

Anatomic study of the pterion in Nigerian dry human skulls

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Abstract

Background: The pterion is a point of sutural confluence seen in the norma lateralis of the skull. The site is an important landmark in surgical approaches to the anterior and middle cranial fossa.

Objective: This study was designed to determine the frequency of pterion types and anatomic positions of the pterion in dry human skulls of Nigerians in the South Eastern Zone.

Materials and Methods: Specific measurements were taken on both sides of 56 Nigerian human skulls of unknown sex, obtained from the Department of Anatomy, Nnamdi Azikiwe University, Nnewi Campus, Nnewi, Nigeria.

Results: All the four types of the pterion were present, i.e. sphenoparietal, frontotemporal, stellate, and epipteric. The study showed that the sphenoparietal type was 75% on the right side, 76% on the left side, the frontotemporal type was 19.6% on both sides, the stellate type was 1.8% on the right side and absent on the left side. The epipteric type was 3.6% on both sides. The distances from the centre of pterion to the frontozygomatic suture were 2.74 ± 0.07 cm on the right side and 2.74 ± 0.06 cm on the left side. The pterion was 4.02 ± 0.05 and 4.01 ± 0.03 cm above the midpoint of the zygomatic arch on the right and left sides, respectively.

Conclusion: These findings are important for the surgeon as the pterion junction is a common extracranial landmark in neurosurgical and surgical approaches.

Key words: Frontozygomatic suture, pterion, zygomatic arch

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Introduction

The pterion is an H-shaped junction where the frontal and parietal bones, the greater wing of the sphenoid and the squamous part of the temporal bones meet. It forms the floor of the temporal fossa. This is an important landmark overlying both the anterior branch of the middle meningeal artery and the lateral (sylvian) cerebral fissure intracranially.^[1] The pterion corresponds to the site of the anteriolateral (sphenoidal) fontanelle on the neonatal skull, which disappears about 3 months after birth.^[1]

It usually lies 4 cm above the zygomatic arch and 3.5 cm behind the frontozygomatic suture.^[1] The pterion is also

an important landmark for the anterior branch of middle meningeal artery, Broca's area (44-45), the insula, and the stem of the lateral sulcus. It is also a primary site during surgery to gain access to the sphenoid ridge and optic canal.^[2] Fractures of the pterion may tear the anterior branch of the middle meningeal artery leading to extradural hematoma.^[3] Murphy^[4] described four types of pterion namely sphenoparietal, frontotemporal, stellate, and epipteric. The sphenoparietal type is where the greater wing of the sphenoid articulates with parietal bone to form letter H,^[5] the frontotemporal is the type where the squamous part of the temporal bone articulates with the frontal, the

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stellate type is where all the four bones articulate to form letter K, and the epipteric type is where a sutural bone is lodged between the four bones forming the pterion.^[4]

In neurosurgery, it is important to have the most suitable bony aperture in order to be minimally invasive.^[6,7] To achieve optimum craniotomy where neuronavigation devices are not available, the surgeon then relies on external landmarks such as the pterion.^[8] Locating the pterion is important in surgical interventions following extra-dural hemorrhage as well as tumors involving inferior aspects of the frontal lobe such as olfactory meningiomas.^[9] The ‘pterial approach’ may also be used in operations on the Broca’s motor speech area^[10] and in repairing aneurysms of the middle cerebral artery as well as those of the upper basilar complex.^[11] The different types of pterion are of interest mainly to anthropologists and should be studied in other populations,^[7] such findings could also be useful for assessing the location of the pterion in incomplete archeological remains or forensic materials.^[12]

Little or no study on the pterion has been done in this part of Nigeria. The present work was therefore carried out to study the anatomic positions of the pterion in dry human skulls of Nigerians in the South East Zone.

Materials and Methods

Fifty-six dry, intact, human adult skulls of unknown sex were obtained from the Department of Anatomy of Nnamdi Azikiwe University, Nnewi Campus. The sutural patterns of the pterion were studied on both sides according to the classification of Murphy [Figure 1].^[4] The frequency of the various types of pterion namely, sphenoparietal, frontotemporal, epipteric, and stellate were observed on both sides of the skull and recorded.

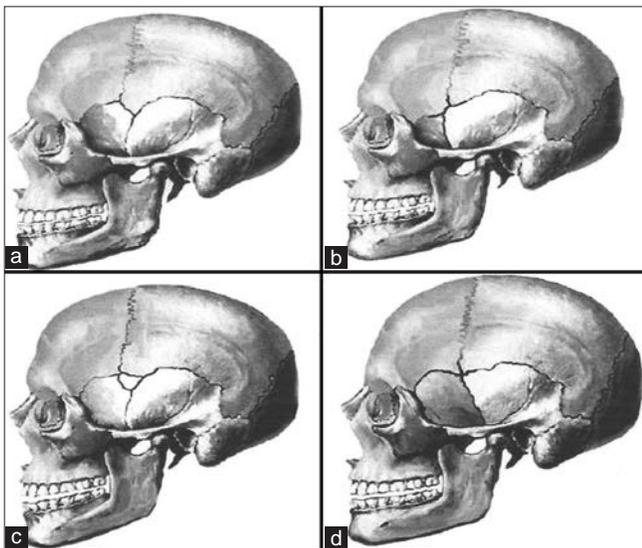


Figure 1: Types of the pterion: (a) sphenoparietal, (b) frontotemporal, (c) epipteric, and (d) stellate

A circle of smallest radius was drawn connecting the four bones involved in the formation of the pterion, the centre of which was taken as the center of the pterion.^[13] The following measurements were taken with a Manutan® digital vernier caliper with an accuracy of 0.1 mm: the distances between the pterion and specific identifiable bony landmarks [Figure 2].

These were:

1. P – FZS – the distance from the centre of the pterion to the posterolateral aspect of the frontozygomatic fissure.
2. P – ZA – the vertical distances from the centre of the pterion to the midpoint of the zygomatic arch.

The measurements were taken by one observer and repeated and the average taken as the final measurement. Data obtained were analyzed using SPSS 16.0.

Results

Table 1 shows the frequency of pterion types observed on the right and left sides of the skull. All the four types of pterion were seen in the studied population. The sphenoparietal type was the most frequent, followed by frontotemporal. A single stellate type was seen on the right side, while sphenoparietal was seen on the left. This was a case of asymmetry

Discussion

The surface anatomy of the pterion has been widely studied by various authors in different populations. Wang *et al.*^[14] stated that population-based differences suggest that various genetic variations in humans underlie the different sutural patterns of the pterion. Four different sutural patterns of the pterion were noted by Murphy,^[4] who also reported that variations of the pterion are likely a result of a combination of environmental and genetic factors [Table 2].

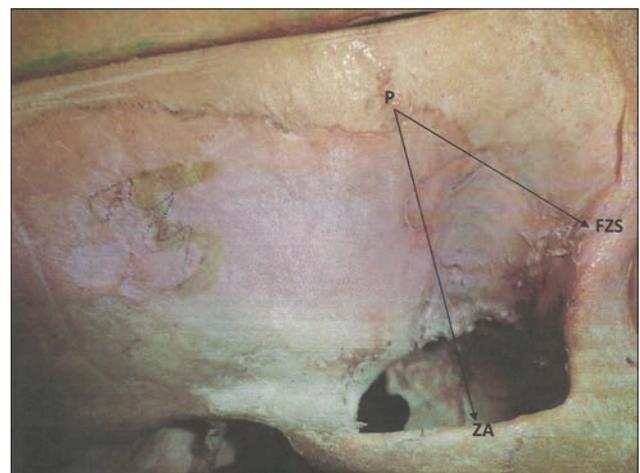


Figure 2: Side view of a dry human skull showing the pterion (P), distance from pterion (P) to frontozygomatic suture (FZS), and distance from pterion (P) to zygomatic arch (ZA)

The frequency of the pterion types in the population has been widely studied. Studies have shown that the sphenoparietal type is the predominant type in humans.^[2,8,13,15-17]

In primate evolution, the anterosuperior segment of the squamous part of the temporal bone of lower primates became detached from its parent and got incorporated into the posteriosuperior angle of the greater wing of the sphenoid bone of humans, thereby changing the pterion pattern from the frontotemporal type of non-human primates to the sphenoparietal type of humans.^[2,15]

The present study is in agreement with the previous studies mentioned above. In our study, the sphenoparietal type constituted 75% of the total on the right side and 76% on the left. Reports from various authors on the Indian population showed that the sphenoparietal type of pterion was 95.1% in Asiatic Indian,^[18] 87.7% in Northern Indians,^[2] 93.6% in South Indians,^[19] and 91.7% in Western Indians.^[13] Earlier reports by Asala et al.^[16] showed the incidence to be 82.1%. All the values were significantly higher than our finding. This could be as a result of genetic and environmental influences. In a study

carried out by Lee et al.,^[17] on Koreans, it was shown that the sphenoparietal type of pterion was 76.5%. Mwachaka et al.^[20] reported 66% on Kenyans. The incidence of the frontotemporal type of the pterion exhibited variation in different populations [Table 3]. Our values (19.6%) were similar to an earlier study in the Northern part of Nigeria by 10.1–23.6%.^[16,18] Incidence in Kenyans was observed to be 15% which is similar to our report.^[20] The stellate type of the pterion was 1.8% on the right side and absent on the left. This finding is comparable to the report of Zalawdia et al.,^[13] in the Gujarat Region of India and that of Saxena et al.^[18] The epipteric type of the pterion was seen in 3.6% on both sides in this study. This finding is significantly less than that reported by Asala and Mbajjorgu^[16] for another part of Nigerian and by Murphy^[4] in the Australian Aborigines (18.5%). However, our finding is similar to that in South Indians.^[19] All these variations could be attributed to genetic and environmental factors.

In anatomy texts, the pterion is reported to be 4.0 cm above the zygomatic arch and 3.0-3.5 cm behind the frontozygomatic suture.^[21] In this study, the pterion was 4.02 ± 0.05 cm above the zygomatic arch on the right side and 4.01 ± 0.03 cm on the left side. This finding shows that there are no side differences noted. It was also observed that the pterion was 2.74 ± 0.07 cm and 2.74 ± 0.06 cm behind the frontozygomatic suture on both right and left sides, respectively. The pterion in Koreans was reported to be positioned 36.9 ± 3.8 mm from the midpoint of the zygomatic arch.^[17] This shows a slight difference from this study. In earlier studies, Nigerian skulls when compared with Indians showed the pterion to be higher in Nigerians.^[18] The basis for these differences could be genetic or environmental.

In this study, the position of the pterion above the midpoint of the zygomatic arch is similar to other studies^[17,20] and the position of the pterion behind the frontozygomatic suture is only slightly different. This information may be useful in this environment in planning prior to surgery as neuronavigation devices may be scarce.

Table 1: Frequency of pterion types observed on the right and left sides of the skull

Pterion type	Right side, % (N=56)	Left side, % (N=56)
Sphenoparietal	75	76
Frontotemporal	19.6	19.6
Stellate	1.8	0
Epipteric	3.6	3.6

Table 2: The mean±SD of linear distances from the pterion to specific identifiable bony landmarks

Distance, cm	Right side (N=56)	Left side (N=56)
P-FZ (cm)	2.74±0.07	2.74±0.06
P-ZA (cm)	4.02±0.05	4.01±0.03

The differences between the various parameters on both sides were not significant.

Table 3: Comparison of the percentage of pterion types in different populations

Study/population n (skull), sex	Type of pterion			
	Sphenoparietal, %	Frontotemporal, %	Stellate, %	Epipteric, %
Saxena et al., ^[18] 1988, Nigerian, n=40, unknown sex	87.79	10.11	5.06	3.79
Saxena et al., 1988, ^[18] South Indian, n=72, unknown sex	95.3	3.46	1.38	11.79
Manjunath et al., ^[19] 1993, South Indian, n=172, unknown sex	93.55	3.52	2.93	17.3
Asala et al., ^[16] 1996, Nigerian, n=212, unknown sex	82.1	23.6	–	5.7
Lee et al., ^[17] 2001, Korean, n=149, unknown sex	76.5	–	–	40.3
Saxena et al., ^[2] 2003, North Indian, n=203, both sex	87.72	10.01	5.17	0
Oguz et al., ^[8] 2004, Turkish, n=26, male	88	10	0	2
Mwachaka et al., ^[20] Kenyan, n=50, both sex	66	15	7	12
Zalawadia et al., ^[13] 2009, Western Indian, n=42, both sex	91.7	2.4	1.2	4.8
Hussain et al., ^[5] 2011, Indians, n=125	69.25	17.35	9.7	3.7
Present study (2012) South Eastern Nigerian, n=56	75.5	19.6	1.8	3.6

Conclusion

The information obtained from this study may be useful in planning prior to surgery and recognition of this anatomy may render pterional craniotomy safer. Knowledge of the location and relations of the pterion is important in relation to surgical intervention, particularly of the middle meningeal artery and Broca's motor speech area on the left side.^[13]

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