A Morphometric Study of Pterion in Adult Human Skulls

Seema D.[1*], Dakshayani K.R.[2], Sumanth M.M.[3]

{[1*]Associate Professor, [2]Professor & Head, Department of Anatomy} {[3]Assistant Professor, Department of Community Medicine}

Mysore Medical College & Research Institute, Mysore -570001, Karnataka, INDIA.

[*]Corresponding address:

seemadeepakmysore@gmail.com

Research Article

Abstract: Pterional access has been the time tested approach in the management of a wide variety of neurosurgical disorders in the anterior, middle and upper part of posterior cranial fossa. Pterion has been described as the 'H' shaped suture which is the confluence of temporal, parietal, sphenoidal and frontal bones at the lateral aspect of skull. Its location is approximately 4 cm above the zygomatic arch and 3.5 cm behind the frontozygomatic suture. Four different types of pterion have been described in various population groups. The present study was undertaken in 50 adult skulls of both sexes available in department of Anatomy, M.M.C & R.I, Mysore, to determine the location of pterion, define its type and measure the distance of various bony landmarks from the centre of the pterion. These findings will be of importance to anthropologists, anatomists, forensic pathologists and neurosurgeons.

Key words: Morphometry of pterion, Pterion types.

Introduction

Pterion has been described as H shaped suture marking the confluence of temporal, parietal, sphenoidal & frontal bones at the lateral aspect of skull. Pterional access has either alone or in combination with other approaches has paved the way for the management of wide variety of neurosurgical disorders in the anterior, middle & upper part of posterior cranial fossa with minimal tissue injury without compromising surgical results. It s location is approximately 4 cm above zygomatic arch and 3.5 cm behind the frontozygomatoc suture [1].This 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. The present study has been undertaken to determine the location, define it s type & to measure the distance of various bony landmarks from pterion that may be of importance to anthropologists, anatomists, forensic pathologists and neurosurgeons.

Materials and Methods

A total of 50 skulls (27 male & 23 female) available in the department of Anatomy, MMC & RI, Mysore were used for the study. Sample size was calculated as 47 using a precision of 0.1cm & SD 0.35cm for - distance from center of interior aspect of pterion to lateral end of lesser wing of sphenoid on sphenoid ridge. Sexing of the skulls were done based on morphological features.

The sutural pattern of pterion was determined on both sides based on description – sphenoparietal, frontotemporal, stellate, epipteric[2]. Following measurements were taken bilaterally using sliding vernier calipers with an accuracy of 0.01 mm, divider and a standard measuring scale.

1) PFZ- distance from center of pterion to the frontozygomatic suture

2) PZA-distance from center of pterion to middle of zygomatic arch

3) PLWS- distance from center of interior aspect of pterion to lateral end of lesser wing of sphenoid on sphenoid ridge

4) POC-distance from center of interior aspect of pterion to optic canal

The centre of a circle with smallest radius connecting the corners of sutural bone was considered the centre in case of epipteric pterion. The readings were taken twice and then averaged so as to minimize the errors. The data was analyzed using SPSS software. Gender & side assessment were done using Chi square & independent t test.

Observation and Results

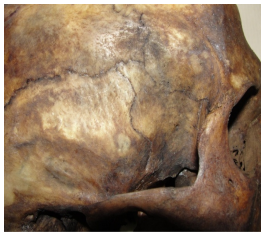
All four types of pterion were found in the 50 skulls (100 sides) studied, sphenoparietal being the commonest (95.7% females & 92.6% males). Stellate variety was observed in 4.3% females & 1.8% male. Frontotemporal was seen in 1.8% male & epipteric in 2% of male skulls. The latter two were absent in female skulls. The variation of pterion in male & female skulls were found to be statistically insignificant. The sphenoparietal type was bilaterally observed in 92% of cases. In rest of the cases frontotemporal, stellate and epipteric occurred unilaterally in combination with sphenoparietal variety.

Table 1: Incidence of different types of pterion in males & females

Gender	Sphenoparietal (%)	Frontotemporal (%)	Stellate (%)	Epipteric (%)
Male n=54	50 (92.6%)	1 (1.8%)	1 (1.8%)	2 (3.7%)
Female n=46	44 (95.7%)	0	2 (4.3%)	0
Total	94	1	3	2

Table 2: Frequency of different types of pterion on right & left sides

Side	Sphenoparietal (%)	Frontotemporal (%)	Stellate (%)	Epipteric (%)
Right n=50	46 (92%)	1 (2%)	1 (2%)	2 (4%)
Left n=50	48 (96%)	0	2 (4%)	0
Total	94	1	3	2



Photograph 1: showing epipteric pterion

Photograph 2: showing stellate pterion

Sphenoparietal & stellate were more common on left side, frontotemporal and epipteric were seen on the right. The means and associated standard deviations of various measurements were compared and p value calculated using independent t test.

Table 3: Means and associated standard deviations of various measurements with p value

Sl. No	parameter	Mean ± SD		p
		Male n=27	Female n=23	
1	PFZ -r	2.94 ± 0.48	2.85±0.46	0.50
	PFZ-l	2.92 ±0.64	2.78±0.59	0.44
2	PZA-r	3.91±0.38	3.79±0.50	0.39
	PZA-l	3.85±0.43	3.48±0.35	0.00
3	PLWS-r	1.73±0.52	1.68±0.62	0.76
	PLWS-l	1.92±0.63	1.74±0.54	0.29
4	POC- r	4.36±0.44	4.06±0.42	0.02
	POC -l	4.50±0.47	4.3±0.49	0.26

The pterion was more posterior from the frontozygomatic suture in males on both right & left sides compared to females. The difference was not statistically significant. The distance of pterion from midpoint of zygoma was more in males on both sides when compared to the females. The difference was statistically significant on the left side (p=0.00). The distance of center of internal aspect of pterion from lateral end of lesser wing of sphenoid on sphenoid ridge was more in males bilaterally than in females. The distance of center of internal aspect of pterion from optic canal was greater in males bilaterally than in females. P value was statistically significant on right side (P=0.02).

Discussion

Table 4: Types of pterion in various population groups

Population	N= skulls	sphenoparietal	Frontotemporal	stellate	epipteric
Saxena (2003) India [3]	203	84.72	10.01	5.17	-
Ilknur (2009) Anatolia[4]	28	89.2	3.6	3.6	3.6
Mwachaka(2009) Kenyan [5]	79	66	15	12	7
Zalawadia (2010) Western India [2]	42	91.7	2.4	1.2	4.8
Saheb (2011) India [6]	125	69.25	17.35	9.7	3.7
Present study(2013)	50	94	1	3	2

The sphenoparietal pterion which is the commonest variety seen in the present study is comparable to other works done on Indian skulls. This can be inferred from from table -4. Incidence of sphenoparietal pterion was also high in Anatolian population. However the frequency of sphenoparietal pterion was significantly lower in Kenyans when compared to other population groups. The incidence of frontotemporal type showed considerable variation not only in different population groups but also varied significantly among different research work in India itself. The current study showed an incidence of 1% which was the least. Frontotemporal has been reported to be the dominant pterional type in non human primates. During evolution the anterosuperior segment of the squamous part of temporal bone became dettached from its parent bone & subsequently incorporated into the posterosuperior angle of greater wing of sphenoid bone,

thus changing the pterion pattern from frontotemporal to sphenoparietal [5]. The percentage of stellate pterion in current study is 3% which is lower compared to other Indian studies. The incidence of stellete pterion is higher in Kenyans. The epipteric variety was found in 2% of skulls. It was lower compared to previous studies. These differences may probably be due to racial characteristics of different population.

Table 5: PFZ- distance b/n pterion and frontozygomatic suture (cm)

	Males		Females	
	R	L	R	L
Bhargavi(2011) India [7]	3.93±0.37	3.8±0.4	3.53±0.42	3.47±0.37
Present study (2013)	2.94±0.48	2.92± 0.64	2.85±0.46	2.78±0.59

The PFZ was 2.94± 0.48 & 2.92± 0.64cm on right & left respectively in male skulls. The same in female was 2.85±0.64 & 2.78±0.59 cm on right & left respectively. In a study done by Bhargavi et al these measurements were 3.93±0.37 & 3.8±0.4 on right & left side respectively in males. In females it was 3.53±0.42 and 3.47±0.37 on right & left respectively. The PFZ was 26.8 ± 4.5mm and 31.12 ±4.89 mm in Koreans [8] and Thai [9] population respectively. The difference in readings in different population can be attributed to racial features.

Table 6: PZA-distance b/n pterion and middle of zygomatic arch (cm)

	Males		Females	
	R	L	R	L
Bhargavi (2011) India [7]	4.52±0.32	4.45±0.35	4.10±0.44	4.10±0.44
Present study (2013)	3.91±0.38	3.85±0.43	3.79±0.50	3.48±0.35

In the present study the PZA was 3.91 ± 0.38 cm and 3.85±0.43 cm on right and left sides respectively in male. The same in females was 3.79± 0.50 cm and 3.48± 0.35 cm on right and left sides respectively. In a study done by Bhargavi et al these measurements were 4.52±0.32 and 4.45± 0.35cm on right & left side respectively in males. In females it was 4.10±0.44 cm bilaterally. In Turks the PZA was 4.05 ± 0.39 cm and 3.85± 0.25 cm 0n right & left sides respectively [10]. In Koreans the mean distance was 36.9±3.8 mm [8]. The basis for these differences could be genetic or environmental. Pterion in males was much higher than in females. This is because female skulls are shorter and broader.

Table 7: PLWS- distance of center of internal aspect of pterion from lateral end of lesser wing of sphenoid on sphenoid ridge (cm)

	R	L
Zalawadi (2010) Western India[2]	1.36±0.35	1.33±0.22
Present study(2013)	1.71±0.45	1.84±0.59

The PLWS in present study was 1.71±0.45 and 1.84±0.59 cm on right & left sides respectively. These measurements are comparable in skulls of western Indian population which was 1.36±0.35 and 1.33±0.22cm on right and left sides respectively. In the Thai group it was 11.70± 4.83mm [9].

Table 8: POC- distance of center of internal aspect of pterion from optic canal (cm)

	R	L
Zalawadi (2010) Western India[2]	4.52± 0.32	4.37±0.23
Present study(2013)	4.22±0.45	4.43±0.48

The POC in the current study was 4.22±0.45 and 4.43±0.48 on right and left sides respectively. The same in Gujarat population was 4.52± 0.32 and 4.37±0.23 cm on right and left side respectively. These distances become important to approach the optic canal through pterion and in cases of meningiomas located in retroorbital area.

Conclusion

The pterional approach has been the most popular method for neurosurgeries. It is the standard approach for most lesions of anterior & middle cranial fossa like in surgical treatment of anterior circulation, tumours involving inferior aspect of frontal lobesuch as olfactory meningiomas, tumours in orbital, retroorbital , sellar & chiasmatic areas and operations on Broca's motor speech area. The present study has shown that sphenoparietal variety is the commonest type of pterion observed in Indian skulls. Knowledge of morphological variants especially the epipteric becomes important when a burr hole placed over the anterior junction of bones may cause inadvertent penetration into orbit [11]. A thorough knowledge of distance of various bony landmarks help in location of pterion. The data obtained will be useful for the clinicians during surgical planning and serves for success in the presence of variable topographic cranial anatomy.

References

1. Williams LP, Bannister LH, Berry MM, Collins P et al, Gray's Anatomy 38th edition, Churchill Livingstone, London;1988: 568-595, 1912-1519
2. Ankur Zalawadi et al; Morphometric study of pterion in dry skull of Gujarat; NJIRM; 2010; 1(4) ; 25-29
3. Saxena RC, Bilodi AKS, ManeSS, Kumar A: Study of pterion in skulls of Awadh area in and around Lucknow; Kathmandu University of Medical Journal; 2003; 1(1); 32-33
4. Ilknur A, Mustafa KI, Sinan B ; A comparative study of variations of pterion of human skulls from 13th and 20th century Anatolia: Int J Morphol; 2009; 27(4); 1291-1298
5. Mwachaka PM, Harsanali J, Odula P: Sutural morphologyof the pterion and asterion among adult Kenyans; Braz J Morphol.Sci; 2009; 26:4-9

6. Sahib HS, Mavishettar, Thomas ST, Prasanna, Muralidhar P, Magi: A study of sutural morphology of the pterion and asterion among human adult Indian skulls: Biomedical research: 2011; 22(1); 73-75
7. Bhargavi C, Vasudha S, Kishan K; Pterion: a site for neurosurgical approach ; International journal of Biomedical research: 2011; 2(12); 588-594
8. Lee UY, Park DK, Kevon SO, Park DJ, Han SH: Morphological analysis of Pterion in Koreans; Korean J Phys Anthropol: 2001;14(4); 281-289
9. Apinhasmit W, chompoopong S, et al ; Anatomical consideration of pterion and its related references in Thai dry skulls for pterional surgical approach; pubmed
10. Oguz O, Sanli SG, Soames RW; The pterion in Turkish male skulls; surgical Radiological Anatomy: June 2004; 26(3) : 220-224
11. Ersoy M, Evliyaoglu C, Bozkurt MC, Konuskan B et al ; Epipteric bones in the pterion may be a surgical pitfall; Minimum invasive neurosurgery ; Dec 2003; 46 (6): 363 -365