.

In the frontal view of the face, lip sucking and lip biting were noted, along with facial symmetry. In profile, the upper lip was protrusive, while the chin was retruded with mentalis strain upon lip closure. Intraorally, the patient had a severe overjet and a deep

overbite with the lower incisors biting into the palate. Occlusal relationship was of mesial step type with 8.5mm of overjet and 5.0mm of overbite. The midlines were on. The cephalogram showed labial tipping of the upper deciduous central incisor, lingual tipping of the lower deciduous central incisor and mandibular retrusion (Fig. 7).

Fig.4. Case 1 - Superimposition of cephalograms

Key:
 Solid line: Initial examination (4Y4M)
 Broken line: Before end of active treatment (5Y3M)
 A - SN plane at S
 B - Palatal plane at ANS
 C - Mandibular plane at Me

Fig.5 Case 1 - Superimposition of cephalograms

Key:

Solid line: Initial examination (4Y4M)

One-dot broken line: After active treatment (6Y6M)

Two-dot broken line: Final record-taking (9Y10M)

A - SN plane at S

B - Palatal plane at ANS

C - Mandibular plane at Me

Fig. 6 Case 2 - Lip biting scenes

DIAGNOSIS, TREATMENT GOALS AND TREATMENT PLAN

The case was diagnosed as maxillary protrusion due to lip sucking and biting. The treatment plan included Phase I orthodontic treatment in the primary- and mixed-dentition periods and observation of the transition to the permanent dentition to determine the need for Phase II treatment. Phase I treatment was aimed at stimulating forward mandibular growth and reminding the patient of the habit by keeping the lower lip out of the mouth using F.A.

COURSE OF TREATMENT

In Phase I, F.A. was worn to retrocline the upper deciduous incisors, procline the lower deciduous incisors and stimulate forward mandibular growth (Fig. 8). F.A. was constructed to achieve about 3mm of open bite and unforced forward positioning of the mandible. The appliance was adjusted every month or two. The child was instructed to wear F.A. as much as possible during the day as well as at nighttime. The lip sucking and lip biting habits were eliminated in 4 to 5 months. F.A. was left in place as a retainer until muscle function adapted to the new mandibular position. Mild crowding occurred in the lower anterior area in the mixed dentition. Another F.A. with screws was fabricated and worn for lateral expansion of the upper and lower arches.

TREATMENT RESULTS

Molar relationship is at present Angle Class I with 6.0mm of overjet and 4.5mm of overbite. There is minor spacing in the upper anterior area and mild crowding in the lower anterior area. Comparison of cephalograms at the start and before the end of F.A. wear in the primary dentition showed changes in SNB from 70.2° to 70.9°, ANB from 6.0° to 4.6°, Mand. pl. from 76.5° (to LA) to 90.1° (to L1) and UA-SN from 91.6° to 91.5°.

Fig. 7 Case 2 - Intraoral photographs

Initial examination
age 4Y6M End of active treatment
6Y0M Final record-taking
10Y11M

Fig. 8 Case 2 - Functional Appliance

Fig.9 - Case 2 - Superimposition of cephalograms

Key:
 Solid line: Initial examination (4Y6M)
 Broken line: Before end of active treatment (5Y9M)
 A - SN plane at S
 B - Palatal plane at ANS
 C - Mandibular plane at Me

Successful breaking of the lip-sucking and lip-biting habits and stimulation of forward mandibular growth led to normalization of jaw and incisor relationships and simultaneous improvement of lip protrusion

and facial profile. Both the patient and the parents were satisfied with the results. F.A. with an expansion screw was effective in expanding the upper and lower arches and thereby eliminating the mild crowding in the mixed dentition (Fig. 9, 10) (Table 3).

DISCUSSION

The following adverse effects may result from lip sucking and lip biting that persist from infancy through early childhood and the mixed dentition (Fig. 11):

Severe labial tipping of the upper incisors and spacing in the upper anterior area.
 Lingual tipping and flattening of the lower anterior segment.

Deep bite.

Narrow, V-shaped upper arch form.

Retruded position and growth suppression of the mandible.

Protrusion of the upper lip and mouth breathing.

Shortened upper lip.

Disharmony of the orofacial muscles.

Secondary open bite.

Sucking or biting of the upper lip activates the orofacial musculature as a functional matrix. Particularly, an infant whose deciduous teeth have not yet erupted has a short distance between the upper and lower alveolar ridges. Lip sucking or lip biting produces negative pressure in the oral cavity with the buccinator applying forces towards the tongue. When deciduous teeth erupt into such an oral environment, the above mentioned adverse effects may start to appear. These are opposite to the effects produced by thumb sucking or tongue thrust in which the resultant open bite and mouth breathing will lead to lip incompetence, weakened chewing muscles and clockwise rotation of the mandible to a high-angle pattern. In light of the influence of lip sucking and lip biting on the dentition, jaws and soft tissues, lip exercises and orthodontic treatment using a simple appliance should be initiated in the primary dentition to break these habits.

Table 3. Case 2 - Cephalometric analysis

Measurements		Initial examination (4Y6M)	Before end of active treatment (5Y9M)	After active treatment (6Y4M)	Final record-taking (10Y11M)
SNA	[°]	76.2	75.5	75.8	76.3
SNB	[°]	70.2	70.9	70.9	73.0
ANB	[°]	6.0	4.6	4.8	3.3
FMA	[°]	34.1	38.2	35.7	33.3
IMPA	[°]	76.5	90.1	86.9	89.4
FMIA	[°]	69.4	51.7	57.4	57.3
U1 - SN	[°]	91.6	91.5	91.0	102.7
A-B plane	[°]	-10.3	-6.1	-7.1	-5.6
Y-axis	[°]	64.5	66.5	65.3	63.7
Occlusal Plane	[°]	19.7	22.5	20.7	16.7
Interincisal Angle	[°]	149.2	131.3	136.6	124.8
Overjet	[mm]	8.5	2.0	4.8	5.9
Overbite	[mm]	4.9	0.1	3.5	4.5

* Measured to $\frac{A}{A}$ ** Measured to $\frac{A}{1}$

Among a few authors who discuss the etiology of lip sucking or lip biting in the literature, Ihara (1994, p.6, 7) states that "...a newborn has a strong sucking reflex for breast milk." He argues that "...this nutritive sucking, a mere reflex, is transformed into non-nutritive sucking in about 2 months after birth, and that the non-nutritive sucking has important psychological functions such as play and control of anxiety." Barnett (1974, p.221) suspects that the most difficult oral habit to correct is the one caused by "a vestigial perinatal sucking aberration". Barber (1978, p.33) says: "Lip sucking is thought by many to be a carry over habit pattern from an earlier infantile thumb-sucking. As the child grows older, he may want to give up infantile sucking patterns. It

is said that the lip sucking habit becomes a thumb substitute yet the relationship between the two is difficult to demonstrate clinically. Personal interviews with parents and children with lip-sucking habit patterns regarding the presence of an earlier thumb habit has demonstrated that the larger percentage of these children did not exhibit earlier thumb or finger sucking habit patterns." Referring to lip biting, he states that it implies a continuous nibbling of either lip with the teeth, and suggests that without traumatizing the lip tissues, the habit more correctly be called a lip resting habit. There are two possible etiologies of lip sucking, "a carry over from thumb or finger sucking" as referred to by Barber (1978) and "a sucking drive" as described by Barnett (1974).

Table 4. Comments made by the mothers of the children with lip sucking and lip biting through interviews and questionnaire

Case No.	Age at initial visit	sex distinction	Dentition at initial visit	Comments on lip sucking and lip biting from the mothers
Case 1	4Y 4M	female	Primary dentition	She began to sleep biting the lower lip shortly after weaning around age 9M.
Case 2	4Y 6M	male	Primary dentition	He has been sucking the lower lip often since shortly after birth. Even when I took the lower lip out from between the upper and lower front teeth, he quickly went back to the habit.
Case 3	7Y11M	female	Mixed dentition	Her lip sucking and lip biting habits started around age 1Y.
Case 4	8Y 3M	female	Mixed dentition	She has been biting the lower lip instead of the thumb or finger since shortly after birth. She has never sucked the thumb or finger. She spontaneously keeps the lower lip in the mouth.
Case 5	8Y 6M	female	Mixed dentition	She has been biting the lower lip since around age 1Y. It's like sucking on the breast and enjoying the taste.
Case 6	8Y 7M	male	Mixed dentition	He began to suck the lower lip while sleeping.
Case 7	8Y 7M	female	Mixed dentition	She was chewing on a towel when she was younger. She started lip biting around the time of weaning.
Case 8	10Y5M	male	Mixed dentition	He has been sucking and biting the lower lip. He has been sucking the thumb or finger. It is not clear when he started these habits.
Case 9	11Y4M	female	Mixed dentition	She began to suck the lower lip shortly after weaning around age 8M. She has never sucked the thumb or finger.

The authors have so far treated nine maxillary protrusion cases with lip sucking and lip biting; seven in the mixed dentition and two in the primary dentition, and conducted interviews and questionnaires with the mothers of these children to obtain the comments shown in Table 4 (Table 4). These comments also indicate possible etiologies of and factors inducing lip sucking and lip biting:

Changeover from thumb or finger sucking or other habits to lip sucking or biting.
Sucking instinct (resorting directly to lip sucking or biting without the preceding habit of thumb or finger sucking).
Factors inducing lip sucking and lip biting

may include:

Skeletal maxillary protrusion due to genetic influence or congenitally missing teeth.
Allergic rhinitis, mouth breathing and others.
Only two of the nine cases switched over from other habits such as thumb sucking to lip sucking and lip biting, and the remaining seven cases sucked the lower lip from the start, contrary to what has been described in the literature.

Based on these comments made by the mothers of nine children including the two cases presented here, which sucking habit (finger, pacifier, towel, blanket or lip sucking) the child will develop may depend on what he sucks during transition from nutritive

sucking to non-nutritive sucking several months after birth. Many children with lip sucking and lip biting seem to suck the lower lip by sucking reflex. As they continue to suck the lower lip, the muscles involved may be programmed and habituated to the sucking behavior, which leads the authors to believe that the sucking reflex is the main etiology of the lip-sucking and lip-biting habits.

Fig. 10 Case 2 - Superimposition of cephalograms

Key:

Solid line: Initial examination (4Y6M)

One-dot broken line: After active treatment (6Y4M)

Two-dot broken line: Final record-taking (10Y11M)

A. SN plane at S

B. Palatal plane at ANS

C. Mandibular plane at Me

SUMMARY

The authors treated two maxillary protrusion cases with lip sucking and lip biting in the primary dentition by prioritizing morphological correction with F.A. and combining it with lip exercises and habituation to obtain the following results:

Correction of maxillary protrusion with F.A. created an environment that made it difficult for the children to suck their lower lips, resulting in complete elimination of lip sucking and lip biting in 5 months in Case 1 and 4 to 5 months in Case 2.

Lip exercises and habituation along with the use of F.A. were effective in preventing the recurrence of lip sucking and lip biting and facilitating the adaptation of the perioral muscles.

F.A. therapy of maxillary protrusion due to lip sucking and lip biting in the primary dentition produced esthetically pleasing facial profile and good occlusion.

Correction of maxillary protrusion with F.A. also had favorable effects on the oral functions of chewing, swallowing, speech and breathing as well as on psychology of these young children.

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Fig. 11 Effects of lip sucking and lip biting on form and function

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