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Lack of correlation between mouth-breathing and bite force

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SUMMARY The correlation between mouth-breathing and bite force was studied in 81 children, 7 to 16 years old. Mouth-breathing was diagnosed on the basis of the subject history, the rhinomanometrically determined nasal airflow and the size of the airway measured on the profile cephalogram. The maximum bite force was measured at the first molars. In addition, the facial morphology was analysed on profile cephalograms.

Both mouth-breathing and bite force were associated with the facial morphology but there was no association between mouth-breathing and bite force. It was concluded that the long-face morphology characteristic of mouth-breathing children is not due to weak masticatory muscles.

Introduction

Mouth-breathing is associated with a long-face morphology. Mouth-breathing children have a retrognathic mandible, a large anterior face height, especially a large lower face height, and steep mandibular inclination (Bushey, 1979; Linder-Aronson, 1979; Hannuksela, 1981; Bresolin *et al.*, 1983; Solow *et al.*, 1984; Thüer *et al.*, 1988).

An explanation for the association has been offered by Solow and Kreiborg (1977), who put forward the 'soft tissue stretch' theory. This is based on the fact that mouth-breathing children have a more extended position of the head than children who breath through their noses (Solow and Greve, 1979; Woodside and Linder-Aronson, 1979; Wenzel *et al.*, 1983; Hellsing *et al.*, 1986). The extension of the head brings with it a stretch of the soft tissues of the face and the neck which could have an influence on the facial skeleton during its growth.

The bite force is also known to be correlated with the facial type. Individuals with weak masticatory muscles have a long-face morphology very similar to the facial type associated with mouth-breathing. This has been demonstrated by measurement of bite force, both in children (Ingervall and Bitsanis, 1987) and in adults (Ringqvist, 1973; Ingervall and Helkimo, 1978; Proffit *et al.*, 1983). Similar results were obtained in electromyographic studies of children (Ahlgren, 1966; Ingervall and Thilander, 1974; Ingervall 1976) and adults (Möller, 1966).

Because of the correlation between both mouth-breathing and bite force and facial morphology, it is possible that mouth-breathing and bite force are related. If children who are mouth-breathers have weak masticatory muscles, this could allow their posterior teeth to erupt. This would lead to a downward, backward rotation of the mandible producing their long-face morphology rather than this being caused by the stretching of the soft tissues. This study is an attempt to clarify this question by investigating the bite force in children diagnosed as mouth-breathers.

Subjects and methods

The study was performed in 81 children, 35 boys and 46 girls, consecutively enrolled at the Orthodontic Clinic, University of Bern, for the treatment of various types of malocclusion. The ages of the children varied between 7 years, 2 months and 15 years, 7 months. The median age was 11 years, 2 months.

The mode of breathing was evaluated by means of a subject history based on a questionnaire, the rhinomanometrically determined nasal airflow and the size of the airway measured on profile cephalograms.

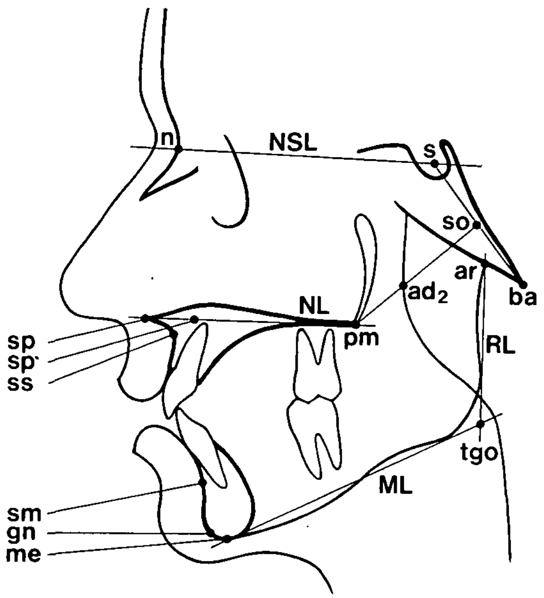

Figure 1 Reference points and lines used in the cephalometric analysis.

From the subject history, a question on mouth-breathing at night was used. The airflow through the nose was recorded in cm^3/sec at a differential pressure of 150 Pa. Eight recordings were done, four before and four after decongestion of the nasal mucosa with nose drops. The mean value of the four recordings before and after decongestion, respectively, was used as a measure of the nasal resistance to breathing. The size of the airway was measured as the distance pm-ad2 in a profile cephalogram (Fig. 1).

The facial morphology was evaluated in profile cephalograms taken in the intercuspal mandibular position using the reference points and lines shown in Figure 1. The following variables were calculated: n-s-ar°, s-n-ss°, s-n-sm°, ss-n-sm°, NSL/NL°, NSL/ML°, NL/ML°, RL/ML°, n-s-gn°, s-tgo: n-me and n-sp': sp'-me. The variable s-tgo: n-me is the quotient between the posterior and anterior face height and the variable n-sp': sp'-me the quotient between the upper and lower anterior face height.

The methods of recording the mode of breathing and the facial morphology are described in detail in a previous report (Thüer *et al.*, 1988). The present group is part of the material used in that previous study.

The maximum bite force was measured with a bite force recorder of the type described by Flöystrand *et al.* (1982). For the measurements, thin acrylic splints covering the occlusal surfaces of the teeth were made. With the acrylic splints in position, bite force was measured at the right and left first permanent molars. Three measurements were made in each location, in random order. The highest of the three values was used as a measure of the bite force on each side and the mean value of the bite force on the right and left sides was subsequently calculated. The same method and apparatus have been used in previous studies of bite force (Ingervall and Bitsanis, 1986, 1987). The errors of the method were evaluated by Dinç and Kober (1985).

Testing of differences between the sexes and between groups was done with the Mann-Whitney U-test and correlations were calculated according to Spearman.

Results

There were no significant sex differences for any of the variables investigated. The material has therefore been studied as one group.

A history of mouth-breathing at night was reported in 27 children. The median airflow before decongestion was 311 cm^3/sec (range 115–638 cm^3/sec) and after decongestion 396 cm^3/sec (range 137–850 cm^3/sec). The median value of the distance pm-ad2 was 15 mm, with a range from 6 mm to 27 mm. The bite force varied between 199 N and 782 N, with a median value of 401 N.

Correlations

The bite force was not significantly correlated to a history of mouth-breathing or to the airflow through the nose before or after decongestion or to the size of the airway (pm-ad2). The coefficients of correlation were very small.

There were significant ($0.01 < P < 0.05$) correlations between the bite force and the cephalometric variables RL/ML (rho −0.23) and s-tgo: n-me (rho 0.23). The coefficients with the variables NSL/ML and NL/ML (rho −0.21) were almost significant ($p = 0.06$). Bite force thus tended to be high in children with a small gonial angle with a large posterior face height in relation to the anterior face height and with a small inclination of the mandible.

Bite force in probable mouth-breathers

To further assess the correlation between mouth-breathing and bite force, groups of children who fulfilled the following criteria were formed:

Group 1 (n = 12): A positive history of mouth-breathing and a value for airflow through the nose after nose drops below the median value and a distance pm-ad2 below the median.

Group 2 (n = 14): A negative history of mouth-breathing and a value for airflow through the nose after nose drops above the median value and a distance pm-ad2 above the median value.

Group 3 (n = 18): A positive history of mouth-breathing and a value for airflow through the nose after nose drops below the median value.

Group 4 (n = 25): A negative history of mouth-breathing and a value for airflow through the nose after nose drops above the median value.

Group 5 (n = 21): A value for airflow through the nose after nose drops below the median value and a distance pm-ad2 below the median value.

Group 6 (n = 21): A value for airflow through the nose after nose drops above the median value and a distance pm-ad2 above the median value.

There were no significant sex or age differences between the groups. Comparison of the contrasting groups 1 and 2 revealed no significant difference in bite force, which had a median value of 418 N in group 1 and 402 N in group 2. The morphological variables s-n-ss ($0.001 < P < 0.01$), s-n-sm and n-sp': sp'-me ($0.01 < P < 0.05$) were significantly smaller in group 1 than in group 2 while the variable n-s-gn was greater ($0.01 < P < 0.05$). The children in group 1 were thus more retrognathic and had a relatively larger lower anterior face height than the children in group 2.

There was no significant difference in bite force between groups 3 and 4 or between the contrasting groups 5 and 6. The median bite force in these groups was 418 N, 412 N, 405 N and 374 N, respectively. In both groups 3 and 5 the variable n-s-gn was greater and the variable n-sp': sp'-me smaller ($0.01 < P < 0.05$) than in groups 4 and 6, respectively.

Discussion

The measurement of bite force is associated with technical errors and intra-individual variation. In order to minimize these sources of error, the bite force values were based on repeated measurements. The diagnosis of mouth-breathing poses a greater problem. It was shown in a previous study (Thüer *et al.*, 1988), in which the present children also participated, that there was no or only a weak correlation between three methods used to diagnose mouth-breathing: the subject history, the rhinomanometrically determined nasal airflow and the size of the airway (distance pm-ad2) measured on the cephalogram. It was concluded that diagnosis of mouth-breathing should preferably be based on independent supplementary methods.

This was done in the present study, with the formation of the groups with a positive or negative history of mouth-breathing, respectively, combined with low or high values for the nasal airflow and the size of the airway on the cephalogram.

Twelve children fulfilled the criteria of a positive subject history combined with a low airflow value and a small airway. It may be assumed that at least these children were mouth-breathers. Their facial morphology was consistent with the facial type associated with mouth-breathing, the long-face morphology, as mentioned in the introduction. The average bite force of these children was, however, the same, and numerically even greater, than in children fulfilling the opposite criteria for the mode of breathing. The same was true when larger groups of children based on two criteria for the diagnosis of the mode of breathing were formed.

It may thus be concluded that mouth-breathing is not accompanied by a low bite force. The facial type associated with mouth-breathing is therefore not due to weak masticatory muscles of mouth-breathing children. Their facial type is thus due to some other factor, possibly soft tissue stretching, according to the theory of Solow and Kreiborg (1977). The lack of association between mouth-breathing and bite force is in line with the results of Corruccini *et al.* (1985) based on field studies.

This study confirmed the correlation between bite force and facial type, the bite force being low in children with a long-face morphology and high in those with opposite facial characteristics. This was expected from the results of previous studies. Both children who are mouth-breathers and those with weak masticatory muscles have a long-face morphology but mouth-breathing children have masticatory muscles of normal strength (Dinç and Kober, 1985). It therefore seems unlikely that the long-face morphology *per se*, through mechanical disadvantages results in the low bite force, as advocated by Throckmorton *et al.* (1980).

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