International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Measurement of the Various Identifiable Bony Landmarks from the Center of Pterion in Human Skulls from Indian Population

Aymen A. Warille[1], Raghuveer Singh Mandloi[2]

[1]Department of Anatomy and Histology, College of Medicine, University of Hail, Kingdom of Saudi Arabia.
[2]Department of Anatomy, MLB Medical College, Jhansi, UP, India-284128.

Corresponding Author: Aymen A. Warille

Received: 22/12/2015 *Revised: 13/01/2016* *Accepted: 21/01/2016*

ABSTRACT

Background: The pterion is an important landmark for the anterior branch of the middle meningeal artery, Broca's area, the insula, and the stem of the lateral sulcus. It is also a primary site during surgery.
Objective: To measure the various identifiable bony landmarks from the center of pterion and to find out the percentage of different pterional types in human skulls from Indian population.
Methods: A total of 71 dry human adult aged skull of unknown sex without any gross pathology or abnormality was studied. Both the left and right sides of each skull, the sutural pattern of the pterion was determined based on descriptions (sphenoparietal, frontemporal, stellate and epipteric types).
Results: Spheno parietal was the commonest type of pterion in both left (78.9%) and right (81.7%) side of skull. The PFZ was insignificantly ($p>0.05$) lower in left side than right side in both manual (Left=3.18±0.31, Right=3.26±0.42) and digital (3.12±0.50, Right=3.22±0.39) measurements. There was no significant ($p>0.05$) difference in the PPM, PSFZ, PSS and PZA between left and right side in both manual and digital.
Conclusion: Anatomical variations of the pterion, which are of interest to anthropologists, forensic pathologists and surgeons, deserve further investigation in other populations from different geographical areas.

Key words: Pterion, Human skull, Anatomical variations, bony landmarks.

INTRODUCTION

Pterion is defined as a meeting point of skull base, calvarium and the skeleton part of facial anatomy. It also forms the floor of temporal fossa. [1] Pterion is a very important landmark for the neurosurgeons. Pterion has generated a lot of interest in anthropologists & forensic pathologists as there are different types of pterion that have been described in various population groups. [2]

Pterional fractures may therefore tear the frontal branch of middle meningeal artery leading to extra dural haematoma. [3] Other structures related to the pterion include: middle cerebral artery, anterior pole of the insula and the Broca's area. [4] The pterion is also an important landmark for the anterior branch of the middle meningeal artery, Broca's area, 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. [5]

The pterion is also commonly used as an important guide for age by cranial suture closure methodology. During the fetal period and at birth the region of pterion form large membranous areas called (soft spots) anterolateral fontanelles

or the sphenoidal fontanelle. It provides space for the skull bones to overlap while passing through the pelvis at birth. The fontanelles permit the skull to accommodate the rapid growth of the brain during infancy. Complete ossification of anterolateral fontanelle normally occurs immediately after birth. [1,6]

The present study was designed to measure the various identifiable bony landmarks from the center of pterion and to find out the percentage of different pterional types in human skulls from Indian population.

MATERIALS AND METHODS

A total of 71 dry human adult aged skull of unknown sex without any gross pathology or abnormality was studied. The skulls were collected from the Department of Anatomy, MLB Medical College, Jhansi, UP, India in collaboration with the College of Medicine, University of Hail, Kingdom of Saudi Arabia.

Both the left and right sides of each skull, the sutural pattern of the pterion was determined based on descriptions (sphenoparietal, frontemporal, stellate and epipteric types). A circle of smallest radius was drawn connecting the four bones involve in the formation of the pterion, the centre of which was taken as the centre of the pterion. The measurements were taken simple sliding vernier calipers and with digital calipers, then the average taken, so as to minimize bias errors of the distances between the pterion and specific identifiable bony landmarks.

With the help of compos, a circle of smallest radius was drawn by taking perpendicular bisectors theorem taken into consideration. For sphenopanetal type of pterion, first the joining point of transverse suture to coronal suture was taken as a centre and arcs having more than of the half of the length of transverse sutured were drawn above and below. Again, the posterior end of transverse suture taken as centre where it joined the squamous suture arcs was drawn above and below. The points where both arc intersected above and below were joined by a scale. The obtained line again halved using perpendicular bisectors, the point where this transverse line intersected was taken as a centre of pterion.

For frontotemporal type, the sutures between the frontal and the temporal bone halved with the help of compos the line which intersected the suture was taken as the centre of pterion. Again, perpendicular bisectors theorem was taken into consideration.

For epipteric type, anteriorly the point where frontozygomatic suture joined the sutural bone, taken as a centre and arcs were drawn having the radius more than half of the length sutural bone above and below. Posteriorly, the point where parietal suture joined to the sutural bone was taken as a centre, arcs were drawn above and below. The intersecting points of arcs were joined by a scale. Again, this obtained lined was halved. The intersecting points of these two lines were taken as a centre of pterion. For Stellate type, the point where all the sutures cross each other was taken as a centre.

The distances from the centre of pterion of different bony landmarks were: **PFZ**: distance from the centre of the pterion to the posterolateral aspect of the frontozygomatic suture; **PSFZ:** distance from the centre of the pterion to the anterior aspect of the frontozygomatic suture; **PZA:** the distance from the centre of the pterion to the superior edge of midpoint of zygomaticus arch; **PPM:** distance from the centre of the pterion to the most inferior aspect of the mastoid process; **PSS**: Distance from the centre of pterion to the anterosuperior margin of external auditory meatus.

Statistical analysis: The results are presented in mean±SD and percentages. The Unpaired t-test was used to compare the distances between left and right side of skull. The p-value<0.05 was considered significant. The analysis was carried out by using Statistical Program for Social

Sciences (SPSS) ver. 16.0 (Chicago, Inc., USA).

RESULTS

Spheno parietal was the commonest type of pterion in both left (78.9%) and right (81.7%) side of skull as well as in total (80.3%). Fronto temporal was found in 5.6% of left and right each (Table-1).

Table-1: Type of pterion in left and right side of the skull

Type of pterion	Left (n=71)		Right (n=71)		Total (n=142)	
	No.	%	No.	%	No.	%
Spheno parietal	56	78.9	58	81.7	114	80.3
Fronto temporal	4	5.6	4	5.6	8	5.6
Stellate	3	4.2	7	9.9	10	7.0
Epipteric	8	11.3	2	2.8	10	7.0

Table-2: Comparison of distances from the centre of pterion of different bony landmarks

	Left (mean±SD)	Right (mean±SD)	p-value[1]
PFZ			
Manual	3.18±0.31	3.26±0.42	0.33
Digital	3.12±0.50	3.22±0.39	0.22
Average	3.20±0.41	3.19±0.38	0.27
PPM			
Manual	7.93±0.56	7.94±0.54	0.64
Digital	8.12±1.44	8.13±0.53	0.54
Average	8.05±0.88	8.12±0.52	0.73
PSFZ			
Manual	3.63±0.41	3.74±0.36	0.18
Digital	3.64±0.43	3.75±0.43	0.22
Average	3.62±0.42	3.76±0.41	0.22
PSS			
Manual	5.11±0.31	5.13±0.37	0.92
Digital	5.13±0.33	5.18±0.56	0.42
Average	5.12±0.30	5.16±0.43	0.57
PZA			
Manual	3.62±0.36	3.65±0.33	0.53
Digital	3.63±0.35	3.73±0.31	0.70
Average	3.67±0.35	3.62±0.35	0.60

[1]Unpaired t-test

The PFZ was lower in left side than right side in both manual (Left=3.18±0.31, Right=3.26±0.42) and digital (3.12±0.50, Right=3.22±0.39) measurements. However, the differences were statistically not significant (p>0.05). No significant (p>0.05) difference was found for average of manual and digital measurements between left and right. The PPM was also lower in left side than right side in both manual and higher in digital measurements. However, the differences were statistically not significant (p>0.05).

There was slight difference for average of manual and digital measurements in PPM. Similarly, there was no significant (p>0.05) difference in the PSFZ, PSS and PZA between left and right side in both manual and digital (Table-2).

Fig.1: The sphenoparietal type is defined as a sutural pattern in which the sphenoid and parietal bones are in direct contact, preventing the frontal and temporal bones making contact with one another.

Fig.2: The frontotemporal type is a sutural pattern in which the frontal and temporal bones are in direct contact, preventing the sphenoid and parietal bones making contact with one another.

Fig.3: The stellate type is characterized by articulation of four bones (frontal, parietal, temporal and sphenoid) at a point.

Fig.4: The epipteric type is defined by presence of a small sutural bone between the four bones articulating at pterion

DISCUSSION

The present study was conducted in the Indian population. The manual and digital approaches were used together to measure the distances in the present study. The morphological configuration of the sutural junctions of the bones associated with the pterion varies significantly in humans. Previous studies of the configuration of sutural articulation patterns associated with the pterion have been focused on variation, classification, presence of epipteric bones, and associated cranial measurements and indexes. [4,7] Murphy [8] reported that variations of the pterion are likely a result of a combination of environmental and genetic factors.

In the present study, spheno parietal was the commonest type of pterion in both left and right side of skull as well as in total. Similar finding was reported by Ashley-Montagu [9] and Saxena et al. [10] In primate evolution, the anterosuperior segment of the squamous part of the temporal bone of lower primates became detached from its parent and incorporated into the posterosuperior angle of the greater wing of the sphenoid bone of humans, thereby changing the pterion pattern from the frontotemporal type of nonhuman primates to the sphenoparietal type of humans. [9]

The pterional approach, which is used in neurosurgery, has been described as the most popular approach. [11] It represents the standard approach for most lesions of the anterior and middle cranial fossae. The pterional approach is commonly employed in surgical treatment of the anterior circulation and upper basilar artery aneurysms, as well as for the tumors of orbital, retroorbital, sellar, chiasmatic, subfrontal and prepontine areas, lesions around the sella, and especially for lesions behind the clivus.

In this study, the PFZ was insignificantly ($p>0.05$) lower in left side than right side in both manual and digital measurements. The PPM was also lower in left side than right side in both manual and higher in digital measurements. There was slight difference for average of manual and digital measurements in PPM. It was also observed that there was no significant ($p>0.05$) difference in the PSFZ, PSS and PZA between left and right side in both manual and digital in this study. These are in agreement with other studies. [12,13]

In the 1970s, Yasargil [11] laid to the foundation of the pterional approach. There are many variants for the pterional approach. Mainly it is a trepanation which permits access to the frontal and to the temporal lobe as well as the Sylvian fissure. [14,15] Pterion is a keyhole approach to such kind of intracranial surgeries. [16,17] The combination of both a vital artery in this area and the relatively thin bone structure has lent itself to the name "God's little joke" by some physicians and clinicians. [18] The study done on Korean population also adds up that the bone thickness at pterion of the left side was significantly thicker than the right side of Korean adult skulls. [19]

The distinctive characteristics of the pterion observed in different population, racial groups and species result from differences in skull formation. Distances between the pterion and neighboring structures have importance in surgical approaches related to the cranium. The anatomical varieties of the pterion, which have been of interest mainly to anthropologists and forensic pathologists,

deserve further investigation in other geographical areas and different population. Such findings could also be useful for assessing the location of the pterion in incomplete archeological remains or forensic materials.

CONCLUSION

Anatomical variations of the pterion, which are of interest to anthropologists, forensic pathologists and surgeons, deserve further investigation in other populations from different geographical areas.

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How to cite this article: Warille AA, Mandloi RS. Measurement of the various identifiable bony landmarks from the center of pterion in human skulls from Indian Population. Int J Health Sci Res. 2016; 6(2):133-137.

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