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MORPHOMETRIC STUDY OF PTERION IN HUMAN SKULLS

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INTRODUCTION

Pterion is a small, H-shaped region located in the temporal fossa on the *Norma lateralis* of the skull, where four bones—frontal, parietal, greater wing of sphenoid, and squamous part of temporal—converge. Covered by the temporalis muscle and fascia, it marks the anterior division of the middle meningeal artery and the Sylvian point. It is typically located ~4 cm above the zygomatic arch and ~3–3.5 cm behind the frontozygomatic suture.

Clinically significant, the pterion is the thinnest part of the skull and lies just above the anterior branch of the middle meningeal artery. This makes it a key site for burr hole surgeries to evacuate extradural hematomas. In neonates, it corresponds to the anterolateral fontanelle, which closes by the third month. The term “pterion” comes from the Greek word for “wing,” and is linked to Hermes in mythology.

Variants like sutural (epipteric) bones may be mistaken for fractures on imaging. Pterion types—classified by Broca, Murphy, and Wang—include sphenoparietal, frontotemporal, stellate, epipteric, and others, with significance in neurosurgery, anthropology, and forensic science.

Material & Methodology

The study was conducted in the **Department of Anatomy at Index Medical College, Indore**, located in Central India. It followed an **observational design** and was conducted between **January 5, 2022**, and an unspecified end date.

A total of **108 human dry skulls** were examined. The **sample size** was determined using the formula:

n=4pqe2n = \frac{4pq}{e^2}n=e24pq

where *p* is prevalence, *q = 100 - p*, and *e* is the permissible error (5%).

The study received **ethical clearance** from the institutional committee.

Instruments Used

- **Digital vernier calipers** (for precise measurement)
- Pencil
- White cotton sheet

Inclusion Criteria

- Skulls separated above the level of the pterion
- Regularly shaped skulls without deformities

Exclusion Criteria

- Skulls with pterion on only one side
- Damaged or irregularly shaped skulls

Fig 1:- Sphenoparietal

Parameters Studied

- **Type of Pterion** (classified by Murphy into):
  - Sphenoparietal
  - Frontotemporal
  - Epipteric
  - Stellate
- **Length of Pterion**
  - Measured differently depending on type
- **Thickness at Pterion**
  - Measured at the center point where four bones meet
- **External Measurements**
  - Centre of pterion to:
    - Posterolateral aspect of frontozygomatic suture (PFZS)
    - Superior margin of zygomatic arch (PZA)
- **Internal Measurements**
  - Centre of pterion to:
    - Lateral end of ridge on the lesser wing of sphenoid (PSR)
    - Lateral margin of optic canal (POC)

Statistical Analysis

- **Mean ± standard deviation**
- **ANOVA (single-factor)** used to compare right and left side measurements
- **Significance level:** $p \leq 0.05$
- **Sample Size:** 108 dry human skulls
- **Focus:** Types of pterion, their symmetry, laterality, and morphometric distances to cranial landmarks
- **Statistical Analysis:** One-way ANOVA using SPSS v16.0

Result

Types of Pterion Observed (Murphy's Classification)

Type	Count	Percentage

Sphenoparietal	133	**61.57%**
Frontotemporal	60	**27.77%**
Epipteric	23	**10.64%**
Stellate	0	**0%**

Symmetry Presentation

Presentation	**Count**	**Percentage**
Symmetrical	91	84.25%
Asymmetrical	17	15.74%

Unilateral and Bilateral Occurrence

Type	**Total**	**Bilateral**	**Unilateral**
Sphenoparietal	133	120	13
Frontotemporal	60	52	8
Epipteric	23	12	11
Stellate	0	0	0

Unilateral Pterion: Side-wise Distribution

Type	**Unilateral**	**Right**	**Left**
Sphenoparietal	13	2	11
Frontotemporal	8	5	3
Epipteric	11	9	2

Side-Wise Percentage Distribution of Pterion Types

Type	**Right (N=108)**	**Left (N=108)**	**Total (%)**
Sphenoparietal	62 (57.40%)	71 (65.74%)	133 (61.57%)
Frontotemporal	31 (28.70%)	29 (26.85%)	60 (27.77%)
Epipteric	15 (13.88%)	8 (7.40%)	23 (10.64%)
Stellate	0	0	0 (0%)

Morphometric Measurements (Mean ± SD)

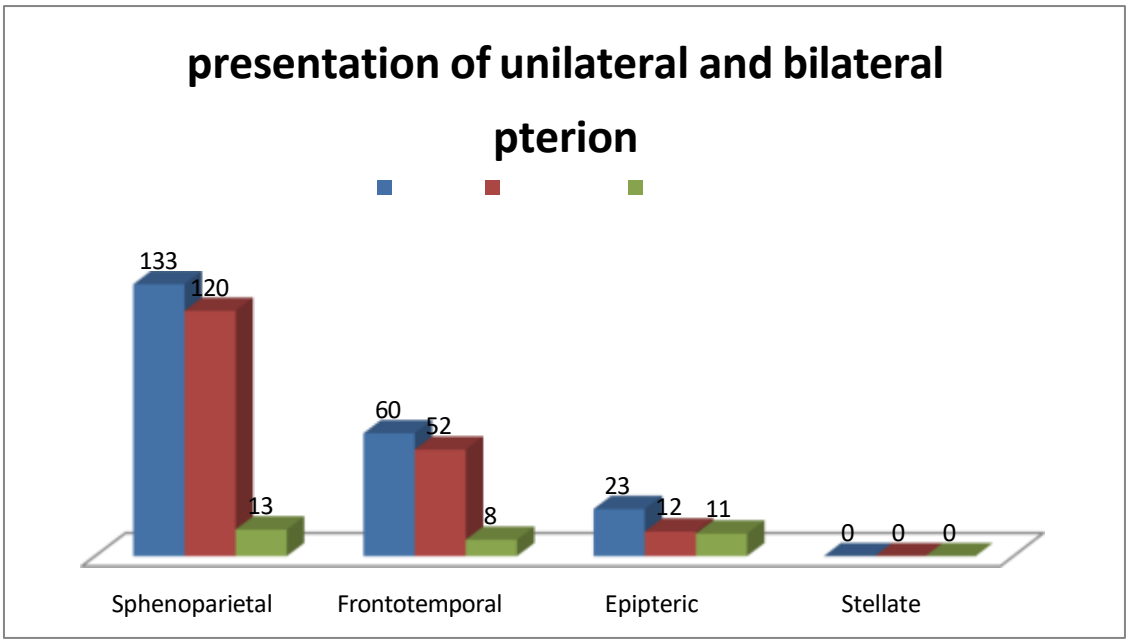
External Skull Measurements

Parameter	Right	Left	f-value	p-value
Length of pterion	2.91 ± 1.30 cm	2.97 ± 1.44 cm	0.108	0.741
Thickness at center	0.53 ± 0.06 cm	0.59 ± 0.46 cm	1.397	0.238
Pterion to Zygomatic Arch (ZA)	4.17 ± 0.18 cm	4.15 ± 0.25 cm	0.593	0.441
Pterion to Frontozygomatic Suture	3.54 ± 0.42 cm	3.49 ± 0.44 cm	0.686	0.3905

Internal Skull Measurements

Parameter	Right	Left	f-value	p-value
Pterion to Optic Canal (OC)	4.57 ± 0.29 cm	4.51 ± 0.36 cm	1.594	0.214
Pterion to Sphenoidal Ridge (SR)	1.53 ± 0.36 cm	1.54 ± 0.35 cm	0.084	0.771

Type of pterion	Total	Bilateral	Unilateral
Sphenoparietal	133	120	13
Frontotemporal	60	52	8
Epipteric	23	12	11
Stellate	0	0	0



DISCUSSION

Table 9: Percentage distribution of **Symmetrical and Asymmetrical** distribution in different studies.

Study/Population	Symmetrical (%)	Asymmetrical (%)
Mwachaka P.M et al, 2009, Kenyans, n=90, Known gender.	78	22
Ankur Zalwadia et al, 2010, Western Indians, n=42, unknown gender.	99	01
Wandee C, et al, 2011, Thailand, n=268, Known gender.	84.7	15.8

In present Study, Indians population, n-108, Unknown gender	84.25	15.74

Sphenoparietal type of pterion is more frequent in all the regions. This is in comparison with other studies.

In the present study the occurrence of SP type was 61.57% which was low when compared to Murphy [9], Ankur Zalwadia et al [23],Wandee C et al [16],Anjana.S. et al [30],Alper Sindel et al [32], studies.

The high occurrence of sphenoparietal type could have some evolutionary basis [13].The sphenoparietal type is dominant in humans and frontotemporal is dominant in non human primates.

Author	**Population**	**N= skulls**	**Stellate (%)**
Murphy, 1956	Australian	388	0.7
Ankur Zalwadia et al, 2010	Western Indians	42	0
Wandee C, et al, 2011 .	Thai	268	0
Anjana.S et al, 2015	Karnataka	32	6.2
Present Study	Indian	108	0

Authors	**Right**	**Left**
Oguzet al, 2004	3.30±0.40	3.44±0.39
Ankur Zalwadia et al, 2010	3.73±0.51	3.55±0.42

Anjana.S et al, 2015	3±0.4	2.9±0.2
Present study	3.54±0.42	3.49±0.44

The pterion is expected to lie 3.0 -3.5 cm behind the frontozygomatic suture[1].In the present study the pterion is 3.54±0.42 cm (right) and 3.49±0.44 cm (left) behind the frontozygomatic suture.

In the study done by Ankur Zalwadia et al these measurements were 3.73±0.51 cm on (right) and 3.49±0.44 cm on (left) side which was slightly high as compared to the present study .

In the study conducted on Turkish population the measurements of PFZS were 3.4 cm respectively. In the study conducted by Oguz et al [2] the measurements observed were 3.30±0.40 cm (right) and 3.44±0.39 which low then the present study.

CONCLUSION

From the present study important interferences drawn were:

- Pterion was observed on the basis of Murphy's classification out of which 3 types of pterions were observed they are sphenoparietal, frontotemporal, and epipteric type of pterion.
- Sphenoparietal type of pterion was the most dominant type of pterion which was observed in 61.57%of cases, frontotemporal was observed in 27.77% of cases, epipteric type of pterion which was observed in 10.64% of cases
- The same type of pterion which occurred on both right and left aspect in the same skull in 84.25% of cases. Sphenoparietal occurred more bilaterally than frontotemporal and stellate.
- The mean distance from the centre of pterion to the frontozygomatic suture was 3.54±0.42 cm (right) and 3.49±0.44 cm (left). The mean distance from centre of pterion to zygomatic arch was 4.17±0.18 cm (right) and 4.15±0.25 cm (left). Statistically no significant side difference were found in the location of the pterion from the centre of the pterion to the zygomatic arch and the

frontozygomatic suture.

- The mean distance from the internal aspect of the centre of pterion to sphenoidal ridge was 1.53±0.36 cm (right) and 1.54±0.35 cm (left). The mean distance from the optic canal to the inner aspect of the centre of pterion was 4.57±0.29 cm (right) and 4.51±0.36 cm (left).
- Statistically no significant side differences were found in the location of the pterion to the sphenoidal ridge and the optic canal.

The present study concludes that the:.

- The measurement of internal aspect is useful in microsurgeries of olfactory meningiomas present on the inferior aspect of the frontal lobe, tumor in retro orbital, orbital, sellar & chiasmatic areas and operations in Broca's motor speech area and the study will be helpful to anatomists, neurosurgeons, anthropologists and researchers.

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