

Anthropometric Evaluation of Pterion in Dry Human Skulls Found in Southern India

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ABSTRACT

BACKGROUND

Pterion is a H-shaped sutural convergence seen in the Norma Lateralis of skull. After 2-3 months of birth, the anterolateral fontanelle in the neonatal skulls close to form the pterion. It is the meeting point of four bones sphenoid, parietal, temporal and frontal. Four types have been noted- sphenoparietal, fronto-temporal, epipteric and stellate. Pterional approach is commonly undertaken in surgical management of tumours involving inferior aspects of frontal lobe, like olfactory meningiomas, orbital, retro-orbital, sellar, chiasmatic, subfrontal, prepontine areas, anterior circulation and basilar artery aneurysm. The knowledge regarding the various shapes and distances from different points to pterion (distance of centre of pterion was calculated from mid-point of superior margin of zygomatic arch (PZA), Frontozygomatic suture (PFZ), tip of the mastoid process (PMP), and anterosuperior margin of external acoustic meatus (PEAM)) is useful for treating number of pathologies in brain. So, this is also useful for neurosurgeons, anatomists, anthropologists and forensic medicine specialists. In the present study, we have attempted to classify the type of pterion and calculated the distance of centre of pterion from various landmarks and compared the measurements on the right and left side.

METHODS

This study was conducted in the Department of Anatomy, K. S. Hegde Medical Academy, Mangalore. 50 dry human skulls of unknown sex were obtained from the Department of Anatomy and studied. The pterion was observed and classified according to the articulation of bones and the distance of centre of pterion was calculated from mid-point of superior margin of zygomatic arch (PZA), Frontozygomatic suture (PFZ), tip of the mastoid process (PMP), and anterosuperior margin of external acoustic meatus (PEAM).

RESULTS

The sphenoparietal variety was the commonest (72%) followed by fronto temporal (18 %) and the least common was epipteric (2%). On comparison of measurements of right and left sides, distance of centre of pterion from mid-point of superior margin of zygomatic arch (PZA), Frontozygomatic suture (PFZ), tip of the mastoid process (PMP), and anterosuperior margin of external acoustic meatus (PEAM) did not show any significant difference.

CONCLUSIONS

Knowledge of position of pterion from various landmarks is very important for neurosurgeons as there is a chance of injury to vital structures present beneath the pterion. The knowledge of position of pterion from various landmarks is very important for neurosurgeons as there is a chance of injury to vital structures present beneath pterion. This study is aimed at South Indian population and can be conducted among other populations.

KEY WORDS

Pterion, Sphenoparietal, Fronto-Temporal, Epipteric and Stellate

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BACKGROUND

Parietal bone near its antero-inferior angle forms a ‘H’ shaped arrangement. Four bones, the parietal, frontal, greater wing of sphenoid and the squamous part of temporal meet here. A circle drawn here encloses all these bones and is called, the pterion. ‘Pterion’ in Greek means ‘wing’.^[1] It lies 4 cm above the zygomatic arch and 3.5 cm behind the fronto-zygomatic suture. Anterior branch of middle meningeal artery and Sylvian point of the brain lies beneath it. It is of surgical importance for positioning of burr – holes to evacuate extradural haematomas. It also corresponds to the anterolateral fontanelle of the neonatal skull. Motor speech area of Broca’s and insula is situated here.^[2]

Intradural pterional approach is used as surgical approach to optic nerve sheath meningioma, whereas extradural pterional approach for optic nerve decompressions as well as for tumour resections and biopsies.^[3] For the Surgical management of tumours involving inferior aspects of frontal lobe, like olfactory meningiomas, retro-orbital sellar, chiasmatic, subfrontal, prepontine areas, anterior circulation and basilar artery aneurysm this approach is useful.^[4] Pterional approach is useful in performing surgeries with minimal tissue injury without compromising surgical results. According to Broca there are three types of pterion – sphenoparietal, frontotemporal and stellate.^[5]

Pterion was classified by Murphy et al^[6] into four types

- a) Spheno –Parietal (SP): here the greater wing of sphenoid articulates with the parietal bone
- b) Fronto-Temporal (FT): here the squamous part of temporal bone articulates with frontal bone
- c) Stellate: here all the bones articulate at one point
- d) Epipteric: here there is a wormian bone present between all the bones.

Two more variety of pterion zygomatico-parietal type and zygomatico temporal types were observed in study by Wang et al.^[7]

In the present study we have attempted to classify the pterion based on Murphy’s classification and to calculate the distance of centre of pterion from various landmarks [Table 2].

Aims and Objectives

In the present study we have attempted to classify the type of pterion and calculated the distance of centre of pterion from various landmarks and compared the measurements on the right and left side.

METHODS

50 dry human skulls of unknown sex were studied obtained from the Department of Anatomy. The pterion was observed and classified according to the articulation of bones and the distance of centre of pterion was calculated from mid-point of superior margin of zygomatic arch (PZA), Frontozygomatic suture (PFZ), tip of the mastoid process (PMP), and anterior – superior margin of external acoustic meatus (PEAM). The measurement was done using Vernier callipers with an accuracy of 0.1 mm. For measurement of centre of pterion perpendicular bisectors theorem was used. The suture coming in direct contact was utilised for taking measurements using

geometric compass. To avoid bias three different measurements were taken and average was calculated.

Statistical Analysis

The result observed was tabulated based on types and their respective percentage was calculated. The distance of pterion to mid-point of zygomatic arch (PZA), frontozygomatic suture, tip of the mastoid process and external acoustic meatus were compared on right and left side. Shapiro Wilk test on SPSS was used to assess the normality distribution of the data, the median IQR values were taken into consideration and on obtaining skewed distribution on the data, accordingly Mann Whitney U test was performed on the data to assess whether there is statistically (p Value of < 0.05) significant difference in the readings of right and left side.

RESULTS

The sphenoparietal variety was the commonest (72%) followed by fronto temporal (18 %) and least common was epipteric (2%).

Types of Pterion

In the present study we found sphenoparietal to be the most common type (72%). Percentage distribution of other types are as shown in Table no 1. Various types of pterion are shown in Figure 1. The measurements of centre of pterion to mid-point of zygomatic arch (PZA), frontozygomatic suture, tip of the mastoid process and external acoustic meatus on right and left side has been tabulated (Table 2). The various parameters when compared on right and left side did not differ significantly as shown in Table 2.

Type of Pterion	n (%)
Spheno-parietal	36(72)
Fronto-temporal	9(18)
Stellate	4(8)
Epipteric	1(2)
Total	50(100)

Table 1. Table Showing Distribution of The Types of Pterion

Measurement	Right (cm) Median [IQR]	Left (cm) Median [IQR]	p Value
PZA	3.2[2.7-3.3]	3.2[2.7-3.3]	0.961
PFZ	4.0[3.8-4.1]	4.0[3.8-4.1]	0.859
PMP	8.3[8.0-8.5]	8.3[8.1-8.5]	0.959
PEAM	5.6[5.4-5.8]	5.6[5.4-5.7]	0.853

Table 2. Table Showing the Various Measurements From the Centre of the Pterion

p Value <0.05- statistically significant- Mann Whitney U Test.

*PZA – distance of centre of Pterion to mid-point of superior margin of zygomatic arch, PFZ – Pterion to frontozygomatic suture, PMP- Pterion to tip of the mastoid process, PEAM- Pterion to superior margin of external acoustic meatus.

Studies	PZA (cm)		PFZ (cm)		PMP (cm)		PEAM (cm)	
	Right	Left	Right	Left	Right	Left	Right	Left
Mishra et al ^[9] (mean ± SD)	3.71	3.68	3.20	3.11	8.02	8.13	5.19	5.12
Oguz et al ^[9] (mean ± SD)	4.05	3.85	3.3	3.44	-	-	-	-
Anjana et al ^[10] (Mean ± SD)	4	4	3	2.9	-	-	-	-
Eboh and Obaroefe (mean ± SD)	4.022	3.952	3.206	3.108	-	-	-	-
Sucharitha & Roshni ^[11]	3.783	3.799	3.062	3.038	-	-	-	-
Present study (Median [IQR])	3.2[2.7-3.3]	3.2[2.7-3.3]	4.0[3.8-4.1]	4.0[3.8-4.1]	8.3[8.0-8.5]	8.3[8.1-8.5]	5.6[5.4-5.8]	5.6[5.4-5.7]

Table 3. Table Showing the Comparative Measurements on Right and Left Side for the Various Measurements

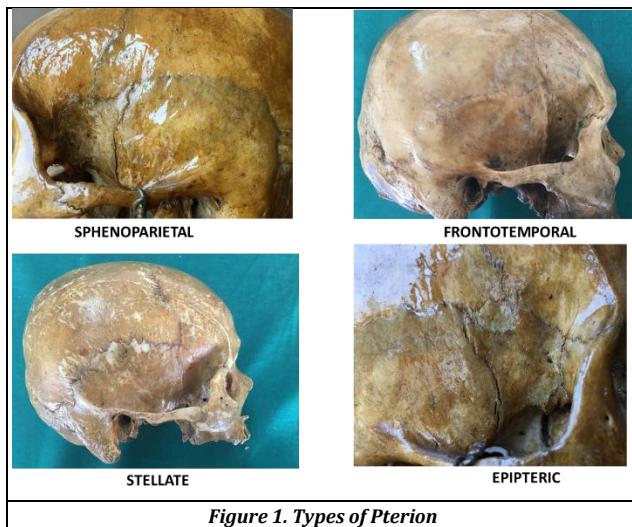


Figure 1. Types of Pterion

DISCUSSION

Pterion is used as a landmark in neurosurgeries especially for draining extradural haematomas for optic nerve decompressions and tumour resections. Thus, detailed knowledge of anatomy of pterion and its distance from important landmarks is necessary to avoid complications of surgery. At birth and during fetal life pterion form large membranous areas called anterolateral fontanelles. It provides space for the skull bones to overlap while passing through the birth canal.^[6]

Types of Pterion

The four types are sphenoparietal, frontotemporal, stellate and epipteric. In sphenoparietal type is a sutural pattern in which the sphenoid and parietal bones are in direct contact. On the contrary frontotemporal type is in which the frontal and temporal bones are in direct contact. In the stellate type articulation of four bones is seen at a point. A sutural bone if present at the pterion is called as the pterion ossicle or epipteric bone or flower's bone.^[12]

In the present study we found sphenoparietal to be commonest on both sides (72%) followed by frontotemporal 18%, stellate 8% and epipteric 2%. This was similar to study by Mwachaka et al^[13] where they found sphenoparietal variety to be commonest 66.7%, 15.5% frontotemporal, 11.1% stellate and 6.7% epipteric.

Sowmya et al^[14] found similar results to ours with sphenoparietal (71.42%) as commonest followed by frontotemporal (9.35%). Although in their study epipteric variety (11.3%) was more common than stellate (6.88%) Study by Adejuwon et al^[15] in Nigerian population too found sphenoparietal (86%) to be commonest but they did not find epipteric variety. Eboh et al.^[16] reported 83% sphenoparietal, 6% stellate and 6% epipteric, 5% frontotemporal type in their study in Nigeria. Matsumura et al.^[17] in their study in Japan, have reported 79.1% sphenoparietal, 17.7% stellate, 2.6% frontotemporal, and 0.6% epipteric type of pterion. Study conducted by Yuvraj et al^[18] also found sphenoparietal (75.41%) to be common. Although the epipteric (13.11%) variety was common than frontotemporal (6.55%) and stellate (4.91%). This difference between various studies may be explained due to genetic and environmental factors among

different populations. A study among 46 dry skulls and 20 cadaveric skulls showed maximum number of epipteric type 21.7% on right and 26% on left.^[19] In another study most common type of pterion was found to be Sphenoparietal and least incidence was found to be of Frontotemporal (3%).^[20]

Comparison was done among various regions of India with present study. In a study conducted on North Indian population they found most commonly sphenoparietal (86.25%), followed by fronto temporal (11.25 %) and stellate (2.5%). There was no epipteric variety.^[21] Study conducted in Western India showed sphenoparietal to be most common with 91.27%, followed by fronto to temporal 2.4%. 1.2 % was stellate variety and 4.8% epipteric.^[22] There was paucity of study among eastern Indian regions. Authors have speculated reasons behind the greater incidence of sphenoparietal variety. According to Ashley-Montague.^[23] sphenoparietal variety of pterion is common in human beings but frontotemporal type is dominant in non-human primates. The development of the calvarium is highly related to the type of brain. This explains the prevalence of frontotemporal pattern of sutures among monkeys who have smaller brains as beings compared to humans with larger brains who have sphenoparietal pattern of suture at pterion.^[24] In order to bring about a change from frontotemporal to sphenoparietal type, during evolution, anterosuperior segment of squamous part of temporal bone got detached from it, and got incorporated into the greater wing of sphenoid.

Wang et al, s work on mice models have shown genetic basis for variation of sutural pattern. The gene MSX 2 (on 5q35.2), was found to be responsible for the articulation of cranial bones in pterion. It is a gene of homeobox family involved in cranial suture morphogenesis.^[7]

In neurosurgery, to be minimally invasive it is imperative to approach through the most suitable bony aperture.^[25] In neurosurgical procedures Pterional approach either alone or in combination with others is the least invasive.^[26] In the present study when the results of median [IQR] of distance of centre of pterion to various landmarks was compared on right and left side we did not find any statistical significance. Comparison with other studies are shown in table 3: The Pterional approach is preferable to traditional craniotomy as it involves minor tissue damage, less brain retraction, a superior cosmetic result and shorter duration of surgery.^[27]

CONCLUSIONS

The present study was undertaken to know the distribution of type of pterion and distance of centre of pterion from important landmarks in dry human skulls found in Mangalore. The study showed that sphenoparietal variety to be the commonest (72%) and least common was epipteric (2%). On comparison of measurements of right and left sides, distance of centre of pterion from mid-point of superior margin of zygomatic arch (PZA), Frontozygomatic suture (PFZ), tip of the mastoid process (PMP), and anterosuperior margin of external acoustic meatus (PEAM) did not show any significant difference. The knowledge of position of pterion from various landmarks is very important for neurosurgeons as there is chance of injury to vital structures present beneath pterion. This study is aimed at South Indian population and can be conducted among other populations.

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