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Original Research Article

Assessment of variations in upper and lower gonial angle in children with mouth breathing habit

Shemnidha Saleem, Dhanya Kamalakshan Belchada*, Ambili Ayilliath, Fazila Azhikoden

Department of Pediatric and Preventive Dentistry, Mahe Institute of Dental Science and Hospital, Chalakkara, Palloor, Mahe, Puducherry, India

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***Correspondence:**
Dr. Dhanya Kamalakshan Belchada,
E-mail: aqualibs983@gmail.com

ABSTRACT

Background: Mouth breathing is one of the most common deleterious oral habits in children. The habitual position of muscles inside and outside the mouth will affect dental development. Mouth breathing influences skeletal growth and thereby affects the cephalometric parameters. The present study aimed to assess if there is any variation in upper and lower gonial angles in children with mouth breathing habit.
Methods: The 33 patients in the age group of 8 to 12 years reporting to the Department of Pediatric and Preventive Dentistry with chief complaint of mouth breathing was selected for the study based on inclusion and exclusion criteria. Lateral cephalograms of these children were taken with a digital panoramic system under standard exposure factors, as recommended by the manufacturer. Upper and lower gonial angles were determined on the lateral cephalograms. The values obtained were tabulated and subjected to statistical evaluation.
Results: The mean upper and lower gonial angles were seen to increase from the normal in children with mouth breathing habit. However, independent sample t test showed no statistically significant difference in upper and lower gonial angles with a p value of 0.598 in upper gonial angle and 0.714 in lower gonial angle.
Contusions: Early detection of the changes in the upper and lower gonial angles can help a pediatric dentist in effectively framing a treatment plan in children with mouth breathing habit, to prevent further deterioration in the dental and skeletal structures and be able to correct the already occurred unfavourable changes in them.

Keywords: Mouth breathing habit, Gonial angle, Upper gonial angle, Lower gonial angle

INTRODUCTION

Mouth breathing is one of the most common deleterious oral habits in children.[1] The function and morphology of the orofacial system are unified. The habitual position of muscles inside and outside the mouth will affect dental development. Malocclusion appears more frequently in mouth-breathing children than in nasal-breathing children. Children with normal breathing patterns keep their lips closed to form a sealed oral space. The tongue is positioned in contact with the palate and lingual side of maxillary dentition. A balanced muscle strength from the internal tongue and external lips and cheek is crucial for the development of a normal upper dental arch.[2]

About 25-30% of children breath through the mouth instead of the nose. Mouth breathing often occurs due to upper airway obstruction which reduces the nasal airflow and forces the air to enter completely or partially through oral cavity.[3] According to the functional matrix theory established by Moss and Salentijn in 1969, normal respiratory function of the nose is essential for the balanced growth of craniofacial structures. When upper airway obstruction is not removed promptly, or when mouth breathing is still habitually present after the removal of obstruction, mouth breathing will have negative effects on not only the normal development and function of the dentofacial complex but also the general health of growing children.[4]

Previously identified independent risk factors of failure include age, obesity, chronic rhinitis, deviated nasal septum and tonsil size. We expect other patient related variables which are yet to be accounted for, or researched, to play a role. In the late 1800's Tomes was one of the first to describe an association with upper airway obstruction and morphological facial changes due to adenoid hypertrophy which he termed "adenoid facies". Since then, research has supported this finding with changes such as narrowing of the nasal passage and larger gonial angle as a result of upper airway obstruction.[1]

Gonial angle is widely used in orthodontic cephalogram tracing. The gonial angle is that angle formed by the mandibular plane and ramus. The gonial angle can also be a handy tool in age assessment in extreme situations like mass disaster, remains of human dead exhumed and murderous mutilations, missing individuals, etc.[5] According to anthropometric standards, the normal gonial angle should be in the range of 123.5±5.9º in men and 122.2±4.2º in women. The downward and backward rotation of the mandible is called as a high angle and these patients showed increased gonial angle. Contrary to this, upward and forward direction of mandible is called as a low angle and these patients showed a decrease in gonial angle. Jarabak and Fizzell divided the gonial angle into upper and lower gonial angle. Gonial angle can be divided by a line drawn from nasion to gonion. This forms upper and lower gonial angle. The upper angle is formed by the ascending ramus and the line joining the gonion and the nasion which has the mean value of 50-55 degree. The lower gonial angle is formed by the line joining the nasion and the gonion and lower border of mandible, the mean value of which is 72 to 75 degree.[6] A large gonial angle would indicate backwards (clockwise) rotation of the mandible causing the tongue/tongue base to be situated inferiorly-posteriorly and potentially cause pharyngeal airway obstruction.[7] This should form a larger lower gonial angle in children with mouth breathing habit.

Furthermore, it can cause the development of anterior open bite thus promoting or enabling mouth breathing. No study has been done so far, on children with mouth breathing habit, to determine if this habit can change the angles beyond the normal limits.

Aim

Aim was to assess the variation in upper and lower gonial angle in children with mouth breathing habit.

Objectives

Objectives were to determine the upper and lower gonial angles in children with mouth breathing habit and to compare the upper and lower gonial angles in these children with the normal.

METHODS

Ethical approval was obtained from the institutional ethics committee for the study. All the participants were informed about the study and written consents were obtained from the parents. The cross-sectional study was undertaken with a total of 33 patients, in the age group of 8 to 12 years who reported to the department of pediatric and preventive dentistry of our institution from December 2023 to May 2024, with chief complaint of mouth breathing were selected for the study based on inclusion and exclusion criteria, as follows.

Inclusion criteria

Children with a history of mouth breathing, children in the age group of 8 to 12 years and with positive water holding test were included.

Exclusion criteria

History of maxillo-facial trauma or surgery and history of congenital craniofacial abnormalities or syndrome were excluded.

Lateral cephalograms of these children were taken. All these radiographs were taken with a digital panoramic system under standard exposure factors, as recommended by the manufacturer. All the lateral cephalograms were traced manually on acetate tracing paper with a 3H sharp pencil on a view box using transilluminated light in a dark room. The mathematical protractor and standard metallic scale were used to measure the upper and lower gonial angles. The values obtained were tabulated and subjected to statistical evaluation.

Data were analyzed using IBM, SPSS (Statistical package for social sciences, IBM Co., Armonk, NY, USA) version 26 statistical software. Independent sample t test was used for comparison of means with accepted standard values. Comparison of categorical variables was done using Chi-square test. Statistical significance was inferred at $p \leq 0.05$

RESULTS

A total of 33 children with mouth breathing habit participated in the study. In this study 18 (54.5%) were boys and 15 (45.5%) were girls. Children of age between 9.7 and 10.54 years with mean age group of 10.12 participated in the study (Table 2). The mean age of males was 10.17±1.15 and in females it was 10.07±1.28. (Table 1) The data were statistically analyzed using SPSS software version 26.

The lowest value for upper gonial angle obtained was 50º and highest was 66º with a mean value of 58.18º. The lowest value for lower gonial angle was 63 º and highest was 86 º with a mean value of 75.82 º (Table 2).

In mouth breathers the mean upper gonial angle in males and females were 58.50º and 57.80º respectively. The mean lower gonial angle in males and females were 76.11º and 75.47 º respectively (Table 3).

Independent sample t test showed that there is no statistically significant difference in upper and lower gonial angle with a p=0.598 in upper gonial angle and 0.714 in lower gonial angle (Table 4).

Table 1: Frequency distribution and mean age of study population based on gender.

Gender	N	Percentage (%)	Mean age (in years)±SD
Male	18	54.5	10.17±1.15
Female	15	45.5	10.07±1.28
Total	33	100.0	10.12±1.19

Table 2: Descriptive statistics for age and gonial angle.

Variables	Mean	SD	95% CI for mean		Median	Minimum	Maximum
			Lower bound	Upper bound			
Age (in years)	10.12	1.19	9.70	10.54	10.00	8.00	12.00
Upper gonial angle	58.18	3.71	56.87	59.50	59.00	50.00	66.00
Lower gonial angle	75.82	4.95	74.06	77.57	78.00	63.00	86.00

Table 3: Descriptive statistics for gonial angles based on gender.

Variables	Gender	N	Mean	Std. Deviation	Std. error mean
Upper gonial angle	**Males**	18	58.50	3.68	0.87
	Females	15	57.80	3.84	0.99
Lower gonial angle	**Males**	18	76.11	5.33	1.26
	Females	15	75.47	4.61	1.19

Table 4: Comparison of mean gonial angles based on gender.

Independent samples test							
Comparison variables	T test for equality of means						
	T	Df	Sig. (2-tailed), p value	Mean difference	Std. error difference	95% CI of difference	
						Lower	Upper
Upper gonial angle	0.533	31	0.598	0.70	1.31	-1.98	3.38
Lower gonial angle	0.367	31	0.716	0.64	1.76	-2.94	4.22

DISCUSSION

One of the most prevalent undesirable oral habits in children is mouth breathing. It frequently happens when there is an obstruction of the upper airway, allowing air to enter the mouth completely or partially. The primary reason of mouth breathing in children tends to be pathological hypertrophy of the tonsils and/or adenoids, in addition to nasal obstruction from a variety of nasal illnesses.[8] Subsequently, a changed respiratory design, such as breathing through the mouth instead of the nose, may alter the pose of the head, jaw, and tongue. Mouth breath modifies the muscle powers applied by the cheeks, tongue, and lips upon the maxillary arch, driving to a contracted maxillary arch with a high palatal vault, a posterior crossbite, an anterior open bite, and a class II or III dental malocclusion.[9]

Oral respiration, low tongue posture and elongation of lower anterior facial height are apparent at three years of age but more commonly detected after age five. The deleterious impact of decreased nasorespiratory function is virtually complete by puberty.[10] Hence the age group 8-12 years was selected for the present study.

Water retention test is one among the breathing tests most cited in the literature to diagnose mouth breathers. This test is not standardized and are described with little or divergent information in different publications so in order to diagnose mouth breathing habit children were sent for ENT evaluation.

Malhotra et al found that children who breathe predominantly through their mouth pose difficult problems for healthcare professionals. The dental professionals apprehend that faces of the mouth breathers might develop aberrantly, possibly because of disruption of normal functional relationships caused by chronic airway obstruction and altered path of airway. In their study, an increase in total gonial angle in mouth breathers was found, which was statistically significant.[2] Bresolin et al who studied on North American Caucasians

and results of Ung et al and Yang confirms the finding of the above study. These cephalometric measurements were not in accordance with the reports of Mattar et al and Lessa et al who concluded that there was decrease in this angular measurement in older age group, nasal breathers and mouth breathers.[2,11-14]

In terms of facial morphology, mouth breathers are expected to have a vertical growth pattern. In our study the lower gonial angle showed a lower value of 50^0 and highest of 66^0. In a study conducted by Rubika et al it was seen that the upper gonial angle is almost the same in horizontal, vertical and average growth pattern. The lower gonial angle on the contrary increased in the degree of angulation from horizontal, average and vertical growth pattern.[5] In this study, there was no significant difference between male and female upper and lower gonial angles. This result was in line with studies conducted by Park et al and Radhakrishnan et al.[15] However, other studies state that the gonial angle in women is greater than men.[16]

The result of our study showed that there is a slight increase in upper and lower gonial angle with a mean value of 58.18 and 75.82 respectively in mouth breathers, but was not statistically significant. This indicates that these is a mild change in upper and lower gonial angle in mouth breathing children. According to Rakosi, the Caucasians having average growth pattern, the standard value for gonial angles range was from 128±7°. Upper gonial angle in Caucasians with average growth pattern ranged from 52° to 55° but in our sample, it had a mean value of 58.18° in mouth breathers. In the Caucasians, lower gonial angle was 70° to 75° but in our study, it had increased to 75.82 on an average.[17]

In a study conducted by Pesqui et al it was observed that in Javanese population, class III malocclusion patients tend to have smaller upper gonial angle and greater lower gonial angle compared to normal range. Even so, the total gonial angle is within the normal range. Based on the correlation and regression analysis results, upper gonial angle is influenced by ramus position. The more posterior the ramus is, the smaller the upper gonial angle measurement. On the contrary, the mean of lower gonial angle is slightly above the normal range, which is caused by excess mandibular length and clockwise rotation of mandible.[18]

Limitations

Since this was a short study done within a time period of 5 months, the sample size considered was less and the sample population under study was of a particular area or region. To make it a real comparison and to obtain definite results, the study should be performed in a larger population with much higher sample size.Eventhough we selected children with mouth breathing habit we could not analyse the duration and frequency of mouth breathing habit.

CONCLUSION

Mouth breathing habit in children can have deleterious effects on the developing orofacial structures. Early detection of the changes in the upper and lower gonial angles can help a pediatric dentist in effectively framing a treatment plan to prevent further deterioration in the dental and skeletal structures and be able to correct the already produced changes in them.

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