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Original Research Article

Build and breathing – Is there an association?

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ABSTRACT

Normal breathing is essential for the harmonious craniofacial growth. Narrowing or functional impairment of the airway can lead to obstructive sleep apnoea (OSA). Orthodontists are well positioned to carry out a screening of OSA and refer the patients-at-risk for further diagnostic valuation by the physician. The aim of this research was to evaluate the presence of a correlation between the build of the patient and airway insufficiency to sensitize the eye of the orthodontist for potential at-risk OSA patients and provide a superior quality of treatment for them. Pre-treatment lateral cephalograms of 45 patients were divided into three groups depending on the build of the patient, i.e., endomorphic, mesomorphic and ectomorphic. The BMI was calculated for each individual and all were evaluated for the presence of airway insufficiency using McNamara's pharyngeal width analysis. The positions of the hyoid bone and the tongue posture was also evaluated. The results of the present study showed that the association between the overall McNamara airway measurements and the build of the patient was statistically insignificant. A statistically significant difference was found between the association of the two sexes with the upper pharyngeal width values and the BMI values with the males showed a higher risk for airway insufficiency. This study suggests that build of the patient cannot be considered as a screening factor for airway insufficiency or OSA. However, a significant correlation exists between the airway insufficiency and the sex of the patient with a higher predilection of upper airway insufficiency in males.

1. Introduction

Orthodontics as a specialty is not limited to tooth movement alone and the diagnosis and management of breathing disorders, especially obstructive sleep apnea (OSA), corroborates this statement. Orthodontists, being the masters of the science of craniofacial growth and development are well suited for collaboration with other health providers for treating patients with OSA. Thus, there has been an ever-increasing interest in the orthodontist's role for both the screening and multi-disciplinary treatment of OSA in both children and adults.[1]

Obstructive sleep apnea, by definition, is "a breathing disorder associated with sleep which involves reduced or completely obstructed airflow despite a continuous effort for breathing by the patient". When affecting an individual, OSA can have several consequences, varying in severity, like EDS (excessive daytime sleepiness), fatigue, learning deficit, increased accident rate and cognitive impairment, to name a few.[2] This severely affects the individual's quality of life, thus making its diagnosis and treatment of utmost importance.

To implement the optimal treatment for such patients, a clear understanding of the underlying pathophysiology

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of OSA is essential to counteract the factors which contribute to the development and severity of this disease. OSA is a complex disease, and this fact is elucidated by its multifactorial etiology. Among the various predisposing/risk factors of OSA is obesity.[3] It has also been associated with a possible constriction of the pharyngeal airway space.[4]

The encounter of the orthodontist with an OSA suspected patient can occur in several ways, be it specific medical referral or chance, owing to the fact that craniofacial morphology acts as a major factor in protecting or worsening OSA.[1,5]

Several imaging techniques have been employed in the screening and diagnosis of OSA including lateral cephalometry, MRI, CBCT, etc. Although 3-D imaging is being explored more and more in today's world, it still carries several limitations along with it, such as increased cost, increased radiation exposure, etc.[1] Lateral cephalometry is an inexpensive and non-invasive imaging technique that forms a routine part of the orthodontic records, thus acting as a valuable tool for screening of suspected patients.[6]

Keeping the above-mentioned facts in mind, one can easily assert that orthodontists can play a pivotal role in the screening of OSA. One of the earliest observations one can make, when the patient enters the clinic, is the build of the patient. Thus, the purpose of the present study was to evaluate the presence of an association between the build of the patient and airway insufficiency for sensitizing the eye of the orthodontist to the at-risk OSA patients in future and thus provide a superior quality of life for them.

1.1. The primary objective of the study was

To evaluate an association between the build and airway.

1.2. The secondary objectives were to evaluate

1. The relation of hyoid bone positioning with the airway insufficiency and the build.
2. Tongue posture.
3. Relation of airway, if any, with the sex of the patient.

2. Materials and Methods

The present study was done using pre-treatment records of 136 patients, who reported to the Department of Orthodontics and Dentofacial Orthopedics from January 2019-July 2020, which were evaluated for the build of the patient. The height and weight of these patients were also recorded for each individual.

On evaluation of the build, it was found that 69 of the 136 patients were mesomorphic, 52 were ectomorphic and 15 were endomorphic. The sample was divided into 3 groups depending on the build of the patient. To eliminate the disharmony in the sample size of each group, 15 patients were included in each group considering the maximum number of endomorphic patients, and the rest were excluded. To eliminate any bias during selection of the 15 subjects included in the ectomorphic and mesomorphic groups, every 3^{rd} and 4^{th} patient was selected for inclusion in the ectomorphic and mesomorphic groups respectively.

Thus, each group consisted of 15 patients constituting a total study sample of 45 patients.

The recruited sample of patients was aged between 12-30 years with a mean age of 18.04 years. The sample consisted of both males and female patients (27 females & 18 males). The BMI was also recorded for all these patients using the formula: $BMI=mass/(height)^2$

Lateral cephalograms of all the subjects were traced as shown in Figure 1 using good quality acetate paper and tracing equipment and evaluated for various parameters which were as follows:

1. Upper and Lower pharyngeal widths (linear measurements) using McNamara's airway analysis.[7,8]
2. Tongue posture[9,10]
3. Position of the hyoid bone from 2 different points:

a. H-C3: Distance of the hyoid bone from the most antero-inferior point on the third cervical vertebra
b. H-MP: perpendicular distance of the hyoid bone from the mandibular plane.[11]

The pharyngeal widths were further divided into groups as follows:

Upper pharyngeal width

1. Normal: 15-20 mm
2. Borderline: 12-15 mm
3. Insufficient: <12 mm

Lower pharyngeal width

1. Normal: 11-14 mm
2. Insufficient: <11 mm

3. Statistical Analysis

All the statistical analyses were performed using the SPSS 22.0 software package for windows (SPSS Inc, Chicago). Tukey test was used for pairwise comparison across various levels of the build. Paired t-test was used for the comparison of sex amongst various groups. Chi-square test was used to evaluate the association of tongue posture amongst the different groups of airway and build.

4. Results

The results of the present study showed that the association between the overall McNamara airway measurements and the build of the patient was statistically insignificant (Table 1).

Table 1: Comparison across various levels of Build.

Dependent Variable				Mean Difference (I-J)	Std. Error	Sig.
Tukey HSD	Upper Airway	Ectomorphic	Endomorphic	2.13	1.14	0.16
			Mesomorphic	1.93	1.14	0.22
		Endomorphic	Ectomorphic	-2.13	1.14	0.16
			Mesomorphic	-0.20	1.14	0.98
		Ectomorphic	Endomorphic	-1.43	1.22	0.48
			Mesomorphic	0.07	1.22	1.00
	Lower Airway	Endomorphic	Ectomorphic	1.43	1.22	0.48
			Mesomorphic	1.50	1.22	0.44

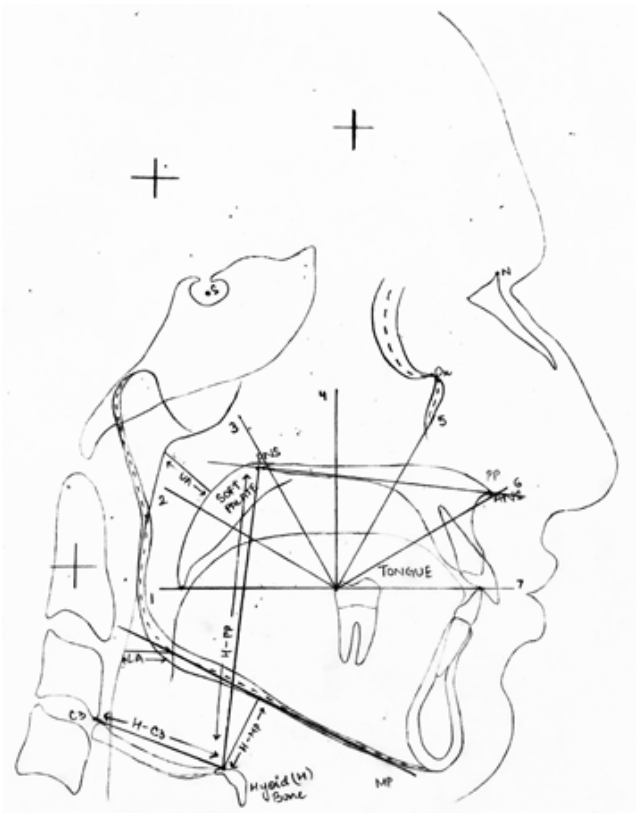

Fig. 1: Lateral Cephalogram traced for the evaluation of upper and lower pharyngeal widths, hyoid positioning and tongue posture.

However, when evaluating the airway insufficiency airway group, it was seen that the H-MP values varied significantly (Figure 2) amongst the various builds in this group, the highest being observed in the ectomorphic group, conveying a more inferiorly placed hyoid in this group of build. The H-C3 values also varied significantly with the maximum distance being observed in the endomorphic group.

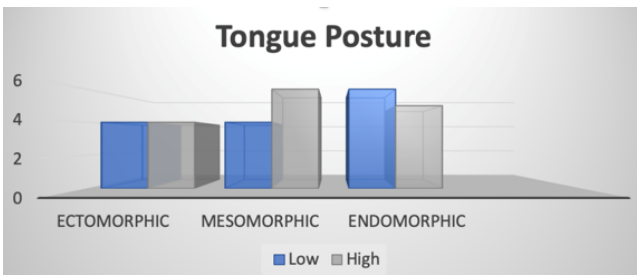

Fig. 2: Comparison amongst groups based on insufficient airway.

A statistically significant difference was found between the association of the two sexes with the upper pharyngeal width values and the BMI values (Figure 3). With respect to both the above-mentioned parameters, males showed a higher risk for airway insufficiency.

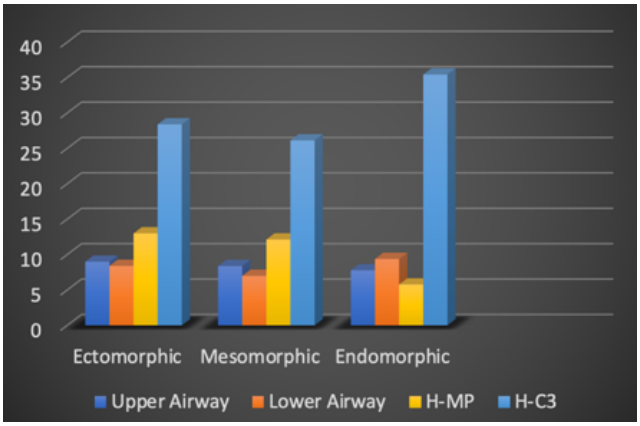

Fig. 3: Association of parameters with the sex of the patient.

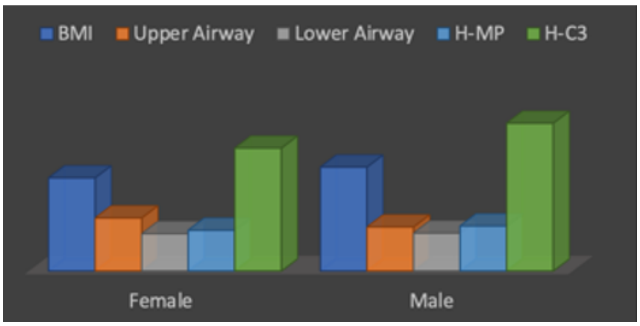

Fig. 4: Association of tongue posture with build (Chi-Square = $1.846a^{NS}$)

The relation of tongue posture with the various groups came out to be statistically insignificant (Figure 4, Chi-Square = $1.846a^{NS}$,3.386^{aNS}, 2.143^{aNS}).

5. Discussion

Obstructive sleep apnea is one of the most common breathing disorders affecting a major portion of the population with a prevalence of 25% in adults[3] and about 3% in children.[12] The grave consequences of OSA severely affect an individual's quality of life. OSA in children can impose adverse and persistent neurological defects and curtails academic achievements, especially during the crucial phases of growth and development of the brain.[2] Thus, early recognition and efficient management of this disease is of paramount importance.

Although, the definitive diagnosis of OSA can only be made by a physician, the orthodontist can play an essential role in screening for OSA patients by identifying its underlying dentofacial features and thus assist in their management.[1] Obesity has been shown to predispose and lead to the potentiation of OSA with the prevalence of OSA being as high as 45% in patients with obesity.[3] Today, the epidemic of obesity affects not only adults, but also children and adolescents. It has been seen that children with obesity have a prevalence of OSA of about 46%.[13] It is well known that obesity is a feature of the endomorphic group of build. Also, it has been reported that patients with OSA have constricted upper airways. Thus, using these two parameters of build and airway constriction, we aimed to evaluate the presence of an association between the two. It has been stated previously that, if radiographs are taken for the purpose of orthodontic treatment, the evaluation of airway and its surrounding structures should be done.[1] As lateral cephalograms are taken as a routine part of our orthodontic records, we chose this method to evaluate the above-mentioned parameters for screening. The advantages presented by this method were the non-invasive nature and the cost effectiveness of lateral cephalograms along with the avoidance of unnecessary extra exposure to radiation for the patients.

The hyoid bone forms the anterior limit of the pharyngeal airway space. Thus, its position is said to affect this space.[4,14,15] It has also been shown that the cephalometric measurements related to the hyoid bone showed correlations with various OSA parameters.[6] In our study, we evaluated this relation using the position of the hyoid bone from two distances namely, H-MP and H-C3, which have been described previously. It has been known that OSA patients have a more inferiorly placed hyoid bone.[11,16] Our results showed that the H-MP was significantly different among the various builds in the airway insufficiency group with the ectomorphic group showing the highest values which showed that this group of people tend to have a more inferiorly placed hyoid. Also, it has been shown in a previously done study that the distance between the mandible and the hyoid bone was significantly greater in OSA group when compared to the healthy control group.[17] These findings help to draw the inference that ectomorphic people tend to be at a higher risk of OSA than the people in the other two groups of build. Bilici et al, in their study, showed that the H-MP distance was approx. 21.4 mm in the group with severe OSA while the primary snoring group had a distance of about 15 mm.[6] None of the groups in our study showed such high values (maximum being 13 mm) which may be due to the fact that our study comprised of a general sample in comparison to the OSA-centered sample in their study.

The H-C3 distance in our study came out to be significantly higher in the endomorphic group. Bayat et al showed through their study that this H-C3 distance was higher in OSA patients in comparison to controls. However, Bilici et al found no such association. The above findings show the inconclusive nature of this parameter putting it in a grey area. The results of the comparison of the hyoid positions shows contradicting results which elucidates the fact that no single build can be said to have a higher predilection for OSA, thus, ruling the build out as a

screening factor. It has been mentioned in a previous study that, among the anatomic factors contributing to OSA, is a low posture of the tongue.[18] Thus, we aimed to evaluate and compare this factor amongst the various groups as a secondary objective. Our results showed that there was no significant relation with the tongue posture.

In the context of the sex of the patient, previous studies have shown that males have a higher risk of OSA than females.[19,20] This finding is corroborated by our study with the males showing a significantly smaller upper pharyngeal width than the females. The males in our study were also found to have a significantly higher BMI, thus putting them at a higher risk. This is supported by the present literature which shows a positive correlation between BMI and OSA patients.[18]

6. Limitations of The Study

The present study had some limitations which are listed below:

1. The sample size of the study was small and may not be representative of the population which emphasizes the need to exercise caution while evaluating the results.
2. Lateral cephalometry cannot demonstrate the precise physiologic changes occurring during sleep or the change in the anatomy of the deeper structures.

7. Conclusion

The findings of our study suggest that:

1. The build of the patient cannot be established as a screening factor for OSA.
2. A significant difference exists between the two sexes when evaluating for airway insufficiency with the males showing a higher risk.

8. Source of Funding

None.

9. Conflict of Interest

None.

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