PTERION ITS LOCATION AND CLINICAL IMPLICATIONS- A STUDY COMPARED

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ABSTRACT: Pterion a cranio-metric point has been described according to its location, type and relationship with the surrounding bony landmarks. Approach through pterion is mostly used to treat lesions of anterior and middle cranial fossa. Pterion ossicle or Epipteric bone are sometimes mistaken as a fracture at this point. **AIM & OBJECTIVE:** The study was set to explore the morphometry of Pterion in the human dry skulls of Uttarakhand region. The data may be useful for the anthropologists, forensic pathologists, neurosurgeons and maxillo-facial surgeons. **MATERIAL AND METHOD:** 40 dry human skulls of unknown sex collected from the department of anatomy of SGRR medical college. Instrument used for linear measurements - Sliding Caliper. **ANALYTICAL TEST:** Students 't' test. **RESULT:** Sphenoparietal type accounted 86.25%, frontotemporal 11.25% and stellate 2.5% collectively on the both sides of skull. The pterion is located 3.25 ± 1.05 cm behind frontozygomatic suture and 3.76 ± 6.62 cm above the temporozygomatic suture. **CONCLUSION:** Pterion is less likely to be diagnosed as a fracture site due to nonoccurrence of epipteric type of pterion in human skull of Uttarakhand. Pterion can be easily located with its relation to bony landmarks, and is most preferable approach in neurosurgery. **KEY WORDS:** pterion, skull, sutural pattern, pterional approach.

INTRODUCTION: Pterion is a significant region which is marked by the junction of frontal bone, parietal bone, squama temporalis and the greater wing of sphenoid bone and forms the floor of

temporal fossa. This cranio-metric point on the lateral side of skull is used by neurosurgeons and maxillo-facial surgeons due to its structural and anatomical importance.

It is an area of bone junction in the anterior part of the temporal fossa. It is usually indicated by an H-shaped formation of sutures that unite the frontal, parietal, sphenoid (greater wing), and temporal bones. Less commonly, the frontal and temporal bone articulate, sometimes all bones meet at a point (1).

The pterion corresponds to the site of anterolateral fontanelle of neonatal skull which closes in the third month after birth (2). The joints of the cranial vault are sutural joints which ossify in membranes. As the bones are growing, the unossified sutural membranes connect the periosteum covering the outer and inner surfaces of the bone, which helps in growth as well as binding the bones together to their apposed margins(3). A sutural bone is sometimes present at the pterion (4). This bone is called pterion ossicle or Epipteric bone or flower's bone.

It is the region mostly used as a guiding point where the position of deeper structures and their relations to the surface of the head are explained. This point is an important clinical landmark because the calvarium is thin and gets fractured easily. It overlies anterior branch of the middle meningeal artery which is the most common artery to be damaged producing extradural haematoma, requiring burr hole surgery to evacuate haematoma(5).

The pattern of bone articulation at pterion however can be varied and small epipteric bones may be present. Its center is approximately 4.0 cm superior to the zygomatic arch and 3.0-3.5 cm posterior to the frontozygomatic suture.(6)

The Pterion was first classified into three types (sphenoparietal, frontotemporal and stellate) by Broca in 1875. Four types of Pterion (sphenoparietal, frontotemporal, stellate, and epipteric) were defined by Murphy in 1956. Lastly Wang et al. proposed six types of pterion (sphenoparietal, frontotemporal, stellate, epipteric zygomatico-parietal and zygomatico-temporal).

Pterion lies two fingers superior to the zygomatic arch and a thumb's breadth posterior to the frontal process of the zygomatic bone (1). It is the point where the greater wing of the sphenoid meets the antero-inferior angle of the parietal bone and is not marked by an eminence or a depression(7). In neurosurgery, it is important to have the most suitable bony aperture in order to be minimally invasive (8).

In present study 40 dry skulls were examined for morphology & variation of the pterion with relation to the 2 bony landmarks. The distance between the pterion with respect to landmarks is measured by the stainless steel sliding caliper and the data obtained was analyzed statistically. This knowledge is mandatory for the surgeons in the pterional approach used for various microsurgeries and surgeries. Due to scarcity of the data on the morphology & location of the Pterion in the Uttarakhand dry skulls this study was undertaken.

MATERIAL AND METHODS: Present study is based on observation of 40 skulls of unknown sex. The study is conducted in the department of Anatomy, Shri Guru Ram Rai Institute of Medical & Health Sciences (SGRRIM & MS), Patel nagar, Dehradun.

The dry skull belongs to the department of Anatomy, SGRRIM & MS.

Morphology of the pterion on both the sides of each skull and the sutural pattern of the pterion was determined.

The type of Pterion was identified in all 40 skulls on both the sides.

The center of pterion was determined by drawing a circle of smallest radius connecting all the four bones taking part in formation of pterion, a center of which was taken as a center of pterion. This method is also used in the previous studies done on Pterion.

Stainless steel sliding caliper with an accuracy of 0.1 cm was used to measure linear distances between the pterion and specific identifiable bony landmarks. All the Measurements were taken twice and then averaged so as to minimize bias errors.

Parameters used in the present study are as follows:

PF: distance from the center of the pterion to the anterior aspect of the frontozygomatic suture.

PT: distance from the center of the pterion to the superior aspect of the temporozygomatic suture.

The linear measurement were taken for the PF with the help sliding caliper, one pointed jaw was kept at anterior aspect of the frontozygomatic suture and other at the center of Pterion. Similarly all the skulls were measured for the particular variable bilaterally. Data collected is summarized in table I.

Fig 1: Measurement taken with the help of sliding caliper for the parameter PF.

Table I

Parameter	No: of skulls	Mean	Median	Minimum	Maximum
PF (r)	40	3.44875	3.47500	2.20000	4.30000
PF (l)	40	3.46250	3.50000	2.20000	4.30000

PT variable was also measured by keeping the pointed jaws of sliding caliper at the center of the pterion and at the superior aspect of the temporozygomatic suture. All skulls were measured for this particular variable bilaterally and data collected is tabulated in table II.

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Fig 2: Measurement taken with the help of sliding caliper for the parameter PT

Table II

Parameter	No: of skulls	Mean	Median	Minimum	Maximum
PT (r)	40	3.75375	3.70000	3.20000	4.45000
PT (l)	40	3.69563	3.65000	3.00000	4.40000

TABLE III: MEASUREMENT OF PTERION FROM BONY LANDMARKS

SLNo	OF	PF (r)	PF(l)	PT (r)	PT(l)	SLNo	OF	PF (r)	PF(l)	PT (r)	PT(l)
SKULL						SKULL					
1		3.2	3.55	4.05	4.05	21		3.5	3.7	3.7	3.7
2		3.5	3.35	3.4	3.4	22		3.2	3.1	3.4	3.3
3		3.8	3.05	4.2	3.5	23		3.2	3.5	3.7	3.6
4		3.25	3	3.8	3.5	24		3.3	3.3	3.4	3.5
5		3.65	3.65	4.3	4.25	25		3.8	3.7	3.6	3.5
6		3.75	3.85	3.85	3.6	26		3.3	3.4	3.9	3.4
7		3.9	4.25	3.6	4	27		2.2	2.3	3.4	3.6
8		3.45	3.7	3.9	3.55	28		3.5	3.4	3.7	3.9
9		4.05	4.1	4.25	4.05	29		3.25	3.3	3.8	3.9
10		3.65	3.65	4.45	4.2	30		3.65	3.8	3.7	3.8
11		3	3.3	3.5	3.7	31		3.3	3.2	3.3	3.5
12		3.85	3.85	3.9	3.9	32		3.5	3.4	3.8	3.7
13		3.6	3.4	3.65	3.6	33		3.6	3.9	3.9	3.7
14		4.15	3.75	4.45	3.95	34		3.4	3.5	3.5	3.5
15		4.3	3.9	3.65	3.5	35		3.3	3.2	3.3	3.4
16		3.55	3.95	3.8	4.05	36		4.1	3.9	3.9	3.8
17		2.95	2.7	3.2	3.7	37		3.6	3.6	4.3	4.25
18		4.3	3.6	4.4	4	38		2.9	2.6	3.2	3.7
19		3.4	2.25	3.75	3	39		4.2	3.6	4.4	4.1
20		2.4	3.3	3.3	3.3	40.		3.5	2.2	3.7	3.1

Keys:

PF-linear distance between pterion and frontozygomatic arch.

PT-linear distance between pterion and temporozygomatic arch.

(r)- right side of skull

(l)- left side of skull

Fig 3 shows that the sphenoparietal type is 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 3.

Fig 4 shows that 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 4

Fig 5 shows that stellate type is characterized by articulation of four bones (frontal, parietal, temporal and sphenoid) at a point.

Fig 5

Table IV: Percentage of pterion observed on right and left side of skulls

Type of Pterion	Right side	Left side	Both sides
	n =40	n =40	n =80
Sphenoparietal	90%	82.50%	86.25%
Frontotemporal	12.5%	10%	11.25%
Stellate	5%	0%	2.5%

Keys: n- number of skulls

RESULT: Sphenoparietal type of pterion accounted 86.25% (90% on the right side and 82.5% on the left side), frontotemporal 11.25% (12.5% on the right side and 10% on the left side) and stellate 2.5% (5% on the right side) in all 40 skulls.

The Student's t test was employed in the assessment of each variable on either side of the skull. A p value ≤ 0.05 was considered significant.

The pterion is located 3.25 ± 1.05 cm behind the anterior aspect of the fronto-zygomatic suture on right side and 3.25 ± 1.05 cm on left side of the skulls. This is comparatively same on either side. The p value for this variable is 0.43824 which is higher than the $p = 0.05$, this is statistically insignificant.

The Pterion is located $3.825 \pm .625$ cm above the superior aspect of the temporo-zygomatic suture on the right side and $3.7 \pm .7$ cm on the left side of skulls. Pterion on the left side is slightly higher than the right side. The p value for this is 0.27527 which is statistically insignificant.

TABLE: V Analysis of linear distances of Pterion from bony landmarks.

Variables	Descriptive Statistics (STAMaster.sta)							
	Valid N	Mean	Median	Minimum	Maximum	Variance	S.D.	S.E
PF(r)	40	3.5	3.47500	2.20000	4.30000	0.164176	±0.44922	0.0710
PF (l)	40	3.41	3.50000	2.20000	4.30000	0.186551	±0.48287	0.07635
PT (r)	40	3.7775	3.70000	3.20000	4.45000	0.116505	±0.35752	0.05653
PT (l)	40	3.69375	3.65000	3.00000	4.40000	0.088430	±0.30153	0.04768

Keys:

S.D- standard deviation

S.E- standard error

(r)- right side

(l)- left side

N- number of skulls.

DISCUSSION: 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).

Sphenoparietal type of pterion is most common in all the regions. It's occurrence is higher in Indians (95.1%)(10), Northern Indians (87.72%)(11), Southern Indians (93.55%)(12), western Indian (91.7%)(9) and Nigerians (87.79% and 82.1%)(10,13), while it was significantly lower in Korean (76.5%)(14) and Kenyan (66%)(15) populations as compared to this study.

The occurrence of frontotemporal type of Pterion also shows dissimilarity among different groups, it accounts 10%–23.6% in Nigerians (10,13) and 15% of Kenyans(15), which are significantly higher than present study in which the pterion is 11.25% being closest to that reported in other populations of India.

Stellate variety was least present in the skulls of Uttarakhand region, study revealed it's occurrence nearly 2.5% (both sides). In the study done in Gujrat it's extremely as low as 0.02% but in the other study done in the region of Awadh area around Lucknow it accounts 5.17% which is higher than the present study (11). It can be concluded that the occurrence of stellate variety increases from east to west in India.

Epipteric type of pterion was not encountered in the present study, this is significant as in Nigerians it accounts 23.6% (13), Australian Aborigines 18.5% (16), and in other Indian studies it ranges from 6.74% to 11.79% which was mostly associated with sphenoparietal type(10,17).

The pterion lie 4.0cm above the arcus zygomaticus and 3.5 cm behind the sutura Frontozygomatica, this is in agreement with the present study where the distance from the arcus zygomaticus ranges from 3.0cm to 4.45cm and the distance from the sutura frontozygomatica ranges from 2.2cm to 4.3cm.

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In the 1970s Yasargil 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 (18, 19). Pterion is a keyhole approach to such kind of intracranial surgeries (20,21).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(22). 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 (23).

The variation in type and location of the pterion from different bony landmarks have been studied and explained in different populations, the findings of this study might be useful in providing information and data to the anthropologists, forensic pathologist neurosurgeons and maxilla-facial surgeons.

Table VI: Types of Pterion in different populations (in percentage)

Study, year	Population, n (skulls), sex	Type of pterion			
		Sphenoparietal	Frontotemporal	Stellate	Epipteric
		In %	In %	In %	In %
Saxena et al, 1988	Nigerian, n=40, unknown sex	87.79	10.11	5.06	3.79
Saxena et al, 1988	Indian, n=72, unknown sex	95.3	3.46	1.38	11.79
Manjunath et al, 1993	Southern Indian, n=172, unknown sex	93.55	3.52	2.93	17.3
Asala et al, 1996	Nigerian, n=212, unknown sex	82.1	23.6	-	5.7
Lee et al, 2001	Korean, n=149, unknown sex	76.5	-	-	40.3
Saxena et al, 2003	Northern Indian, n=203, both sex	87.72	10.01	5.17	0
Mwachaka et al,	Kenyan, n=50, both sex	66	15	7	12
Prabha et al, 2012	Southern Indian, n=50, both sex	74	3	9	14
Present study, 2013	Uttarakhand, n=40, unknown sex	86.25	11.25	2.5	0

Keys: n-number of skull

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