

ESTABLISHMENT OF PHARYNGEAL DIMENSIONS IN POPULATION OF HARYANA USING CEPHALOMETRIC RADIOGRAPHS

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ABSTRACT

A study for pharyngeal dimensions in normal healthy population of Haryana by utilizing digital radiographs was conducted with an objective to establish normal pharyngeal dimensions using cephalometric radiographs and to observe age and sex related variations in these dimensions. A total of 120 subjects participated in the study out of which 60 were males and 60 were females with the age varying from 18-60 years. Lateral cephalometric radiographs were obtained by using standardized technique. Measurement of depth of pharyngeal cavity was done at the level of hard palate (depth of nasopharynx), soft palate (depth of oropharynx), tongue base (minimum posterior airway space) and the vallecula (depth of hypopharynx) in the cephalometric radiographs by utilizing IPAX-DICOM software. In males the cavity was deeper than females only at the level of tongue base and vallecula. As age advances the depth of pharyngeal cavity at the level of soft palate and tongue base reduces in males. The females were showing the significant reduction at the level of soft palate only.

KEYWORDS: Pharynx, cephalometric, radiograph, morphometry.

INTRODUCTION:

The pharyngeal cavity functions as a conducting airway for ventilation of lungs as well as channel for fluids and food to the esophagus. It also forms a part of the chamber whose variations in shape is concerned with speech. The pharyngeal cavity from the posterior nasal opening to the inlet of larynx is having different dimensions. The variations in the dimensions of pharyngeal cavity will lead to disturbances in its functioning. The widening of pharyngeal cavity at the level of hard palate will lead to nasal voice as the soft palate cannot compensate and the air escapes into nasopharynx. The variations in the lumen make the pharynx prone to pathology so it is important to have data for normal pharyngeal cavity dimensions in a given population. The pharyngeal cavity dimensions show variations with regard to different races, sex and age². So, in the present study by using lateral head radiographs, pharyngeal cavity dimensions at various levels in mid sagittal plane were measured to have normal data for the population of Haryana.

MATERIAL AND METHODS:

Consent was taken from the 120 subjects out of which

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60 were males and 60 were females. Ages varied from 18-60 years and all belonged to the Haryana State. Both the male and female subjects were separated into three groups. All the age groups of adult population varying from 18-60 years were studied by dividing into three groups according to age, Group A 18-30 years, Group B 31-45 years and Group C 46-60 years. Each individual group males and females were compared with each other. Further inter group comparison was also done.

After examining ear, nose and throat to exclude the pathology of pharynx, lateral cephalometric radiographs of all the individuals were taken with standardized technique. Data was recorded on a predesigned proforma. Data management was done on excel spreadsheets. All entries were checked for any keyboard error. Student "t" test was used to analyze mean depth of pharyngeal dimensions at various levels between various groups and males and females of same group.

STATA 9.0 software was used for all statistical calculations. In the present study p value <0.05 has been taken as statistically significant. Measurement of depth of pharyngeal cavity was done at following levels:

- (i) Hard palate (depth of nasopharynx),
- (ii) Soft palate (depth of oropharynx),
- (iii) Tongue base (minimal posterior airway space)
- (iv) Vallecula (depth of hypopharynx)

The measurement points on the pharyngeal wall were

	Parameter	Age group			p- value		
		Group A (18-30yrs)	Group B (31-45yrs)	Group C (46-60yrs)	Group A Vs B	Group B Vs C	Group A Vs C
1.	Depth of nasopharyngeal airway(mm)	24.51±0.51	23.74±0.55	24.10±0.45	>0.05	>0.05	>0.05
2.	Depth of oropharyngeal airway(mm)	11.16±0.35	9.79±0.41	9.28±0.30	>0.05	>0.05	<0.05
3.	Shortest distance from the base of tongue to the posterior pharyngeal wall(mm)	10.7±0.46	9.85±0.44	9.43±0.30	>0.05	>0.05	>0.05
4.	Depth of hypopharyngeal airway(mm)	12.87±0.42	12.92±0.52	12.67±0.33	>0.05	>0.05	>0.05

Table I: Comparison of pharyngeal dimensions between various age groups in females

S.N.	Parameter	Age group			p- value		
		Group A (18-30yrs)	Group B (31-45yrs)	Group C (46-60yrs)	Group A vs B	Group B vs C	Group A vs C
1.	Depth of nasopharyngeal airway	25.73±0.70	25.38±0.48	25.57±0.50	>0.05	>0.05	>0.05
2.	Depth of oropharyngeal airway(mm)	12.68±0.52	10.95±0.50	9.95±0.47	>0.05	>0.05	<0.05
3.	Shortest distance from the base of tongue to the posterior pharyngeal wall(mm)	13.27±0.61	11.56±0.42	10.89±0.41	>0.05	>0.05	<0.05
4.	Depth of hypopharyngeal airway(mm)	15.24±0.64	15.4±0.46	15.69±0.33	>0.05	>0.05	>0.05

Table II: Comparison of pharyngeal dimensions between males of various age groups

Sr.No.	Measurement (in mm)	Age Group	Sex				p-value
			Male		Female		
			Mean	SD	Mean	SD	
1.	Depth of nasopharyngeal airway	Group A (18-30 years)	25.73±0.70	3.14	24.51±0.51	3.10	>0.05
		Group B (31-45 years)	25.38±0.48	2.14	23.74±0.55	2.44	>0.05
		Group C (46-60 years)	25.57±0.50	2.25	24.10±0.45	2.01	>0.05
2.	Depth of oropharyngeal airway	Group A (18-30 years)	12.68±0.52	2.33	11.16±0.35	1.60	>0.05
		Group B (31-45 years)	10.95±0.50	2.24	9.79±0.41	1.86	>0.05
		Group C (46-60 years)	9.95±0.47	2.11	9.28±0.30	1.35	>0.05
3.	Shortest distance from the base of tongue to the posterior pharyngeal wall	Group A (18-30 years)	13.27±0.61	2.7	10.70±0.46	2.07	<0.05
		Group B (31-45 years)	11.56±0.42	1.9	9.85±0.44	1.97	<0.05
		Group C (46-60 years)	10.89±0.41	1.83	9.43±0.33	1.47	<0.05
4.	Depth of hypopharyngeal airway	Group A (18-30 years)	15.24±0.64	2.8	12.87±0.42	1.88	<0.05
		Group B (31-45 years)	15.4±0.46	2.67	12.92±0.52	2.35	<0.05
		Group C (46-60 years)	15.69±0.33	1.51	12.67±0.33	1.49	<0.05

Table III: Comparison of Pharyngeal dimensions between males and females of various groups

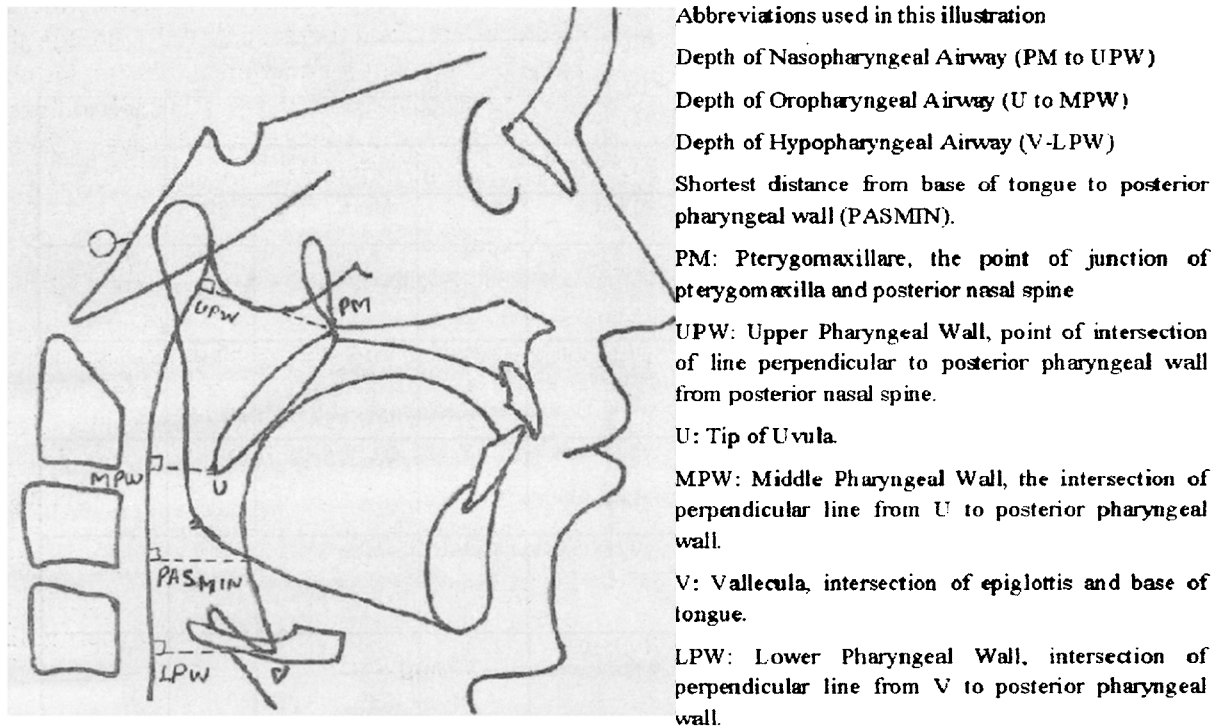


Figure:1 - Diagram to illustrate parameters measured in the study.

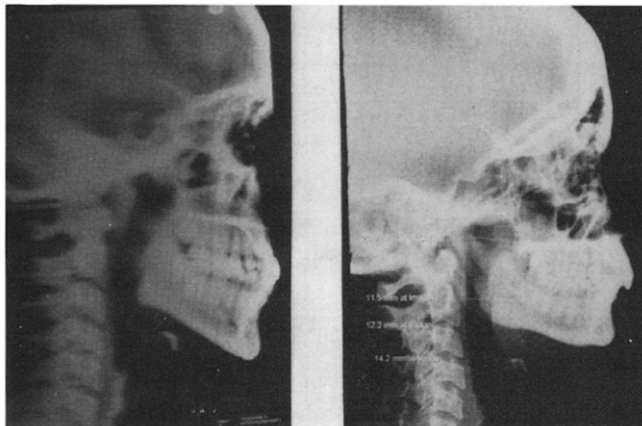


Figure:2- Cephalometric radiographs on male (on right side) and female (on left side) subjects.

taken such that the measurements were perpendicular to the entering and leaving air column. The measurements were made in the cephalometric radiographs by utilizing IPAX-DICOM software.

RESULTS:

The results of the present study are shown in tables I - III. Table I shows Comparison of pharyngeal dimensions between various age groups in females. It shows that depth of oropharyngeal airway was significantly higher in group A versus group C (P<0.05). Table II shows Comparison of pharyngeal

dimensions between males of various age groups. It shows that the depth of oropharyngeal airway and shortest distance from the base of tongue to the posterior pharyngeal wall are significantly higher in group A as compare to group C.

DISCUSSION:

The pharyngeal dimensions were studied by many scientists first two decades of life while studying soft tissue growth around pharyngeal wall^{2,3,4}. Little information seemed to be available regarding pharyngeal dimensions of adult population. However, it was known that these dimensions are altered as the surrounding soft tissue kept on altering with age⁵. Although studies were done also in adult population in cases of obstructive pharyngeal airway and sleep apnoea^{6,7,8}. These cases showed some change in the anatomy of the pharyngeal cavity. Information regarding normal pharyngeal dimensions in adult is lacking in literature. The present study was carried out in subjects representing normal adult healthy population of Haryana.

Magnetic resonance imaging represents the best upper airway anatomy. It was used by Daniel et al for establishing normal pharyngeal dimension in Brazilian population⁹. Though dimension can be

measured by using magnetic resonance imaging but this facility is not available in every part of India and specialized person are required for its operation. So in our country setup it may not be possible to work with magnetic resonance imaging everywhere. Computerized tomography is other good option for studying upper airway anatomy that was used for studying upper airway and the surroundings soft tissue but the radiation exposure with that technique was very large¹⁰. Acoustic reflection technique was used by Martin et al and Brown et al for measuring cross section area of pharyngeal airway^{1,12}. This technique also requires special instrument and machines. So when we considered the cost effectiveness, availability and radiation exposure digital radiography was found to be the best investigation.

Although males apparently showed more depth of naso-pharyngeal and oro-pharyngeal airways than females of same age but these were insignificant statistically. The two levels where the pharyngeal airway of males and females showed significant differences were; (1) shortest distance between the base of tongue and posterior pharyngeal wall (PASMN); (2) depth of hypopharyngeal airway (i.e. distance between vallecula and posterior pharyngeal wall). This was in accordance with the study conducted by Brown et al by using acoustic reflection which showed females having a less cross sectional area of pharyngeal airway than males¹¹. Our findings were supported by the study conducted by Shen et al in Chinese population¹². Daniel in his study with MRI in 10 males and 10 females showed that there were no difference in the pharyngeal dimension of males and females but the sample size was too small to comment on gender differences⁹. The difference in the depth of pharyngeal airway can be due to difference in craniofacial complex of males and females¹³.

The depth of nasopharyngeal airway remained almost unchanged throughout various age groups at all levels in this study irrespective of sex. These results were in accordance with Tourne who concluded that nasopharyngeal dimensions were established earlier in life and there is little change with maturity². The depth of pharyngeal airway was decreasing at the soft palatal level (depth of oropharynx) and at the dorsum of tongue with increasing age from Group A to C in both males and females. The minimum distance from the dorsum of tongue to pharyngeal wall was showing significant reduction only in males but the depth of oro-pharyngeal airway at the tip of soft palate showed the significant decrease in both sexes. This is in

accordance with the study conducted by Martin et al by using acoustic reflection¹. With the age the soft palate and tongue undergoes changes in their size that could be the possible reason of alterations in the dimensions of the pharyngeal airways at the level of soft palate and tongue with the age^{10,14,15}

CONCLUSIONS:

The results of present study show that as that as age advances from 18 to 60 years, the depth of pharyngeal cavity at the level of soft palate and tongue base decreases. The males of showed a statistically significant reduction in the depth of pharyngeal cavity at the level of soft palate and tongue while the females showed the statistically significant reduction at the level of soft palate only. We conclude from this study that significant narrowing in the depth of pharyngeal cavity at the level of soft palate and tongue base is a normal finding with advancing age.

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