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Original Research Paper

Comparison of craniofacial morphology in mouth breathers and nasal breathers: a cephalometric study.

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INTRODUCTION:

Respiration is one of the body's vital functions. Under normal conditions breathing takes place through nose.(1) According to Moss's theory of functional matrix, normal nasal respiratory activity influences the development of craniofacial structures, favouring their harmonious growth and development by adequately interacting with mastication and swallowing and other components of the head and the neck region. (2) Respiratory airway function affects both facial and craniofacial morphology as well as cervical functions. The breathing pattern of an individual may influence the development of transverse relation between the maxilla and the mandible resulting in the development of a posterior cross bite.(3) Chronic nasal obstruction in turn leads to mouth breathing resulting in an anterior or lower position of the tongue, incompetent lips, retroclined mandibular incisors, a steep mandibular plane angle, an increased anterior open bite, increased anterior facial height and lowered position of the mandible. It also results in reduced oro-facial muscle tonicity, which compensates for decrease in nasal airflow and also facilitates respiration.(4) All these characteristics are typical of the so called "adenoidal facies".(3) Children with mouth breathing have typical facial features such as long face, dark circles around the eyes, vague facial expressions, narrow nostrils, transverse contraction of the upper jaw, high arched palate and gummy smile associated with class II or class III malocclusion. In mouth breathers, the lower lip is large and bulbous and the upper lip is short and functionless, therefore the lower lip is often forced up under the upper incisor, which further protrudes the upper incisors and hence increases overjet.(5) Ucar FI et al found that the maxilla was more retro-gnathic in mouth breathing patients. Additionally the palatal plane had a posterior counter- clockwise rotation in mouth breathing patients.(3) The craniofacial complex can therefore be effectively analysed by using cephalometry, as it is an important tool for studying craniofacial growth pattern, anatomic anomalies in patients and their diagnosis and treatment planning.(6) Literature search revealed that there are many studies comparing craniofacial morphology between mouth breathers and nose breathers yet there are controversies regarding a clear association between mouth breathing and craniofacial anomalies. Thus more research and that too with standardized protocols/methods is required to clarify the effects of mouth breathing on the craniofacial complex. Having in mind the importance of studying mouth breathing and its consequences on craniofacial complex, our study is aimed at strengthening the evidence for association between the mouth breathing and craniofacial anomalies and to check whether or not there are differences between mouth breathers and nasal breathers with regard to craniofacial morphology.

MATERIAL AND METHODS:

The present cross- sectional cephalometric study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, D.A.V. Dental College, Yamunanagar. The present study was planned to assess the comparison of craniofacial morphology between mouth breathers and nasal breathers. All the subjects of the study were approved by the members of the institutional ethical committee and University review board. Informed consent was obtained from all the subjects after explaining the nature and purpose of the study. Only those subjects who agreed to participate and allowed their radiographs to be taken were included in the study. Each individual's basic information about name, age, gender, history of trauma, surgery or craniofacial deformities and previous orthodontic treatment was taken and only those subjects fulfilling the following criteria of age between 11- 18 years; no history of orthodontic treatment and/or maxillary functional orthopaedic treatment; no history of naso-respiratory complex surgery; no vestibular or equilibrium problems; and no visual, hearing or swallowing disorders and facial or spinal abnormalities (i.e., torticollis, scoliosis, or kyphosis); were included in the study. Thorough history of all the subjects was taken and breathing pattern of the patients was assessed with the help of the following methods:

1. ***VISUAL ASSESSMENT***

The presence of the extraoral and intraoral characteristics typical of mouth breathers (eg. Long face, dark eye circles, short lip, narrow and high arched palate, cross bites,etc.), was examined to distinguish them from nasal breathers while the patient was sitting in the rest position.

2. ***QUESTIONNAIRE***

The following Questions were directed to the patients or parents:

Do You:

- Sleep with your mouth open?
- Keep your mouth open when you are at rest?
- Snore?
- Drool on your pillow?
- Wake up with a headache?
- Get tired easily?
- Often have allergies?
- Often have a stuffy nose and/or running nose?

3. ***BREATHING TESTS***

The breathing tests performed were as follows: (at least two tests were performed in the sitting position).

A. *Mirror test:* In mirror test the patients were made to sit in a resting position for 3 minutes with a double sided mirror placed in front of the nasal fossa, and the mirror were observed for the presence of fogging or water vapour.

B. ***Water retention test****:* The patients were asked to hold approximately 15 ml of water in their mouth for 3 minutes without difficulty in breathing.

C. ***Lip seal test:*** It was performed by sealing the patient's mouth completely with a tape for 3 minutes and observed if the patient can resist the tape and can breathe through the nose normally.

A total of 70 subjects were selected for our study based on the inclusion criteria. The subjects were further divided into two groups based on their breathing pattern assessed by visual assessment, questionnaire and breathing tests as: Group-I Mouth breathers and Group-II Nasal breathers. Each group consisted of equal number of subjects i.e. 35 subjects in Group-I and 35 subjects in Group-II. The age range of the subjects was between 12 - 16 years, with the mean age of 13.5 ± 2.21 years in Group-I [Mouth Breathers] and 14.1 ± 2.22 years in Group-II [Nasal Breathers]. Out of the total 70 subjects, Group-I consisted of 20 males and 15 females and Group-II consisted of 17 males and 18 females.

Lateral cephalometry was used in all the subjects for the evaluation and analysis of the craniofacial morphology. A total of 13 parameters were selected and measured for both mouth breathers and nasal breathers. Further a comparison of cephalometric values was done between both mouth and nasal breathers. The parameters measured are depicted in Figure1.

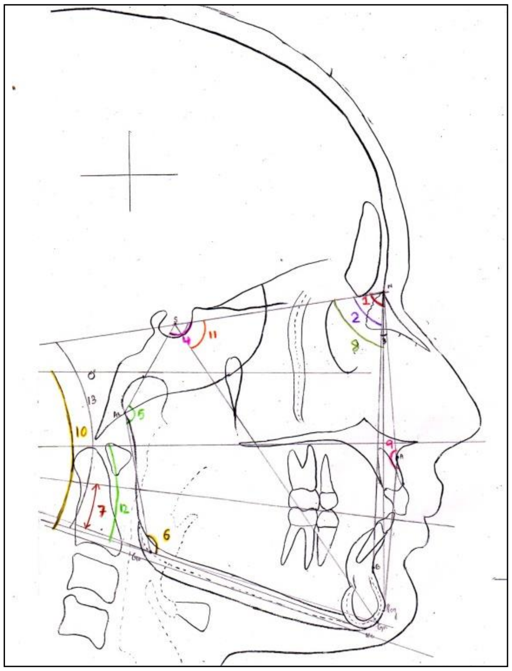

Fig 1 Parameters for Craniofacial Morphology
(1)SNA angle (SNA), (2) SNB angle (SNB), (3) ANB angle (ANB), (4) Saddle/Sella angle (SN-Ar), (5) Articular angle, (6) Gonial/Jaw angle (Ar-Go/MP), (7) Mand Plane to Occ Plane(MP-OP),(8) SN-NPog, (9) NA-Apog (convexity, (10) FMA, (11) Y-Axis, (12) Palatal-Mand angle (PP-GoGn), (13) SN plane to mandibular plane angle (SN-MP)

Statistical analysis:
After all the measurements were made, compilation of the data was done and appropriate statistical tests were applied. All the statistical analysis were done using SPSS version 22.0. All the statistical tests were performed at the significance level of 0.05. Descriptive statistics was performed by calculating mean and standard deviation for the continuous variables. The statistical tests used were; Unpaired or Independent t-test , used for comparison of mean value between the two groups when the data follows normal distribution and Pearson's correlation coefficient (r) test, used for calculating the correlation between the two variables when the data follows normal distribution. Intra-operator error was calculated using the Dahlberg's formula. Cephalograms of 25% of the total sample size were retraced after a period of 3 weeks to check for the intra-operator error.

RESULTS:

COMPARISON OF CRANIOFACIAL MORPHOLOGY PARAMETERS BETWEEN THE TWO GROUPS: The mean values of SNA, SNB, ANB, N-S-Ar, S-Ar-Go, Ar-Go-Gn, MP-OP, SN-Npog, NA-Apog, FMA, Y-axis, PP-Go-Gn and SN-Go-Gn were compared between Mouth breathers and Nasal breathers using the Unpaired t-test. The mean values of SNA, SNB and SN-Npog were: higher for Group II (Nasal Breathers) and the difference was statistically significant with the p- value of <0.05. The mean values of Ar-Go-Gn, NA-Apog, Y- axis, FMA, PP-Go-Gn and SN-Go-Gn were: higher for Group I (Mouth Breathers) and the difference was statistically significant with the p- value of <0.05. (Table 1)

Table 1. Comparison of parameters of craniofacial morphology between the two groups

	Mouth breathers		Nasal breathers				
	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
SNA	80.17	4.85	82.80	4.23	-2.63	-2.414	0.018*
SNB	74.43	4.94	77.89	4.18	-3.46	-3.160	0.002*
ANB	5.74	2.48	4.91	2.75	0.83	1.325	0.190
N-S-Ar	126.29	5.07	125.63	6.47	0.66	0.473	0.638
S-Ar-Go	141.57	6.37	140.00	7.27	1.57	0.962	0.340
Ar-Go-Gn	127.46	6.46	124.40	5.30	3.06	2.164	0.034*
MP-OP	17.40	4.58	16.89	2.95	0.51	0.558	0.579
SN-Npog	75.69	4.55	78.89	3.98	-3.20	-3.133	0.003*
NA-Apog	11.26	6.48	8.20	7.41	3.06	1.837	0.071

FMA	29.51	5.42	25.20	3.60	4.31	3.921	< 0.001*
Y-axis	69.86	4.43	67.14	5.30	2.71	2.324	0.023*
PP-Go-Gn	26.77	5.36	22.20	4.44	4.57	3.887	< 0.001*
SN-Go-Gn	34.00	5.28	28.94	5.34	5.06	3.986	< 0.001*

DISCUSSION:

The association between mouth breathing and cranioofacial morphology has been studied extensively and many authors believe that the pattern of growth of the craniofacial skeleton can be affected by unbalanced muscle function which are typical of mouth breathing.(5) This abnormal pressure of muscles interferes in facial growth, alters the facial skeleton and causes malocclusion. The low and forward position of the tongue is common in the presence of hypertrophic palatine tonsils, it thus increase the posterior airway space and ease breathing. The low position of the tongue decreases internal pressure in the upper arch, increasing the external pressure of perioral muscles and causes an atresic palate.(7) In the present study, the mean values of SNA, SNB and SN-N-Pog were statistically significantly higher in nasal breathers as compared to mouth breathers. This inferred that the maxilla and mandible are more retrognathic in the mouth breathers as compared to nasal breathers. These results are in concurrence with the already existing literature, Faria et al found that there was a statistically significant difference for SNA and SNB angles. The maxilla and mandible were more retrognathic in the mouth-brathing group which depicted that the maxillae were more retrognathic due to upper airway obstruction resulting from the hypoplasia of the maxillary sinus and narrowing of the nasal cavities.(8) Similarly, in a study by Subtelny, it was observed that the muscular pull induced by mouth breathing may be the cause of reduced maxillary dimensions. They also observed that the downward deviation of the posterior aspect of the naso-maxillary complex could be responsible for the rapid increase in lower facial height. Radiographically, the same can be evident as, when hard palate tends to tip down posteriorly away from the cranial base to a greater extent.(9) In the present study, it was found that the vertical measurements (FMA, Y- axis, PP-Go-Gn, Ar-Go-Gn and SN- MP) were significantly higher in mouth breathers as compared to nasal breathers. This result confirmed the evidence that mouth breathing children present a clockwise rotation of the mandible (downward and backward rotation) stimulating increased vertical growth of the anterior portion of the face relative to the posterior portion of the face leading to vertical growth pattern.(4) This lends credence to the definition of ‘‘long face’’ for mouth breathing cases, reminiscent of the ‘‘adenoid face’’ concept.(10) These results were consistent with the findings of previous study by Hellsing et al. They found that patients in the mouth breathing group are likely to present with increased mandibular inclination, characterized by decreased posterior facial height and increased lower anterior facial height. These measurements suggest that respiratory function influences craniofacial development. (11)

CONCLUSION:

The maxilla and mandible were retrognathic in relation to the cranial base in mouth breathers when compared to nasal breathers and in mouth breathers, a vertical pattern of growth and a predominance of Class II malocclusion were seen.

Hence, it can be deduced that changes in normal pattern of breathing has a marked effect on the craniofacial growth and development, resulting in a series of functional transformations that may affect the cranio-facial as well as dentofacial complex.

Way forward:

A multidisciplinary team should work to have early diagnosis and appropriate treatment, preventing the consequent disorders of chronic mouth breathing. The early recognition of such facial patterns may be utilized to identify those breathing compromised individuals who are likely to develop malocclusions. Hence, a joint effort by pedodontist, orthodontist, otorhinolaryngologist and paediatrician is thus required for reducing the continuing detrimental effects of breathing impairments on facial characteristics.

Declarations:

Authors' contributions: RG and VS conceived the idea. TG, RG and VS designed the analysis, TG conducted data analysis. TG, RG, ZB, VKS and VS conducted the literature review and drafted the manuscript; TG, RG, ZB, VKS and VS critically revised the manuscript for intellectual content. All authors read and approved the final manuscript.

Ethics approval and consent to participate:
Ethical approval for this study was approved by the members of the institutional ethical committee and University review board. Informed consent was obtained from all the subjects after explaining the nature and purpose of the study. Only those subjects who agreed to participate and allowed their radiographs to be taken were included in the study.

Consent for publication: Not applicable

Availability of data and material: The datasets generated and/or analyzed during the current study are not publicly available due to the institution policy but are available from the corresponding author on reasonable request.

Competing interests: We declare no conflict of interest.

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