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RESEARCH ARTICLE

Morphometric and Morphological Variant of Pterion in Adult Human Skulls

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Abstract

Background: The pterion is the H-shaped suture formed by the meeting off our bones namely frontal bone, parietal bone, temporal bone and greater wing of sphenoid bone. It is clinically significant because the middle meningeal artery passes in close proximity beneath it and also the bones here are thinner compared to the other parts of the skull, so any injury over this region may lead to haemorrhage and serious complications. It also serves as an important neurosurgical and mark to access vital structures such as the sylvian fissure, circle of Willis, optic nerve, para sellar region, middle meningeal vessels and cavernous sinus. Variations in the pterion morphology have been described in literature. The thorough understanding and the knowledge of the presence of various pterion types is needed by the surgeons for safe and effective surgical access. **Aim:** To study the location of pterion and its morphological variations. **Objective:** The objectives of the present study is to determine theme a distance of center of pterion to the midpoint of front zygomatic suture and to the midpoint of zygoma. To observe the prevalence of sutural types of pterions. **Materials and Methods:** A cross-sectional study was conducted on 50 dry adult human skulls of unknown sex and age from the Institute of Anatomy, Madras Medical College. Measurements were taken using a digital vernier caliper. **Results:** In the current study, SPHENOPARIETAL type of suture is present in 40 dry skulls (80%) followed by Fronto temporal type of suture in 9 dry skulls (18%) and Epipteric (2%). **Conclusion:** The precise location of the pterion is of great significance for neurosurgeons, as it provides access for various surgical procedures such as pterional keyhole surgeries, trephination for extradural hematoma, and aneurysm repair.

Keywords: Neurosurgery, Pterion, Sutural Morphology

1. Introduction

The pterion is a bony landmark on the lateral aspect of the skull that marks the junction of the squamous part of the frontal bone, sphenoidal angle of the parietal bone, greater wing of the sphenoid, and the squamous part of the temporal bone. These bones converge to form an H-shaped suture[2] The pterion overlies vital structures such as the Sylvian fissure, circle of Willis, optic nerve, parasellar region, middle meningeal vessels, and cavernous sinus, making it an important site in clinical neurosurgery[4].

The pterion corresponds to the site of the anterolateral fontanel leinthe neonatal skull, which normally closes by three months of age. According to Murphy[2], four patterns of pterion were recognized:

1. Sphenoparietal (Figure 1)
2. Frontotemporal (Figure 2)
3. Stellate (Figure 3)
4. Epipteric (Figure 4)

2. Aim and Objectives

Aim: The aim of the present study is

1. To locate the position of Pterion.
2. To determine the most common type of sutural variety of Pterion.

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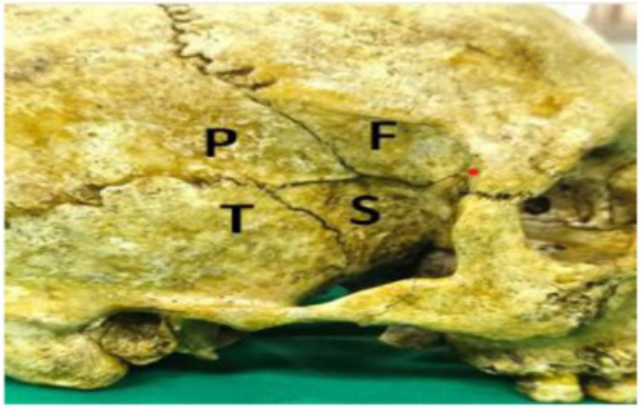

Figure 1. Pterion-a bony landmark in the lateral aspect of the skull that marks the confluence of skull bones.

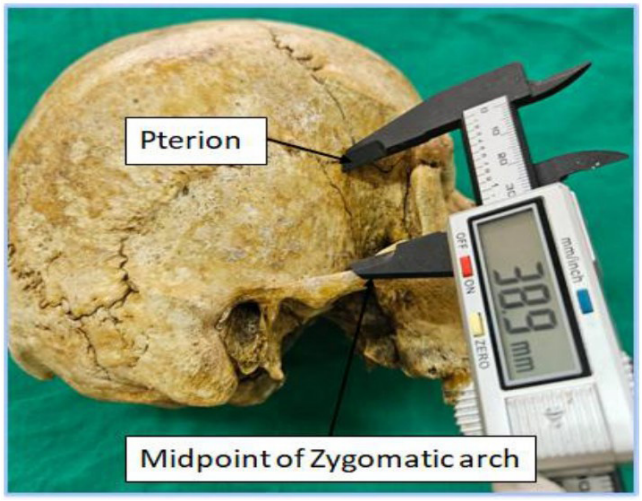

Figure 2. Distance between centre of pterion and midpoint of zygomatic arch.

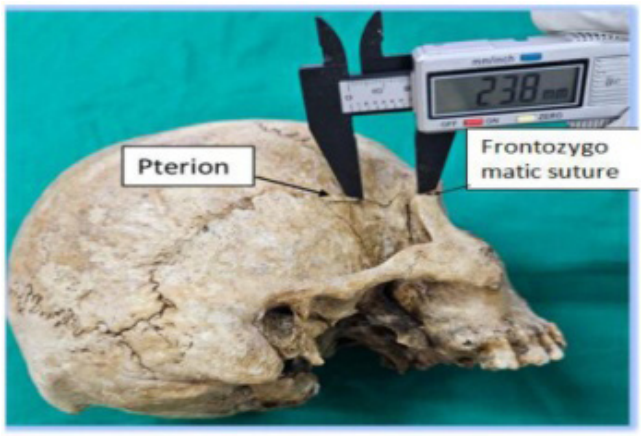

Figure 3. Distance between centre of pterion to midpoint of frontozygomatic suture.

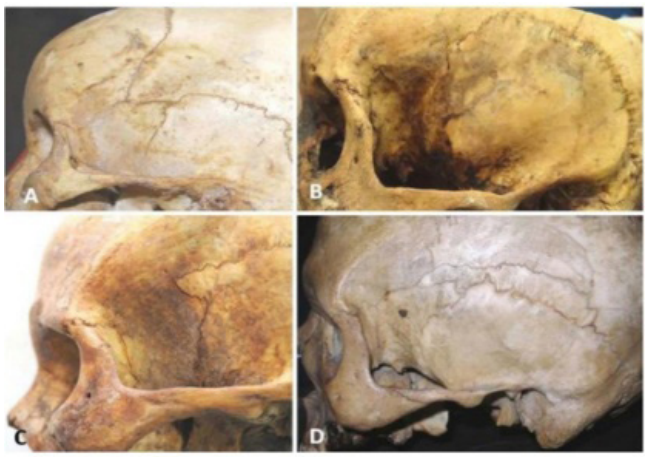

Figure 4. Variants of pterion.

Objective: The objectives of the present study are

1. To determine the location of Pterion using various bony landmarks.
2. To observe the prevalence of variants and compare them with previous studies.

3. Review of Literature

- Murphy[2] (1956): Classified the pterion into four morphological types—Sphenoparietal, Frontotemporal, Stellate, and Epipteric—with the Sphenoparietal type being the most common in most populations.
- Ersoy *et al*[9] (2003): Reported that Epipteric bones may mimic fractures radiographically, potentially misleading surgeons and causing intraoperative errors.
- Oguz *et al.*[6] (2004): Studying Turkish skulls, found the Sphenoparietal type predominant, followed by Frontotemporal, Stellate, and Epipteric types. Highlighted the importance of regional variation for surgical planning.
- Mwachaka *et al* (2008): Measured morphometric distances from the pterion to cranial landmarks in Kenyan skulls, providing practical guidance for burr-hole placement when imaging is unavailable.
- Ilayperumal *et al.*[14] (2010): Reported the distribution of pterion types in Sri Lankan skulls and emphasized ethnic variation.
- Adejuwon *et al.*[11] (2013): Found similar predominance of the Sphenoparietal type in Nigerian skulls, but observed a higher frequency of Epipteric bones compared to Asian populations.

- Cimen *et al.*[13] (2019): Studied Middle and South Anatolian skulls and reported regional differences in both morphology and morphometry of the pterion.
- Samarasinghe *et al.*[16] (2024): Conducted a cadaveric study in Sri Lanka, analyzing 37 adult dry skulls for both pterion types and precise morphometric distances to surrounding landmarks. The Sphenoparietal type was most common, followed by Frontotemporal, Epipteric, and then the least frequent Stellate.

4. Material and Methods

- 50 dry adult human skulls of unknown sex and age from the Institute of Anatomy, Madras Medical College.
- Cross-sectional study; measurements taken using a digital vernier caliper. A circle is drawn with the smallest radius connecting all the four bones involved in the formation of the pterion, and the centre of this circle is marked as the centre of the pterion.
- Skulls exhibiting pathological changes and congenital anomalies, broken skulls, and skulls with obliterated sutures due to synostosis were excluded from the study.

5. Results (Including Observations)

In the present study of 50 dry adult skulls:

5.1 Morphometric Distances

- The mean distance from the centre of the pterion to the midpoint of the frontozygomatic suture was 23.8 mm.
- The mean distance from the centre of the pterion to the midpoint of the zygoma was 38.9 mm.

Table 1. Distribution of types of pteria observed in 50 dry skulls

Type of Pterion	Right side	Left side	Both sides	Total percentage
Sphenoparietal	24	10	6	80%
Frontotemporal	5	1	3	18%
Epipteric	-	1	-	2%
Stellate	-	-	-	-

5.2 Morphological Variants

The Sphenoparietal type was the most common, present in 40 skulls (80%). The Frontotemporal type was observed in 9 skulls (18%). The Epipteric type was found in 1 skull (2%). The Stellate type was absent.

6. Discussion

The present study confirms that the Sphenoparietal type of pterion is the most common (80%), which is consistent with earlier reports by Kamath *et al.*[18] (2016) and Murphy[2] (1956). The Frontotemporal type (18%) was higher than most previous studies, suggesting regional variation. The Epipteric type (2%) was similar to Oguz *et al.* but much lower than Murphy's findings, while the Stellate type was absent, unlike in some Indian series that reported small percentages. These differences highlight the role of ethnic and geographic factors in sutural morphology. No skulls in this study exhibited the stellate variety, which has been occasionally reported in other populations.

The morphometric findings in the present study are consistent with earlier studies and provide useful surface landmarks when imaging is unavailable. The relative predominance of the right-sided phenoparietal and Frontotemporal types also suggests possible lateral differences worth exploring in larger samples. The presence of Epipteric bones, although rare, remains clinically important as they can mimic fractures radiologically and complicate surgical approaches.

Table 2. Comparison of the percentage of pteria with other studies on types of pteria

Author	Sample Size	Spheno Parietal (%)	Fronto Temporal (%)	Epipteric (%)	Stellate (%)
Murphy (1956)[2]	368	73.23	7.75	18.34	0.68
Oguz *et al* (2004)[8]	26	88	10	2	-
Zalawadia *et al* (2010)[17]	42	91.7	2.4	4.8	1.2
Kamath *et al* (2016)[18]	72	79.25	10.25	6.3	4.2
Present study (2024)	50	80	18	2	-

6.1 Clinical Implications

Accurate localization of the pterion and the understanding of the various morphological types are essential for neurosurgeons, as improper drilling can result in orbital penetration or injury to underlying neurovascular structures.

The most common type being Sphenoparietal and the least common being Stellate, these findings emphasize the importance of considering variations during preoperative planning. Even though rare, Epipteric bones may cause radiological misinterpretation or intraoperative fragmentation; therefore, preoperative CT recognition is essential for safe planning.

The knowledge of morphometric measurements helps to guide burr-hole placement in a precise location during emergency neurosurgical procedures when imaging is not available. The data of these morphometric values improve surgical precision and patient safety.

7. Summary and Conclusion

- The surgical approach via the pterion is most widely used for the management of intracranial anterior circulation aneurysms.
- The precise location of the pterion is of profound significance for a neurosurgeon, as drilling at an improper site can result in orbital penetration or neurosurgical complications.
- The pterion provides access for surgeries such as repair of aneurysm, trephination of extradural hematoma, and pterional keyhole surgeries.
- The trans-Sylvian approach through the pterion facilitates resection of tumors of the sellar, parasellar, and paraclinoid regions, as well as optic nerve meningiomas, with minimal craniotomy.

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