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# Cephalometric evaluation of facial pattern and hyoid bone position in children with obstructive sleep apnea syndrome

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ABSTRACT

*Objectives:* To assess the development of face and hyoid bone in children with obstructive sleep apnea syndrome (OSAS) through lateral cephalometries.
*Materials and methods:* Children aged 7–10 years with mixed dentition and with no previous otorhinolaryngologic, orthodontic or speech therapy treatments were studied. Twenty nasal breathers were compared to 20 mouth breathing children diagnosed as OSAS patients. All children underwent otorhinolaryngologic evaluation and cephalometries; children with OSAS also underwent nocturnal polysomnography in a sleep laboratory.
*Results:* Children with OSAS presented increase in total and lower anterior heights of the face when compared to nasal breathers. In addition, children with OSAS presented a significantly more anterior and inferior position of the hyoid bone than nasal breathers. No significant differences in upper, anterior or posterior heights of the face were observed between groups.
*Conclusion:* The results suggest that there are evident and early changes in facial growth and development among children with OSAS, characterized by increased total and inferior anterior heights of the face, as well as more anterior and inferior position of the hyoid bone.


## 1. Introduction

Mouth breathing is one of the most frequent symptoms in childhood, and rhinitis and tonsils hypertrophy are the most frequent causes for it [1]. It influences the perioral muscles and soft tissues, and thus affects the apposition of bone tissue during the infant growth [2]. The severity of respiratory disorders may range from intermittent nasal obstruction to more exuberant symptoms such as obstructive sleep apnea syndrome (OSAS) [3].

It has been previously reported that adult patients with OSAS present a more anterior and inferior hyoid bone position when compared to controls, associated to lower position of the tongue. This is related to changes in geniohyoid muscle, which in turn worsen apnea during sleep [4]. The position of the hyoid bone may be also related to a poorer prognosis in surgeries for uvulopalatopharyngoplasty (UPPP) for OSAS in adults, and patients with a higher distance between the hyoid bone to the mandibular base present a poorer postoperative success [5].

Tonsils hypertrophy is the main cause of OSAS in children [6]. In this age group, OSAS may be more subtle and silent, whereas this characteristic does not prevent the development of serious neurobehavioral and cognitive impairment, as well as facial and occlusal changes.

The study of facial development and mainly of the hyoid position in children precisely diagnosed with OSAS has been scarcely reported in the literature. The purpose of this study was to evaluate children in scholar age, comparing children with OSAS (group 1) to nasal breathers (group 2), in terms of skeletal facial and hyoid changes.

## 2. Materials and methods

Twenty patients with OSAS and 20 nasal breathing patients, from 7 to 10 years, and with mixed dentition, were selected. Patients with systemic disorders and those with adjuvant orthodontic, speech therapeutic and otorhinolaryngologic treatment were excluded.

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Group 1 patients (OSAS) were selected at the Mouth Breathing Center of the School of Medicine of Ribeirão Preto, University of São Paulo, and group 2 patients (nasal breathers) were selected at the Pediatric Clinic of the Dental School of Ribeirão Preto, University of São Paulo. All childrens' parents gave informed consent prior the evaluations, and the patient was included in the study only if their parents agreed to perform the whole study.

Otorhinolaryngologic evaluation was performed in each patient to confirm the breathing pattern. This evaluation included a questionnaire about the intensity and frequency of respiratory symptoms and a specific otorhinolaryngologic examination. The palatine tonsils were graded according to Brodsky [7] and percentage of adenoid obstruction on choanal area was graded by nasoendoscopy.

Mouth breathing group also underwent to nocturnal diagnostic polysomnographic examination, according to the 2007 criteria of the AASM [8]. Only children with an apnea-hypopnea index higher than 1 and symptoms of OSAS were included in this group. For ethical reasons, the control group was not submitted to polysomnography.

After the inclusion in each group, a complete orthodontic evaluation and documentation was performed in each child, including lateral cephalometric radiograph. Based on this exam, the following linear measurements were obtained (Fig. 1):

N–Me: linear distance from N (nasion) to Me (menton); represents the total anterior facial height
N–ANS: linear distance from N to ANS (anterior nasal spine); represents the upper anterior height of the face
ANS–Me: linear distance from ANS to Me; represents the lower anterior height of the face
S–Go: linear distance from S (sella) to Go (gonion); represents the total posterior facial height

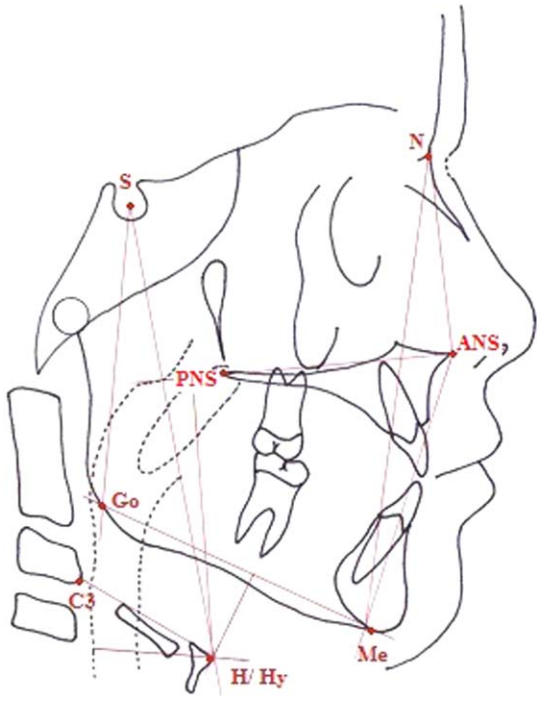


**Fig. 1.** Cephalometric tracing illustrating the points and linear measurements employed in this study: N–Me: total anterior facial height; N–ANS: upper anterior height of the face; ANS–Me: lower anterior height of the face; S–Go: total posterior height of the face; HyS: vertical distance from Hy to sella; vert.dH: vertical distance from H to the palatal plane; HyMP: vertical distance from Hy to the mandibular plane; horiz.dH: horizontal distance from H to the posterior wall of the hipopharynx; C3–H: linear measure from H to the most anterior point of C3.

HyS: linear vertical distance from Hy (uppermost point of the hyoid) to S
vert.dH: linear vertical distance from H (most anterior point of the hyoid) to the palatal plane
HyMP: vertical distance from Hy to the mandibular plane
horiz.dH: linear horizontal distance from H to the posterior wall of the hypopharynx
C3–H: linear measure from the H to the most anterior and inferior point of C3.

The study was approved by the Research Ethics Committee of the University Hospital, School of Medicine of Ribeirão Preto, University of São Paulo (protocol no. 4212/2009).

### 2.1. Statistical analysis

Otorhinolaryngologic evaluation and polysomnography were used to stratify the patients into the different groups and no statistical analysis was applied to these data. The orthodontic measures were compared statistically by unpaired parametric tests, through ANOVA. The GraphPad Instat 3.0 software was used for the analyses.

## 3. Results

A total of 40 non-obese children were selected, from which 20 belonged to the group of nasal breathers (mean age 7.35 years) and 20 were from OSAS group (mean age 7.85 years).

### 3.1. Otolorayngologic and polysomnographic exams

All patients in the OSAS group presented a history of snoring and apnea witnessed by their parents. In addition, these children had obstructive adenoids (more than 70% of the choana) and/or grade III or IV palatine tonsils. The polysomnographic diagnosis showed that OSAS was mild in 10 children, moderate in 6 and severe in 4.

In contrast, nasal breathing group did not present obstructive respiratory symptoms for more than 15 consecutive days. ENT exams revealed that adenoids obstructed less than 50% of the choana and palatine tonsils were grade I or II in all patients.

### 3.2. Orthodontic exam

The cephalometric facial measures demonstrated a significant increase of the total anterior facial height (N–Me, $109.9 \pm 5.0$ for OSAS vs. $106.1 \pm 5.6$ for controls, $P < 0.05$), due to a significant increase of the lower anterior facial height (ANS–Me, $65.9 \pm 4.6$ for OSAS vs. $62.3 \pm 4.3$ for controls, $P < 0.05$). No significant difference was observed in upper anterior height (N–ANS) or the posterior height (S–Go) of the face (Table 1).

Hyoid bone measures revealed a significant lower position in relation to the skull base (HyS, $98.7 \pm 8.6$ for OSAS vs. $88.9 \pm 5.9$ for controls, $P < 0.0005$), to the palatal plane (vert.dH, $56.9 \pm 6.9$ for OSAS vs. $47.6 \pm 3.7$ for controls, $P < 0.0001$) and to the mandibular plane (HyMP, $16.4 \pm 6.5$ for OSAS vs. $8.1 \pm 4.8$ for controls,

**Table 1**
Comparison of cephalometric facial data between the OSAS and nasal breathing groups.

| | Nasal breathing | OSAS | *P* |
|---|---|---|---|
| N.Me | $106.0 \pm 5.6$ | $109.9 \pm 5.0$ | 0.024 |
| N.ANS | $46.7 \pm 3.1$ | $48.4 \pm 2.3$ | 0.065 |
| ANS.Me | $62.3 \pm 4.3$ | $65.8 \pm 4.6$ | 0.017 |
| S.Go | $65.5 \pm 4.3$ | $67.5 \pm 4.0$ | 0.144 |