

# Morphological study of the pterion: An important landmark for neurosurgery and to determine its clinical significance

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## ABSTRACT

**Introduction:** The pterion is known to be the weakest part of the skull and the most interesting bone meeting points in craniofacial osteology. Pterion depicts the H-shaped sutural junction of frontal, sphenoid, parietal, and temporal bones within the temporal fossa. **Materials and Methods:** The material for the study was 50 dry human skulls which were collected from the anatomy department of this college. The skulls were of unknown sex and race. Abnormal and damaged skulls were discarded. Both the sides of the skull were studied for the locations and types of the pterion. The shapes of the Pteria were noted by observing the articulation of the bones forming the sutures. The types of the Pteria were recorded. The photographs were taken of all the types of Pteria. **Observation and Results:** On observing the sutural pattern and the bones articulating to form the pterion, we found that sphenoparietal type of pattern was most common on both the right and left sides. The second most common type observed in our study was epipteric type. **Discussion:** The most common variety of pterion in the present study was found to be of the sphenoparietal type. The study revealed the distance from the center of pterion to posterolateral aspect of frontozygomatic suture as  $3.46 \pm 0.2$  cm and from the center of pterion to the midpoint of the upper border of zygomatic arch as  $3.98 \pm 0.2$  cm. **Conclusion:** The most common variety of pterion in the present study was found to be of the sphenoparietal type.

**KEY WORDS:** Pterion, Dry Skull, Morphology

## INTRODUCTION

The pterion correlates to the site of the anterolateral fontanelle of the neonatal skull which closes at 3 months of age. The pterion is known to be the weakest part of the skull and the most interesting bone meeting points in craniofacial osteology.<sup>[1]</sup> The fontanelles help for the molding of the fetal head while it passes through the birth canal as well as the rapid growth of brain during infancy period. The pterion portrays variations in the sutural pattern of the fusion of constituent bones. Pterion depicts the H-shaped sutural junction of frontal, sphenoid, parietal, and temporal bones within the temporal fossa. It is situated within 1 cm diameter of a circle centered about 2.6 cm posterior and 1.3 cm superior to the posterolateral margin of the frontozygomatic suture.<sup>[2]</sup>

The pterion is located approximately 4 cm above the midpoint of the upper border of the zygomatic arch. Pterion generally marks the position of the frontal or anterior branch of the middle meningeal artery, the lateral sulcus of brain, and Broca's motor speech area. Knowing about the location of the middle meningeal artery is important for accuracy regarding the position of the burr holes to evacuate extradural hematoma caused due to injury to middle meningeal vessels.

The pterion may also be fractured indirectly by blows to the top or back of the head that places sufficient force on the skull to fracture the pterion.<sup>[3]</sup> Furthermore, the pterion is a primary site for surgeries to obtain access to the sphenoid ridge and the optic canal.<sup>[4]</sup> Thus, the location of the pterion is very important for neurosurgery. Based on this, the pterion can be divided into various types. According to Murphy, they are – sphenoparietal, frontotemporal, stellate, and epipteric.

The sphenoparietal pterion type is defined as a sutural pattern, in which the sphenoid and parietal

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bones come in direct contact, preventing the frontal and temporal bones from making contact with one another.<sup>[1,5]</sup>

The frontotemporal pterion type is a sutural pattern, in which the frontal and temporal bones are in direct contact preventing the sphenoid and parietal bones from making contact with one another. The stellate pterion type is characterized by the articulation of four bones (frontal, parietal, temporal, and sphenoid) at a point.<sup>[6]</sup> The fourth variety is the epipteric type, which has the presence of small sutural bones between sphenoid and parietal bones. These variations are important for anthropologists.<sup>[7]</sup>

Pterion is defined as a point of sutural confluence seen in *norma lateralis* of the skull, wherein the frontal, parietal, temporal, and sphenoid bones meet each other. It is most commonly used as a neurosurgical landmark. This is important in surgical interventions following surgical approaches to the anterior and middle cranial fossae, extradural hemorrhage, as well as tumors involving certain inferior aspects of the frontal lobe, such as olfactory meningioma, it is used in operations on the Broca's motor speech area and in repairing aneurysms of the middle cerebral artery and those of the upper basilar complex.<sup>[8]</sup>

The anatomical varieties of the pterion are mainly of interest to anthropologists and forensic pathologists for assessing the location of the pterion in archeological remains or forensic materials.<sup>[2]</sup> The pterion portrays population-based variations.

## MATERIALS AND METHODS

The material for the study was 50 dry human skulls which were collected from the anatomy department of this college. The skulls were of unknown sex and race. Abnormal and damaged skulls were discarded. Both the sides of the skull were studied for the locations and types of the pterion. The shapes of the Pteria were noted by observing the articulation of the bones forming the sutures. The types of the Pteria were recorded. The photographs were taken of all the types of Pteria. The following criteria were looked on to categorize the different types of pterion among the 50 dry skulls:

1. Sphenoparietal type: The greater wing of sphenoid articulates with the parietal bone to form the letter "H" as shown in the picture that was taken of the skull below [Figure 1].
2. Frontotemporal type: The squamous part of the temporal bone articulates with the frontal bone as shown below [Figure 2].
3. Stellate type: In this, all the bones articulate at a point in the form of the letter "K" as shown below [Figure 3].

4. Epipteric type: A sutural bone is lodged between the four bones that form the pterion as shown below [Figure 4].

## OBSERVATIONS AND RESULTS

On observing the sutural pattern and the bones articulating to form the pterion, we found that sphenoparietal type of pattern was most common on both the right and left sides. The second most common type observed in our study was epipteric type.

The findings are tabulated in Table 1.



Figure 1: Sphenoparietal pterion

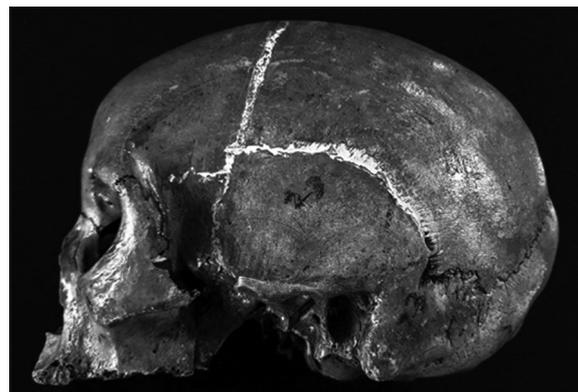


Figure 2: Frontotemporal pterion



Figure 3: Stellate pterion

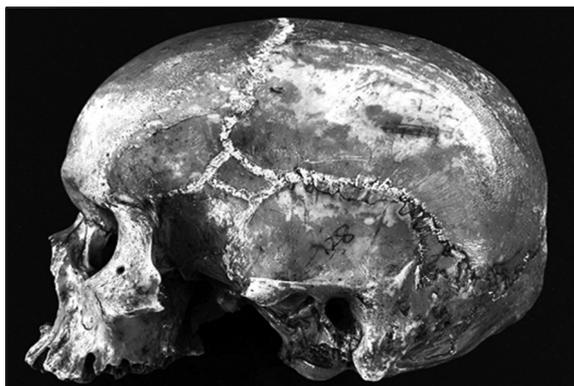
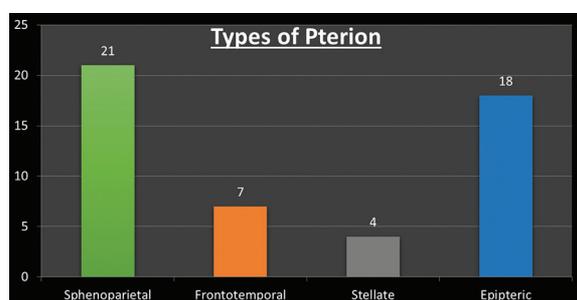


Figure 4: Epipterion pterion

Table 1: Number of skulls observed with each type of pterion

Types of Pteria			
Sphenoparietal	Frontotemporal	Stellate	Epipterion
21	7	4	18



## DISCUSSION

Knowledge and understanding of the type and location of the pterion and its relation to surrounding bony landmarks are important, especially with respect to neurosurgery. In skulls with an epipterion bone variation, particularly the anterior and proprium types; the pterion can mistakenly be assessed to be at the most anterior junction of bones and a burr hole placed over there may cause inadvertent penetration into the orbit.<sup>[7]</sup>

The importance of the pterion is its relation to the middle meningeal artery, Broca's motor speech area on the left side, and surgical interventions relating to pathologies of the sphenoid ridge and optic canal. Pterion is a crucial surgical landmark for surgical approaches to the middle meningeal artery particular lesions and tumors in the brain.<sup>[9]</sup> Although the control of the pattern of articulation of bones forming the pterion is not known, genetic factors may play some role. The *MSX2* gene, which encodes a home domain transcription factor, plays a crucial role in craniofacial morphogenesis by influencing fusion of sutures.<sup>[10,11]</sup>

The high occurrence of the sphenoparietal pterion could have an evolutionary basis. Sphenoparietal type is the most common type in humans and biped primates such as bonobos and orangutans. Furthermore, it has been shown that the development of calvarial bones is tightly coordinated with the growth of the brain and requires interactions between different tissues in the sutures. Consequently, the increase in brain size in bipeds (ASHLEY-MONTAGU, 1933) may have caused morphological changes in neurocranium that led to meeting of greater wing of sphenoid and parietal bone.

An accurate knowledge of the location and relations of the pterion is important in relation to surgical intervention, particularly with respect to the course of the branches of the middle meningeal artery and Broca's motor speech area on the left side.<sup>[12]</sup> The distances between the pterion and the lesser wing of the sphenoid and optic canal are of practical importance in surgical approaches to these regions through the pterion.

## CONCLUSION

The most common variety of pterion in the present study was found to be of the sphenoparietal type. The study revealed the distance from the center of pterion to posterolateral aspect of frontozygomatic suture as  $3.46 \pm 0.2$  cm and from the center of pterion to the midpoint of the upper border of zygomatic arch as  $3.98 \pm 0.2$  cm. This will be useful to neurosurgeons, radiologists, anthropologists, and forensic scientists.

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