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### Original Article

# A study of the distance between the free edges of Medial Pterygoid Plates in the Skulls of Central Indian Population

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#### ABSTRACT

**Objective:** To stabilize the craniometric data for central Indian population and to find out any sexual dimorphism in distance between the free edges of medial Pterygoid plates in the nasopharyngeal region. **Method:** The present study was conducted on three hundred fourteen dry skulls of central India region. The dry skulls taken for study are first examined to determine the sex of the skull then various measurements of the distance between the free edges of medial Pterygoid plates were taken and compared to find out any sexual dimorphism. The maximum transverse distance between free edges of medial pterygoid plates has been measured at three sites-

Site-I : At the uppermost part where the pterygoid plates meet the body of sphenoid bone,

Site-II : At middle of pterygoid plates,

Site-III : At the level of posterior free margin of hard palate.

**Results:** At the site I, the average distance between free edges of medial pterygoid plates for male cases and female cases were 27.84(2.44) mm and 26.93(2.45) mm respectively. At the site II, the average distance between free edges of medial pterygoid plates for male cases and female cases were 29.32(2.86) mm and 28.25(2.57) mm respectively. At site III, the average distance between free edges of medial pterygoid plates for male cases and female cases were 0.44(2.50) mm and 29.54(2.77) mm respectively. For all the three sites, the average values for the male cases were significantly higher as compared with the female cases (P 0.05).

**Conclusion:** This study shows that the distance between the free edges of medial Pterygoid plates in the skulls of central Indian population is slightly lower than that mentioned in other studies and the distance between the free edges of medial Pterygoid plates were found significantly higher in the male skulls than female skulls.

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### 1. Introduction

Pharynx is a 12-14 cm long musculomembranous tube shaped like an inverted cone; it extends from the cranial base to the lower border of cricoid cartilage (at the level of sixth cervical vertebra) where it becomes continuous with the Oesophagus.

The pharynx is subdivided into Nasopharynx, Oropharynx and Laryngopharynx. This subdivision of the pharynx is used in most modern textbooks of Anatomy, and the Nasopharynx is described as the upper portion of the pharynx lying above the soft palate and

behind the posterior nares, which allows the free respiratory passage between the nasal cavity and lower airway. Nasopharynx is an open Cuboidal chamber that lies beneath base of skull at the posterior aspect of nasal fossa. The Nasopharynx measures 4.0-5.5 cm transversely, 2.5-3.5 cm antero-posteriorly and roughly 4.0 cm in height [1].

The nasal and oral part of the pharynx communicates through the pharyngeal isthmus, which lies between the posterior border of the soft palate and the posterior pharyngeal wall. Elevation of the soft palate and constriction of the palatopharyngeal isthmus occurs during swallowing

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The walls of the Nasopharynx are rigid except for the soft palate therefore the cavity of the Nasopharynx is never obliterated unlike the cavity of the Oropharynx and Laryngopharynx [2]. The Nasopharynx has a roof, a posterior wall, two lateral walls and a floor.

The roof and posterior wall form a continuous slope that leads down from the nasal septum to the Oropharynx. It is bounded above by the mucosa overlying the posterior part of the body of sphenoid and further backs the basilar part of the occipital bone as far as pharyngeal tubercle, further down the mucosa overlies the Pharyngobasilar fascia and the superior constrictor and behind these the anterior Arch of the Atlas.

The Nasopharyngeal tonsil lies in the midline in the roof and posterior wall. The superior constrictor and fascia completes the posterior wall [3].

It is a non-expansible sheet of fascia. Pharyngobasilar fascia is thick above where muscular fibers are absent and starting at the Pharyngeal tubercle of basioccipital bone passes laterally anterior to the longus capitis muscle. It is firmly attached to the basilar occipital and petrous temporal bones medial to the carotid canal, curving under the auditory tube and forwards to the sharp posterior border of medial pterygoid plate and pterygomandibular raphe. As it descends it diminishes in thickness but is strengthened posteriorly by a fibrous band attached to the occipital's pharyngeal tubercle and descending as the median raphe of constrictors. This provides firmness to the nasopharyngeal wall to help it in keeping its patency [2-4].

From above anatomical knowledge we know that the Nasopharynx has bony relations in the roof and posterior wall by body of sphenoid and occipital bone and also to the atlas and axis vertebra. On anterior side the posterior nares are bounded both side by the medial pterygoid plates. Only the lateral wall in its posterior part is muscular (superior constrictor muscle).

So if there are any deformities in the normal development of skull in this region it leads to variation in the size of the Nasopharynx.

As we know that Nasopharynx is a communication between nose and rest of the respiratory apparatus, any variation in the size of the Nasopharynx leads to disturbed respiratory function.

Syndrome related to sleep disorder called, as 'sleep apnea syndrome' in which there is difficulty in breathing during the sleep. Restricted bony pharynx is one of the causes of sleep apnea syndrome [5]. The knowledge that sleep apnea commonly results from upper airway obstruction rises the questions How, Where and why the airway is obstructed. The answers to these questions may continue to provide the basis for the management of patients with obstructive sleep apneas (OSA) through the development of therapies designed to eliminate the airway closer. Understanding the airway occlusion in patients of sleep apnea will be facilitated by first considering the normal Anatomy and Physiology of the upper airway [6].

Instrumentation of Nasopharynx like nasopharyngoscopy and nasogastric intubation will also need the normal structure and dimension of the region to be known for meticulous manipulation of instruments as well as for their better designing.

The cases of nasopharyngeal carcinoma are common and the knowledge of anatomy of Nasopharynx and its relations is useful in interpretation of images for investigative purpose and understanding the course of spread of carcinoma.

While going through the available literature on Nasopharynx it was found that data regarding its measurements are scanty. Therefore the current study was proposed. It was decided that various dimensions determining the size of Nasopharynx be measured at the base of skull and the variations and sexual dimorphism be noted if any.

**OBJECTIVE:** To stabilize the craniometric data for central Indian population and to find out any sexual dimorphism in the distance between the free edges of medial Pterygoid plates in the nasopharyngeal region.

## 2. Material and Methods

The present study was conducted in the department of anatomy at NSCB Medical College Jabalpur India, from August 2005 to July 2007. Total 314 dry skulls of central India region were taken for this study. The skulls were selected only after confirming that there was intact base of skull especially in the anterior cranial fosse & middle cranial fosse region. The skulls taken for study are of adult to old age groups where development in the Nasopharyngeal region has completed.

The dry skulls taken for this study was first examined for determine the sex of the skull. With the help of various traits, we first determined the probable sex of the skull. When the skull shows more points towards male, it was marked male and the same criteria taken for female skull.

The instruments used in present study for the measurement size of are a metallic scale (having calibrations of 0.5 millimeter) and a spreading caliper. The spreading caliper is spreaded between the two bony points to be measured and fixed. The fixed caliper is then matched with the calibrations on the scale and the reading is taken. Each reading was repeated twice to rule out any manual error.

The parameter measured in this study is maximum transverse distance between free edges of medial pterygoid plates. This has been measured at three sites-

Site-I : At the uppermost part where the pterygoid plates meet the body of sphenoid bone,

Site-II : At middle of pterygoid plates,

Site-III : At the level of posterior free margin of hard palate.

**Photo-1. Maximum transverse distance between free edges of medial pterygoid plates at site I (at the uppermost part where the pterygoid plates meet the body of sphenoid bone).**



**Photo-2. Maximum transverse distance between free edges of medial pterygoid plates at Site II (at the level of middle of pterygoid plates).**



**Photo-3. Maximum transverse distance between free edges of medial pterygoid plates at Site III (at the level of posterior free margin of hard palate).**



## 2.1. Statistical analysis

Statistical analysis was carried out with appropriate statistical software. All results were expressed as mean with their standard deviation (mean=SD). A p value of < 0.05 was considered significant.

## 3. Results

**Table no-1. Mean distance between free edges of medial pterygoid plates at position -I.**

SEX	N	Mean	SD	Minimum	Maximum
Male	219	27.84	2.44	23.0	36.5
Female	95	26.93	2.45	21.0	33.0
Total (M+F)	314	27.56	2.47	21.0	36.5

**Z= 3.42; P<0.001**

The average distance between free edges of medial pterygoid plates at position -I is presented in this table. The average value for male cases and female cases were 27.84(2.44) mm and 26.93(2.45) mm respectively. The range for male cases was 22 to 36.5 mm and for females it was 21 to 33mm. The average value for male cases was significantly higher as compared with the female cases. (P 0.001).

**Table no-2. Mean distance between free edges of medial Pterygoid Plates at position -II.**

SEX	N	Mean	SD	Minimum	Maximum
Male	219	29.32	2.86	21.0	35
Female	95	28.25	2.57	23.0	33
Total (M+F)	314	28.64	2.78	21.0	35

**Z= 2.45; P<0.05**

The average distance between free edges of medial pterygoid plates at position -II is presented in this table. The average value for male cases and female cases were 29.32( 2.86) mm and 28.25( 2.57) mm respectively. The range for male cases was 21 to 35 mm and for females it was 23 to 33mm. The average value for male cases was significantly higher as compared with the female cases (P 0.05).

**Table-3. Mean distance between free edges of medial Pterygoid plates at position -III.**

SEX	N	Mean	SD	Minimum	Maximum
Male	219	30.44	2.50	24	38
Female	95	29.54	2.77	24	39
Total (M+F)	314	30.17	2.61	24	39

**Z= 3.14; P<0.005**

The average distance between free edges of medial pterygoid plates at position-III is presented in this table. The average value for male cases and female cases were 30.44(( 2.50) mm and 29.54( 2.77) mm respectively. The range for male cases was 24 to 38mm and for female it was 24 to 39mm. The average value for male cases was significantly higher as compared with the female cases (P 0.005).

#### 4. Discussion

Nasopharynx has always been an area of special interest for workers of various disciplines. Its situation at the base of the skull has attracted attention during craniometry. Craniometrical measurements have been done and attempts have been made to stabilize a proper relationship between size of the mandible and the Nasopharynx [7].

Being associated with important vital functions like respiration, Nasopharynx has attracted attention of otorhinolaryngologists. Young children with difficulty in breathing are found to have enlarged lymphoid tissue in the posterior pharyngeal wall. The calculation of Adenoid -Nasopharyngeal ratio has been suggested for assessment of adenoidal hypertrophy, as adenoidectomy will not be effective in cases of stenosis of bony Nasopharynx [8, 9]. A another study demonstrated that the upper airway was smaller in children with 'Sleep Apnoea Syndrome' in comparison with control subjects whereas the volume of tongue and mandible were same in both cases [10]. Transverse measurements of Nasopharynx are done to estimate the width of operating field in cases planned for Transsphenoidal Hypophysectomy [11].

Cephalometric studies have been used for many years for evaluation of growth and development of face. In recent past various sleep disorders like snoring, sleep apnoeas and upper airway diseases has drawn the attention of scientists for study of measurement of Nasopharynx. Radiological and Imaging techniques have been used for measurement of nasopharyngeal dimensions.

The present study was conducted on three hundred fourteen dry skulls of central India region. Various measurements of the Nasopharyngeal region were taken. The purpose of the study is to stabilize data for central India population and to find out if there is any sexual dimorphism.

A measurement for transverse diameter of Nasopharynx is the distance between the free edges of medial Pterygoid plates which was measured at three places in our study –

Site- I. Where the Pterygoid plates meet the Sphenoid bone - 27.564± 2.47mm

Site- II. At the Middle of the Pterygoid plates - 28.64±2.78mm

Site- III. At the level of hard palate - 30.17±2.61mm

The various patterns are observed in the distance between the medial Pterygoid plates as we go downwards from position I to position III.

In 68.79 % Medial Pterygoid plate deviate from each other.

In 17.2 % cases the Medial Pterygoid plates are parallel,

In 06.05% cases the Medial Pterygoid plates are narrowest in the middle,

In 05.73 % cases the Medial Pterygoid plates moves closer as we go down from position I –III.

And in 2.23 % cases the Medial Pterygoid plates are broadest in the middle. These findings are compared with that of Kobayashi H, Kato I and Terabayashi T [12].

Mean distance between medial Pterygoid plates	
Kobayashi H, Kato I and Terabayashi T	Site I - 27.56± 2.47mm
In present study	Site II. - 28.64±2.78mm
	Site III. - 30.17±2.61mm

Kobayashi H, Kato I and Terabayashi T.[12] also measured the distance between the right and left Medial Pterygoid plates in twenty-seven normal adults from antero-posteriorly Tomograms. They observed the mean distance between Medial Pterygoid plates about 32mm. They related this value for the calculation of actual operating field, which was about 1cm less than the distance between the Medial Pterygoid plates. The space was calculated for Sublabial transeptal transsphenoidal Hypophysectomy in Asiatic type of skull. They did not mention that at which site, they measured the distance between the Medial Pterygoid plates.

We measured the distance between the free edges of Medial Pterygoid plates at three sites. All values of our measurements are lower than as mentioned by Kobayashi H, Kato I and Terabayashi T.

#### 4. Discussion

This study shows that the distance between the free edges of medial Pterygoid plates in the skulls of central Indian population is slightly lower than that mentioned in other studies and the distance between the free edges of medial Pterygoid plates were found significantly higher in male skulls than female skulls in central Indian population.

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