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## A STUDY ON SUTURAL MORPHOLOGY AND ANATOMICAL POSITION OF PTERION

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### ABSTRACT

**Objective:** Pterion is an interesting bony landmark on the lateral aspect of the skull. It is 'H' shaped sutural confluence formed by the articulation of four bones: frontal, parietal, greater wing of sphenoid and squamous part of temporal bone. Pterional approach is most widely used in neurosurgery for a variety of lesions in the anterior and middle cranial fossae. Since previous studies have reported the racial difference in the pterional morphology, in the present study it was aimed to study the sutural morphology of pteria and also to locate it with respect to the frontozygomatic suture. **Methods:** Seventy five (50 male and 25 female) skulls were studied on both the sides to evaluate the sutural pattern of pteria. The distance between center of the pterion to frontozygomatic suture was measured on both the sides.

**Results and Conclusion:** According to the present study Sphenoparietal pterion was the commonest (77.33%) finding and was followed in frequency by Epipteric type (21.33%) and Stellate type (1.33%). Frontotemporal pterion was not observed. Average distance between the center of pterion and frontozygomatic suture was found to be 2.95 cm.

**Keywords:** Pterion, Frontozygomatic suture, Burr-hole surgery, sutural bone, fontanelle, cranial fossae.

### INTRODUCTION

Pterion is a neurosurgically significant bony landmark on the lateral aspect of the human skull. It is 'H' shaped sutural confluence formed by the articulation of four skull bones: frontal, parietal, greater wing of sphenoid and squamous part of temporal bone.<sup>1</sup> The pterion corresponds to the anterolateral fontanelle of the neonatal skull which usually closes at third month after birth.<sup>1</sup> In neurosurgery pterional approach is widely used for the treatment of variety of

neuro-vascular disorders located in the anterior and middle cranial fossae.

According to the previous studies there are four types of adult pteria: Sphenoparietal (SP), Frontotemporal (FT), Stellate (ST) and Epipteric (EP). In SP type of pterion the sphenoid and parietal bones are in direct contact. In FT type of pterion frontal and temporal bones are in direct contact. The ST type is characterized by articulation of all the four bones at a point. The EP pterion is characterized by the presence of a sutural bone in the region of pterion (Fig 1).<sup>2</sup>

Aim of the present study was to classify the pteria based on their sutural morphology and to locate them with respect to a nearby palpable

bony landmark namely frontozygomatic suture (FZS).

## MATERIALS AND METHODS

The study was conducted in the department of anatomy, Saveetha Medical College, Chennai. A total of 75 (50 male and 25 female) skulls were studied. The skulls in the present study comprised whole skulls and skulls with a cut at the upper part of the cranium but intact pterion and frontozygomatic suture (FZS). Criteria of exclusion were those in which the pterion pattern could not be clearly identified owing to breakage or advanced synostosis.

1. Each pterion was classified into one of four types - Sphenoparietal (SP), Frontotemporal (FT), Stellate (ST) or Epipterice (EP) according to the criterion previously described.
2. Distance between pterion and Frontozygomatic suture (P-FZS) was measured on both right side and left side.
3. Pterion was classified as backward pterion if  $P-FZS \geq 3.5 \text{ cm}$ .<sup>2</sup>

A circle with the smallest radius connecting the four bones involved in the formation of the pterion was drawn; the center of this circle was considered as the center of the pterion. P-FZS was measured as the distance between the center of the pterion to the posterolateral aspect of FZS. P-FZS measurements were taken twice then average of the two measurements was recorded so as to minimize bias errors. A sliding vernier caliper was used to measure P-FZS. All the parameters studied were tabulated and analysed. The sexing of the skulls was done on the morphological basis.

## RESULTS

In the present study it was observed that SP pterion was the commonest, observed in 116 out of 150 sides (77.33%) of the skulls. The next common was EP found in 32 sides (21.33%),

followed by ST which was observed in 2 out of 150 sides (1.33%) of the skulls studied. FT type was not found in the present study (Table 1 & Fig 2).

Among the 50 male skulls studied SP pterion was the commonest (82%), followed by EP (17%). ST Pterion was found only on one side (1%) (Table 2).

Among the 25 female skulls studied SP pterion was the commonest (68%), it was followed by EP (30%) and ST Pterion (2%). It was observed that incidence of EP was more common in female skulls (30%) than in male skulls (21.3%) (Table 2).

Out of 116 SP pteria 49 SP pteria were present bilaterally (42.2%), 8 out of 32 EP pteria showed bilaterality (25%), whereas ST variety was purely (100%) unilateral.

On the right side 80% of the pteria were SP, 18.66% were EP and 1.3 % were ST type. On the left side SP type was observed in 74.6%, EP was observed in 24%, ST type in 1.3 %.

The distance between center of pterion to the FZS (P-FZS) was ranging from 1.42 cm – 3.74 cm on the right side and on the left side the range was 1.6 cm - 4.15 cm (Fig 3).

The AVG of P-FZS on the right side was  $2.9532 \pm 0.37 \text{ cm}$  and on the left side it was  $2.9452 \pm 0.438 \text{ cm}$ . There was no significant difference in the values on right and left side ( $p=0.452060383$ ). Table 3 represents the P-FZS in male and female skulls. There was no significant difference on right and left sides in both male and female skulls.

Out of 150 pteria studied 10 were belonging to 'Backward pterion' (6.67%). Among the backward pteria, 6 were on the left side and 4 were on the right side (Fig 3). 7 out of 10 backward pteria were found in male skulls and 3 were found in female skulls (Table 4).

## DISCUSSION

The pterion is considered to be one of the interesting bony meeting points in the skull. Its complexity is based on the fact that it is the meeting point of the facial skeleton, skull base and calvarium. Knowledge of its peculiar morphology is mandatory during the pterional surgical approaches.<sup>3</sup>

In a study on Nigerian skulls it was found that SP pterion was the commonest and was found in 82.1%, the next common was FT pterion found in 23.6%, EP pterion was found in 5.7% and ST was the least common found only in 1.9%.<sup>4</sup> Another study on 26 Turkish male skulls also reported SP type being the commonest, followed by FT type and then EP pterion. In the same study EP type of pteria were found only on the left side.<sup>5</sup>

A study on 236 adult Thai skulls has reported that SP and EP are the common types of the pteria, found in 81.2% and 17.4% respectively. FT type was found in 1.1% and ST type in 0.4%.<sup>2</sup> One more study reported the incidence of SP as 78%, EP as 16% and FT as 5%.<sup>6</sup>

Saxena et al. conducted a study to compare the pteria of Nigerians and Indians. The study reported all the 4 types of pterion in both the races. Among the 4 varieties of pteria, SP pteria were the highest in both races (Indians 95.3%, Nigerians 84.79%). EP was more frequent in Indians (Indians 11.79%, Nigerians 3.79%), whereas FT (Indians 3.46%, Nigerians 10.11%) and ST (Indians 1.38%, Nigerians 5.06%) pteria were more common in Nigerians.<sup>7</sup> In a study on 490 sides of the skulls, epipteric pteria were observed only in 9%.<sup>8</sup>

A study on 90 Kenyan skulls reported that SP pterion as the commonest and was observed in 66.7%. FT pterion was observed in 15.5%, ST pterion in 11.1% and EP pterion in 6.7%. The study also observed that EP type occurred more in females (10.5%) than in males (4.8%).<sup>9</sup>

It is evident from the studies mentioned (2, 4-9) that there are racial differences in the sutural morphology of pterion.

The present study revealed that out of 150 pterional articulations, SP type was the commonest (77.33%), next common was EP (21.33%) and ST was observed in 1.33%. In the present study FT type of pterion was not found. Compared to the previous studies the present study reports a higher incidence of EP type of pterion.

Previous studies have reported that SP is dominant pterion type in Homo whereas in primates it is FT pterion. According to them during phylogenesis, anterosuperior segment of the squamous part of temporal bone of the lower primates detached and got incorporated in the posterosuperior angle of the greater wing of sphenoid of Homo. During the process if the detached bony segment does not fuse with either of the bones, then it gives rise to EP type of pterion.<sup>2</sup>

Pterional craniotomy is the preferred approach for the lesions located in the anterior branch of middle meningeal artery, sylvian fissure, sellar and parasellar regions, superior orbital fissure, sphenoidal wing, cavernous sinus, orbit, optic nerve, temporal lobe, midbrain, and posterior-inferior frontal lobe.<sup>2,10</sup> Successful microsurgical removal of sylvian fissure lipoma with pterion approach is also reported.<sup>2</sup> Hence, detailed knowledge of sutural morphology of pterion and its location is crucial for neurosurgeons dealing in the region. Even though sutural bones are found more commonly in hydrocephalic skulls,<sup>11</sup> the earlier studies on skulls have reported the presence of epipteric bones. It is also stated that skull bone fractures during infancy or early childhood can result in sutural bones. During burr hole surgeries at pterion, presence of EP type of pterion may lead to continuation of fracture lines.<sup>11</sup> Therefore the knowledge of presence and incidence of EP

variety of pterion is essential information during any surgical intervention in the region.

In Thai skulls P-FZS was found to be 31.12 mm.<sup>2</sup> In Turkish male skulls P-FZS on the right and left sides respectively were 3.30 cm and 3.44 cm.<sup>5</sup>

According to a study on South Indian skulls right side pterion was  $3.93 \pm 0.37$  cm and left side pterion was  $3.80 \pm 0.40$  cm posterior to the FZS in male skulls. The same study reported that in female skulls right side pterion was  $3.53 \pm 0.42$  cm and left side pterion was  $3.47 \pm 0.37$  cm posterior to the FZS.<sup>10</sup>

In the present study P-FZS was observed to be  $2.95 \pm 0.37$  cm on the right side and on the left side it was  $2.945 \pm 0.44$  cm. In case of male skulls on the right side P-FZS was  $2.84 \pm 0.68$  cm and on the left side P-FZS was  $2.88 \pm 0.65$  cm. In case of female skulls P-FZS on the right side and left side was  $2.8 \pm 0.44$  cm and  $2.86 \pm 0.46$  cm respectively (Table 3).

A study has reported that the skulls with EP pterion, the most anterior junction of the bones found to be as close as 16 mm to the lateral orbital rim. In such conditions the pterion can be wrongly assessed to be at the most anterior articulation of bones and a burr hole over this place may cause inadvertent penetration into the orbit, thus complicating the surgery.<sup>8</sup>

In the present study only 10 out of 150 pteria (6.67%) were 'backward pteria'. In Thai skulls 'backward pteria' were found in 22.9%,<sup>2</sup> which is comparatively higher than the findings of the present study. The 'backward pteria' were more frequently observed in males (78.9%) than in females (21.1%) in Thai skulls,<sup>2</sup> similar to the findings of the present study. Another comparative study reported that in Indians 'backward pterion' was more common on the right side, whereas in Nigerians it was more common on the left side.<sup>7</sup> But in the present study it was observed that 'backward pterion' were more common on the left side (Table 4).

## CONCLUSION

Most of the neurosurgical approaches are based on minimally invasive procedures. Since pterional approach is one of the most common and versatile approaches in neurosurgery,<sup>2</sup> detailed knowledge of pterion morphology and its location is crucial for neurosurgeons. Sutural bones at pterion may complicate surgical orientation and can be mistaken for fracture radiologically.<sup>11</sup> Hence the knowledge of various types of pteria, especially that of EP variety becomes essential for radiologists as well as to neurosurgeons. In the present study SP pterion was the commonest (77.33%) finding and was followed in frequency by EP type (21.33%) and ST type (1.33%). FT type of pterion was not found in the present study. According to the present study pterion was located 2.95 cm posterior to the FZS.

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**Table 1: Table showing the incidence of various morphological patterns of pteria**

	SP	EP	ST	FT
Right (n=75)	60	14	1	0
Left (n=75)	56	18	1	0
Both the sides (n=150)	116	32	2	0

SP- Sphenoparietal, EP-Epipteric, ST – Stellate, FT- Frontotemporal

**Table 2: Table showing the incidence of various patterns of pteria in male and female skulls**

Type of Pterion	Male skulls (N=50)			Female skulls (N=25)		
	Right side (n=50)	Left side (n=50)	Total (n=100)	Right side (n=25)	Left side (n=25)	Total (n=50)
SP	40	42	82	20	14	34
EP	9	8	17	5	10	15
ST	1	0	1	0	1	1
FT	0	0	0	0	0	0

SP - Sphenoparietal, EP - Epipteric, ST - Stellate, FT- Frontotemporal

**Table 3: Table showing the average distance of pterion to FZS in male and female skulls**

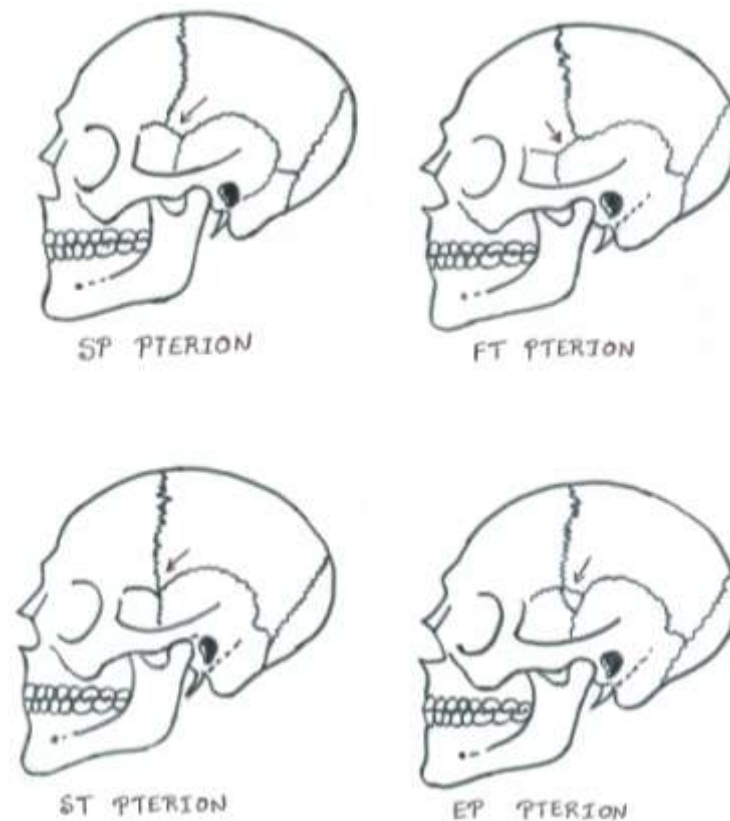
	Right P-FZS AVG (cm)	Left P-FZS AVG (cm)
Male (n=50)	2.839902	2.88032297
Female (n=25)	2.798	2.8628

AVG - Average, P-FZS : Pterion -frontozygomatic suture

**Table 4: Table showing the incidence of 'Backward Pterion'**

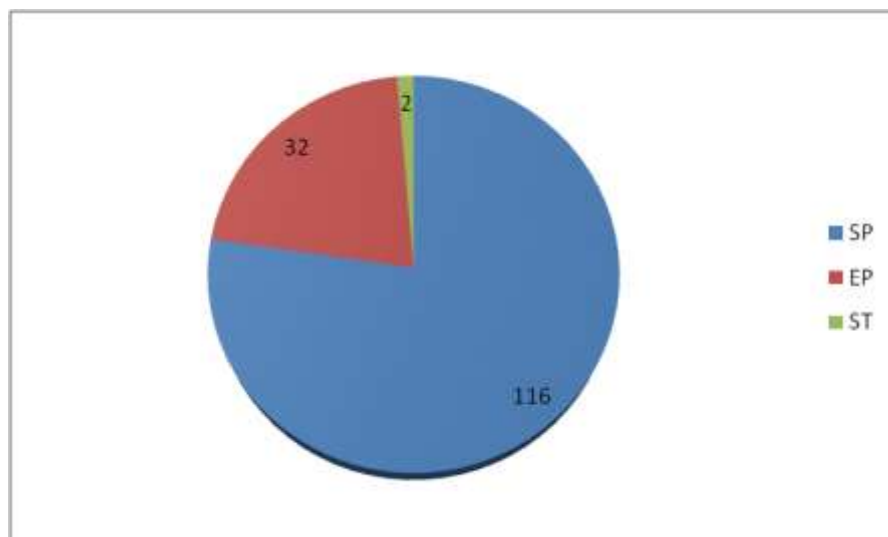
Side	Incidence of backward pterion	Males	Females
Right (n=75)	4 (5.33%)	3	1
Left (n=75)	6 (8%)	4	2

**Figure 1: Schematic diagram showing the various types sutural morphology of pterion**

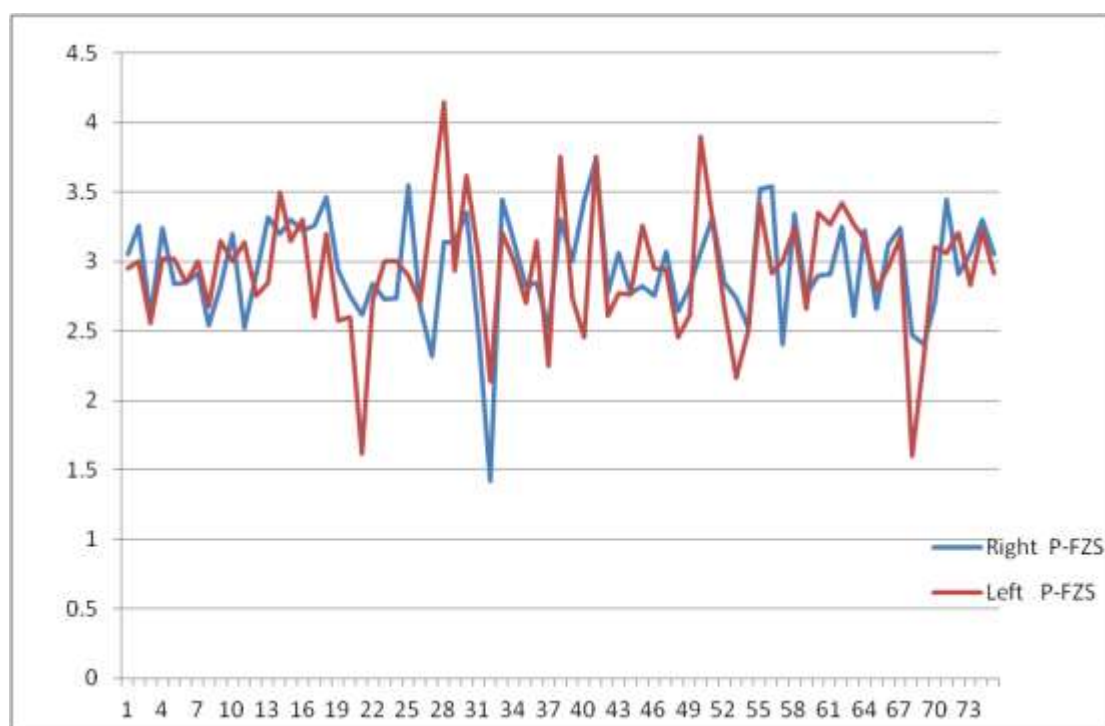


SP - Sphenoparietal, ST- Stellate, FT- Frontotemporal, EP- Epipteric

**Figure 2: Pie diagram showing the incidence of various patterns of pterion in the present study**



**Fig 3: Line diagram showing distribution of P-FZS on the right side and left side.**



P-FZS: Pterion – Frontozygomatic suture

**Figure 4: Photograph showing Sphenoparietal type of pterion**



**Figure 5: Photograph showing Epipteric type of pterion**





**Figure 6: Photograph showing Stellate type of pterion**

