International Journal of Pediatric Otorhinolaryngology 78 (2014) 1167–1172

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Comparison of cephalometric patterns in mouth breathing and nose breathing children

Isabel Chung Leng Muñoz *, Paola Beltri Orta

Oral Health Sciences, School of Dentistry, European University of Madrid, Madrid, Spain

ARTICLE INFO

Article history:
Received 3 February 2014
Received in revised form 22 April 2014
Accepted 24 April 2014
Available online 6 May 2014

Keywords:
Mouth breathing children
Cephalometry
Dentofacial growth
Airway

ABSTRACT

Objective: The aim of this study was to compare cephalometric values between nasal and oral breathing children and to measure the upper and lower airway space in both groups.
Methods: The study was conducted on 118 pediatric patients, 51 girls and 67 boys, from the Dental Clinic of the Universidad Europea de Madrid. The age ranges of the sample were 6–12 years old. 53 of them were mouth breathers and 65 nose breathers. Lateral cephalometric radiographs were obtained for all of the subjects. The radiographs were analyzed and a cephalometric tracing was performed on each one.
Results: The mouth breathing children showed a more retruded mandible (SNB), and a greater inclination of the mandibular plane (NS-Go Gn) and occlusal plane (NS-O Pl.), than the nose breathing children ($P < 0.05$). The mouth breathing group also had a higher frequency of having the hyoid bone in a more elevated position and the nasopharyngeal air space significantly smaller than the nasal breathing group ($P < 0.001$).
Conclusion: Mouth breathing children seem to have an increase in anterior lower facial height, the hyoid bone in a more elevated position and higher tendency towards having a class II malocclusion compared to nose breathing children.

1. Introduction

Abnormal breathing occurs when breathing takes place continually through the mouth, and this indicates a presence of breathing obstacles that will eventually result in a considerable number of common anomalies if left untreated [1].

A modification in the breathing pattern that favors mouth breathing is accompanied by a series of functional transformations that affects the position of the tongue and mandible as well as the balance of the oral and perioral muscles. With regard to posture characteristics, the oral breather will bend the neck forward in order to breathe through the mouth. Changing the position of the head and neck has the objective of adapting the angle of the pharynx in order to facilitate air entering the mouth, which leads to an increase in upper airway flow [2].

The most common cause of nasal airway obstruction is due to adenoid and palatine tonsillar hypertrophy. When this obstruction occurs, considerable anomalies can arise in children, such as an increase in the anterior lower facial height, a narrow maxilla, a likelihood of a posterior crossbite and class II malocclusion. We may also find children with clockwise mandibular rotation, labial deficiency, lowering of the tongue, hypotonia of the muscle bands, an increase in the available space between the arches and mandibular growth inhibition [3].

A lateral teleradiography of the cranium is useful for the analysis of the craniofacial complex and morphology in both adults and children as well as the evaluation of the upper airway. Cephalometry is another important tool for studying anatomic anomalies, and for following craniofacial growth in patients and for developing treatment plans for orthodontics and dentofacial orthopedics [4,5].

There are previous studies in which the authors have used cephalometric analysis to compare dentofacial parameters between mouth and nose breathing children, such as the one conducted by D'Ascanio et al. to compare cephalometric analysis in children with nasal-breathing obstruction due to nasal septum deviation with respect to nasal-breathing controls [6]. Souki et al. contemplated their study in a different way, comparing cephalometric patterns in mouth breathing children with primary and mixed dentition in order to prove that there are no significant differences in the cephalometric analysis between them [7].

In recent studies it has been described the used of 3D cephalometric tracings, which allows the evaluation of volumetric measurements of the airway [8,9] nevertheless in this study we

* Corresponding author. Present address: European University of Madrid, Oral Health Sciences, School of Dentistry, Clínica Universitaria Odontológica, Paseo Santa María de la Cabeza, 92, Madrid 28045, Spain. Tel.: +34610276887.
E-mail address: isabelchungleng@hotmail.com (I. Chung Leng Muñoz).

http://dx.doi.org/10.1016/j.ijporl.2014.04.046
0165-5876/

used a conventional lateral cephalogram because those were the records we had at our complete disposal.

2. Objective

The aim of the present investigation was to compare cephalometric values between nasal and oral breathing children and to measure the upper and lower airway space in both groups.

3. Methods

A sample of 118 children was obtained (51 girls and 67 boys) who were aged between 6 and 12 years, with an average age of 10.13 years. 53 children were oral breathers and 65 were nasal breathers. They had attended the University's Dental Clinic of the Universidad Europea de Madrid.

The study was approved by the Collected Research Commission of Biomedical Sciences Areas and Health Sciences of the European University of Madrid. The parents of the children signed a consent form to give authorization for the children to participate in the study, after receiving information about the study's objectives.

Personal details were taken along with respective medical histories for each child. The parents completed a questionnaire where they reported the type of breathing of the children when sleeping, and if dribbling on the pillow occurred three times a week or more. Intra and extraoral examinations were made of each child, including the type of breathing of the child when resting. The type of breathing of each child was evaluated during a period of 3 min by the child sitting in a resting position with a mirror placed on the nasal fossa, and the mirror was observed for the presence of fogging, or water vapor.

To be classified as a mouth breather, the child needed to fulfill all of the following clinical criteria: their parents reported that they were breathing through the mouth, sleeping with their mouth opened, and dribbling on the pillow three times a week or more. Also, during the phase of the clinical examination, they would not fog up the mirror in the nasal fossa observation.

None of the children had received orthodontic treatment previously. However, some in both groups had undergone tonsil and adenoid surgery. Patients with systemic disorders, craniofacial malformations and syndromes were excluded.

The orthodontic files of the 118 children were obtained from the Oral Radiology Department of the University Clinic. The lateral skull teleradiographies were taken of every subject standing in a profile position, using ear rods for stabilization and the nasal positioner at the nasion, from a side position where the rays fall perpendicular to the mean sagittal plane of the subject's head. They were taken using the same radiologist, equipment and technique using a manual Gendex Orthoralix- SD2 system Table 1.

A blind direct examination was made of each X-ray by one of the authors, who was not aware to which group the radiographs belonged. All the points and planes were traced by hand using a negatoscope on acetate paper by the same person, who was previously calibrated. The cephalometric tracing was done in the following way:

- SNA
- SNB
- SN-Go Gn
- SN-Occlusal plane
- 1.NA
- 1.NB

Table 1
Case-control tables.

Mouth breathing		
Gender	Number of individual	Average age SD
Girls	20	9.3 ± 1.8
Boys	33	10.06 ± 1.5
Nasal breathing		
Gender	Number of individual	Average age SD
Girls	31	10.36 ± 1.4
Boys	34	10.58 ± 1.1

3.1. Hyoid triangle tracing

- C3: antero-inferior angle of the third cervical vertebra.
- RGn: retrognathion, the most posterior point of the mandibular symphysis.
- H: hyoidale, the most superior and anterior point of the hyoid bone.
- H1: a point resulting from the perpendicular projection of point H on the RGn–C3 line (Fig. 1).

The hyoid triangle tracing was conducted on all the teleradiographies [10], according to where the cephalometric points RGn, H and C3 joined.

The plane: RGn–C3 plane. This is formed by joining the cephalometric point RGn (retrognathion) and C3 (third cervical bone).

The position of the hyoid bone in relation to the vertebral column and the mandible is the following: in the case of a normal cervical relationship, the vertical position of the hyoid bone should be under the RGn–C3 plane, which would give a positive triangular position (Fig. 1B).

The hyoid bone is in a normal position when it is situated up to 5 mm under the RGn–C3 plane, thus forming the hyoid triangle. If there is any disturbance to the position of the hyoid bone the latter will be found over the RGn–C3 plane or above this, therefore forming a negative hyoid triangle (Fig. 1A).

We also measured the sides and the height of the triangle: (Fig. 2)

- Base of the triangle: C3–RGn
- Side 1 (S1): C3–H
- Side 2 (S2): H–RGn
- Height of the triangle

3.2. Airway space

- Superior posterior airway space (SPAS): the thickness of the airway behind the soft palate along a line parallel to the Go-B point plane.

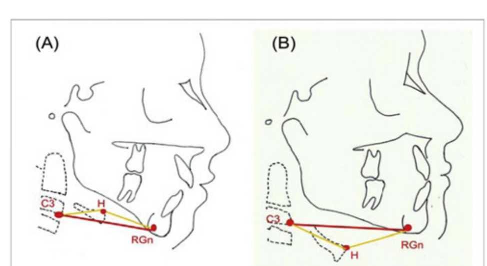

Fig. 1. Hyoid triangle tracing. (A) Hyoid bone located over the RGn–C3 plane. A negative hyoid triangle. Mouth breathing children. (B) Hyoid bone located under the RGn–C3 plane, which would give a positive triangular position. Nose breathing children.