ORIGINAL ARTICLE

The Role of Cephalometric Analysis in Obese and Non Obese Urban Indian Adults with Obstructive Sleep Apnea Syndrome : A Pilot Study

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Abstract

Cephalometric data of 28 Urban Indian Obese (Group I) and 15 urban Indian non obese (Group II) Polysomnography (PSG) diagnosed Obstructive sleep apnea (OSA) adult cases based on linear and angular measurements were compiled and compared with 20 age-sex matched controls (Group III).Co –relation of cephalometric variables with apnea Hypopnea index (AHI) was also evaluated and suitable statistical tests applied.

In Group I, Cephalometric measurements; PAS (posterior airway space), PNS-P (Length of soft palate), MPH (Hyoid distance) were found to be highly significant ($p<0.01$) and G (Width of soft palate) was found to be significant ($p<0.05$). In Group II, Cephalometric measurements; PAS, PNS-P and G were found to be highly significant ($p<0.01$)), while SNB (relationship of mandible to cranial base), MPH, were found to be statistically significant ($p<0.05$). Positive correlation ($p<0.05$, $r^2 = 0.163$) was observed between MPH and AHI. No significant correlation was observed in other cephalometric variables with AHI in Group I and Group II.

We concluded that predictable cephalometric measurements in OSA patients combined with PSG findings can be employed effectively for diagnosis and treatment planning in our settings.

Introduction

Cephalometrics is a standardized lateral radiograph of the head and neck used to examine upper airway, craniofacial and soft tissue structures. The technique is widely available, easily performed and much less expensive than CT scanning or MR imaging. Studies using cephalometrics to compare patients of Obstructive sleep apnea (OSA) with age and gender matched controls have demonstrated craniofacial differences between the two populations [1, 2, 3, 4, 5]. However a meta- analysis concluded that only one cephalometric variable, mandibular body length, demonstrated clinically significant association with OSA [6]. There is paucity of such studies in our country. Hence we carried out a pilot study with the aim of establishing the role of lateral Cephalograms in the diagnosis and management of OSA cases. The objectives of the study were to evaluate the cephalometric features of the patients with Polysomnography diagnosed obstructive sleep apnea syndrome and to elucidate the cephalometric variables and their correlation with severity of apnea hypopnea index.

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Patients and Methods

The study population consisted of Polysomnography diagnosed OSA patients referred by Department of Respiratory Medicine for cephalometric analysis and suitable Oral appliance therapy. The OSA patients were divided into two groups and one group was selected as control, details provided in Table 1.

Table 1: Baseline characteristics of study subjects

S No	Characteristic	Group I (Obese OSA)	Group II (Non Obese OSA)	Group III (Healthy Controls)
1.	Number (N)	28	15	20
2.	Age (mean ± sd)	54.89 ± 12.28	49.20 ±10.05	41.30 ± 9.47
3.	Sex Distribution			
	Males	18	8	11
	Females	10	7	9
4.	BMI (mean ± sd)	29.70 ± 2.72	25.20 ± 0.53	----

Standardized lateral Cephalograms were recorded in the study using natural head posture (mirror technique) at end expiration, without swallowing and in centric occlusion using Asahi cephalostat machine in all the cases [7]. Single individual manually performed composite acetate tracings. 10 Cephalograms were marked twice after a gap of a week to assure anatomic point placement reproducibility (kappa 0.90). The various cephalometric landmarks/ reference points and linear and angular measurements considered for the present study are as depicted in Fig 1 and Table 2.

The database was created on MS Excel worksheet and SPSS version 13 was used for analysis. Appropriate statistical tests of significance were carried out.

Fig 1: Lateral Cephalogram tracing showing cephalometric land marks and measurements used in the study (Table 1.)

Table 2: Cephalometric measurements, definitions and their mean ± sd of the three groups

Cephalometric measurement	Definition	Group I (mean ± sd)	Group II (mean ± sd)	Group III (mean ± sd)
SNA (deg)	Relationship of maxilla to cranial base	82.35 ± 3.00	75.53 ± 16.37	82.30 ± 3.97
SNB (deg)	Relationship of mandible to cranial base	79.78 ± 4.48	76.60 ± 4.45	79.75 ± 4.48
ANB (deg)	Relationship of maxilla to mandible	3.0 ± 3.69	2.93 ± 2.43	2.4 ± 1.81
PAS (mm)	Posterior airway space. Distance from posterior tongue margin to posterior pharyngeal wall measured on the line B-Go.	6.60 ± 2.02	6.26 ± 2.12	11.46 ± 3.66
PNS-P (mm)	Length of the soft palate	41.75 ± 4.55	40.93 ± 3.47	34.05 ± 4.63
MPH (mm)	Distance of hyoid measure perpendicular plane	21.14 ± 8.46	18.33 ± 4.41	13.80 ± 7.21
G (mm)	Width of the soft palate	8.10 ± 1.96	7.8 ± 1.74	6.5 ± 1.27
SN-MP(deg)	Mandibular plane angle	29.39 ± 6.93	30.06 ± 7.65	30.90 ± 5.26

Results

(Tables 2,3,4,5)

The cephalometric measurements considered in the study, their definitions and other details of the three groups are as depicted in Table 2.

Comparison of cephalometric features of patients of OSA (Group I) with controls (Group III) showed several differences which were statistically highly significant ($p < 0.01$); Posterior airway space (PAS), Length of soft palate (PNS-P), Hyoid distance (MPH), Width / thickness of the soft palate (G). The differences in other cephalometric measurements tested i.e., SNA, SNB, ANB and SN-MP were not found to be statistically significant ($p > 0.05$).

Comparison of cephalometric features of patients of OSA (Group II) with controls (Group III) showed several differences which were statistically highly significant ($p < 0.01$); Posterior airway space (PAS), Length of soft palate (PNS-P), and Width / thickness of the soft palate (G). The difference between hyoid distance (MPH) and relationship of mandible to Cranial base (SNB) of both the groups was found to be statistically significant ($p < 0.05$). However, this statistically significant difference was not observed for other cephalometric measurements tested i.e., SNA, ANB and SN-MP.

Comparison of Groups I and II revealed that only cephalometric variable SNB angle was statistically significantly different ($p < 0.05$).

Pearson correlation coefficient was applied to elucidate the cephalometric variables and correlation with severity of AHI. The only positive correlation was observed between MPH and AHI in Group I ($p < 0.05$, $r^2 = 0.163$) (fig 2).Four Cephalometric variables in Group I which were found to be different ($p < 0.05$) were taken as predictors and a linear regression model was created with dependent variable as AHI. The r^2 was 0.36 (i.e., 36% of variance of AHI could be explained by independent variables used in the model) showing the model to be quite good but the variables lost statistical significance in the model.

Discussion

In the present study we demonstrate significant cephalometric findings in urban Indian obese and non obese OSA patients (fig 3, 4, 5). These include retrognathic mandible, decreased posterior airway space/ retroglossal space, elongation of soft palate and increased distance of hyoid measured perpendicular to the mandibular plane and width of soft palate. Our findings are similar to the findings reported in literature [2, 3, 4, 8, 9]. But most of these studies have been performed on Caucasian population. Our study was performed on urban Indian mixed population however we couldn't maintain ethnicity.

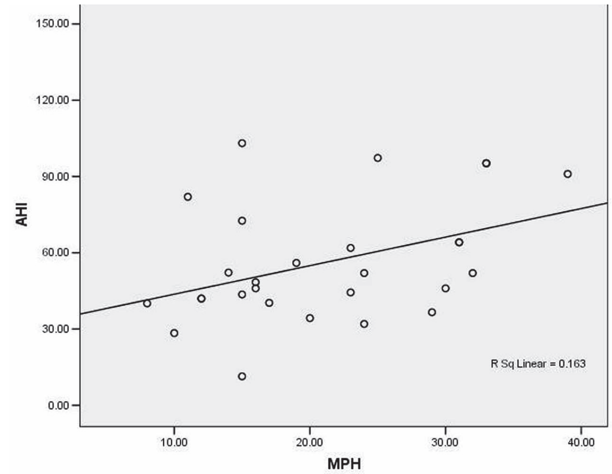

Fig 2: Scatter plot depicting co-relation between MPH and AHI.

The results observed are relevant as it would be of help in diagnosis and treatment planning. In cases with decreased posterior airway space and retrognathic mandible, one can infer that mandibular protrusion with oral appliance or by surgery would increase upper airway caliber at the oro-pharynx and hypo pharynx. In cases where hyoid distance increased from the mandibular plane, we may come to a conclusion that alteration in

Fig 3: A representative sample of Group III showing optimum Posterior airway space, hyoid distance, length and width of soft palate.

Fig 4: A representative of Group II showing decreased Posterior airway space.

Fig 5: A representative of Group I showing severely compromised Posterior airway space and increased hyoid distance.

mandibular position can effect hyoid position and also the pharyngeal critical pressure. Therefore the cephalometric measurement can be a use full indicator for considering mandibular advancement during sleep. Similar such observation has been reported earlier [10]. A predictable correlation between cephalometric variables PAS, PNS-P, MPH, and G with dependent variable AHI in Group I is of great clinical relevance for diagnosis and treatment planning.

A long and flaccid velum can produce obstruction. In cases were only PNS-P is increased, pharyngeal and

Table 3: Comparison of Cephalometric Features of Urban Indian obese adults with OSA (Group I) and Urban Indian non OSA, sex and age matched controls (Group III) .

S No	Cephalometric Measurement	T test value	P value
1	SNA	0.054	0.957
2	SNB	0.027	0.978
3	ANB	0.743	0.462
4	PAS	5.303	0.000
5	PNS-P	5.714	0.000
6	MPH	3.231	0.002
7	G	2.969	0.005
8	SN-MP	0.856	0.396

Table 4: Comparison of Cephalometric Features of Urban Indian Non obese adults with OSA (Group II) and Urban Indian non OSA ,sex and age matched controls (Group III)

S No.	Cephalometric Measurement	T test value	P value
1	SNA	1.566	0.138
2	SNB	2.065	0.048
3	ANB	0.713	0.483
4	PAS	5.212	0.000
5	PNS-P	5.019	0.000
6	MPH	2.294	0.029
7	G	3.193	0.004
8	SN-MP	0.507	0.617

palatal edema secondary to trauma from snoring can further aggravate the situation [5]. There fore these finding on the cephalogram could be a valuable input for treatment planning. One may consider palatal lift appliance or palato-uvulo-pharyngoplasty in such cases. But if the above finding is with reduced posterior airway space or increased hyoid distance one can address the later issues with appliance or surgery than the former.

We found a statistically significant co relation between AHI and hyoid distance. Such observation was also made by Nagaumma and coworkers in 2002 [11].

Limitations of the study

Lateral Cephalograms were recorded when the patients were awake and in the standing position and thus did

Table 5: Comparison of Cephalometric Features of Urban Indian obese adults with OSA (Group I) and Urban Indian non obese with OSA (Group II).

S No.	Cephalometric Measurement	T test value	P value
1	SNA	1.599	0.131
2	SNB	2.231	0.034
3	ANB	0.071	0.944
4	PAS	0.510	0.614
5	PNS-P	0.657	0.515
6	MPH	1.430	0.160
7	G	0.526	0.602
8	SN-MP	1.127	0.270

not reflect the changes that occur during sleep. Cephalometrics provides information in anteroposterior plane and not in lateral plane that are often implicated in airway narrowing. Studies using MRI techniques have demonstrated that differences between snorers and patients with OSA in airway caliber are more related to lateral pharyngeal wall size and thickness than to anteroposterior dimension [12].

Conclusion

The present study has observed predictable cephalometric measurements in OSA patients. Cephalometric analysis combined with Polsomnography and airway grading is recommended as diagnostic and treatment planning aid in our settings for management of patients with obstructive sleep apnea.

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