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Original Research Article

Evaluation of Airway Landmarks in Cephalometry Among Patients with Mouth Breathing Complaints and Normal Individuals

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Abstract: ***Background***: Breathing is one of the vital functions of the human body, which must be done naturally through the nose, while it is done through the mouth in case of airway obstruction. Various studies have examined the effect of mouth breathing on craniofacial evolution and developments in jaw relations and dental occlusion.The current study compares the airway landmarks in cephalometry between persons who breathe through their mouths and those who do not. ***Methods***: This was a case-control study comprised 40 patients had mouth breathing, and 40 patients had normal breathing. Data collection tools included clinical examinations and lateral cephalometry ***Results***: According to the results of this study, soft palate thickness (SPT) of individuals with mouth breathing (mean value of 0.57.5±2224.) and tongue height (TH) of individual with mouth breathing (mean value of 397.14±5341.1). was significantly greater than normal individuals .In the group of patients with mouth breathing, adenoid size was 10% with severe hypertrophy, while normal individuals had 2.5% severe hypertrophy. ***Conclusions***: The results of this study show that in comparison of airway landmarks, soft palate thickness (SPT), tongue height (TH), and adenoid size were significantly greater in individuals with mouth breathing

Keywords: Lateral Cephalogram, Mouth Breathing, Nose Breathing.

INTRODUCTION

Breathing is one of the vital functions of the body, which must be done naturally through the nose while breathing is done through the mouth in the case of airway obstruction.[1] Nose or nasal breathing stimulates the correct muscle function along with some natural functions such as chewing and swallowing, and tongue and lips position leading to suitable growth of fat and bone.[2] Various studies have examined the effect of mouth breathing on the craniofacial evolution and developments in jaw relations and dental occlusion.[3]

These anatomical regions' notably large features, including the adenoid in the Nasopharyngeal space (posterior obstruction) and tentacles in the nose cavities (anterior obstruction) may cause airflow disruption through the nose, and subsequently, the mouth breathing.[4,5]

A common cause of airway blockage in children that has a significant impact on their health is adenoid hypertrophy. Children with hypertrophic adenoids typically have snoring, sleep apnea, nasal obstruction, recurring middle ear infections, and brain abnormalities if they breathe via their mouths the majority of the time, particularly when they are sleeping and not moving or exercising.[6]

Mouth breathing incidence after the breathing way obstruction increases nose resistance 2-3 times more, and severe mouth breathing causes mandible rotation and its retraction and the gap between front teeth (diastema), so tongue' position creates sufficient space for air to pass through the mouth.[7]

The constant opening of the mouth would increase the lateral pressure on the upper jaw. Also, the upper jaw may be narrowed and the palate becomes deep and dome-shaped, which may lead to higher pressure on the nasal septum or deviated nose if the severe mouth breathing continues during the growth years, from childhood to puberty time.[8]

Since parents are not aware of their child's disease, they visit the doctor for treatment after the abnormality has been completed, which creates complications. This abnormality is diagnosed accidentally in most cases when a child is brought to the clinic for another purpose, such as dental decay or gum disease, so the dentist diagnoses the child's problem. Hence, the mentioned reasons have led to more patients with this disease who suffer from these problems and complications forever.[9] This study was done to examine the effects of mouth breathing on the jaw and facial structures to compare the airway landmarks in cephalometry between patients with mouth breathing complaints and normal individuals.

MATERIALS AND METHODS

This study was conducted at Zahedan University of Medical Sciences with the approval of the research deputy under the ethics code IR.ZAUMS.REC.1399.104.

According to the previous similar study and considering the confidence factor of 40 people in each group, a total of 80 people are considered.

This study was conducted on 80 patients that had cephalometry radiography, and patients were evaluated in terms of mouth and nose breathing. Two clinical tests are used to evaluate mouth breathing: the mirror test and the oral moisture test. The mirror test involves holding a mirror in front of the nose and measuring the amount of steam that appears on it. If the created steam is on the upper part of the patient's face, it indicates the nose breathing, and if the steam created on the mirror is on the lower or in both the upper or lower part of the face then it shows the mouth breathing.

Patients who did not want to participate in the study, had a history of jaw fracture or jaw lesions, and a history of jaw surgery were excluded from the study.
In the oral moisture test, the patient keeps water in his/her mouth for 3 minutes; if the patient cannot keep their lips closed, the patient has oral breathing.
In the next phase, patients are divided into two group's mouth breathing and breathing through the nose (normal). The studied landmarks were done on each initial tracing cephalogram then the image was inserted into the AutoCAD 2014 software to measure the considered variables. The measurements are done in the next step (Figure 1).

In order to avoid bias, the person who performed the tracing of the radiographs did not know the type of breathing of the patient
(PPFS-PP1): to measure the upper airway (PPFS-PP1), we draw a line from the lowest part behind the palate to the edge of the soft tissue of the anterior wall of the nasopharynx.

(PPFM-PAFM): to measure the middle airway (PPFM-PAFM), we draw a line from the anterior-middle wall of the pharynx to the posterior-middle wall of the pharynx.

(Tt-BGO): we draw a line from the gonial to the posterior wall of the pharynx along the plane mandible.

(SPT): soft palate thickness is measured based on the highest thickness of the tissue, which continues from PNS to uvula.

(TH): tongue height was considered as a line perpendicular to the tongue length from the middle part of the palate.

(TL): to measure the tongue length, we draw a line from the tip of the tongue (behind the central teeth) to the lowest part of the epiglottis where the soft palate is finished.

(HMP): we draw a line from the hyoid gland perpendicular to the plane mandibular then measure the line to find HMP.[10]

In the measurement of adenoid size, we divide the width of the airway behind the soft palate by the thickness of the soft palate (1cm beneath the PNS).[11]
If the obtained value is greater than 1, the size of the adenoid is normal;

If the value is $0.5<x<1$, the size of adenoid in mild-moderate;

If the value is less than 0.5, the size of the adenoid is severe.

RESULTS

In this study, 80 patients including 31 women (38.8%) and 49 men (61.2%) were checked. The age distribution was the same in each group (p=0.9), while gender distribution was significantly different between the two groups, so there were more girls in the normal group rather than mouth breathing.

Table 1. Frequency of girls and boys in the group of patients.

Gender	Mouth breathing	Nasal breathing	Total

girls	(45%) 18	(70%)28	(38.8%)31
boys	(55%)22	(30%)12	(61.2%)49

Table 2. Comparison of (PPFM-PAFM) scores in mouth and normal breathing.

Type	Number	Average PPFM-PAFM	Standard deviation	P value
Mouth breathing	40	6.377	1.5760	0.34
Nasal breathing	40	6.758	1.9545	

According to the PPFM-PAFM comparison that is related to the middle airway (Table 2), in mouth breathing, the ratio of individuals with mouth breathing with a mean value of 6.377±1.5760 is similar (p=0.34) to the normal individuals with a mean value of 6.758±1.9545. The highest measured value was seen in the mouth-breathing group, and the lowest measured equaled 3.2, which is common in mouth-breathing and normal groups. No significant difference was observed in the PAFM-PPFM landmarks between the two groups.

Table 3. Comparison of (PPFS-PP1) scores in mouth breathing and normal breathing.

Type	Number	Average PPFS-PP1	Standard deviation	P value
Mouth breathing	40	7.635	1.9342	0.1
Nasal breathing	40	6.822	2.4229	

The comparative assessment of PPFS-PP1 that is related to upper airway (Table 3) in mouth breathing compared to normal individuals indicates that this variable is similar (p=0.1) between individuals with mouth breathing and mean value of 7.653±1.9342 and normal individuals with mean value of 6.822±2.4229. The mean value is a little greater in the patients with mouth breathing but has no significant difference with the normal group.

Table 4. Comparison of Tt-(BGO) scores in mouth breathing and normal breathing.

Type	Number	Average BGO-Tt	Standard deviation	P value
Mouth breathing	40	5.1950	1.25636	0.068
Nasal breathing	40	5.8275	1.77056	

The BGO-Tt landmark that is related to the posterior airway (Table 4) was compared between the two groups. The mean value of this variable is less in the group of mouth breathing with a 5.1950 score than in the group with normal breathing with a mean value of 5.8275, which is a significant difference (p=0.068).

Table 5. Comparison of (SPT) scores in mouth breathing and normal breathing.

Type	number	Average SPT	Standard deviation	P value
Mouth breathing	40	5.057	1.2224	0.015
Nasal breathing	40	4.420	1.0668	

Comparative assessment of SPT that is related to soft palate thickness (Table 5) in the group of mouth breathing and normal individuals indicates that this variable is significantly (p=0.015) greater among individuals with mouth breathing with a mean value of 5.057±1.2224 rather than individuals with normal breathing and the mean value of 4.1±420.0668. Moreover, the highest SPT equaled 8.3, which was observed in the group of mouth breathing.

Table 6. Comparison of (TH) scores in mouth breathing and normal breathing.

Type	Number	Average TH	Standard deviation	P value
Mouth breathing	40	14.397	1.5341	0.042
Nasal breathing	40	13.768	1.1731	

According to a comparative assessment of TH that is related to tongue height (Table 6) between mouth breathing and the group of normal individuals, this variable is significantly greater (p=0.042) in the individuals with mouth breathing and a mean value of 14.397±1.5341 rather than the individuals with normal breathing and the mean value of 13.768±1.1731. The range of changes in TH landmark varies between 11.5 and 17.2 in mouth breathing, while varies between 10.9 and 16.6 in normal breathing.

Table 7. Comparison of (TL) scores in mouth breathing and normal breathing.

Type	number	Average TL	Standard deviation	P value
Mouth breathing	40	39.652	3.2935	0.45
Nasal breathing	40	39.105	3.2701	

According to a comparative assessment of TL that is related to tongue length (Table 7) between mouth breathing and the group of normal individuals, this variable is significantly similar (p=0.45) among individuals with mouth breathing and mean value of 39.652±3.2935 rather than the individuals with normal breathing and mean value of 39.105±3.2701. The range of changes in TL landmark varies between 35.1 and 49.6 in mouth breathing, while varies between 32.2 and 45.5 in normal breathing, and no significant difference was seen between the two groups.

Table 8. Comparison of (HMP) scores in mouth breathing and normal breathing.

Type	Number	Average HMP	Standard deviation	P value
Mouth breathing	40	7.273	3.2935	0.13
Nasal breathing	40	8.402	3.6344	

According to a comparative assessment of HMP that is related distance between hyoid and plane mandibular (Table 8) between mouth breathing and the group of normal individuals, this variable is similar (p=0.13) among individuals with mouth breathing and mean value of 7.273±2.9274 rather than the individuals with normal breathing and mean value of 8.402±3.6344. This difference is a little greater in the normal group rather than the group with mouth breathing, while this difference is not significant, and no significant difference is seen between the two groups.

Table 9. Measurement and comparison of the size of an adenoid landmark in patients with mouth breathing and normal breathing.

Adenoid size / Breathing type	Normal (AN ratio>1)	Mild-moderate(AN ratio=0.5-1)	Sever (AN ratio<0.5)
Mouth breathing	16 (40%)	20 (50%)	4(10%)
Nasal breathing	28 (70%)	11(27.5%)	1 (2.5%)

Table 9 reports the prevalence of different adenoid sizes in two groups. The mild-moderate size in the group of mouth breathing with 50% has the higher prevalence, while the severe size with 10% has the lowest prevalence, and with a 70% prevalence rate, the normal size had the highest value in the normal breathing group. According to a comparative assessment of adenoid size (Table 9) in mouth breathing rather than normal individuals, the frequency of individuals with mouth breathing and severe adenoid hypertrophy equals 10%, and the frequency of normal individuals with severe adenoid hypertrophy equals 2.5% (Figures 2, 3). According to Table 9, severe adenoid hypertrophy was greater in mouth breathing rather than in normal individuals.

DISCUSSION

Breathing is one of the vital functions of the human body, which must be done naturally through the nose, is carried out via the mouth in the event of an obstruction of the airway. Studies on mouth breathing's impact on the development of the craniofacial structure, jaw relationships, and dental occlusion have been conducted.

This study was conducted on 80 patients, including 40 patients with mouth breathing and 40 individuals with normal breathing.

According to the comparison between airway landmarks, SPT (P=0.015), TH (P=0.042), and severe adenoid hypertrophy are significantly greater in patients with mouth breathing than in normal individuals.

In the study conducted by Abreu et al. (2008) to examine the clinical manifestations in mouth-breathing children regarding the airway landmarks, 79.2% of individuals with mouth breathing had severe adenoid hypertrophy. In the extant study, 70% of individuals with normal breathing had normal-size adenoids only 2.5% had severe hypertrophy, and 10% of individuals with mouth breathing had severe adenoid hypertrophy.[12]

In both studies, the group of mouth breathing has higher adenoid hypertrophy than the normal group. Adenoid hypertrophy is a mouth-breathing manifestation.

The results of a study conducted by Kecik et al. to examine and evaluate the morphology of the palate and airway among individuals with sleep apnea regarding the airway landmarks are in line with the results of the present paper.[13]

In this study, 50% of patients with sleep apnea and mouth breathing whose airway size and soft palate thickness were measured based on the lateral cephalogram. According to the results of this study, individuals with sleep apnea had larger soft palate areas (P≤0.001), and a mean value of 248.89 was reported. The study's findings indicate that those who mouth breathe have lengthy, thick soft palates and smaller anterior-posterior pharyngeal spaces in the middle and lower regions.

In the present study, the average size of soft palate thickness was measured, which equaled 5.057 in the mouth-breathing group which was significantly greater (P=0.015) than the individuals with normal breathing that had an average value of 4.420.

According to the study conducted by Basheer et al. titled "Influence of mouth breathing on the dentofacial growth of children," 20 mouth-breathing children had severe adenoid hypertrophy and 60% had airway obstruction of nasopharynx,[14] while no significant different was observed in upper airway (P=0.1), middle airway (P=0.34), and posterior airway (P=0.2) through airway assessment of individuals with mouth breathing and normal individuals in present study.

According to the study conducted by Farrez et al. to examine and evaluate the position of hyoid bone in mouth-breathing and normal children, 47% of individuals with mouth breathing and 53% with normal breathing were studied. In this study, the average value of the hyoid position equaled 2.36±5.12 among individuals with mouth breathing while equaled 1.53±5.18 among normal individuals, so no significant difference was observed among these two groups.[15] In the present study, no significant difference (P=0.13) was seen in the average hyoid distance between mouth-breathing and normal individuals. In the study carried out by Vukićević et al. tongue length could be decreased because, in 50% of patients who mouth breathed, there was a trend towards class 2, a vertical rotation of the jaw, and a head tilt towards the spine. However, tongue length was not examined independently in this investigation.[16]

However, no significant difference (P=0.45) was seen in individuals with mouth breathing and normal individuals. The variable of TL has not been separately studied in any paper.

CONCLUSION

The results of this study compared to airway landmarks indicated that the average SPT, TH, and adenoid size of mouth-breathing patients were significantly greater than these values among normal individuals. It is also suggested for further studies to evaluate airway landmarks in similar studies with higher sample sizes considering other landmarks related to the airway.

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