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Original article

Comparision of orofacial airway dimensions in subject with different breathing pattern

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ABSTRACT

Objective: To test the null hypothesis that there is no significant difference in the craniofacial morphology and orofacial airway dimensions between mouth breathing (MB) and nasal breathing (NB) subjects.
Materials and methods: Lateral cephalometric radiographs of 34 MB subjects (mean age: 12.8±1.5 years; range: 12.0–15.2 years) and 33 NB subjects (mean 13.9±1.3 years; age range: 12.2–15.8 years) with Class I occlusion were examined. Totally, 34 measurements (27 craniofacial and 7 orofacial airway) were evaluated. Group differences were statistically evaluated by independent samples t-test at $p < 0.05$ levels.
Results: Statistical comparisons showed that SNA ($p < 0.01$), ANB ($p < 0.01$), A to N perp ($p < 0.05$), convexity ($p < 0.05$), IMPA ($p < 0.05$) and overbite ($p < 0.05$) measurements were significantly lower in MB group when compared to NB group. However, SN-MP ($p < 0.01$) and PP-GoGn ($p < 0.01$) from angular measurements and S-N ($p < 0.05$) and anterior facial height ($p < 0.05$) from linear measurements were significantly higher in MB subjects. Among orofacial airway measurements, only upper posterior airway space was found significantly higher($p < 0.001$) in MB than NB subjects.
Conclusions: The null hypothesis was rejected. Mouth breathing affects craniofacial morphology and orofacial airway dimensions.

1. Introduction

Nasal obstruction, chronic allergic rhinitis, hypertrophic adenoids decrease the nasal breathing (NB) and compensation of this situation by mouth breathing (MB) might be essential.[1] Respiratory airway function influences the facial morphology and craniofacial functions.[2] The breathing pattern may influence the development of the transverse relationship, resulting in the development of posterior crossbite and also MB can affect the form of the jaw or cause malocclusions.[3] MB may lead to adenoid face which is characterized by a narrow upper dental arch, retroclined mandibular incisors, an incompetent lip seal, a steep mandibular plane angle and increased anterior facial height[4–6]

MB has a multifactorial etiology including physical obstructions, hypertrophic adenoids, tonsils, nasal polyps, nasal septum deviations, chronic allergic rhinitis,[7] sinusitis, hypertrophic chonca and hypertrophic pharyngeal tonsils.[4] MB is clinically characterized by postural open bite, shorter upper

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lip, protrusive upper incisive teeth, deficient maxilla,[2] narrow and V-shaped maxillary arch, deep palate vault and posterior cross bite,[3] increased lower face height, retroclined mandibular incisors, incompetent lip seal.[4–6] Chronic MB causes unfavorable dentofacial development during growth period of a child resulting in several morphological disorders.[6,8]

MB demonstrated considerable backward and downward rotation of the mandible, increased overjet, increase in the mandible plane angle, a higher palatal plane compared to NB. Abnormal lip-to-tongue anterior oral seal was significantly more frequent in the MB than in the NB. In pediatric patients, naso-respiratory obstruction with mouth breathing during critical growth periods in children has a higher tendency for clockwise rotation of the growing mandible, with a disproportionate increase in anterior lower vertical face height and decreased posterior facial height.[9]

Pharyngeal size is very important for all subjects and especially for the patient with obstructive sleep apnea (OSA). The size of the nasopharynx may be of particular importance in determining whether the mode of breathing is predominantly nasal or oral. The orthodontist should contribute to the initial diagnosis of many nasopharyngeal obstructions that can result in a predisposition to MB.

The aim of this study was to compare the craniofacial morphology and orofacial airway dimensions in Class I, MB and NB subjects. For this purpose, the null hypothesis assumed that there is no significant difference in the craniofacial morphology and orofacial airway dimensions between MB and NB subjects.

2. Materials and methods

The Regional Ethical Committee on Research of the Erciyes University, Faculty of Dentistry, approved this study.

In the present study, 155 MB and 50 NB Class I subjects were evaluated and 34 MB and 33 NB patients were selected by the following sample selection criteria: subjects were between 12-16 years of age, skeletal Class I relationship according to ANB angle. Subjects were permanent dentition and no history of previous orthodontic or functional orthopedic treatment. Subjects with history of nasal respiratory complex surgery, allergic or acute rhinitis, visual, vestibular, equilibrium, swallowing disorders and facial or spinal abnormalities and severe sleeping disorders with moderate and severe AHI index (15-30 and greater than 30) were excluded from the study.

Sixty-seven pretreatment cephalometric radiographs of these Class I patients formed the sample for this study taken by a standard technique at the relaxed position of tongue and perioral muscles. Patients were divided into two groups according to respiration pattern: MB children used as experimental group and NB children used as control group.

All patients had Class I skeletal relationship (ANB: $2.2^{\circ}\pm1.5^{\circ}$ and $2.9^{\circ}\pm0.9^{\circ}$ in MB group and NB group, respectively). To participate in the study written informed consents were given by the parents of the patients.

Evaluation of the breathing pattern was adapted from the study by Cuccia et al.[10] Most subjects in MB group showed a diaphragmatic mode of inhalation under expansion of the thorax and a reduced mobility of the nostrils suggesting a reduced patency of the upper airway. MB was shown by water vapor condensed on the surface of a mirror placed outside the mouth.

MB group comprised 16 boys and 18 girls (mean age 12.8 ± 1.5 years; range: 12.0–15.2 years). On clinical examination MB patients showed lip incompetence, dry lips at rest, dental crowding in the upper arch, "adenoidal face" and reduced maxillary transverse dimension with unilateral or bilateral cross bite. These factors were considered for the diagnosis of MB in agreement with Moyer's criteria.[11]

NB group comprised 8 boys and 25 girls (mean age 13.9 ± 1.3 years; range: 12.2–15.8 years). This group was chosen at random from a group of children according to inclusion criteria, who had various orthodontic problems, but who did not have a past history or any clinical signs of MB.

2.1. *Cephalometric Measurements*

Lateral cephalometric radiographs were taken with Instrumentarum Cephalometer (Ortoceph OC100, Tuusula, Finland). All subjects were positioned in the cephalostat with the sagittal plane at a right angle to the path of the x-rays, the Frankfort plane was parallel to the horizontal, the teeth were in centric occlusion, and the lips were lightly closed. All radiographs were taken with the same machine and magnification (110%; 1-1.1).

All radiographs were traced manually. Whole measurements were recorded by a single author (F.I.U.) and were reviewed twice by other investigator for accurate landmark identification. Tracings were transferred to computer in JPEG format by the same resolution and scanner. Orofacial airway areas were obtained with the same resolution. Orofacial airway areas were separated into three parts showed in Figure 5. Each part was painted and calculated the number of pixels separately in histogram section on the Adobe Photoshop® CS5 trial version (Adobe, California, USA) and converted to mm^2.

Landmarks and reference lines used for orofacial airway dimensions were shown in Figure 1 and craniofacial measurements were shown in Figures 2–4. Fifteen angular (Figs. 2 and 3) and 12 linear (Fig. 4) measurements were used for the evaluation of craniofacial morphology. Additionally, seven measurements were used to evaluate orofacial airway dimensions (Figs. 5 and 6).

2.2. *Statistical Analysis*

All statistical analyses were performed using the Statistical Package for Social Sciences 13.0 (SPSS Inc., Chicago, Illinois, USA). A power analysis established by G*Power Ver. 3.0.10. (Franz Faul, Universität Kiel, Germany) software, based on 1:1 ratio between groups, sample size of 33 patients would give more than 80% power to detect significant differences with 0.30 effect size [to detect a clinically meaningful difference of 1 mm (±1.5 mm) for the distance of the A to N perp.] between two groups and at $\alpha = 0.05$ significance level.

The normality test of Shapiro–Wilks and Levene's variance homogeneity test were applied to the data. The data were found normally distributed, and there was homogeneity of variance between the groups. Arithmetic mean and standard deviation values were calculated for each measurement.