ANTERO-POSTERIOR PHARYNGEAL SIZE OF WELL BALANCED FACES AND NORMAL OCCLUSION IN DIFFERENT GROWTH PATTERNS.

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A cross sectional study has been carried out to evaluate & compare the anterior-posterior size of nasopharynx & oropharynx area of persons of Malwa area, Indore with different growth patterns. About 1500 subjects from various colleges & schools were screened for the collection of sample & a team of layman , an artist, a general dentist & a senior orthodontist selected 180 subjects. Lateral cephalograms were taken. The subjects and were divided into three groups according to different growth patterns: vertical grower, average grower and horizontal grower, which were further divided into subgroups: male and female. The effect of the growth patterns and sex on the pharyngeal airway size was investigated by means of variance analysis. It was observed that both nasopharyngeal and oropharyngeal area measurements were affected by sex; but no difference found between subjects of various growth patterns.

The nasopharynx and the oropharynx have significant locations and functions because both of them form a part of the unit in which respiration and deglutition are carried out. Because of the close relationship between the pharynx and the dentofacial structures, a mutual interaction is expected to occur between the pharyngeal structure and the dentofacial pattern, and therefore justifies orthodontic interest.

Studies involving the pharyngeal airway space are somewhat limited in orthodontic literature, and most of them are related to obstructive sleep apnea.

The literature on nasopharyngeal and oropharyngeal size is scanty. Rarely have various growth patterns and the associated airway dimensions and its relation are compared.

As we know that different growth patterns have different facial types (Schudy (1964)[1], Popovich and Thompson (1977)[2], Siriwat and Jarabak (1985)[3] Bishara and Jacobson (1985)[4]) so there was a possibility that pharynx which has a close proximity to dento-facial structure could also affect them . There might be a mutual interaction between them.

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Since no such cephalometric study has been done to date on the Malwa population, hence this study was undertaken to establish the norms of different pharyngeal parameters with lateral Cephalograms in Malwa population, and to compare different pharyngeal parameters between male and female, among different facial growth pattern.

Linder-Aronson[5] found a high level of correlation between the result of posterior rhinoscopy and radiographic cephalometrics in the assessment of adenoid size.

He found that lateral skull radiographs provide a good picture of the size of the nasopharyngeal airway in children of all ages.

The Aims of the study

1. To establish the norms of pharyngeal area in Malwa subjects with different growth patterns.
2. To evaluate and compare the antero-posterior size of nasopharynx and oropharynx area of persons with different growth patterns.
3. To investigate whether the pharyngeal area of the subjects with normal nasal breathing could be affected by the different growth patterns.

4. To find out difference (if any) in the size of nasopharynx and oropharynx area of male and female subjects.

MATERIAL AND METHOD

The study was done on lateral cephalometric radiographs of 90 male and 90 female subjects. About 1500 subjects from various colleges and schools were screened for the collection of sample and a team of a layman people, an artist, a general dentist and a senior orthodontist selected 180 subjects.

The selection criteria of the subjects:-

1. Malwa subjects, age ranging from 15-25 years.
2. Average built without any physical deformity and without any wound, burn, and scar tissue in the neck region.
3. Subjects without any facial asymmetry and/or mandibular deviation.
4. Normal breathing subjects without any deglutition disorder or visual or hearing disorder.
5. No history of previous orthodontic treatment.
6. Molar relation-Angle's class I and canine relation-Angle's class I with overjet of 3mm and overbite of 3mm.
7. Presence of all permanent teeth from second permanent molar to second permanent molar on both the arches.
8. Absence of crowding, rotation, dental\skeletal protrusions, cross bite, dental asymmetry, ectopic eruptions, supernumery teeth, retained deciduous teeth and deep curve of spee.

The following records were collected and were shown to senior orthodontist.

1. Lateral Cephalograms.
2. Models -Upper and lower
3. Facial photographs -

a) Front view
b) Right side view
c) Left side view
d) Teeth in occlusion, front view

All subjects were divided into three groups according to growth pattern on the basis of Steiner's Angle SN-GoGn (mean value 32^0), Jarabak Ratio (normal range 62%-65%), Tweed's angle FMA (mean value 25^0) and ratio of lower anterior facial height to total anterior facial height (45:55) and clinical judgment.

The rationale behind the use of these facial parameters is that one parameter is constructed from anatomic landmarks (S-Go/N-Me), while-the other parameter (FH:MP) involves a plane of orientation. This ensures that neither anatomic variation nor inaccurate orientation will, by itself, adversely influence the disposition of the cases with respect to their appropriate facial types.

a) Vertical grower.
b) Average grower.
c) Horizontal grower.

Radiographic Technique

The lateral Cephalograms were taken in self-balancing position, standing position at ease in an unstrained manner. With the Frankfort horizontal plane parallel to the floor and the teeth in centric occlusion, without allowing subjects to move and swallow while taking X-ray. Kodak X-ray films (8"x10") are exposed at 70 KvP; 30 mA from a fixed distance of 60 inches for two seconds by following the standard technique employed in the Department of Orthodontics & Dentofacial Orthopedics, College of Dentistry, Indore.

All Cephalograms were traced by the same operator. The lateral Cephalograms obtained were traced on acetate tracing sheets of 0.5-micron thickness with a sharp 4H pencil on a view box, using Tran illuminated

Light in a dark room, eliminating stray light. Angular and linear measurements were obtained nearest to 0.5° and 0.5 mm by ruler scale and protector.

The area was measured manually on the graph paper (1 square=1 sq.mm) enclosed within the de-

fined area. If the curved outline covered less than half area of a square, the particular square was excluded, and in cases where it was covered half or more of the square, the square in question was included.

To eliminate intra-operator error, 30 randomly selected Cephalograms were traced twice by the same operator to evaluate the reliability and reproducibility of landmarks and measurements. Minimal errors indicate that the measurements were reliable.

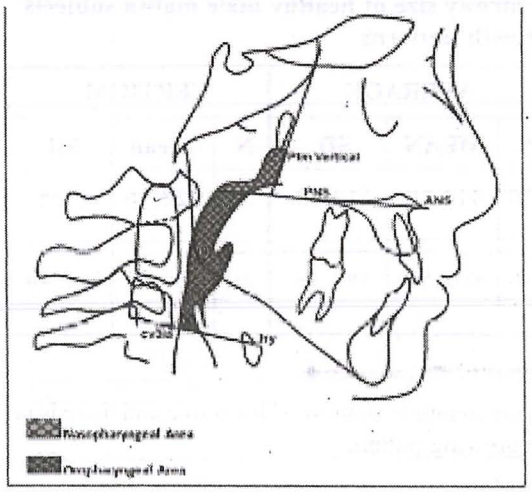


FIGURE 1: NASOPHARYNGEAL AND OROPHARYNGEAL AIRWAY SPACE

STATISTICAL ANALYSIS

The different measurements were collected from the tracing of Cephalograms of 180 subjects and tabulated then subjected to statistical analysis. 2x3 factorial design ANOVA (Analysis of variance) was applied to calculate the data.

The airway areas of nasopharynx and oropharynx were measured separately. The ptm vertical was used as the anterior border of the nasopharyngeal airway, and the ANS-PNS plane as the lower border. The ANS-PNS plane and the hy-cv3ia line as upper and lower borders of oropharyngeal air passage. [7]

CEPHALOMETRIC LANDMARKS

- **ptm** Pterygomaxillary point. Most inferior point on average of right and left outlines of pterygomaxillary fissure.
- **ANS** Tip of anterior nasal spine.
- **PNS** Tip of posterior nasal spine of palatine bone in hard palate.
- **Cv3ia** Most inferoanterior point on body of third cervical vertebra.
- **hy** Most superior and anterior point on body of hyoid bone.

FINDINGS

The present study was conducted on 180 lateral Cephalograms of Malwa subjects with normal occlusion. These subjects were classified based on facial growth patterns. Two area measurements were measured on the lateral Cephalograms. The observations made for the parameters were subjected to various statistical analysis for obtaining Mean, Standard Deviation and Standard Error of Mean etc. A comparison was made between values obtained for cases with horizontal facial growth pattern, vertical facial growth pattern, and average facial growth pattern of male and female subjects. The data thus obtained was used to study any relationship of these parameters between males and females between subjects of different growth patterns.

The distribution of sample based on growth pattern was 60- Horizontal growers (30-male and 30-female), 60 Vertical growers (30-male and 30-female) and 60-Average growers (30-male and 30-female). The means, standard deviations, minimum and maximum each group are presented in following tables.

From the above sample's observations we conclude that $M_1 \neq M_2$ & there is much significant difference between values of male & female and the average statistic for male is much greater than female at any level of significance.

H_0: $M_1 = M_2 = M_3$

H_1: $M_1 \neq M_2 \neq M_3$

Table 1

Showing mean & standard deviation of pharyngeal airway size of male & female healthy subjects of malwa region

S. No.	Parameters	MALE			FEMALE		
		N	Mean	SD	N	Mean	SD
1.	Nasopharyngeal area mm²	90	423.23	105.549	90	360.72	85.085
2.	Oropharyngeal area mm²	90	802.96	163.553	90	671.07	141.560

Table 2

Showing mean & standard deviation of pharyngeal airway size of healthy male malwa subjects exhibiting different growth patterns

S. No.	Parameters	HORIZONTAL			AVERAGE			VERTICAL		
		N	MEAN	SD	N	MEAN	SD	N	Mean	SD
1	Nasopharyngeal area mm²	30	426.63	115.59	30	414.30	113.53	30	428.76	88.38
2	Oropharyngeal area mm²	30	766.73	148.67	30	802.53	184.39	30	839.63	152.44

F=.00185, C.V. =5.17(at any level of significance)

Since calculated value of "F" is less than the critical value so null hypothesis (Ho) is true and there is no significant difference between male subjects of different growing pattern.

Table 3

Showing mean & standard deviation of pharyngeal airway size of healthy female malwa subjects exhibiting different growth patterns

S. No.	Parameters	HORIZONTAL			AVERAGE			VERTICAL		
		N	MEAN	SD	N	MEAN	SD	N	Mean	SD
1	Nasopharyngeal area mm²	30	369.36	76.56	30	349.26	80.35	30	363.53	98.37
2	Oropharyngeal area mm²	30	667.56	115.59	30	662.46	160.89	30	683.20	148.34

F=.0007861, C.V. =5.17(at any level of significance)

Since calculated value of "F" is less than the critical value so null hypothesis (Ho) is true and there is no significant difference between female subjects of different growing pattern.

Table 4

Influence of sex, growth pattern and their interaction on nasopharyngeal area Summary of 2x3 factorial design ANOVA (analysis of variance) for nasopharyngeal area

Source of Variance	SS	DF	mss	F-VALUE	Sig
Sex (A)	175843.75	1	175843.756	18.820	.000
Growth pattern (B)	9456.078	2	4728.039	.506	.604
A×B	619.144	2	309.572	.033	.967
Error	1625764.933	119	9343.477		
Total		124			

From table-4, it is evident that F value for sex is 18.820 which are significant at .05 levels. It indicates that the nasopharyngeal area for male and female differ significantly.

For male (423.233 mm² SD 105.519) is grater than female (360.7222 mm² SD 85.085).

The F value for growth pattern is 0.506 which is not significant. It shows that the mean nasopharyngeal area of peoples with different growth pattern do not differ significantly. In average growth pattern mean value is (381.783 mm² SD 102.884), for vertical growth pattern is (396.150 mm² SD 98.378) and in horizontal growth pattern is (398.00 mm² SD 101.403). Thus the nasopharyngeal area is independent of growth pattern.

Table 5

Influence of sex, growth pattern and their interaction on oropharyngeal area Summary of 2x3 factorial design ANOVA (analysis of variance for) oropharyngeal areas

Source of Variance	SS	DF	mss	F-VALUE	Sig
Sex (A)	782760.556	1	782760.556	33.403	.000
Growth pattern (B)	60626.678	2	30313.339	1.294	.277
A×B	26100.744	2	13050.372	.557	.574
Error	407481.933	119	23433.804		
Total		124			

From table-5, it is evident that F value for sex is 33.403 which are significant at .05 levels. It indicates that the oropharyngeal area for male and female differ significantly.

For male (802.966 mm² SD 163.553) is grater than female (671.0778 mm² SD 141.560).

The F value for growth pattern is 1.294 which is not significant. It shows that the mean oropharyngeal area of peoples with different growth pattern do not differ significantly. In average growth pattern mean value is (732.5000 mm² SD 185.541), for vertical growth pattern is (761.416 mm² SD 168.704) and in horizontal growth pattern is (717.150 mm² SD

141.182) thus the oropharyngeal area is independent of growth pattern.

DISCUSSION

Normal respiration denotes that nasal and pharyngeal structures are being used sufficiently (Subtelny)[7]. To breathe normally, it is necessary that not only there exists no nasal passage disease but also there exists no problem impeding the normal respiration, such as enlarged adenoid tissue and tonsil hypertrophy in the nasopharynx and oropharynx, respectively.

A normal nasal airway is dependent on sufficient anatomical dimensions of the airway. In addition, the size of nasopharynx is of particular importance in determining whether the mode of breathing is nasal or oral[4]. Subjects with a normal breathing pattern were included to this study.

Team of a general dentist, an artist, a senior orthodontist, and a layman selected 180 cases from records of 1500 people of various colleges and schools for this study. Various parameters SN-Go-Gn angle, Jarabak ratio, FMA angle, ratio of lower anterior facial height to total anterior facial height and clinical judgment were used to classify 180 cases into Average, vertical and horizontal growth patterns. After classifying them, naso and oro pharyngeal area were measured for each case. t-test was applied to each area measurement and t-value and p value was determined for each area. Each area was analyzed to find out sexual dimorphism (if any), and difference (if any) in different facial growth patterns with the help of (2x3) factorial design ANOVA (analysis of variance) test.

The graphical method was used to measure the different area because **Khanna et al. (1987)**[7] found that the difference between two readings obtained by graphical method was very minimal and statically insignificant while the difference between two readings obtained by the planimeter for the same area was statically significant.

Nasopharyngeal and Oropharyngeal area

Nasopharyngeal area for male and female differ significantly. For male (423.233 mm² SD 105.549) is grater than female (360.7222 mm² SD 85.085). [Figure. 2,3,4].

Oropharyngeal area for male and female differ significantly. For male (802.966 mm² SD 163.553) is grater than female (671.0778 mm² SD 141.560). [Figure. 2,3,4].

There was no significant difference in nasopharyngeal as well as oropharyngeal area due to change in growth pattern.

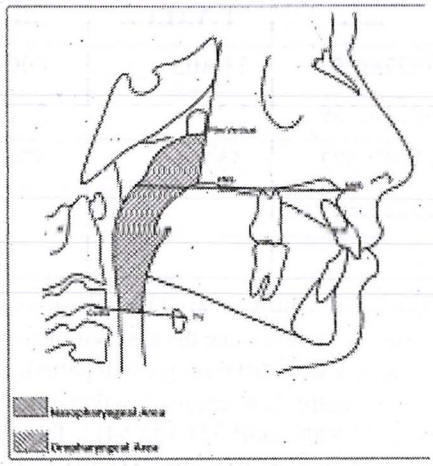


Fig. 2: Nasopharyngeal and Oropharyngeal Airway Space in Males

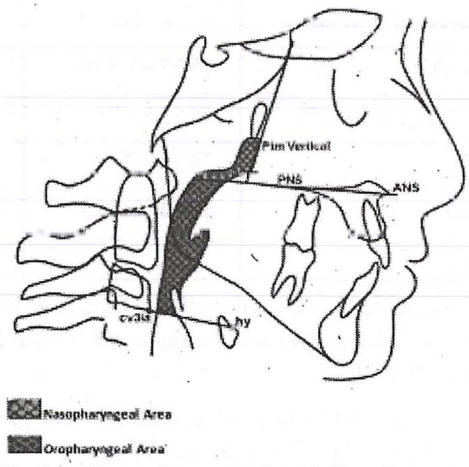


Fig 3: Nasopharyngeal and Oropharyngeal Airway Space in Females

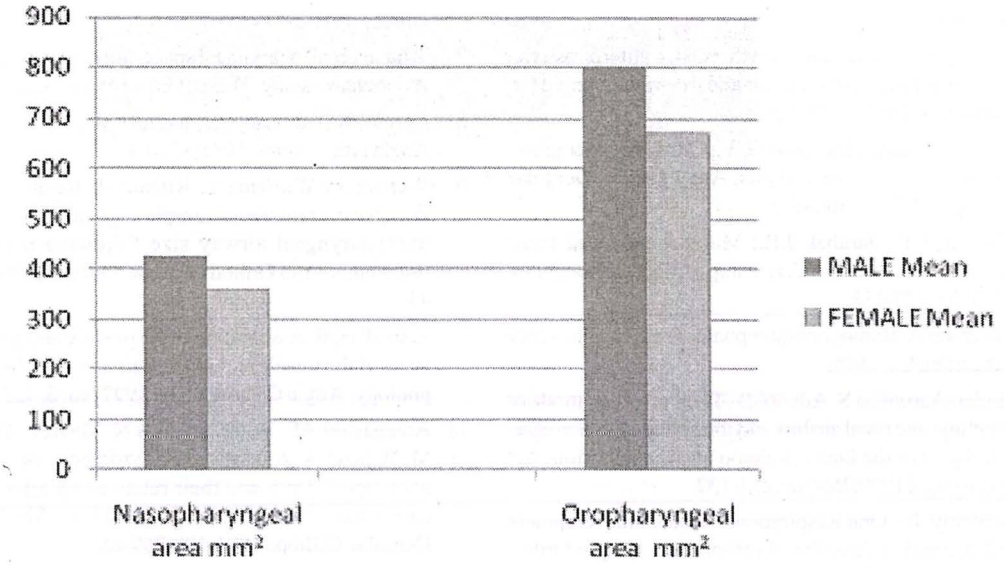


Fig 4: Bar chart showing Mean Values of Pharyngeal Airway Size of Male and Female Healthy Subjects of Malwa.

This finding is similar with the study of **Kerr (1985)**[8] who found that when no breathing problems or extreme facial growth pattern is present the structure and growth of the nasopharynx, specially in sagittal depth, is fairly independent relative to anterior dentofacial dimensions.

This finding is also supported by **Wenzel et al. (1989)**[9] in which they found that changes in nasopharyngeal airway size were not correlated to any changes in morphology apart from maxillary prognathism, nor to change in posture.

Carroll et al. (1997)[10] also revealed similar results. They found that lip posture, sagittal airway size, and tonsil size represents three different and unrelated phenomena with respect to their effects on craniofacial growth and form.

This finding is also supported by the study of **Athanasiou at al. (1991)**[11] in which they found that the posterior surgical mandibular repositioning does not reduce the airway at the level of the second and fourth cervical vertebrae. Additionally it is indicated that a reflex alteration in the pharyngeal musculature mechanism and the biochemical conditions of the supra and infrahyoid muscles takes place post operatively.

The study could be carried out for only males and females of different growth patterns with a large sample to continue this study. The same study could also be taken on frontal Cephalograms to measure transverse dimensions also.

Results :

1. Nasopharyngeal size - male (423.233 mm² SD 105.549)
   - female (360.7222 mm² SD 85.085).
2. Oropharyngeal size - male (802.966 mm² SD 163.553)
   - female (671.0778 mm² SD 141.560).

3. Relation nasopharyngeal and oropharyngeal size with growth pattern -

There was no significant difference in nasopharyngeal as well as oropharyngeal area due to change in growth pattern.

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