

Original Research Article

## Study of anatomic position of Pterion in dry human skulls in Karnataka

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**Abstract:** Pterion is H-shaped sutural junction wherein the frontal and parietal bones superiorly, greater wing of sphenoid and squamous temporal inferiorly of one side meet. It is an important neurosurgical and anthropometric landmark in the temporal fossa. The aim of the study is to determine and map the position of the pterion in relation to two bony landmarks namely the Frontozygomatic suture and the midpoint of zygomatic arch and also to compare the findings on right and left sides. The prospective study was done for a period of two years in the Department of Anatomy at Kempegowda Institute of Medical Sciences and Research center, Bengaluru. A total of 100 unsexed dry human skulls from bone sets possessed by first year students of Kempegowda Institute of Medical Sciences and Research center, Bengaluru were evaluated for the position of pterion. Frontozygomatic suture and midpoint of the zygomatic arch were used in locating pterion. The mean distance between the center of the pterion and the fronto-zygomatic suture is 3.062cms on right side and 3.038cms on left side whereas the mean distance between the midpoint of zygomatic arch and pterion is 3.783cms on right side and 3.799cms on left side. No statistically significant side-difference is found in the location of the pterion from the midpoint of the zygomatic arch as well as from the fronto-zygomatic suture. To conclude, the two measurable distances, one from the zygomatic arch and the other from the frontozygomatic suture could be used to precisely determine the center of pterion.

**Keywords:** Pterion, human skulls, Frontozygomatic suture, mid point of zygomatic arch

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### INTRODUCTION

The term Pterion is derived from the greek word “pteron” which means wing[1]. Pterion is a small circular area which is a H-shaped sutural junction wherein the frontal and parietal bones superiorly, greater wing of sphenoid and squamous temporal inferiorly of one side meet[2]. It is an important neurosurgical and anthropometric landmark in the temporal fossa where facial skeleton, calvaria and skull base meet. It is an important landmark for anterior branch of middle meningeal artery, Broca’s motor speech area to the left, insula and the lateral (sylvian) cerebral fissure[3]. Pterion corresponds to the site of the antero-lateral fontanelle of the neonatal skull, which closes in the third month after birth. It usually lies 4.0cms above the zygomatic arch and 3.5cms behind the frontozygomatic suture[2].

In neurosurgery, successful treatment of pathologies with minimally invasive procedure is the main objective [4]. Pterional (Frontotemporal) craniotomy is the most common neurosurgical approach

for microsurgical clipping of intracranial aneurysms. Typically, a 5 to 7 cm bone flap centered on the pterion is elevated, providing the neurosurgeon with excellent exposure to the anterior circle of Willis. This approach is beneficial for access to almost all aneurysms of the anterior circulation (anterior communicating artery, ophthalmic artery, anterior choroidal artery, posterior communicating artery, internal carotid artery and middle cerebral artery bifurcation aneurysms) as well as for some basilar artery aneurysms[5-8]. The anatomical location of the pterion is also important in operations reducing an extradural hematoma, as well as for inferior tumors of the frontal lobe and operations on Broca’s motor speech area on the left side. In addition, the pterion is an important landmark in operations on the optic nerve using the “pterional approach[9-12].

The pterion is also commonly used in cranial structure closure methodology as an important guide for age estimation and sex determination in archeological and forensic specimens [13].

The position of the pterion however cannot be discerned easily because it is usually covered by scalp. Also, position of Pterion exhibits variations among different racial population. Thus, detailed information of pterional position can only reliably be obtained from examination of dry skulls. Hence, this study was taken up to determine the position of the pterion using the midpoint of the zygoma and the frontozygomatic suture as palpable points in dry human skulls.

#### Objectives of the Study

- 1) To determine and map the position of the pterion in relation to two bony landmarks namely the FZ suture and the midpoint of zygomatic arch.
- 2) To compare the findings on right and left sides.

#### MATERIALS AND METHODS

100 unsexed adult human skulls collected from the department of Anatomy and Forensic Medicine at Kempegowda Institute of Medical Sciences and from other Medical and Dental colleges in and around Bengaluru. All human skulls (irrespective of sex) with intact calvaria, well defined sutures and erupted third molar teeth were included in the study. Damaged skulls, old skulls with obliterated sutures and skulls of newborn, infants and children were excluded from the study. Vernier calipers (Figure 1) of 0.2mm accuracy and a digital camera were used for the study. Two linear measurements (Figure 2 and 3) were taken on the external aspect of the skull from the center of the pterion to determine its location. One measurement was taken vertically from the center of the pterion to the midpoint of zygomatic arch (MZ) and other was taken from center of the pterion to the frontozygomatic suture (FZS) anteriorly. The measurements were taken on both sides of the skull. Each of the measurements were taken twice then averaged so as to minimize bias errors.



Fig-1: Vernier calipers of 0.2mms accuracy



Fig-2: Measuring distance from center of pterion to Midpoint of Zygomatic arch.



**Fig-3: Measuring distance from center of pterion to Frontozygomatic suture.**

Findings of position of pterion were noted. Values were recorded separately on right and left sides and compared. Values were also be compared with previous studies for their statistical significance.

It is an observational study, the data collected in this study were analysed statistically using descriptive statistics like percentages, mean and standard deviation. The statistical analysis was done using SPSS 16.0 software. To compare between right and left sides, One-Way ANOVA (Analysis of Variance) was used.

**RESULTS**

The maximum and minimum distances from frontozygomatic suture and Midpoint of zygomatic arch

to the center of the pterion are shown in Table 1. The means and associated standard deviations of the measurements taken from the center of pterion are shown in Table 2. The mean distances measured from the center of the pterion to the anteriorly placed frontozygomatic suture were 3.062 on right side and 3.038 on left side. The mean vertical distances measured from the center of the pterion to the inferiorly placed zygomatic arch (midpoint) were 3.783 on right side and 3.799 on left side.

No statistically significant differences were found between right and left sides, in the location of the pterion from the midpoint of the zygomatic arch as well as from the frontozygomatic suture.

**Table 1: Maximum and Minimum distances from FZS & MZ on right and left sides.**

Distance	Maximum		Minimum	
	Right	Left	Right	Left
From FZS suture to the center of Pterion.	4.2cms	4.3cms	1.9cms	2.0cms
From midpoint of Zygomatic arch to center of Pterion.	4.7cms	4.4cms	3.1cms	3.0cms

**Table 2: Mean, Standard deviation, ‘f’ and ‘p’ values for location of pterion.**

Distance	Mean		Standard Deviation		‘f’ and ‘p’ values	
	Right	Left	Right	Left	‘f’ value	‘p’ value
From Frontozygomatic suture to the center of pterion.	3.062	3.038	0.424	0.422	0.161	0.689
From midpoint of Zygomatic arch to the center of the pterion.	3.783	3.799	0.310	0.316	0.131	0.718

**DISCUSSION**

Knowledge pertaining to pterional location and its relation to surrounding bony landmarks is important, especially with respect to neurosurgery. Pterional craniotomy is one of the most common and versatile

approaches for the neurosurgeons because its use is amenable for gaining access to many lesions and tumors of the brain located in the anterior and posterior circulation, sylvian fissure, sellar and parasellar regions, superior orbital fissure, sphenoidal wing, cavernous

sinus, orbit, optic nerve, mesial temporal lobe, midbrain and posterior-inferior frontal lobe[4,14-23]. The Pterional approach has several advantages over traditional craniotomy that includes minor tissue damage, less brain retraction, a superior cosmetic result and shorter duration of surgery[17].

The pterion has been reported to lie 4.0cms above the zygomatic arch and 3.5cms behind the Frontozygomatic suture[2]. The location of the pterion shows lot of regional variations as seen in different studies on Indian population (Table 3). In the present study the pterion was 3.78 +/- 0.31cms and 3.80 +/- 0.32cms above the zygomatic arch, and 3.06 +/- 0.42cms and 3.04 +/- 0.42cms behind the frontozygomatic suture on the right and left sides respectively.

According to study done in skulls from Gujarat region by Ankur Z *et al*[24], the distance between the center of pterion to the frontozygomatic suture was

more than the vertical distance from the midpoint of the zygomatic arch. However, in our study, the distance between the center of pterion to the frontozygomatic suture was less than the distance from the midpoint of the zygomatic arch.

The findings in our study were consistent with studies done by S Hussain *et al*[25], Suchit *et al*[26], Seema *et al*[27] and Hariprasad *et al*[28]. However, in our study the distance from frontozygomatic suture to the center of the pterion is just above 3.0cms, which is marginally shorter compared to other studies.

No statistically significant differences were found between right and left sides, in the location of the pterion from the midpoint of the zygomatic arch as well as from the frontozygomatic suture. This indicates that the pterion can reliably be located using the frontozygomatic suture and midpoint of zygoma. This is in tandem with other studies.

**Table 3: Comparison of location of pterion in different populations.**

Study / Population	Distance (cms)			
	From FZS to the center of Pterion.		From midpoint of Zygomatic arch to the center of Pterion.	
	Right	Left	Right	Left
Ankur Zalawadia <i>et al</i> [24], Gujarat, n=42.	3.73 +/- 0.51	3.55 +/- 0.42	3.12 +/- 0.44	2.97 +/- 0.33
Hussain S S <i>et al</i> [25], South India, n = 125	3.47 +/- 0.48	3.40 +/- 0.45	3.90 +/- 0.35	3.78 +/- 0.35
Suchit Kumar <i>et al</i> [26], Uttarakhand, n = 40	3.25 +/- 0.11	3.25 +/- 0.11	3.76 +/- 0.66	3.76 +/- 0.66
Seema & Mahajan A[27], North India, n=50	3.1 +/- 0.44	3.4 +/- 0.40	4.1 +/- 0.45	4.4 +/- 0.32
Hari Prasad N <i>et al</i> [28], North India, n = 50	3.20 +/- 0.39	3.11 +/- 0.40	3.71 +/- 0.39	3.68 +/- 0.35
Present Study, Karnataka, n=100.	3.06 +/- 0.42	3.04 +/- 0.42	3.78 +/- 0.31	3.80 +/- 0.32

## CONCLUSION

To conclude, pterion can be used as a guiding point where the position of deeper structures and their relations to the surface of the head may be explained. The recognizable external bony landmarks namely zygomatic arch and frontozygomatic suture could be used to precisely determine the center of pterion. Also, since there was minimal side differences in all measurements used to locate the pterion, this landmark can be reliably located. This information may be useful in planning prior to surgery especially where neuronavigation devices are scarce.

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