To Determine the Head Posture in Oral Breathing Children: A Cephalometric Study

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ABSTRACT

Objective: Mouth breathing, being a cause for various orthodontic problems, has been a subject of concern to orthodontists since years. This study was aimed to analyze the influence, mouth breathing on the head posture and to compare variations in head posture between physiologic breathing and mouth breathing groups.

Materials and methods: Lateral cephalograms of 25 physiologic breathing (PB) and 25 mouth breathing (MB) children within the age group of 8 to 14 years were analyzed using standard cephalometric parameters. The Student’s t-test was used to determine, if significant cephalometric differences existed between the MB and the PB children. Values in male and female subjects were determined and expressed as mean and standard deviation.

Results: The findings revealed that craniofacial morphology in mouth breathers differs profoundly when compared to that of the physiologic breathers.

Conclusion: There should be an early interception of mouth breathing in growing children as these postural changes, if maintained for long periods, could lead to severe skeletal deformities.

Keywords: Head posture, Oral breathing, Physiologic breathing, Craniofacial structure, Cephalometry.

INTRODUCTION

Obligatory mouth breathing is related to impaired nasal breathing. The possible causes of impaired nasal breathing include enlarged adenoids, inadequate nasal airway development and soft tissue obstructions or swellings like allergies.1 Mouth breathing causes various orthodontic problems and a mouth breather’s face develops aberrantly because of disruption of functional relationships caused by chronic airway obstruction.2 Associations have been noted between cranial postures, the predominant mode of breathing and facial structures.3 It has been indicated that mode of breathing may influence craniofacial morphology indirectly through a change in head position. As a result, natural head posture (NHP) has been increasingly used as the logical reference position for the evaluation of craniofacial morphology.5

The purpose of this study was to contribute to our understanding of the head posture and cephalometric characteristics in mouth breathing children. We wanted to compare variations in head posture between physiologic breathing and mouth breathing children and analyze the influence of mouth breathing, not necessarily connected to an upper airway obstruction, on the head posture in growing children within the age group of 8 to 14 years.

MATERIALS AND METHODS

The study included, 50 children selected randomly, who were seen in the Department of Orthodontics and Dentofacial Orthopedics, Sri Sai College of Dental Surgery. The children included were between the age group of 8 and 14 years and were divided into two groups based on the type of breathing pattern.

1. Physiologic breathing (PB)—25 subjects
2. Mouth breathing (MB)—25 subjects.

Inclusion Criteria

The subjects included in PB group were children with various orthodontic problems:
1. Without any past history of MB or
2. Without any clinical signs of MB

The subjects included in MB group had:
1. History of MB confirmed by either the parents or their medical history
2. Incompetent lips
3. Dental crowding in the upper arch
4. ‘Adenoidal facies’ and reduced maxillary transverse dimension with unilateral or bilateral crossbite

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5. The breathing pattern showed a diaphragmatic mode of inhalation and a reduced mobility of the nostrils (a reduced patency of the upper airway).

6. MB was confirmed by water vapor condensed on the surface of a mirror placed outside the mouth (mirror fog test).

Exclusion Criteria

Exclusion criteria for both groups included previous or ongoing orthodontic treatment, vestibular or equilibrium problems, visual, hearing or swallowing disorders, and facial or spinal abnormalities (i.e. torticollis, scoliosis or kyphosis).

METHOD

A lateral cephalogram was taken of each subject (50 in total) in the NHP as in ‘self-balancing method’. Informed consent was obtained from the parents of all subjects and the procedures were conducted in accordance with the ethical standards of the Committee on Human Experimentation of the institution in which the experiments were done. The radiographs were taken from motorized, vertical adjustable Planmeca Proline 2002 series, with an anode X-ray source of 0.8 mm focus. The vertical adjustability of the machine permits the recording of standing subjects. The transverse adjustment of the head in the cephalostat is facilitated by a light source projecting a horizontal line through the plane of the ear rods and a vertical line through the median plane of the head holder. The focus-median plane distance was 150 cm and the film median plane distance was 10 cm for the lateral cephalometric film with an enlargement of 5.6%. A wedge shape collimator made up of lead is used for the passage of radiation for image quality.

Cephalometry

All the lateral cephalograms were traced manually for each subject.

The cephalometric and craniocervical landmark points taken were (Fig. 1) as follows:

- A—the most posterior point on the anterior contour of the upper alveolar process
- ANS (anterior nasal spine)—the tip of the bony anterior nasal spine of the maxilla
- B—deepest point on the anterior contour of the lower alveolar process
- Ba (basion)—median point of the anterior margin of the foramen magnum
- Go (gonion)—constructed point of the intersection of the ramus plane and the mandibular plane
- N (nasion)—the most anterior point of the frontonasal suture in the median plane
- S (sella)—the midpoint of the pituitary fossa
- PNS (posterior nasal spine)—the tip of the bony posterior nasal spine

Fig. 1: The cephalometric and craniocervical landmarks

- Gn (gnathion)—the most anterior-inferior point on the bony chin in the midsagittal plane
- Hy—most superior and anterior point on the body of the hyoid bone
- CV2ip—most inferior and posterior point on the second cervical vertebra corpus
- CV2tg—the tangent point at the superior posterior extremity of the odontoid process of the second cervical vertebra
- CV4ip—most inferior and posterior point on the fourth cervical vertebra corpus
- Ris—the most posterior and superior point on the condyle
- Rli—the most posterior and inferior point on the ascending ramus.
Reference Lines and Angular Measurements

Linear
- SN (anterior cranial base length)—line joining sella to nasion
- NSL (anterior cranial base)—extended line from N to S
- NL (palatal plane)—extended line from ANS to PNS
- VER—line drawn parallel to the vertical plane of the cephalogram
- ML (mandibular plane)—line joining Gn to Go
- HOR—line drawn perpendicular to VER
- RL—line joining Ris and Rli
- Hy-NL—line perpendicular from the most anterior and superior point on the hyoid to palatal plane
- Hy-ML—line perpendicular from the most anterior and superior point on the hyoid to mandibular plane
- CVT (posterior tangent cervical)—an extended line from CV2tg to CV4ip
- OPT—line connecting the tangent point at the superior, posterior extremity of the odontoid process of CV2tg and the most inferior/posterior point on the corpus of CV2ip (Fig. 2).

The Angular Measurements
1. N-S-Ba—inner angle formed by the line joining nasion to sella to basion
2. NL/ML (basal plane angle)—angle between ML and NL
3. ML/RL (mandibular gonial angle)—angle between ML and RL
4. S-N-A—inner angle formed by the connection of the sella, nasion and A point
5. S-N-B—inner angle formed by the connection of the sella, nasion and B point
6. A-N-B—the difference of the angles SNA and SNB, indicating the amount of jaw dysplasia.
   For head posture, the angular measurements (cranio-cervical postural variables) taken were (see Fig. 2) as follows:
   - Craniovertical
   7. NSL/VER—the angle between NSL and VER
   8. NL/VER—the angle formed by the intersection of NL and VER
   - Craniovertical
   9. NSL/OPT—head position in relation to the second cervical vertebra, intersection of NSL and OPT
   10. NL/OPT—head position in relation to the palatal plane, intersection of NL and OPT
   - Craniohorizontal
   11. OPT/HOR—cervical inclination, the angle between OPT and HOR
   12. CVT/HOR—cervical inclination, the angle between CVT and HOR (see Fig. 2).

Craniofacial Measurements

Linear Measurements
1. S-N
2. Hy-NL
3. Hy-ML (see Fig. 2)

Craniofacial Measurements

Method Errors
In the postural recording method, the radiographs were taken with the subject standing in NHP as described by Sahin Saglam and Uydas. All linear and angular variables measured on the lateral cephalometric radiographs that were taken 2 weeks apart, were determined by two orthodontists independently and no significant differences were found for any of the craniofacial variables in the two data sets. The measurement error was calculated using 20 radiographs (10 each randomly chosen from MB and PB).

Statistical Method

Cephalometric variables were presented as mean, standard deviation (SD), and the lowest and highest values. The Student’s t-test was used to determine if significant cephalometric differences existed between the MB and PB children. Values in male and female subjects were determined and expressed as mean and standard deviation.

Statistical Software

RESULTS

Cephalometric and Hyoid Variables (Angular Values)

1. The mean N-S-Ba in the MB group increased compared to the PB (p < 0.063).
2. In MB group the mean NL/ML was increased (p < 0.001).
3. Mean ML/RL in the MB group increased and also NL/ML (p = 0.017).
4. The difference of mean for S-N-A of PB and MB group was little (p = 0.289).
5. The S-N-B mean between PB and MB was significant (p = 0.017).
6. The mean A-N-B difference of the two groups was significant statistically (p = 0.016) (Table 1).

Cephalometric and Hyoid Variables (Linear Values)

1. The difference of mean for S-N of PB and MB was not significant (p = 0.875).
2. The mean for Hy–ML was increased in MB (p = 0.545).
3. The Hy-NL increased in MB (p = 0.088) (Table 2).
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Craniocervical Values (Angular Measurements)

1. The mean NSL/VER and NL/VER was higher in MB group (p < 0.001).
2. The mean NSL/OPT was higher in MB group (p = 0.044).
3. The mean NL/OPT in PB group was higher (p = 0.012).
4. The mean OPT/HOR difference in both groups was not significant (p = 0.704).
5. The mean CVT/HOR difference in both groups was not significant (p = 0.768) (Table 3).

DISCUSSION

Respiratory needs are the primary determinants of the posture of the jaws and tongue (and of the head itself, to a lesser extent). Therefore an altered respiratory pattern, such as breathing through the mouth rather than the nose, could change the posture of the head, jaw and tongue. Oral respiration alters the muscle forces exerted by the tongue, cheeks and lips upon the maxillary arch, leading to a narrow maxillary arch with a high palatal vault, a posterior crossbite, a Class II or III dental malocclusion, and an anterior open bite. An abnormal posture of the head changes the load in several joints of the craniovertebral region, resulting in unfavorable dentofacial and craniofacial growth. Thus, 50 subjects in the age group of 8 to 14 years were selected for this study.

The purpose of the study was to assess whether there was a relationship between MB and variables of head posture in children before these same variables might influence their development. Several studies have shown that MB is connected with a variation in the head posture and with an increased craniocervical extension in order to increase the dimension of the airway and the oropharyngeal permeability with mandibular and lingual postural modifications, and of the soft palate as well.
Some authors have evaluated the patency of the upper airways using cephalometric techniques and established a connection between the reduction of the nasopharyngeal space and the increase in craniocervical angle. An increased ANB and intermaxillary divergence (ANS-PNS/Go-Me) were prevailing in MB patients. This finding is similar to other studies on mouth breathing and its influence on dentofacial structures. These skeletal measurements indicate a tendency for MB children to present with a dolichocephalic Class II skeletal pattern.

**Cephalometric Variables**

The angle between the palatal plane to mandibular plane (NL/ML) is significantly increased (p < 0.001) in MB group (Table 1). This suggests that in MB there was downward and backward rotation of the mandible in concurrence with the study done by Cuccia AM et al 2008. The angle between the mandibular plane and the ascending ramus (ML/RL) is also increased significantly (p=0.017) in MB (mean—125.24°), when compared to the PB (mean=121.08°). This indicates an opening of the gonial angle in mouth breathers on account of a down and back rotated mandible. Further study is required to evaluate the changes in the values of both the upper and lower gonial angles and the Bjork sum.

The S-N-A did not show any statistically significant change (p=0.289) in MB when compared to the PB. S-N-B reduced (p=0.017) in MB in comparison to PB, indicating a down and back rotated mandible. Angular measurement of SN to ANS–PNS and also inclination angle would have provided better insight into the maxilla and its role in the opening of the ML/RL and can be incorporated in future studies.

The N-S-Ba angle did not increase (p=0.063) in MB when compared to PB. This finding is similar to the study by Ang et al 2004 and Cuccia AM et al 2008 found the mean N-S-Ba to be increased in MB when compared to the PB (p=0.717), which is similar to the present study.

S-N did not show any significant variation in the MB and PB groups (p=0.875). This finding is similar to the finding by Ang et al 2004 (p=0.352).

**Hyoid Variables**

The hyoid bone is located at a lower position in MB patients. Some studies found a correlation between a lower hyoid bone position in relation to the mandibular plane and increase in craniocervical extension. Bibby supported the stability of the hyoid position which should not be influenced by the postural anomalies of mouth breathers. Extension of the head by 10° does not significantly affect upper airway resistance. The increased caudal position of hyoid bone is a frequent finding in previous studies and this is confirmed in the present investigation.

The hyoid variable, Hy–NL, the linear length from the maxilla to the hyoid, indicates a more caudally positioned hyoid bone in MB (57.36 mm) when compared to the PB (54.24 mm) (Table 2). The linear length from the hyoid to the mandible, Hy-ML, value also indicates toward a lowered hyoid position in mouth breathers when compared to the PB.

**Craniovertical**

The craniovertical angles may be useful as a diagnostic or monitoring measurement in subjects with MB because it represents both head posture and cervical vertebral compensatory changes. Extreme extension of both the head and cervical column, however, may represent an overactive compensatory mechanism that ultimately leads not to reduction of airway resistance, but rather has an adverse effect on airway patency that further compounds the obstructive problem.

**Craniohorizontal**

OPT/HOR and CVT/HOR were found increased in the MB when compared to the PB. The findings in the present study seems to suggest that craniofacial morphology in subjects with MB differ profoundly when compared to that of the PB. The lower jaw was found more retrognathic as shown by SNB when compared to the upper jaw. This reflects toward a tendency to skeletal Class II malocclusion, increased ANB angle. The head was also found to be tilted backward as illustrated with a caudal hyoid bone position. The gonial angles were found to increase, showing a downward and backward rotation of mandible.

However, some of the findings could not be concluded well and there lies a need to investigate those variables with a bigger sample size which was a limitation of the present study.
Moreover, further clinical studies are necessary to evaluate this parameter with larger samples and methodological refinements.

The findings in the present study indicate toward an early interception of mouth breathing habit in growing children, because if these postural changes are maintained for a longer duration they could definitely lead to skeletal and dental malocclusions.

This further stresses the role of general dental practitioners, pedodontists and orthodontists to identify the mouth breathing habit at the earliest possible age to prevent the impending changes associated with it.

**SUMMARY AND CONCLUSION**

The following can be concluded with this study performed on 50 subjects (25 MB and 25 PB) to assess variations in head posture:

1. NL/ML is significantly increased in MB when compared to the PB, indicating a downward and backward rotation of the mandible.
2. ML/RL is also increased significantly in MB which indicates an opening of the gonial angle.
3. A-N-B is also significantly increased in MB, when compared to the PB. This shows a tendency toward skeletal Class II malocclusion.
4. The S-N-B angle was statistically reduced in MB in comparison to the PB, indicating downward and backward rotated mandible.
5. NSL/VER value was found increased in the MB when compared to the PB, which indicates an upward and backward tilting of the head.
6. NSL/OPT angle is found increased in the MB when compared to the PB. The increased value indicates that there is upward and backward rotation of the head and a cervical flexion.
7. NL/OPT angle was also found increased in the MB, indicating a backward flexion of the cervical column.

**REFERENCES**