

A Cross-sectional Study on Morphology and Position of Pterion in Andhra Pradesh Population

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ABSTRACT

Introduction: Pterion is the important surgical landmark in temporal fossa, deeper to which vital areas of the brain are located. Injuries are common at this suture area due to confluence of multiple bones which are relatively slender and weak. Since the variations in morphology of the pterion is common, thorough knowledge of its location, types and subtypes, helps health professionals of varied speciality to confidently explore this area and perform the necessary interventions.

Aim: This study is aimed to determine the prevalence of different types of pterion, position of pterion, and compare the morphological variance between the right and left side among adult human skulls in Andhra Pradesh.

Materials and Methods: This cross-sectional study on human skull bones was conducted in Apollo institute of medical sciences and research, Chittoor, and Great eastern medical school and hospital, Srikakulam of Andhra Pradesh state in India from June 2020 to August 2020. The study was conducted on 54 adult dried human skulls with well-defined sutures. The

pterions of both sides of the skulls were keenly observed and studied for the type and subtypes of Pterions based on Murphy's classification. The position of pterion was measured from Frontozygomatic Suture (FZS) and Midpoint of Zygomatic Arch (MZA) with Vernier callipers. Data was analysed with descriptive statistics and also compared with earlier research works.

Results: Sphenoparietal 89 (82.4%) was the commonly observed pterion type in the present study, frontotemporal pterion was not found. Pterion was positioned at a Mean distance of 3.16 ± 0.48 cm and 3.20 ± 0.50 cm from frontozygomatic arch on right and left side, respectively. From MZA the pterion was present at 3.70 ± 0.35 cm and 3.78 ± 0.35 cm on right and left side respectively.

Conclusion: The present study reveals variations in sutural morphology pattern and position of pterion in the skulls oftentimes. Notable difference was observed while comparing the position of pterion with other country population. Cognizance of such variations would help the radiologists, neurosurgeons and forensic experts to diagnose opine and treat judiciously.

Keywords: Fontanelle, Middle meningeal artery, Suture, Sutural bones

INTRODUCTION

Pterion word was coined by Broca in 1875, derived from 'Pteron' which means 'wing'. The floor of the temporal fossa is formed by the frontal and parietal bones superiorly and the greater wing of the sphenoid and squamous part of the temporal bone inferiorly. All four bones of one side meet at a roughly H-shaped sutural junction termed the pterion. The pterion is usually positioned 4.0 cm above the zygomatic arch and 3.5 cm behind the FZS. It corresponds to the site of the anterolateral (sphenoidal) fontanelle of the neonatal skull, which closes during the third month after birth [1]. Presence of fontanelle in the fetal head helps for the molding during its passage through the birth canal as well as the rapid growth of brain during infancy period. The pterion is known to be the weakest part of the skull; therefore it is most important sutural landmark in craniofacial region and has clinical significance [2].

Neurosurgeons operate through this reference landmark to approach anterior branch of middle meningeal artery, lateral (sylvian) cerebral fissure, insula, Broca's motor speech area to the left, pathologies of optic nerve, orbit, sphenoidal ridge and for the anterior circulation aneurysms and tumors. Pterion burr hole operation helps in evacuating and treating extradural haematomas [3]. Determination of age of the skull by archaeology and forensic experts can be done by studying pterion. Sutural bones at pterion, detected on X-rays should not be confused as fracture by radiologists [3]. Pterion presents as various structural patterns that can mislead the clinicians during diagnosis of the lateral skull fractures in emergency situations [4].

As the variations in the morphological pattern and position of pterion is common [4], study of pterion gains importance as a valuable reference landmark to various health professionals. Therefore, this

study of pterion on adult human skulls of Andhra Pradesh population aims to determine the prevalence of types of pterion and compare between right and left sides of skull. Also, to determine the Pterion position and compare between right and left sides of skull. Further the differences of Pterion type and position is compared among Indian and overseas population.

MATERIALS AND METHODS

This Cross-sectional study was performed on 54 adult human dry skulls of both sexes collected from the osteology museum Department of Anatomy, Apollo Institute of Medical Sciences and Research, Chittoor and Great Eastern Medical School and Hospital, Srikakulam, Andhra Pradesh state, India. The study was done over a period of three months from June 2020 to August 2020. As the study was conducted on anonymous human skull bones, ethical clearance was not considered.

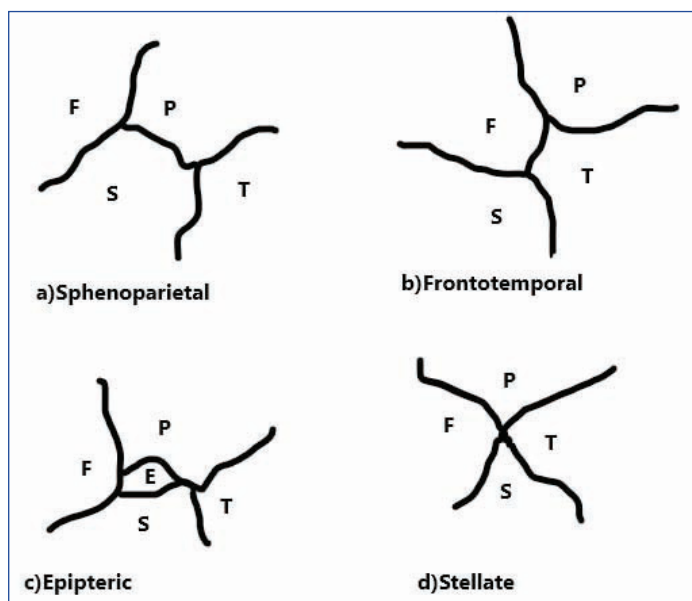
Sample size: The number of samples studied was 54 skulls. Sample size was calculated based on previous studies with expected proportion of 89%, absolute precision of 10% and desired confidence level of 95%.

Inclusion criteria: Adult human skulls with well-defined pterion sutures were considered for the study (adult skulls were determined by observing the third molar teeth eruption).

Exclusion criteria: Deformed, damaged and skulls with obliterated sutures were not included in the study. Skulls of new born, infants and children were excluded in this study.

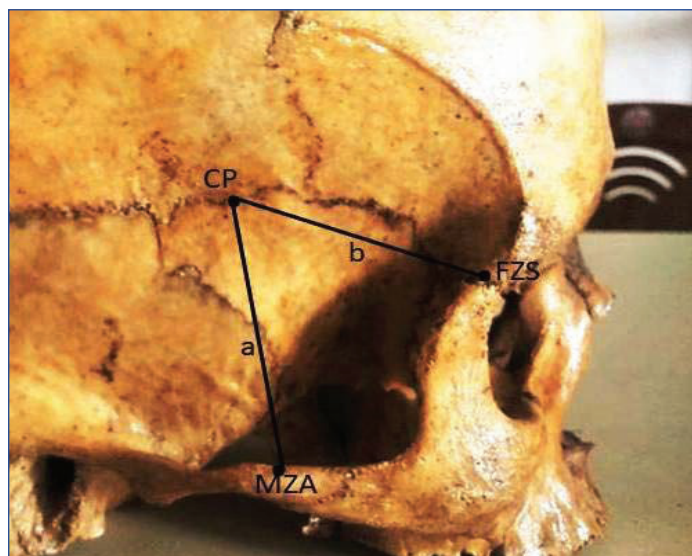
Methods: The pterion morphology were studied and categorised based on Murphy's classification into four types [Table/Fig-1].

Sphenoparietal (sphenoid and parietal bones are in direct contact), Frontotemporal (frontal and temporal bones are in direct contact), Stellate (all the four bones meet at a single point to form star shaped suture) and Epipteretic (sutural bones are present in the Pterion suture) [Table/Fig-1] [2].



[Table/Fig-1]: Four Types of pterion as described by Murphy. The four pterion types: a) Sphenoparietal; b) Frontotemporal; c) Epipteretic; and d) stellate are represented; F: frontal; P: parietal; S: sphenoidal and T: temporal bones. E: epipteric bone or wormian bone

The position of pterion was determined by measuring the pterion Centre Point (CP) distance from FZS and MZA using vernier callipers [Table/Fig-2]. To minimise the errors in measurements, average of two readings was considered.



[Table/Fig-2]: Position of Pterion From frontozygomatic suture and Midpoint of Zygomatic Arch (MZA). CP: center of pterion; FZS: Frontozygomatic suture; MZA: Midpoint of zygomatic arch; a: distance of pterion from midpoint of zygomatic arch; b: distance of pterion from FZS

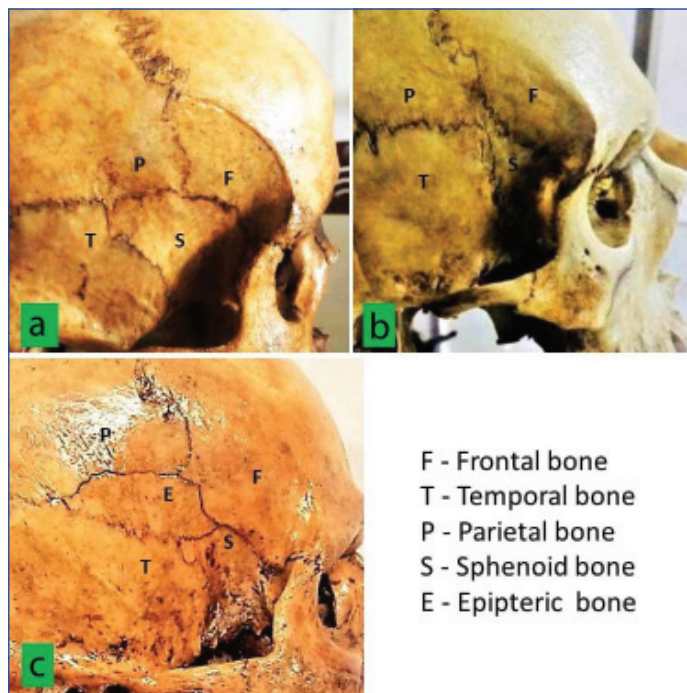
STATISTICAL ANALYSIS

The observational findings were tabulated in excel sheet and analysed. The descriptive statistical data like mean, percentage and standard deviation was derived using Statistical Package For The Social Sciences (SPSS) software version 22.

RESULTS

a. Percentage occurrence of types of pterion: In the current study, the following types of pterion were observed Sphenoparietal, Epipteretic and Stellate [Table/Fig-3]. Majority of the pterions 89 (82.4%) were sphenoparietal, the second common type was epipteric 17(15.7%) and least were stellate 2(1.85%) type. The

present study did not find the Frontotemporal type of pterion [Table/Fig-4].



[Table/Fig-3]: Three types of pterion from the present study. The 3 types of pterion observed in the current study are a- sphenoparietal, b- stellate, and c- Epipteretic

Type of Pterion	Prevalence of Pterion Types	On Right Side	On Left Side
Sphenoparietal	89 (82.4%)	46 (51.7%)	43 (48.3%)
Frontotemporal	0 (0%)	0 (0%)	0 (0%)
Stellate	2 (1.85%)	01 (50%)	01 (50%)
Epipteretic	17(15.7%)	07 (41%)	10 (59%)

[Table/Fig-4]: Type of pterion and its occurrence on right and left side (N=108). Type of pterion occurrence on right and left side: Maximum number of sphenoparietal type of pterion was observed; No frontotemporal types were seen

b. Presentation: About 42(78%) of the skulls studied have shown bilateral symmetry (same type of pterion on right and left side), but in the rest, there were different pterions on right and left sides of the skull. Sphenoparietal pterion were more commonly observed on right side than on left side, on the contrary epipteric were more common on left side than on the right side [Table/Fig-5].

Presentation	Number of skulls	Percentage (%)
Bilaterally symmetrical	42	78%
Asymmetrical	12	32%

[Table/Fig-5]: Pterion Presentation (N=54). Symmetrical or asymmetrical presentation of pterion: It was observed that in 42 (78%) of the skulls, the same type of pterion were observed on both sides, but in 12(32%) skulls different types of pterion were present

c. Position of pterion: The center of pterion (CP) from FZS on right side was 3.16±0.48cm and on left side was 3.20±0.50cm. From MZA the (CP) was at distance of 3.7±0.35cm on right side and 3.78±0.35cm on left side [Table/Fig-6].

Location of pterion	Right side (cm) Mean±SD	Left side (cm) Mean±SD
From FZS to CP	3.16±0.48	3.20±0.50
From MZA to CP	3.7±0.35	3.78±0.35

[Table/Fig-6]: Position of pterion from FZS and MZA. Position of pterion from named bony landmarks: FZS: frontozygomatic suture; CP: Position of centre of pterion; MZA: Midpoint of zygomatic arch; SD: Standard deviation

DISCUSSION

The current study reveals the similarity of occurrence of sphenoparietal (82.4%) type of pterion with the findings of Satpute C

and Wahane A, (82.9%) of Maharashtra region. Frontotemporal type of pterion was not found in present study which is in accordance with Sumathy G et al., and Shenoy V et al., of Tamilnadu state. The epipteric pterion (15.7%) occurrence is same as that of study by Sucharitha A and Bajpe R, (16%) of Karnataka state. The stellate pterion (1.85%) occurrence was consistent with findings of Shenoy V et al., of Tamilnadu and Manjunath KY and Thomas IM of Karnataka [Table/Fig-7] [3,5-13].

Year of study	Author	State	Sphenoparietal %	Fronto-temporal %	Epipteric %	Stellate %
1993	Manjunath KY and Thomas IM, [5], n=172	Karnataka, India	93.55	3.52	17.3	2.93
2010	Zalawadia DA et al., [6], n=42	Gujarat, India	91.70	2.40	4.80	1.20
2016	Sucharitha A and Bajpe R, [3], n=100	Karnataka, India	78	02	16	04
2012	Shenoy V et al., [7], n=75	Tamilnadu, India	77.3	-----	21.3	1.3
2012	Praba AMA and Venkatramaniah C [8], n=50	Tamilnadu, India	74	3	14	9
2014	Seema and Mahajan A, [9], n=50	North India, Punjab	89	7	12	4
2017	Gindha GS et al., [10], n=65	Himachal Pradesh, North India	72.3	4.6	23.1	0
2015	Satpute C and Wahane A, [11], n=85	Vidarbha, Maharashtra, India	82.9	2.9	7.0	5.3
2017	Sowmya S et al., [12], n=50	Karnataka, India	71.4	9.4	11.3	6.9
2017	Sumathy G et al., [13], n=50	Tamilnadu, India	60	--	22	18
2020	Present study n=54	Andhra Pradesh, India	82.4	0	15.7	1.9

[Table/Fig-7]: Pterion type in skulls among Indian population [3,5-13].

The percentage occurrence of four types of pterion were framed in the table and compared with studies from various states of India conducted earlier

Altogether the present study findings of Pterion types are close by to the findings of earlier studies done on south Indian population. The incidence of sphenoparietal pterion (82.4%) in present study is adjacent to that by Matsumura G et al., (79.1%) of Japan and Chaijaronkhanarak W et al., (87.27%) of Thailand. The findings of epipteric (15.7%) and stellate (1.85%) variety are similar to that of Matsumura G et al., (17.7% and 0.6%, respectively) [Table/Fig-8] [2,4,14-18].

Year of study	Author	Region/country	Sphenoparietal %	Fronto-temporal %	Epipteric %	Stellate %
1956	Murphy T [2], n=388	Australian aborigine	73.2	7.7	0.7	18.3
1988	Saxena SK et al., [14], n=40	Nigeria	87.79	10.11	3.79	5.06
1991	Matsumura G et al., [15], n=614	Japan	79.1	2.6	17.7	0.6
2004	Oguz O et al., [16], n = 26	Turkish	88	10	02	0
2009	Mwachaka PM et al., [17], n=90	Kenya	66.7	15.5	6.7	11.1
2017	Chaijaronkhanarak W et al., [4] n=110	Thailand	87.27	4.55	8.18	0
2019	Murrieta-Angulo S et al., [18], n=90	Peru	70	24	0	6
2020	Present Study n=54	India	82.4	0	15.7	1.85

[Table/Fig-8]: Pterion type in skulls of various ethnic groups [2,4,14-18].

The percentage occurrence of four types of pterion were framed in the table and compared with studies conducted earlier across various countries

The findings of current study correlate with the study by Matsumura G et al., of Japan.

In the present study, the position of pterion (CP) from FZS and MZA is similar on right and left side of the skull, which is in agreement with earlier studies conducted in India [Table/Fig-9] [3,6,9,19-21]. When compared among different ethnic groups, the pterion position of present study is consistent with Nigerians [Table/Fig-10] [16,17,22].

Year of study	Author	State	Distance from FZS Right side. Mean±SD (cm)	Distance from FZS Left side. Mean±SD (cm)	Distance from MZA-Right side. Mean±SD (cm)	Distance from MZA Left side. Mean±SD (cm)
2010	Zalawadia DA et al., [6], n=42	Gujarat, India	3.73±0.50	3.55±0.44	3.12±0.44	2.97±0.33
2016	Sucharitha A and Bajpe R, [3], n=100.	Karnataka	3.06±0.42	3.04±0.42	3.78±0.31	3.80±0.32
2014	Seema and Mahajan A, [9], n=50	Punjab	3.1±0.44	3.4±0.40	4.1±0.45	4.4±0.32
2015	Prasad H et al., [19], North India, n=50	Uttar Pradesh	3.20±0.39	3.11±0.40	3.71± 0.39	3.68±0.35
2017	Nayak G et al., [20], n=50	Odisha	3.48±0.21	3.41±0.16	4.01± 0.19	3.94±0.20
2018	Rosli AB [21], n=25	Tamilnadu	3.20±0.98	3.21±0.16	4.10± 0.52	3.93±0.96
2020	Present study, n=54	Andhra Pradesh	3.16±0.48	3.20±0.50	3.70±0.35	3.78±0.35

[Table/Fig-9]: Position of pterion in skulls among Indian population [3,6,9,19-21].

Distance of Pterion from Frontozygomatic suture (FZS) and from Midpoint of Zygomatic arch (MZA) was compared with earlier studies done in Indian population; SD: Standard deviation

Year of study	Author	Region	Distance from FZS Right side. Mean±SD (cm)	Distance from FZS Left side. Mean±SD (cm)	Distance from MZA Right side. Mean±SD (cm)	Distance from MZA Left side. Mean±SD (cm)
2004	Oguz O et al., [16], n=26	Turkey	3.30±0.40	3.44±0.39	4.05±0.39	3.85±0.25
2009	Mwachaka PM et al., [17], n=90	Kenya	3.88±3.49	3.82±3.47	3.03±3.40	3.03±4.30
2014	Eboh DEO and Obaroefe M, [22], n=50	Nigeria	3.2±0.3	3.1±0.2	4±0.3	3.9±0.3
2020	Present study, n=54	India	3.16±0.48	3.20±0.50	3.70±0.35	3.78±0.35

[Table/Fig-10]: Pterion position in skulls of various ethnic groups [16,17,22].

Distance of Pterion from Frontozygomatic suture (FZS) and from Midpoint of Zygomatic arch (MZA) was compared with earlier studies done in other countries; SD: Standard deviation

Limitation(s)

The current study was done on human skulls to determine the pterion morphology and position. Sexual dimorphism of pterion was not considered in this study. Hence there is scope for further research, to compare the pterion types and position between male and female skulls.

CONCLUSION(S)

The variations in the pterion morphology are commonly observed. Sphenoparietal type of pterion is the most commonly observed pterion while there are no frontotemporal pterion observed in the present study. Minimal variation of position of pterion was observed on right and left side. There is similarity among south Indian population pterion morphology and position, but difference was

noted from that of north Indian population. Notable difference was observed while comparing the position of pteria with other country population. In conclusion, the key knowledge of similarities and differences found in the present study will help the radiologists, forensic experts, neurosurgeons, anthropologists and other health professionals in perfect diagnosis, ethnic comparisons, postmortem reporting, surgical interventions and treatment of ailments of anatomical structures lying deeper to this cardinal surgical landmark of skull.

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