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Assessment of Airway Among South Indian Population - A Cephalometric Study

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ABSTRACT

Introduction: Normal airway is one of the important factors for the normal growth of the craniofacial structure. The form and function of the pharynx have been an interest to orthodontic research. Cephalometry enables analysis of dental, skeletal and soft tissue anomalies; it also helps to assess the airway morphology.

Method: This retrospective study includes lateral cephalogram of 300 healthy individuals in which 150 males and 150 females with class I malocclusion from South India and patients above the age of 20 years were taken for the study.

Results: The mean upper and lower airway values for male patients were 13.61mm and 11.31mm and for female patients, it was 13.5 mm and 11.50 mm.

Conclusion: The study concludes that there is a difference between upper and lower airway width among Caucasians and South Indian populations with Class I skeletal patterns. The study also suggests that there is no difference between upper and lower airway width among male and female South Indian populations.

Key Words: Cephalometrics, Cephalogram, Lower airway, McNamara analysis, South Indians, Upper airway

INTRODUCTION

A normal upper airway improves nasal breathing and it is more important in the growth and development of craniofacial structures.^{1,2} An ideal upper airway is essential for normal nasal breathing. Upper airway constriction alters the normal breathing pattern and eventually impacts the normal development of craniofacial structure which causes deficiency of maxilla in the transverse direction and leads to rotational growth on posterior aspects of the mandible. Upper airway constriction requires early intervention so that a normal dentofacial morphology can be achieved.³

The recognition of sleep-disordered breathing as a common clinical problem, particularly obstructive sleep apnea (OSA) which affects 2-4 per cent of middle-aged men has intensified interest in normal and abnormal pharyngeal morphology. The consensus on the aetiology of OSA is that it results from the variable combination of pharyngeal anatomy and pathophysiological factors,⁴ such as hypertrophy of adenoids tonsils, chronic allergic rhinitis, irritant environmental factors, infections, congenital nasal deformities, nasal trauma,

polyps and tumours are present in the obstructive upper airway which causes functional imbalance resulting in oral breathing patterns,^{5,6,7} which may alter the craniofacial morphology leading to various malocclusion. The relative growth and size of the soft tissues surrounding craniofacial skeletal structures determine the size of the pharyngeal space.⁸⁻¹¹

The various techniques used for the assessment of the upper airway are cephalograms, cine-computed tomography, fluoroscopy, acoustic reflection, fibre-optic laryngoscopy, and magnetic resonance imaging. The integral part of diagnosis and treatment planning to achieve functional balance and stability of orthodontic treatment is the evaluation of upper and lower airway space.¹² Lateral cephalogram is a commonly used radiograph due to its simplicity, cost-effectiveness, accessibility and low radiation.¹³ Cephalometric tracing is an easy tool to identify narrow upper airway but it has its demerits which give only reliable linear measurements by measuring the nasopharyngeal and retropalatal regions but the reliability yet to be proven to measure the airway in the

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posterior aspects of the tongue.¹⁴ In 1984 Mc Namarasaid anything which is less than 5mm is considered as a constricted airway. The advanced techniques are more expensive and may not be available in all places.^{15,16,17}

Most of the previous cephalometric studies are investigations concerning the anatomy of the pharyngeal airway in OSA patients and there is scarce literature about the normal width of upper and lower airway anatomy among the different racial populations. The current norms of upper and lower airway width given by McNamara followed by most were done among Caucasians. So the purpose of this investigation is to determine the width of the upper airway among the South Indian population

Null hypothesis

Following is the null hypothesis of this study:

- (1) There is no difference between upper and lower airway width among Caucasians and the South Indian population
- (2) There is no difference between upper and lower airway width among male and female South Indian population

MATERIALS AND METHODS

In this Retrospective Study, pretreatment lateral cephalograms of 300 south Indian patients (150 males and 150 females) with class I skeletal patterns above the age of 20 years were selected from the department of orthodontics Sathyabama Dental College and Hospital from which we evaluated the upper and lower airway width. Lateral *cephalometric* radiographs were taken using the jaw and the teeth in occlusion, lips relaxed and the head in the upright position. The study was presented before the institutional board and received approval (Ref No-Sathyabama University/IHEC/study no081) at Sathyabama Dental College & Hospital.

All cephalometric-ray were traced for basic airway outline based on McNamara's analysis. The Upper pharyngeal width was measured from the posterior outline of the soft palate to a point closest on the pharyngeal wall, the normal width was 15-20 mm and lower pharyngeal width was measured from the point of intersection of the posterior border of the tongue and inferior border of the mandible to the closest point on the posterior pharyngeal wall, the normal width of the lower airway is 11-14mm.^{18,19}(Figure 1).

STATISTICAL ANALYSIS

The data was tabulated and computed using SPSS software version 21.0 the measurement of the upper airway and lower airway are presented as mean, median and standard deviation.

The data was statistically analyzed by student's paired t-test, P-value <0.001 was considered to be significant.

RESULTS

Upper airway width

The mean pharyngeal upper airway width among the male south Indian population was found to be 13.61mm and 13.45mm among the females' population. (Table 1)

Lower airway width

The mean pharyngeal lower airway width among the male south Indian population was found to be 11.31mm and 11.50mm among the females' population. (Table 2)

Overall mean airway width of South Indian population

The average value for upper airway width among the South Indian population with class I skeletal pattern is 13.52mm and the average value for lower airway width was 11.42mm. (Table 3).

DISCUSSION

Lateral cephalograms were used by many researchers to compare the obstruction of upper and lower pharyngeal airway width in mouth breathing.²²⁻²⁵ Alkoc *et al.* did a study to evaluate the reproducibility of airway dimensions with lateral cephalometric radiographs. The results of his study suggest that airway dimension, tongue and hyoid position measurements are highly reproducible on natural-head-position cephalograms.¹⁹⁻²¹

In a study done by De Freitas MR et al. where he evaluated the upper and lower pharyngeal airways in Brazilian subjects with class I and class II malocclusions and different growth patterns. The result of his study suggested that vertical grower with class I and Class II malocclusion has narrow upper pharyngeal airway than those with class I and class II malocclusion and normal growth pattern.²⁶

Prabhakaran et al. in another study where he compared the upper and lower pharyngeal airway width in Class II malocclusion patients with low, average and high vertical growth patterns suggested that subjects with Class II malocclusions and hyper-divergent growth patterns have significantly narrow upper pharyngeal airway space when compared to other two vertical patterns.

The above study is focused on finding the normal width of upper and lower airways among the South Indian population using lateral Cephalogram.

Comparison between Upper and Lower Airway Based on gender

The mean pharyngeal upper airway width among the male south Indian population was found to be 13.61 ± 3.11 mm and the female south Indian population showed a mean of 13.45 ± 2.90 mm. There was no significant difference in the upper airway width between the male and female South Indian population. The lower airway width also did not show any significant difference among gender, the mean pharyngeal lower airway width among the male south Indian population was found to be 11.31 ± 2.5 mm and the female south Indian population showed a mean of 11.50 ± 2.45 mm.

Comparison between Caucasians and South Indian population

The upper pharyngeal width was measured from the posterior outline of the soft palate to a point closest to the pharyngeal wall, McNamara suggests the average value for the upper airway to be 15 to 20 mm. The above study suggests that the mean width of the upper pharynx of the south Indian population was around 13.52 ± 2.99 mm. The lower pharyngeal width measured from the point of intersection of the posterior border of tongue and inferior border of the mandible to the closest point on the posterior pharyngeal wall, the normal width of lower airway suggested by McNamara was 11 to 14 mm, the mean lower pharynx width for the above south Indian population was 11.42 ± 2.48 mm.

The above study suggests that the mean upper airway of the South Indian population showed a reduction of 1.48 mm when compared to the lower normal extent suggested by McNamara. Whereas the lower airway value of the South Indian population was concurrent with the mean lower airway value stated by McNamara.

The result of the above study concurrent with the null hypothesis, that there is no difference between upper and lower airway width among the male and female South Indian population, but the above result reject the null hypothesis, that there is a difference between upper and lower airway width among Caucasians and South Indian population.

LIMITATION AND RECOMMENDATION

This study was performed only among the South Indian population, to have a better understanding of the normal pharyngeal anatomy of the Indian population; studies must be performed among other cardinal parts of India. It must also be stressed that a cephalogram is a two-dimensional representation of the three-dimensional structure, so further studies of three-dimensional evaluation is recommended for a better understanding of the normal pharyngeal airway anatomy.

CONCLUSION

The study concludes that there is a difference between upper and lower airway width among Caucasians and South Indian populations with class I skeletal patterns.

The study also suggests that there is no difference between upper and lower airway width among male and female South Indian populations.

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Conflict of interest- No conflict of interest

Ethics- The retrospective study was approved by the institutional review board of Sathyabama University

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Authors' Contribution

1. Dr. Dhayananth Xavier (M.D.S)– Study Design, Write up, Discussion
2. Dr. Clement Evan. A. (M.D.S) –Data collection, Write up, Discussion
3. Dr. Faizee Shahul Hameed (M.D.S)-Study Design, Write up, Discussion
4. Dr. Hema Malini (B.D.S)- Statistics , grammar check
5. Dr. Iswarya.A (B.D.S)-Data collection, Grammar check
6. Dr. Christy Arul Stella (B.D.S)- Discussion, Grammar check

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Figure 1: Landmarks of Upper and Lower pharyngeal airway width A-Upper pharyngeal airway, B- Lower pharyngeal airway.

Table 1: Comparison between upper airway based on gender

Airway	Gender	Number	Mean	Std. Deviation	P-value
Upper airway	Male	150	13.6172	3.11239	0.65
	Female	150	13.4593	2.90665	0.65

Table 2: Comparison between lower airway based on gender

Airway	Gender	Number	Mean	Std. Deviation	P-value
Lower airway	Male	150	11.3125	2.53091	0.51
	Female	150	11.5058	2.45544	0.51

Table 3: Overall mean of upper and Lower Airway

Airway	Number	Mean	Std. Deviation	P-value
Upper airway	300	13.526	2.992	<0.001
Lower airway	300	11.423	2.485	<0.001