Effect of Naso-respiratory Obstruction with Mouth Breathing on Dentofacial and Craniofacial Development

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ABSTRACT

Objective: To evaluate the effects of mouth breathing on craniofacial and dentofacial development during childhood in comparison to nasal breathing in malocclusion patients.

Materials & Method: A retrospective study done at SOA University. Cephalometric parameters and clinical variables of 90 pediatric patients who had undergone orthodontic treatment were reviewed. Study group included 40 pediatric patients who suffered from signs and symptoms of nasal obstruction, and control group included 50 patients who were normal nasal breathers. Dental and craniofacial parameters were compared between nasal breathers and mouth breathers using clinical and cephalometric records.

Result: The mouth breathers had backward and downward rotation of mandible with increased overjet, increased mandibular plane angle, higher palatal plane, and constriction of upper and lower arches at the level of cuspids and first molars when compared with nasal breathers group. The prevalence of posterior cross bite was observed greater in mouth breathers group (40%) than the nose breathers (20%) ($p = 0.006$). Abnormal lip-to-tongue anterior oral seal was seen more in the mouth breathers group (55%) than in nose breathers group (25%) ($p = 0.05$).

Conclusion: Naso-respiratory obstruction with mouth breathing during growth periods in children has a greater tendency for clockwise rotation of growing mandible, with an irregular increase in anterior lower vertical face height and decreased posterior facial height.

Keywords: anterior oral seal, dentofacial growth, mouth breathing, malocclusion, nasal obstruction

INTRODUCTION

The relationship between nasal obstruction and craniofacial growth is highly debatable in literature.[1] Much of the disagreement relates to lack of sophistication in quantifying nasal versus oral respiration and deficiency of longitudinal data. According to Moss's theory of functional matrix, nasal breathing allows growth and development of dentofacial complex.[2] This theory is entirely based on the principle that normal nasal respiratory activity has an impact on the development of craniofacial structures, favoring harmonious growth and development by interacting with mastication and swallowing along with other components of head and neck region.[3,4] Chronic nasal obstruction leads to mouth breathing, resulting in an anterior or lower position of the tongue, incompetent lips, lowered position of the mandible, and decreased orofacial muscle tonicity to compensate for decreased nasal airflow and facilitate respiration.[5–8] Hence, there is disharmony in growth and development of orofacial structures, narrowing of maxilla, underdevelopment of mandible, alterations in the position of head in relation to the neck, protrusion of maxillary incisors, and distal position of mandible in relation to maxilla.[9]

Mouth breathing has a multifactorial etiology which varies from anatomical obstruction like palatine and pharyngeal tonsil hypertrophy, nasal polyp, septal deviation, allergic rhinitis, nasal turbinate hypertrophy and deleterious oral habits that might deform the dental arch and alter facial harmony depending on intensity, duration and frequency of such habits.[10,11] The most common cause of mouth breathing is nasal obstruction, specifically adenoid hypertrophy in pediatric population.[12] In children, the phenomenon of mouth breathing is important as it adversely influences growth and development. The children with chronic mouth breathing might develop morphological disorders during the growth phase resulting in unfavorable development of craniofacial and dentofacial complex. However, relationship between mouth breathing and dentofacial development is controversial as some authors do not associate nasal obstruction as a significant factor causing abnormal dentofacial and craniofacial development.[13–15]

The purpose of this study was to evaluate the effects of mouth breathing during childhood on craniofacial and dentofacial development in comparison to nasal breathing in malocclusion patients treated in orthodontic department.

MATERIALS AND METHOD

A retrospective review of 90 pediatric patients who had undergone orthodontic treatment at the Department of Orthodontics from 2012 to 2016 was performed. Cephalometric and clinical parameters of those patients were reviewed. Study group included 40 pediatric patients who suffered from the signs and symptoms of nasal obstruction as a result of mouth breathing (Table 1). The control group included 50 patients who were normal nasal breathers. Patients in both groups were orthodontically treated. Mode of breathing was illustrated according to history and clinical examination which included anterior rhinoscopy, lateral nasopharyngeal x-ray, flexible nasopharyngoscopy, and then confirmed by questionnaires answered by patients' parents (Table 2).[16] The two groups did not have any past history of nasorespiratory surgery. The examined parameters during orthodontic evaluation included demographic data, respiratory status of patient, comprehensive oral examination, cephalometric analysis, and study models. The study models were evaluated and measured for arch form, symmetry, position of tooth, occlusion, and other parameters liable to undergo changes because of mouth breathing.

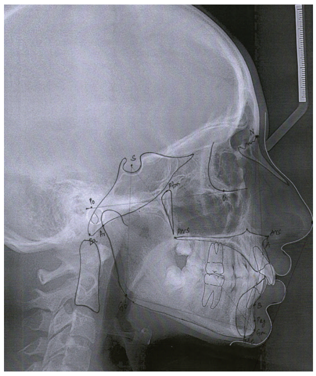

Figure 1. Cephalometric landmarks

Cephalometric analysis was made on standardized lateral head plates to compare parameters that might be influenced by different modes of breathing in two groups. The performed cephalometric analysis was used to define planes and angles representing deviations from accepted norms in affected patients. Cephalometric points marked in cephalograms taken in Frankfort Horizontal position are described in Figure 1. After locating landmarks of anatomical skeletal points, angular and linear cephalometric measurements were obtained. The data were collected in a table and subjected to statistical analysis for determination of differences.

The data were evaluated using descriptive statistical methods. Differences between groups were analyzed by using v2 test for categorical variables. Statistical tests were performed using SPSS version 12.0 software. Statistical significance was accepted at a level $p<0.05$.

Table 1. Demographic characteristics of samples

Parameter		Mouth Breathers, n=40 (%)	Nose Breathers, n=50 (%)
Gender	Female	20 (19.1%)	30 (50.4%)
	Male	20 (29.9%)	20 (40.6%)
Age (years)	Mean±SD	12.49±1.94	12.55±2.11
	Range	10–14	10–14

Table 2. Breathing Mode according to Questionnaire

Parameter	Mouth Breathers (n=40)	Nose Breathers (n=50)
Snoring	31	0
Sleep apnea	5	0
Allergic rhinitis	7	0
Closed rhinolalia	6	0
Mouth open at rest	35	0
Drooling on pillar	35	0
Recurrent otitis media	4	0
Chronic middle ear effusion	5	0

RESULT

Dental and craniofacial parameters of mouth breathers and nose breathers are shown in Table 3. In horizontal, vertical, and lateral dimensions there were significant differences between mouth breathers and nose breathers groups. The horizontal dimension showed an increased overjet in mouth breathing group with backward and downward rotation of the mandible, which was represented by the lower lip to E-line distance. The vertical dimension evaluated a significant increase in mandibular plane angle (Go-Gn to SN), an increase in the y-axis angle and a higher palatal plane. The lateral dimension of arches showed narrowing of both upper and lower arches at the level of canines and first molars in mouth breathers group. However, other cephalometric landmarks, like SNA angle, overbite, and ANB angle, did not show any significant differences between mouth breathers and control group.

The distribution of Angle's classification and anterior and posterior crossbite malocclusions in mouth breathers and nose breathers is shown in Table 4. In the study population most of them presented with Class II malocclusion (66%). No significant differences in malocclusion classification was found between mouth breathers and the nose breathers (*p*=0.49). However, a tendency toward an increased rate of Class II malocclusion was found among mouth breathers (70%). In mouth breather group, Class II was three times more common than Class I. In fact, when comparing prevalence of posterior crossbite between the two groups, posterior crossbite was significantly more frequent in the mouth breathers group (40%) than nose breathers (20%) (*p*=0.006).

The relationship between anterior oral seal (AOS) and mode of breathing is shown in Table 5. Most of the nose breathers had normal lip-to-lip AOS during swallowing (70%). However, an abnormal lip-to-tongue AOS was more frequent in the mouth breathers group (55%) than nose breathers group (25%) (*p*=0.05).

Table 3. Dental and craniofacial parameters of mouth breathers and nose breathers

Dimension	Parameter	Mouth Breathers, n=40 (%) (Mean±SD)	Nose Breathers, n=50 (%) (Mean±SD)	*p*-Value
Horizontal	Overjet, mm	5.95±3.31	4.47±2.53	0.01*
	SNB angle	74.84±3.94	75.96±3.61	0.002*
	SNA angle	78.61±6.61	81.35±7.88	0.2
	ANB angle	4.43±2.81	3.39 ±9.00	0.416
	Lower lip to E-line, mm	1.43±2.77	0.06±2.84	0.01*
Vertical	ANS-Me, mm	66.66±6.40	65.07±6.00	0.038
	Go-GN to SN angle	35.85±5.80	33.76±4.53	0.002*
	Y-axis angle	70.45±4.20	65.27±4.85	0.002*
	Overbite	2.85±2.34	3.10±1.98	0.521
	S-Go to N-Me, ratio in %	60.47±5.23	64.66±2.41	0.025*
	Palatal height, mm	25.14±1.82	22.89±2.21	0.02*
Lateral	Upper 3–3 width	27.70±1.89	30.78±2.09	0.02*
	Upper 6–6 width	31.21±2.06	35.64±2.68	0.02*
	Lower 3–3 width	25.94±1.95	28.30±1.96	0.02*
	Lower 6–6 width	31.62±2.00	32.61±2.63	0.02*

**Statistically significant at p<0.05*

Table 4. Prevalence of Angle's classification and posterior crossbite malocclusions in mouth breathers and nose breathers

Dimension	Parameter	Mouth Breathers, n=40 (%)	Nose Breathers, n=50 (%)	*p*-Value
Horizontal (Angle's classification)	Class I	10 (22)	21 (31)	0.48
	Class II	27 (73)	25 (62)	
	Class III	3 (5)	4 (7)	
Lateral	Posterior crossbite	28 (39)	16(26)	0.006*

Table 5. Association between anterior oral seal and mode of breathing

Anterior Oral Sealing (AOS)	Mouth Breathers, n=40 (%)	Nose Breathers, n=50 (%)	*p*-Value
Normal AOS (lip to lip)	15 (45)	30 (70)	0.05*
Abnormal AOS (lip to tongue)	25 (39)	20 (30)	

**Significant at p≤0.05*

DISCUSSION

The concepts that nasal obstruction and mouth breathing adversely affects the craniofacial and dentofacial development still ontinues to be controversial, and this is at least in part due to criterion used to define mouth breathing, which is often subjective.

In the present study, a significant difference was found between mouth breathers and control groups in horizontal, vertical, and lateral dimensions. In the horizontal dimension, mandible was located in a posterior position in relation to maxilla in mouth breather patients, which was demonstrated by an increased overjet, SNB angle, and distance between lower lip to E-line. These findings support previous evidence that retrognathic mandible and posterior inclination of mandibular plane in mouth breathing children are higher than the nasal breathing children.[17–19]

In the vertical dimension, posterior and anterior facial height ratio (S-Go to N-Me ratio) was lower in mouth breathing children, indicating proportionally lower posterior facial height than anterior facial height in these patients. This result confirms evidence that mouth breathing children present clockwise rotation of mandible (downward and posterior rotation) stimulating increased vertical growth of anterior portion of the face relative to posterior portion of the face.[5] In the lateral dimension, there was narrowing of the upper and lower dental arches in mouth breathers group compared to control group.

The findings in three dimensions support previous theories that the mouth breathers have higher tendency for abnormal skeletal and dental growth in comparison to normal growth parameters. In Angle's classification we found an increased tendency towards class II in mouth breathers group, which indicates posterior position of mandible. Our finding was without any significant difference between both groups. The cause for this finding could be due to study population that has known malocclusion. However, prevalence of class II malocclusion in the mouth breathers (73%) was higher than prevalence of class II malocclusion in Israeli population (28.1%).[20] However, in lateral dimension, a significant difference was found in the prevalence of posterior cross bite. This finding might be explained by the lower position of tongue followed by downward rotation of the mandible to enhance oral breathing exclusively. Elongation of buccinator muscles might create inward pressure on upper dental arch. When determining AOS we found a significant difference between both groups. The mouth breathers group showed increased rate of abnormal AOS (55%) compared to the control group (25%), which indicates inability to bring upper and lower lip together to create normal OS. The unique feature of our study in comparison to the previous studies is that orthodontic malocclusion was present in both groups, and the difference between them was mode of breathing.

Normal craniofacial and dentofacial development depends on various other factors. Genetic factors influence constitution of facial and occlusal pattern of an individual, and stomatognathic apparatus function plays an important role.[13,21,22] The craniofacial and dentofacial abnormalities that have been linked with nasal obstruction are usually featured with an elongated face, open-mouth posture, protrusive and proclined maxillary incisors, constricted maxillary arch, high-arched palate, and Angle's Class II malocclusion. The term 'adenoid face' encompasses most of these features.[22-24]

Upper airway obstruction induces a change in balance between forces and the pressure exerted by various musculature such as muscles of tongue, orbicularis oris, and buccinators, generating morphological changes in dental and craniofacial parameters.[25,26] Some authors described a physiological mechanism that causes these changes in neuromuscular system as a result of upper respiratory airway obstruction.[27] The neuromuscular changes encourage alteration in bony and soft tissues of dental and craniofacial structures (Figure 2).

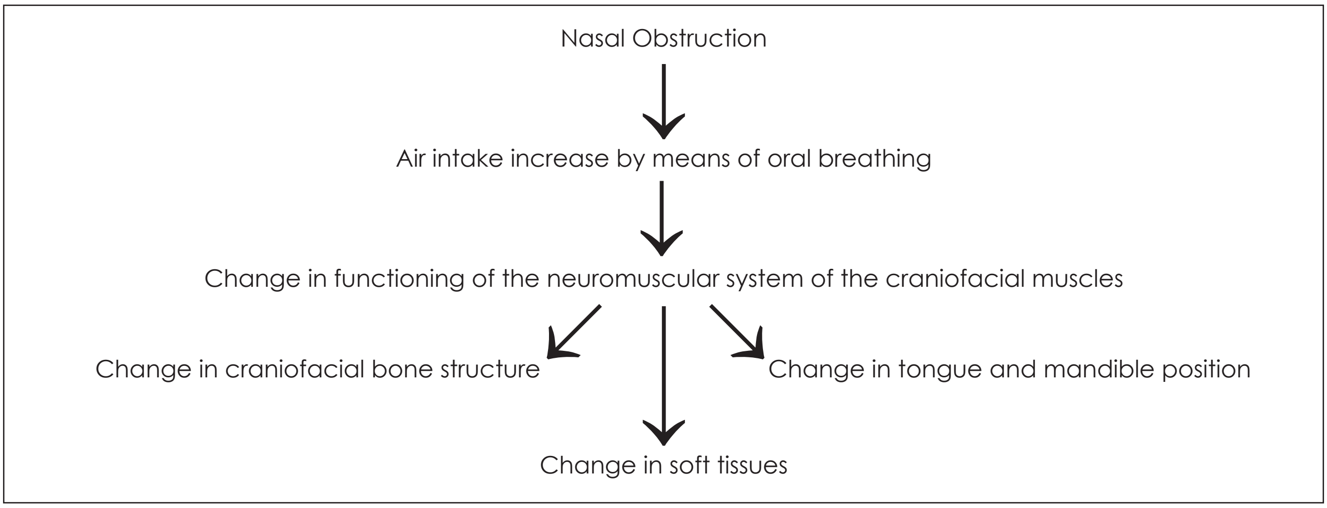

Figure 2. Relationship between naso-respiratory obstruction and craniofacial growth

Previous data and results from our study show that longstanding nasal obstruction which causes mouth breathing correlated with a negative impact on dentofacial and craniofacial development. In addition, mouth breathing has a similar effect on mandibular growth irrespective of its etiology.[28-30]

CONCLUSION

Nasorespiratory obstruction along with mouth breathing during critical growth periods in children has a higher tendency for clockwise rotation of growing mandible, with a disproportionate increase in the anterior lower vertical face height and decreased posterior facial height. Such increase in the anterior lower vertical face height is often associated with open bite and retrognathia Otolaryngologists, pediatricians, and orthodontists must take note of the chronic mouth breathing in children, since any delay in diagnosis and treatment might cause abnormal dentofacial and craniofacial development. They also have a significant role in the diagnosis and management of orthodontic patients since the signs and symptoms might be recognizable in the dental practice.

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