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RESEARCH ARTICLE

CORRELATION OF NASOPHARYNGEAL FREE AIRWAY SPACE MEASURED ON LATERAL CEPHALOGRAM WITH QUANTITATIVE NASAL AIR FLOW IN NASAL AND ORO-NASAL BREATHERS REPRESENTING THREE FACIAL MORPHOLOGICAL TYPES

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ABSTRACT

Objective: To calculate the mean free nasal airway space through specific measurements on lateral cephalogram and to correlate it with quantitative nasal air flow in nasal and oronasal breathers with three altered craniofacial morphological types. **Methods:** 90 subjects (45 males and 45 females) were divided into three groups:control group; Lip-incompetence group; long face group according to facial morphological criteria. They were again subdivided into three groups: Group I,II,III according to age groups. Each subject had undergone standard lateral cephalometric examination procedure and quantitative nasal air flow measurement using respiratory trnsducers. Linear and area measurement parameters were noted from lateral cephalometric tracings and different respiratory parameters were noted from respiratory cycle and compared. **Results:** There was significant correlation of Nasopharyngeal free airway space measured from Linear and Area measurements on a trapezoid on Lateral cephalometric tracings with different respiratory parameters used in this study. **Conclusion:** Ptm-ad_2 should be routinely measured on lateral cephalogram to evaluate whether a patient suffers from obstruction of the nasal airway.

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INTRODUCTION

Nasal breathing is the primary mode of air intake for every individual and it is essential for a supply of properly cleansed, moistened and warmed air for lungs. Mouth breathing introduces cold, dry unprepared air that insults the tissues of oral cavity, nasopharynx and lungs, leading to pathological changes in oronasal, nasopharyngeal and other respiratory tissues[1].Mouth breathing is one of the major environmental causes of malocclusion observed in growing children[2]. It has multifactorial etiological factors. Linder Aronson and Backstrom(1960)[3], Ricketts(1968)[4], Linder Aronson (1979)[5] and McNamara Jr (1981)[6], found direct relationship between chronic airway obstruction and development of craniofacial complex. On the other hand some clinicians and researchers question the assumption that impaired nasal function influences growth[7,8]. The size of the nasopharynx is particularly important in determining whether the mode of breathing is nasal or oral. Even children with small adenoids may have a low nasal air flow if nasopharynx is also small. Such children are consequently not obliged to resort to mouth breathing[5]. The potential disharmony of the adenoid mass and the nasopharyngeal airway may be due, in part, to the different growth patterns of the bony nasopharynx and attached tonsillar tissue[9]. The lateral cephalogram, a standardized sagittal X-ray of head and neck, is the most commonly used diagnostic aid in dentistry.

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It is a simple, economical, readily available, and reproducible way to diagnose upper airway obstruction. A high correlation has been found between the results of posterior rhinoscopy and the size of adenoids on the posterior nasopharyngeal wall seen on lateral cephalograms[5, 10]. Aronson S.L and Henrikson C.O [11] studied radiocephalometric dimensions in 6 to 12 year old mouth breathers and compared them with nasal breathers. With the help of radiocephalometric data of anterioposterior nasopharyngeal dimensions it was possible to assess the ability of a patient to breathe through the nose. Various authors have stated that the lateral cephalogram can be used as a diagnostic tool for giving relevant information of obstructed nasopharyngeal airways[12]. Vig P.S [8] studied the relationship between facial morphology and nasal respiration in 28 adults which were divided into three groups- lips competent with normal vertical facial height, long vertical facial height and competent lips and facial height within normal limits. The respiratory pattern of lip incompetent, long face and normal persons, when compared in groups were not significantly different, though long faced subjects as a group had a higher mean value of nasal resistance[8].

Vitella D.V et al[13] calculated the mean anteroposterior size of nasopharyngeal airway by using cephalometric linear and area measurements in nasal and mouth breathers aged 6-12 years and compared them with the findings of nasopharyngeal endoscopy. The otologic examination should be initiated when these values are smaller than age specific values obtained in his study, which were < 9.9 mm at age of 8-9 years, or < 11.6 mm at the ages 10-11 years for ptm-ad_1 distance. Ptm-ad2 distance was found to average < 8.6 mm at age of 6-7 years, or < 8.8 mm at the ages 8-9 years, or < 10.0 mm at 10-11 years. Much of the data indicated that it is rare for a person to breath hundred percent through the mouth and a more common mode of respiration is a combination of simultaneous oral and nasal airflow [14]. Use of internal thermistors as an indirect measure for flow as well as pressure was used to differentiate between oral and nasal breathing. This new method of measuring flow has proven to be very accurate as well as simple and reliable[15]. Quantification of nasal airflow is essential in obtaining an objective picture of passage of air through the nasopharynx especially so for children with oronasal or oral breathing. The aim of the present study was to calculate the mean free nasal airway space through specific measurements on lateral cephalogram and to correlate it with quantitative nasal air flow in nasal and oronasal breathers with three altered craniofacial morphological types.

METHODS

Ethical clearance was obtained from the Ethical Committee of Baba Farid University of Health Sciences vide. letter no: BFUHS/2K9/p-TH/6154 dated 13–7–2009 for the research protocol. Consent was obtained from parents/guardian of each subject included in the study.

***Patient Selection**:* After having conducted random pilot detailed case histories of the individuals visiting the Department of Pedodontics and Orthodontics, a total of 90 individuals were included in this study between the age groups of 6-18 years for males and 6-14 for females. A double blind screening through detailed case history and clinical examination was carried out by two clinical observers and then these individuals were further divided into oro-nasal and nasal breathers. They were divided into 45 males and 45 females. Males & Females were further divided as shown in Table no.1 Each age group vis. a vis. Group I, Group II, Group III was further subdivided into 3 groups according to facial morphological appearance (Figure 1) Control group: Showing lip competence with facial height and proportion within the normal limits (5 Subjects). Lip-Incompetence Group: At resting posture showing incompetent lip seal but normal limits of vertical facial development (5 subjects). Long face Group: Wherein lower facial height was more than 55 percent of total facial height. (5 subjects), thereby resulting in a total of 15 subjects representing three facial forms in each age Group.

***Standardized lateral cephalogram**:* Cephalometric radiographs were taken using ADVAPEX OPG, TMJ, CEPH X-ray systems,(Apex Medical Systems Pvt.Ltd,India).The films used were AGFA, ORTHO-LUX 8X10 T-MAT (AGFA-Gevaert Limited ,Burwood, Victoria). The peak voltage was adjusted to 65Kvp .Distances between the anode, the midsagittal plane and the film were set at 150 centimeters and 15 centimeters respectively, giving a magnification factor of 10 percent linear enlargement at the median plane. All the lateral cephalometric radiographs were taken using a standardized technique, with the teeth in centric occlusion, lips relaxed and body comfortable in upright position.

Tracing of lateral cephalograph: Tracings were made on the lateral cephalograms taken in the intercuspal position. Tracings were made by the same person to avoid inter examiner variation, using a 3-H lead pencil on acetate paper over an illuminated light box. Several linear and area measurements along with ratios were determined to evaluate the sizes of the adenoidal tissues and upper airway dimensions. The cephalometric reference points(Figure 2), used for measurements were:Ba (Basion) :the most anterior inferior point on the margin of the foramen magnum, in the midsagittal plane, Anterior nasal spine(ANS): the tip of the bony anterior nasal spine at the inferior margin of the piriform aperture, in the midsagittal plane, Pterygomaxillary (Ptm): the most posterior point on the bony hard palate in the midsagittal plane, Anterior arch of Atlas(aa) :most anterior point on arch of atlas, So: the midpoint on the line joining Sella and basion,Sella (S): the centre of the sella turcica,ad_1 : The intersection of the line Ptm-Ba and the posterior nasopharyngeal wall,ad_2 : The intersection of the line Ptm-So and the posterior nasopharyngeal wall[5] . The cephalometric reference lines(Figure 3), used for measurement were: Palatal line (PL): Line representing palatal plane passing most superior point on Dens Axis,Anterior atlas line (AAL): Line perpendicular to palatal plane tangent to anterior surfaces of Dens Axis (aa),Pterygomaxillary line (PML): Line perpendicular to palatal plane that intersects palatal plane at ptergomaxillary fissure,Sphenoid line (SpL): Line tangent to lower border of sphenoid bone registered at basion.

Linear measurements

The following measurements were made:

Ptm-ad_1 = linear distance from the point Ptm to the point ad_1, in mm (Figure 2), Ptm- ad_2 = linear distance from the point Ptm to the point ad_2, in mm(Figure 2),

Area Measurement

The Nasopharyngeal area (NP Area)

The nasopharyngeal area (NP) area was derived mathematically by using a formula given by Handelman CS, Osborne G[16].

$$\text{Nasopharynx Area} = \frac{d\,(h - d \tan \theta)}{2}$$

Where,d (Depth): The distance between ptm and the intersection point of PL and AAL lines, h (Height): The distance between ptm and the intersection point of PML and SPL lines,represented the anterior height of the nasopharyngeal bony space, ϴ(theta angle): Sphenoid line/palatal line angle (As shown in Figure 4.)

Air area measurement: Air area(Figure 5) was calculated using AUTOCAD 2008 software system using following steps:1)Traced image were scanned with the help of scanner.2)scanned image were digitalized with AUTOCAD 2008.3) The process of Dimensioning was done to add measurements annotation to the image.4)air area were calculated using main tools menu of the software.

Measurement of nasal airflow: Air flow was calculated using Biopac Respiratory Transducer SS5LB And Biopac Temperature Transducer SS6L. (Biopac Systems Inc,CA,USA These thermistors were attached to MP 36 (Biopac Systems Inc,CA,USA) hardware system and following parameters of respiratory cycle were noted with the help of Biopac Student Lab System: software BSL 3.7.3 (MP 36): Average nasal air flow rate: It was calculated by dividing average airflow by delta time and recorded in lit/ sec. , Average airflow per cycle: It is the area under the curve and recorded in liter, Peak nasal airflow per cycle.

Statistical methods: The following 8 parameters were noted for each subject: weight, height, Linear distance ptm-ad_1 ,Linear distance ptm-ad_2,Total Nasopharynx area (NP Area), Nasopharyngeal air rate. The mean, S.D, minimum and maximum values were calculated for each parameter. All data were processed by SPSS software (14.0,SPSS Inc.,Chicago I11,USA). The statistical analysis were divided into two parts. Part 1: simple correlation analysis was applied to the parameters of three facial morphological groups to study their correlation using Pearsons correlation test. Part 2: The unpaired student 't' test was applied to study the comparison between parameters in different groups of subjects. A *P*-value less than 0.05 were considered as statistically significant.

RESULTS

Table 2, 3, 4 shows the correlation among different parameters in control group, lip-incompetence group and long face group respectively. Parameters like ptm-ad_1 ,ptm-ad_2 three groups. Following correlations was stronger than the others: ptm-ad_2, air area and Average nasal air flow rate. No correlation was found between NP area and air area in long face group subjects. There was positive correlation of ptm-ad_2 and air area with all three respiratory parameters in lip-incompetence and long face group subjects. Table 5, 6, 7 shows the comparison of all parameters in three groups using unpaired student't' test. Statistically significant differences were found in ptm-ad_2 ($p=0.00$), air area ($p<0.05$) and Average nasal air flow rate when all parameters were compared between control and lip-incompetence group (table:5) When long face group subjects were compared with control and lip-incompetence group subjects parameters like ptm-ad_1 ptm-ad_2 ,air area, Average nasal air flow rate, average nasal air flow and peak nasal air flow were statistically different.(table 6 and7)

Table 1. Showing Age distribution and no. of subjects among males and females

Age groups	Range (in years+- 3 months)		Number Of Subjects
	Males	Females	
1	6-10 yrs	6-10 yrs	15
2	10-14 yrs	10-12 yrs	15
3	12-18 yrs	14-14 yrs	15

DISCUSSION

Mouth breathing has long been considered a significant factor in the etiology of malocclusion. The relationship between respiratory function and craniofacial development is still an issue of controversy as far as occlusion and facial morphology is concerned. Linder Aronson S. ,Henrikson C.O (1973)[11]and Vitella D.V et al (2004)[13] suggested that while planning orthodontic therapy it may be desirable to assess the ability of the patient to breathe through the nose and mode of breathing should be evaluated since a combination of oral and nasal breathing commonly occurs.

Over the years clinicians have tried to define clearly a mouth breather. Some clinicians classify them as those who entirely breathe through the mouth[17]. Vig K.W.L (1998)[17] stated that while classifying mouth breathers no allowance should be made for the possibility that combination of oral and nasal breathing may occur and it may be normal. major obstacle to resolving the issue of a true mouth breather or one with combination of oral and nasal breathing is dependent on very unclear parameters. The unanswered fundamental questions are - Is nasal obstruction an indisputable indicator of oral breathing? Can nasal respiration exist with concurrent partial nasal obstruction? Complete obstruction of nasal airway is a relatively rare condition. In human beings relatively high degree of nasal obstructions are overcome to maintain nasal airflow if, nasal respiration is the preferred mode of function. The critical value of the nasal obstruction at which this becomes impossible or too difficult is not yet known.

This clinical research model included 90 subjects who were selected after double blind screening, of individuals visiting the Department Of Pedodontics and Orthodontics at Pb. Government Dental College and Hospital, Amritsar for orthodontic intervention or clinical examination for other dental problems. The purpose of this study was to obtain quantitative data of the respiratory parameters i.e amount of nasal airflow and nasopharyngeal area in subjects representing three facial morphologic types (namely, normal facial proportions with competent lips, lip-incompetent with normal facial proportions and long face) and to compare these values between the groups to determine whether significant differences existed in these selected respiratory parameters. The results obtained by comparative analysis (Unpaired 't' test) showed that there is statistically significant difference in respiratory parameters between

Table 2. Showing pearsons correlation between different parameters in control group subjects (n=30)

		Weight	Height	Ptm-ad1	Ptm-ad2	Np area	Air area	Nasal air flow rate	Average nasal air flow	Peak nasal air flow
Weight	r value p value	1	.977** <0.01	.472** .009	.619** <0.01	.625** <0.01	.726** <0.01	.695** <0.01	.314 .091	.539** .002
Height	r value p value	.977** <0.01	1	.467** .009	.657** <0.01	.661** <0.01	.750** <0.01	.737** <0.01	.290 .120	.515** .004
Ptm-ad$_1$	r value p value	.472** .009	.467** .009	1	.625** <0.01	.571** .001	.574** .001	.630** <0.01	.134 .480	.160 .398
Ptm-ad$_2$	r value p value	.619** <0.01	.657** <0.01	.625** <0.01	1	.762** <0.01	.888** <0.01	.863** <0.01	.234 .213	.380* .039
NP area	r value p value	.625** <0.01	.661** <0.01	.571** .001	.762** <0.01	1	.826** <0.01	.768** <0.01	.099 .603	.518** .003
Air area	r value p value	.726** <0.01	.750** <0.01	.574** .001	.888** <0.01	.826** <0.01	1	.937** <0.01	.205 .277	.489** .006
Nasal air flow rate	r value p value	.695** <0.01	.737** <0.01	.630** <0.01	.863** <0.01	.768** <0.01	.937** <0.01	1	.254 .176	.445* .014
Avg.nasal air flow	r value p value	.314 .091	.290 .120	.134 .480	.234 .213	.099 .603	.205 .277	.254 .176	1	.296 .112
Peak Nasal Air Flow	r value p value	.539** .002	.515** .004	.160 .398	.380* ..039	.518** .003	.489** .006	.445* .014	.296 .112	1

**. Correlation was significant at the 0.01 level (2-tailed). *. Correlation was significant at the 0.05 level (2-tailed).

Table 3. Showing pearsons correlation between different parameters in lip incompetence group subjects (n=30)

		Weight	Height	Ptm- ad$_1$	Ptm-ad$_2$	NP area	Air area	Nasal air flow rate	Average nasal air flow	Peak nasal air flow
Weight	r value p value	1	.960** <0.01	-.124 .514	.208 .270	.487** .006	.285 .127	218.248	.435* .016	.239.204
Height	r value p value	.960** <0.01	1	-.187 .322	.203 .282	.447* .013	.266 .155	182 .335	.378* .040	.159.402
Ptm-ad$_1$	r value p value	-.124 .514	-.187 .322	1	.671** <0.01	.211 .264	.618** <0.01	543** .002	.256 .171	.255.174
Ptm-ad$_2$	r value p value	.208 .270	.203..282	.671** <0.01	1	.437* .016	.940** <0.01	901* <0.01	.595** .001	.367* .046
NP area	r value p value	.487** .006	.447* .013	.211 .264	.437* .016	1	.419* .021	.379* .039	.261 .163	.382* .037
Air area	r value p value	.285 .127	.266 .155	.618** <0.01	.940** <0.01	.419* .021	1	.925** <0.01	.554** .001	.485** .007
Nasal air flow rate	r value p value	.218 .248	.182 .335	.543** .002	.901** <0.01	.379* .039	.925** <0.01	1	.571** .001	.471** .009
Avg.nasal air flow	r value p value	.435* .016	.378* .040	.256 .171	.595** .001	.261 .163	.554** .001	571** .001	1	.086.650
Peaknasal air flow	r value p value	.239 .204	.159 .402	.255 .174	.367* .046	.382* .037	.485** .007	.471** .009	.086.650	1

**. Correlation was significant at the 0.01 level (2-tailed). *. Correlation was significant at the 0.05 level (2-tailed)

Table 4. Showing pearsons correlation between different parameters in long face group subjects (n=30)

		Weight	Height	Ptm-ad$_1$	Ptm-ad$_2$	NP area	Air area	Nasal air flow rate	Average nasal air flow	Peak nasal air flow
Weight	r value p value	1	.866** <0.01	.348 .059	.483** .007	.527** .003	.283 .129	.336 .069	.428* .018	.284 .128
Height	r value p value	.866** <0.01	1	.244 .195	.404* .027	.450* .013	.112 .556	.183 .332	.275 .141	.248 .186
Ptm-ad$_1$	r value p value	.348 .059	.244 .195	1	.545** .002	.368* .045	.549** .002	.553** .002	.431* .017	.299 .108
Ptm-ad$_2$	r value p value	.483** .007	.404* .027	.545** .002	1	.363* .049	.752** <0.01	.781** <0.01	.720** <0.01	.667** <0.01
Np area	r value p value	.527** .003	.450* .013	.368* .045	.363* .049	1	.198 .293	.226 .229	.188 .319	.405* .026
Air area	r value p value	.283 .129	.112 .556	.549** .002	.752** <0.01	.198 .293	1	.959** <0.01	.778** <0.01	.584** .001
Nasal air flow rate	r value p value	.336 .069	.183 .332	.553** .002	.781** <0.01	.226 .229	.959** <0.01	1	.853** <0.01	.596** .001
Avg.nasal air flow	r value p value	.428* .018	.275 .141	.431* .017	.720** <0.01	.188 .319	.778** <0.01	.853** <0.01	1	.681** <0.01
Peak nasal air flow	r value p value	.284 .128	.248 .186	.299 .108	.667** <0.01	.405* .026	.584** .001	.596** .001	.681** <0.01	1

**. Correlation was significant at the 0.01 level (2-tailed). *. Correlation was significant at the 0.05 level (2-tailed).

Table 5. Showing comparison between different parameters in control and lip-incompetence group subjects (n=30)

Parameters	Group	n	Mean	Std. Deviation	Std. Error Mean	't 'value	'p' value
Weight	Control	30	36.800	10.6363	1.9419	.239	.812
	Lip I	30	36.183	9.3130	1.7003		
Height	Control	30	143.58	13.579	2.479	.122	.903
	Lip I	30	143.15	13.870	2.532		
$Ptmad_1$	Control	30	18.78	2.903	.530	1.161	.250
	Lip I	30	17.82	3.517	.642		
$Ptmad_2$	Control	30	16.13	2.084	.381	3.941	<0.01
	Lip I	30	13.97	2.173	.397		
NP area	Control	30	422.93	101.34	18.503	.068	.946
	Lip I	30	421.28	86.726	15.834		
AIR area	Control	30	225.16	54.05	9.869	2.654	.010
	Lip I	30	191.17	44.67	8.156		
Rate nasal air flow	Control	30	0.23	0.016	0.0030	2.282	.026
	Lip I	30	0.22	0.0223	0.0040		
Average nasal air flow	Control	30	0.59	0.090	0.0166	1.323	.191
	Lip I	30	0.57	0.0685	0.0125		
Peak nasal air flow	Control	30	0.329	0.0623	0.0113	-1.730	.089
	Lip I	30	0.354	0.0502	0.0091		

Table 6. Showing comparison between different parameters in control and long face group subjects (n=30)

Parameters	Group	n	Mean	Std. Deviation	Std. Error Mean	t value	p value
Weight	Control	30	36.800	10.6363	1.9419	.606	.547
	Long Face	30	35.277	8.7267	1.5933	.606	
Height	Control	30	143.58	13.579	2.479	.624	.535
	Long Face	30	141.62	10.657	1.946	.624	
$Ptmad_1$	Control	30	18.78	2.903	.530	6.427	<0.01
	Long Face	30	13.22	3.752	.685	6.427	
$Ptmad_2$	Control	30	16.13	2.084	.381	11.465	<0.01
	Long Face	30	9.45	2.419	.442	11.465	
NP area	Control	30	422.93	101.347	18.503	1.536	.130
	Long Face	30	465.48	112.970	20.625	1.536	
AIR area	Control	30	225.16	54.055	9.8690	10.027	<0.01
	Long Face	30	106.53	35.735	6.524	10.027	
Rate nasal air flow	Control	30	0.23	0.01653	.00301	14.555	<0.01
	Long Face	30	0.11	0.04240	.0077	14.555	
Average nasal air flow	Control	30	0.59	0.090	.0166	10.744	<0.01
	Long Face	30	0.288	0.131	.0239	10.744	
Peak nasal air flow	Control	30	0.329	0.062	.0113	4.908	<0.01
	Long Face	30	0.211	0.115	.0211	4.908	

Table 7. Showing comparison between parameters in lip-incompetence and long face group subjects (n=30)

Parameters	group	n	Mean	Std. Deviation	Std. Error Mean	‘t ’value	‘p’ value
Weight	Lip I	30	36.183	9.3130	1.7003	.389	.699
	Long face	30	35.277	8.7267	1.5933		
Height	Lip I l	30	143.15	13.870	2.532	.480	.633
	Long face	30	141.62	10.657	1.946		
$Ptmad_1$	Lip I	30	17.82	3.517	.642	4.899	<0.01
	Long face	30	13.22	3.752	.685		
$Ptmad_2$	Lip I	30	13.97	2.173	.397	7.608	<0.01
	Long face	30	9.45	2.419	.442		
NP area	Lip I	30	421.28	86.726	15.83	-1.700	.094
	Long face	30	465.487	112.970	20.62		
AIR area	Lip I	30	191.178	44.674	8.156	8.104	<0.01
	Long face	30	106.53	35.735	6.524		
Rate nasal air flow	Lip I	30	0.22071	0.0219	0.004	12.555	<0.01
	Long face	30	0.111	0.0424	0.007		
Average nasal air flow	Lip I	30	0.571	0.068	0.0125	10.571	<0.01
	Long face	30	0.28	0.131	0.0239		
Peak nasal air flow	Lip I	30	0.354	0.050	0.009	6.209	<0.01
	Long face	30	0.21	0.115	0.021		

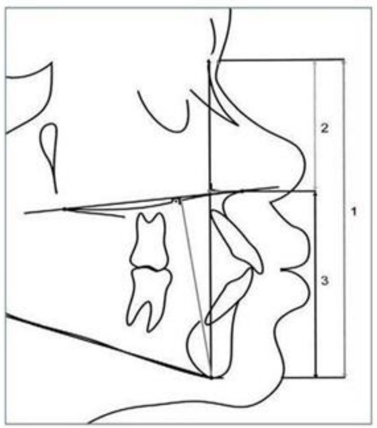

Figure 1. Diagram showing Total anterior face height(1),Upper anterior face height(2) and Lower anterior face height(3).

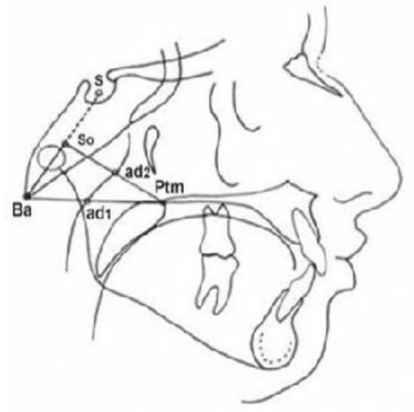

Figure 2. Figure showing Reference Points

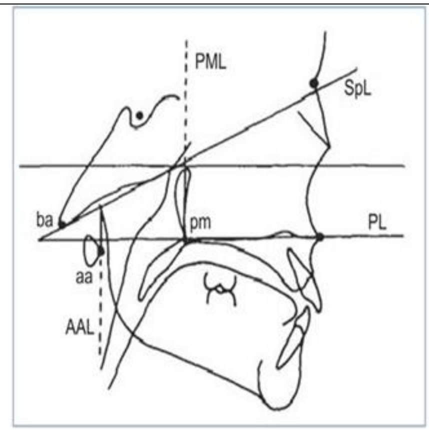

Figure 3. Figure showing Reference Lines.

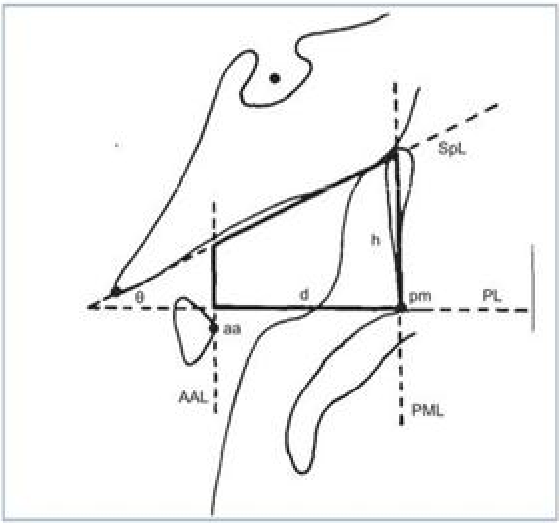

Figure 4. Figure showing reference points and linear measurements

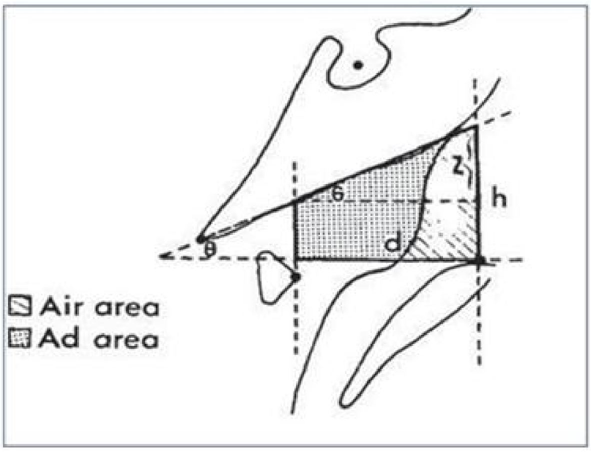

Figure 5. Figure showing nasopahyngeal and nasal area

normal and long face group and in between lip-incompetence and long face group. The nasopharyngeal area for purpose of analysis in this study was calculated using Handelman C.S and Osborne G. (1976)[16] method of trapezoid which is formed by four reference planes Ba-N Plane, the palatal plane, two perpendiculars to palatal plane one at Atlas vertebra and other that crosses the PNS on a lateral cephalogram. . The results obtained by simple correlation analysis showed that bony nasopharynx area was correlated to Ptm-ad.

There was also a significant correlation of Air area and Average nasal air flow rate in control and lip-incompetence group of subjects but no correlation was found in long face group subjects which shows that in long face group subjects growth of adenoid is fast as compared to the bony nasopharynx leading to nasopharyngeal obstruction. The posterior limit of the nasopharynx is dependent upon the position of the anterior arch of the atlas. Hence, the cephalometric radiograph should be taken in natural head position as atlas moves anteriorly or posteriorly with extension or flexion of cervical vertebrae. Holmberg H, Aronson S.L (1979)[10] found significant relation between the size of adenoids, capacity of nasal airway measured on lateral cephalogram with nasal airflow which is in compliance with our study.

Ptm-ad_2 was found to be highly correlated with Air area, Average nasal air flow rate, Average nasal air flow, Peak nasal air flow rate in all Sub-age groups and in different craniofacial morphological types.Ptm-ad_2 was also significantly comparable in different craniofacial morphological types. The value of Ptm-ad_2 in control group of subjects was in range of 14 -20 mm. The value of Ptm-ad_2 of lip-incompetence facial type was in range of 9 to 18.5 mm and in long face type it was in range of 5 to 13.5 mm, thus indicating that it should be routinely measured on each cephalogram to evaluate whether a patient suffers from obstruction of airway, or not, instead of mere chair side tests and reference to ENT Specialist. . Norman R.G et al (1997)[18] analyzed respiratory events using thermistor. He stated that use of thermistor is a sensitive, reliable, technically simple and easily applicable noninvasive means that detects respiratory events. Akre H. et al (1999)[15] used internal thermistors as an indirect measure for airflow as well as pressure.

They suggested that this method of measuring flow has proven to be very accurate as well as simple and reliable. It also had the ability to distinguish between nasal and oral breathing. In the present study BIOPAC Respiratory Transducer (SS5LB) and BIOPAC Temperature Transducer (SS6L) were used for the quantitative evaluation of nasal air flow. The respiratory parameters like Average nasal air flow rate, Average nasal air flow and Peak nasal air flow rate were significantly different in long face group as compared to normal and lip-incompetence group. Fields H.W,Warren D.W, Black K,Phillips C.L (1991)[19] had also stated that long faced subjects had significantly smaller component of nasal respiration. Fricke B. et al (1993)[20] stated that mean values of nasal airflow were not significantly different in open lip posture children when compared with children with close lip posture and found no connection between open mouth posture and obstructed airways. Our results have also shown that respiratory parameters when compared between control and lip-incompetence group showed statistically significant difference only in Average nasal air flow rate, Other respiratory parameters were statistically insignificant. The reason for the lack of lip competence could be a discrepancy between the development between hard and soft tissue in vertical plane either with a genetic background or based upon an inadequacy of the orbicularis oris muscle to produce a competent seal, leading to a compensatory activity of mentalis and suprahyoid muscles. It may also be a manifestation of a general weakness in body posture with hypotonic muscles.

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