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ORIGINAL ARTICLE

Oral habits in a group of consecutively treated orthodontic patients, using standardized video recordings for diagnosis

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Abstract

Objective. To investigate the prevalence and correlation of soft tissue dysfunctions documented by standardized video recordings in a group of orthodontic patients and to evaluate orthodontic treatment changes. ***Subjects and methods.*** The presence of an oral habit was evaluated from standardized pre- and post-treatment video recordings of 80 consecutive patients (30 boys and 50 girls, mean age 12.2 ± 1.7 years). Any digit-sucking habit was noted during a routine interview. Pre- and post-treatment cephalograms were traced to assess sagittal and vertical jaw and incisor relationships. Correlations and differences were tested for statistical significance using the *t*-test and Odds-ratio. ***Results.*** 56.3% had one or more habits before treatment. The total prevalence fell during treatment. A clear correlation was found between digit sucking and atypical tongue activity. Pre-treatment cephalograms showed that patients with a habit had a larger overjet, smaller overbite, more proclined and protruded incisors, a greater ANB angle and a greater inter-maxillary angle (ML/NL) than those without a habit. Cephalometric differences between the groups after orthodontic treatment were much less pronounced. Those with an oral habit also showed a tendency for increased treatment time/number of visits. ***Conclusions.*** Standardized video recordings improved the reliability of the recordings of the oral soft tissue dysfunctions. Their overall reduction after the end of orthodontic treatment coincided with a normalization of the sagittal skeletal and dental variables.

Key Words: *finger-sucking, habits, malocclusion, orthodontic treatment, tongue habits*

Introduction

The precise etiology of a malocclusion is difficult to determine, as both genetic and environmental factors may play a role in the development. Digit sucking, lip incompetence, tongue thrust and lip habits are all reported to be related to dento-alveolar anomalies that often require orthodontic treatment [1-5].

The prevalence of digit sucking varies between studies, but most agree on its effects on the dentition, such as increased overjet, reduced overbite and proclined maxillary incisors [2-5]. Protruded and proclined incisors are also reported in children with incompetent lips, suggesting a relationship between lip posture and dental morphology [6-8]. Sagittal jaw discrepancies and anterior open bite are more common in individuals with a tongue habit [9-11]. Tongue thrust on swallowing has been considered as one of the main causes. Alternatively, the resting position of the tongue through a light but sustained pressure may have a greater effect on the dentition than tongue thrust on swallowing [12,13]. Although less frequently recorded, lip habits appear in all ages and are particularly seen in situations requiring increased attention and concentration [14,15]. This habit can result in protruded maxillary incisors, lingually tipped mandibular incisors and an anterior open bite [16,17].

Most studies of oral habits include untreated population samples and have been cross-sectional. Lip/tongue dysfunction and finger sucking have been shown to be closely associated with apical root resorption during orthodontic treatment [18]. It is important for orthodontists to understand the prevalence and effects of oral habits amongst orthodontic patients since they contribute to the development of malocclusions and may comprise treatment objectives. Further longitudinal studies are required, using

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standardized and adequate diagnostic methods. Therefore, this study aims to determine the prevalence of oral habits in a group of consecutive orthodontic patients and to investigate their possible correlation. Furthermore, this study aims to evaluate their association with the dental and skeletal variables before and after orthodontic treatment.

Subjects and methods

Eighty consecutive orthodontic patients were treated by two orthodontists (LL and BOL) at a private practice in Skien, Norway. Pre- (T1) and post-treatment (T2) records (color slides, lateral cephalograms, journals and video-recordings) existed for 30 boys and 50 girls, mean age 12 years 2 months (SD ± 1 year 7 months), referred for orthodontic treatment between September and December 1994. Most of these patients were treated with fixed appliances, two children were treated with an activator only. The patients were treated to an individualized treatment objective, based on the anterior dentition relative to the surrounding soft-tissue. Post-treatment records were taken at an average of 8.5 months (± 4.5 months) after the completion of active treatment. At that time most patients were using a retention plate and/or a bonded retainer. The mean age at the end of active orthodontic treatment was 15 years 2 months (SD ± 1 year 5 months).

The presence of lip incompetence, a lip habit or atypical tongue activity was registered from standardized video recordings of each patient, taken as a part of the pre- and post-treatment records. The standardized video recordings were designed and taped by one of the orthodontists (LL). Each patient was seated in an upright position looking into the camera at a distance of 2 m, with mirrors placed at 45° on both sides to allow frontal and lateral views of the face. The 10-min recording started with a short conversation based on a set of cards with pictures (a tractor, a plum, a hammer, etc.). A series of sentences containing sounds used in the Norwegian language followed. Each recording was watched twice, 2 months apart, in random order, by the same examiner (NT). If registrations from the two viewings of the same patient did not match, the video was watched a third time to decide on the presence of the habit. Incompetent lips were defined by the activity of m. mentalis (visible dimpling of the skin on the chin) on lip closure. Atypical tongue activity was registered when the tongue was consistently held in an abnormal, forward position whilst at rest, speaking and/or swallowing. A lip habit was recorded when repeated biting or sucking was seen, usually evidenced by the presence of lip irritations. Digit sucking that still persisted or a history of digit sucking until at least the age of 6 was registered by the orthodontists at T1 and this was recorded in the patient's journal.

Pre- and post-treatment standard lateral cephalograms were scanned and traced using Facad (Ilexis AB, Linnköping, Sweden) to evaluate the following dental and skeletal characteristics; overjet, overbite, AnB angle, ML/NL angle, mandibular and maxillary incisor positions and inclinations. Girls and boys were analyzed together, as it has been shown that, at the age relevant to orthodontic treatment, they do not differ significantly in angular measurements and boys tend to have only slightly larger linear measurements [19]. The total number of visits and the total treatment time were calculated from the patients' journals.

Error of the method

Twenty cephalograms were randomly selected and re-measured 1 year later. The study error (SE) was calculated using the formula by Dahlberg: $SE = \Sigma d^2/2n$, where d is the difference between two registrations and n is the number of double registrations. The SE for measurements on the cephalograms ranged from 0.2–0.6 mm, with a mean of 0.5 mm and from 0.7–1.2° with a mean of 1.0° for the linear and angular measurements.

Statistical analysis

The Sign test was employed to test for statistical significance regarding changes in prevalence of the habits from T1 to T2. Odds-ratio was used to test for correlations between the oral habits. The independent samples *T*-test was utilized to test for cephalometric differences between those with habits and those without, at T1 and at T2. Three levels of statistical significance were defined; highly statistically significant $p < 0.001$ (***), statistically significant $p < 0.01$ (**) and lightly significant $p < 0.05$ (*).

Results

Prevalence and correlation of oral habits

Before treatment, 45 children (56%) had at least one of the four oral habits studied. Only 19 children (34%) had an oral habit after treatment and that reduction was statistically significant ($p < 0.01$). The prevalence of each habit is seen in Table I. As some children had more than one habit, the total number of habits is greater than the number of children with habits. At T2 the prevalence of incompetent lips, digit sucking and lip biting/sucking was highly and significantly reduced. Atypical tongue activity did not significantly decrease and five of the children exhibiting the habit at T2 acquired it during treatment.

There was a positive and significant correlation between atypical tongue activity and digit sucking. The other habits were not significantly correlated to each other.

Table I. The prevalence of each individual habit/oral dysfunction before treatment (T1) and after treatment (T2).

	T1, *n*	T2, *n*	*p*-value
Incompetent lips	22	8	< 0.001
Atypical tongue activity	17	12	NS
Digit sucking (until/past 6 years)	16	0	< 0.001
Lip biting/sucking	8	0	< 0.01

NS, not statistically significant.

Skeletal and dental characteristics

For comparison of the skeletal and dental characteristics, the children were first divided into three groups: Group N = no habits, Group 1 = one habit and Group 2 = two or more habits. At T1, the groups with habits had higher mean values for several variables when compared with Group N, although the overbite was smaller (Table II). After treatment (T2), there were far fewer variables that differed between the groups (Table III).

When each habit was evaluated independently, the children with incompetent lips showed significantly greater values than Group N for all variables except overbite (Table II). Children with an atypical tongue activity had a significantly smaller overbite and a greater protrusion of the mandibular incisors when compared to Group N. The digit sucking group exhibited a significantly smaller overbite and a more distal sagittal jaw relationship. Post-treatment (T2), the group with incompetent lips displayed significant differences for most of the variables, while the digit sucking group demonstrated significantly more upright and retroclined mandibular incisors when compared to Group N (Table III).

To test the effect of persisting oral habits, a group of patients with a habit persisting at T2 (only tongue habit and incompetent lips persisted) was compared to the group where the habit was lost (Table IV). After treatment, the sagittal jaw relationship was the only variable showing significantly higher values in the group with persisting habits.

For the whole sample, the mean treatment time was 2.4 years (± 0.8) and the mean number of visits was 21 (± 5). With an increasing number of habits present in a patient, there was a slight trend for an increased total treatment time and more visits, however this was not statistically significant.

Discussion

Lip incompetence, digit sucking, atypical tongue activity and lip biting were observed and registered in a standardized manner in a group of 80 consecutive orthodontic patients. The video recordings enabled a more accurate and standardized diagnosis of oral habits than would have been possible with a clinical exam, since they could be watched and examined several times. The patients were treated in the same practice by two experienced orthodontists, hence the treatment methods and objectives were consistent.

Ovsenik et al. [20] found habits such as atypical swallowing and thumb sucking in 37% of the children aged 12 years. In comparison, over half of the children in this study demonstrated an oral habit. The number of children with a habit was significantly reduced during orthodontic treatment. Although the number of children with atypical tongue activity also fell after treatment, five children acquired the habit. The prevalence of an atypical tongue habit in this sample was 21%. Previous investigations could not be used for comparison because of the different classifications and diagnostic methods used. However, a decrease of prevalence with age has also been reported in other studies [21-23].

A higher number of children had a history of digit sucking (20%) than had previously been reported, although a varying degree of prevalence has been presented in the literature [1-4]. One explanation may be that the children in this study belong to a group already seeking orthodontic treatment as opposed to a normal population sample.

It was observed that incompetent lips are relatively common in orthodontic patients. The number of children with incompetent lips decreased during the study, suggesting that normal growth and/or orthodontic treatment normalizes lip function. Lip habits were only detected at the start of treatment; a possible reason may be the nervousness of the patient during the first visit to the orthodontist.

A statistically significant correlation was found between an atypical tongue activity and digit sucking, a finding also reported in other studies [20,22,24]. It is likely that the tongue habit is facilitated by the opening of the bite produced by the previous digit sucking.

Previously reported effects of oral habits on the dentition are generally supported by this study. On average, children with oral habits exhibited a greater overjet, sagittal jaw relationship, inter-maxillary relationship, protrusion and proclination of the incisors and a smaller overbite (tendency for open bite) than children with no oral habits. An increased number of habits had a greater effect on the dentition. The overall reduction of oral habits by the end of orthodontic treatment coincided with a general normalization of dental and skeletal relationships.

Children with incompetent lips displayed the greatest number and magnitude of skeletal and dental differences when compared to the group with no habits: a greater overjet, higher inter-maxillary angle, more protruded and proclined incisors and a smaller

Table II. Pre-treatment (T1) means (X) and standard deviations (SD) of cephalometric variables for Group N (children with no habits), Group 1 (one habit), Group 2 (two or more habits), for children with incompetent lips, an atypical tongue activity, digit sucking history, or lip habit.

		Group N $n = 35$		Group 1 $n = 32$		Group 2 $n = 13$		Incompetent lips $n = 14$		Atcypial tongue activity $n = 6$		Digit sucking $n = 7$		Lip habit $n = 5$	
Variable		X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
Overjet	(mm)	4.7	±2.3	6.2	±2.9*	6.0	±2.7	7.2	±3.3**	4.4	±3.4	6.5	±1.3	5.2	±1.9
Overbite	(mm)	4.1	±1.9	2.7	±2.0**	1.5	±1.9***	3.1	±2.0	1.7	±2.2**	2.3	±1.6*	3.5	±1.9
Sagittal jaw relationship	AnB (°)	2.5	±2.1	3.7	±2.0*	3.3	±2.8	4.4	±2.1**	2.3	±2.1	4.3	±1.6*	2.6	±1.3
Inter-maxillary jaw relationship	ML/NL (°)	25.7	±5.1	28.9	±4.7**	32.6	±3.8***	31.3	±4.1***	27.5	±5.0	25.9	±4.1	28	±4.0
Protrusion of mandibular incisors	ii- Apg (mm)	1.0	±1.9	2.7	±1.9***	3.3	±2.1***	3.8	±2.0***	2.7	±1.6*	1.2	±1.1	1.6	±0.7
Inclination of mandibular incisors	ILi/Apg (°)	18.6	±4.3	21.5	±3.6**	21.2	±4.0	23.0	±3.3***	20.5	±3.3	20.4	±4.0	20.2	±4.0
Protrusion of maxillary incisors	is-Apg (mm)	6.2	±2.5	9.0	±3.0***	9.7	±2.8***	11.0	±2.4***	7.4	±3.6	7.7	±1.7	7	±2.0
Inclination of maxillary incisors	ILs/Apg (°)	24.1	±8.2	30.4	±8.2**	31.7	±8.2**	35.2	±7.7***	26.8	±9.4	29.9	±2.6	22	±4.8

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table III. Post-treatment (T2) means (X) and standard deviations (SD) of cephalometric variables for Group N (children with no habits), Group 1 (one habit), Group 2 (two or more habits), for children with incompetent lips, an atypical tongue activity, digit sucking history, or lip habit.

		Group N $n = 35$		Group 1 $n = 32$		Group 2 $n = 13$		Incompetent lips $n = 14$		Atcypial tongue activity $n = 6$		Digit sucking $n = 7$		Lip habit $n = 5$	
Variable		X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
Overjet	(mm)	3.6	± 0.9	3.4	±1.0	3.2	±0.9	3.4	±0.8	2.9	±1.0	3.8	±1.4	3.5	±0.9
Overbite	(mm)	3.0	±1.3	2.4	±1.3	1.4	±1.4***	2.1	±1.2*	1.9	±1.0	3.4	±1.4	2.6	±1.0
Sagittal jaw relationship	AnB (°)	2.6	±2.2	3.6	±2.2	3.9	±2.3	3.9	±2.7	3.2	±1.9	3.9	±1.9	2.6	±0.9
Inter-maxillary jaw relationship	ML/NL (°)	23.1	±4.8	25.7	±4.9*	29.4	±4.5***	28.5	±4.1***	25.8	±4.9	2.09	±3.6	24.5	±4.0
Protrusion of mandibular incisors	ii-Apg (mm)	1.8	±2.2	2.7	±3.1	2.9	±2.1	4.8	±3.2***	1.8	±1.2	–0.4	±2.2*	2.1	±1.1
Inclination of mandibular incisors	ILi/Apg (°)	27.3	±3.9	27.3	±5.7	22.7	±7.1**	30.3	±5.1*	25.1	±3.7	22.5	±4.9**	28.4	±5.4
Protrusion of maxillary	is-Apg (mm)	5.1	±2.2	5.9	±3.0	6.1	±2.4	7.7	±3.1**	5.0	±1.7	3.4	±2.2	5.4	±1.3
Inclination of maxillary incisors	ILs/Apg (°)	24.1	±6.0	25.7	±5.6	26.7	±6.4	27.0	±6.2	25.0	±5.9	22.4	±4.4	27.3	±4.3

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table IV. Means and standard deviations of evaluated cephalometric variables for children who stop their habit by T2 and for children who keep their oral habit until T2, tested for inter-group differences post-treatment (T2).

Variable		Habit stopped by T2 (n = 27), $M \pm$ SD	Habit still present at T2 (n = 18), $M \pm$ SD	p-value
Overjet	(mm)	3.5 ± 0.8	3.2 ± 1.2	NS
Overbite	(mm)	2.3 ± 1.5	1.8 ± 1.2	NS
Sagittal jaw relationship	AnB (°)	3.1 ± 2.0	4.5 ± 2.2	< 0.05
Inter-maxillary jaw relationship	ML/NL (°)	25.7 ± 5.0	28.4 ± 4.8	NS
Protrusion of mandibular incisors	ii-Apg (mm)	2.3 ± 2.5	3.3 ± 3.3	NS
Inclination of mandibular incisors	ILi/Apg (°)	26.0 ± 6.7	25.9 ± 6.2	NS
Protrusion of maxillary incisors	is-Apg (mm)	5.6 ± 2.4	6.5 ± 3.2	NS
Inclination of maxillary incisors	ILs/Apg (°)	25.6 ± 5.5	26.6 ± 6.3	NS

overbite. These findings are in agreement with earlier studies [6-8,25,26]. However, it is unclear whether the incompetent lips cause or contribute to the malocclusion or whether they are the result of the deviating traits themselves.

An atypical tongue activity was related to a significantly smaller overbite and greater protrusion of the mandibular incisors compared to the children with no habits. Previous studies examining effects of the tongue on the dentition use different classifications/definitions of tongue habits, thereby making direct comparisons difficult. Nevertheless, many of the malocclusion traits previously correlated with a tongue-thrusting habit [10,11,23,27,28] are the same as the tendencies found in this study: a greater overjet, protruded and proclined incisors and a distal sagittal jaw relationship. An increased frequency of CL III malocclusions related to a lower tongue posture has also been reported [9], but this was not supported by the findings in the present study.

A smaller overbite and a distal sagittal jaw relationship were characteristic for the children with a history of digit sucking. The effects of digit sucking on the occlusion have been widely investigated [1-7,24,29] and are in agreement with the present findings. After treatment, the skeletal and dental variables showed no significant differences when compared to the group without habits. Larsson [30,31] documented some degree of self-correction when the habit stopped. It is likely that some degree of self-correction had also occurred in our patient group prior to treatment; this may explain why the dental and skeletal effects of digit sucking were not as apparent.

The lip habit group had the smallest and fewest cephalometric differences when compared to the group with no habits. In contrast, other studies have reported larger overjet, open bite and lingual tipping of the lower incisors [15-17,32]. It is assumed that the frequency, intensity and duration of lip sucking may have to be more extreme than observed here to be able to affect the dentition.

Patients who stopped their oral habit had similar dental and skeletal characteristics as the group of children who continued with their habits after treatment, indicating that the presence of an oral habit at the start of treatment appears to have more impact than if it is still present subsequent to treatment completion. It is difficult to determine the precise role of any single etiologic factor in a growing individual, as growth will also play its part in the development or correction of a malocclusion. For example, incompetent lips may normalize with growth, without any orthodontic correction [26]. To complicate matters further, oral habits may precede one another or may co-exist, so that the effect of each individual habit cannot be clearly differentiated.

A habit/dysfunction that is present after treatment has the potential to contribute to relapse even if it has not contributed to an overall poorer treatment outcome. It would be interesting to compare the tendencies for relapse several years post-retention, as it is assumed that children still possessing an oral habit/dysfunction may demonstrate an increased tendency for relapse.

A trend for slightly increased treatment time and number of appointments was found where several habits were present. The orthodontists responsible for treatment in this study were conscious of the possible side-effects of prolonged orthodontic treatment and, thus, the treatment times may be slightly biased.

Conclusions

(1) More than half of the children in this study demonstrated at least one oral habit at the start of orthodontic treatment.
(2) The reduction in the number of children with an oral habit subsequent to orthodontic treatment was highly significant.

(3) The overall reduction of oral habits by the end of orthodontic treatment coincided with a general normalization of skeletal and dental cephalometric variables.

(4) Normalization of skeletal and dental cephalometric variables was seen regardless of whether patients continued with or seized their habits during treatment.

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