Original Article

A Morphometric Study On Variation In The Position Of Pterion – Its Clinical Implications

Chaitra D[1], Divya N Pai[2]*, Ashwija Shetty[3]

[1, 2]*Tutor, Department of Anatomy, KS Hegde Medical Academy, Mangalore
[3]Tutor, Department of Anatomy, KMC, Manipal

***Corresponding Author:** Divya N Pai

*Department of Anatomy, KS Hegde Medical Academy
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Abstract

The pterion is a very important neurosurgical landmark that provides access to various neurological structures like the optic nerve, circle of Willis, Sylvian point, middle meningeal vessels, cavernous sinus, and parasellar regions. The variation in the position of the pterion bilaterally was observed and analyzed in both genders.

Methods: The study involved 47 male and 39 female skulls. The linear distance of the center of the pterion to the midpoint of the zygomatic arch and frontozygomatic suture was measured bilaterally in both sexes. The results were analyzed by using paired and unpaired t-tests and a bar graph was plotted.

Results: The mean distance from the midpoint of the zygomatic arch to the center of the pterion is 37.86± 2.62 mm and 33.31± 1.2 mm in males and females respectively. The mean distance from the midpoint of the frontozygomatic suture and the pterion is 31.10±2.45 mm and 29.04±1.27 mm in males and females respectively. There was a significant difference between the position of pterion of both sexes. The p-value was less than 0.001.

Conclusion: The position of pterion shows variations in the different ethnic populations. In our study, we found that the position of the pterion is higher in male skulls than the female skulls. With the advancement of technology, neurosurgeons prefer burr hole surgeries over craniotomy to approach the various neurological structures. The variation in the position of the pterion is essential for neurosurgeons for the pterional burr hole surgeries.

Keywords: pterion, neuro surgeries, burr hole, neurological structure

INTRODUCTION:

The lateral aspect of the skull marks the presence of the pterion which is the meeting point of the frontal, parietal, greater wing of the sphenoid, and squamous part of temporal bones. The pterion is situated approximately 4 cm above the midpoint of the zygomatic arch and 3.5 cm posterior to the frontozygomatic suture (1). The anatomical and clinical significance of pterion is it marks the position of the anterior branch of the middle meningeal artery, Broca's area of speech, Sylvian point, and anterior pole of the insula (2). The knowledge of the position the of pterion and the structures deep to it has the utmost importance to burr holes in draining the extradural hematoma caused due to the rupture of branches of middle meningeal arteries. In the neonatal skull, it corresponds to anterolateral fontanelle (3). To gain access to the optic canal and sphenoidal ridges the pterion forms an important landmark (4). Murphy classified the pterion into four types, which includes sphenoparietal, frontotemporal, stellate and epipteric. Sphenoparietal is fusion of greater wing of sphenoid and parietal bone, frontotemporal involves the fusion of frontal and temporal bone, stellate is a type where all the four bones are articulating and epipteric type is the one where a sutural bone is present (5). The study of pterion has been conducted in different ethnic group that includes Thai ethnic group by Apinhasmit et al., Nigerian ethnic group by Ukoha et al., Anatolian skulls of thirteenth and twentieth century, Kenyan ethnic group by Mwachaka et al., Turkish ethnic group by Oguz et al., (6,7,8,9,10). These studies showed the position of pterion exhibited moderate variation in different ethnic group and also there existed the sexual dimorphism. Thus, the position of pterion in different ethnic population is important pertaining to its clinical approaches. The knowledge of position of pterion helps in the estimation of age. The positions of pterion also show the sexual dimorphism. Thus, can be used as a tool in forensic and archaeological specimens to identify the sex of the individual (11). To access some of the neurological structures, the pterion forms the important landmark for the neurosurgical procedures (12). There are clinical studies that stressed the importance of position of pterion in approaching the neurological studies (13, 14, 15,16). The reason for approaching the neurological structures via pterion is due to these keyhole surgeries provide minimal retraction of brain tissue, the time taken for such approaches is shorter, there is minor loss of tissues (17). The difference in the position of the pterion, thus helps the radiologists and surgeons while handling the pathologies of this part of cranium and also the sutural asymmetry can be understood. Thus, our study aimed to analyze the variations in the position of pterion in the skulls of the Dakshina Kannada population.

METHODS AND MATERIALS:

The study was conducted on 47 male and 39 female skulls. The sex of the skulls was determined by observing the anatomical features and skeletal morphology. To avoid inter-observer errors, the measurements were made and noted by a single observer. Each measurement was repeated again and the values were noted. The measurements were done by using the sliding digital vernier caliper. Two linear distances were considered from the midpoint of the zygomatic arch to the center of the pterion (ZP) and from the midpoint of the zygomatic suture to the center of the pterion (FP). These linear distances were measured and the values were noted. Bilateral measurements were taken both in males and females. Figure 1 shows the linear distances measured. The measurements taken were in accordance with Karg et al., (18). The data obtained were analyzed by SPSS version 20.0 software. Paired and unpaired t-tests ($p<0.05$) were used to analyze the data.

Inclusion criteria: Dry intact skulls were included in the study

Exclusion criteria: The skulls that were damaged, deformed, and had callus formation were excluded from the study.

RESULTS:

For this study, 47 male and 39 female skulls were included. The mean distance from the midpoint of the zygomatic arch to the center of the pterion (ZAP) is 37.86± 2.6 mm in males and 33.31± 1.2 mm respectively. The mean distance from the midpoint of the frontozygomatic suture and the pterion (FZSP) is 31.10±2.45 mm and 29.04±1.27 mm in male and female skulls respectively. There was a significant difference between the position of pterion of both the sexes as was observed. The ZAP and FZSP of the right-side pterion were 36.07±2.98 and 30.49±1.79 mm respectively. The ZAP and FZSP of the left side were 35.52±2.5 mm and 29.85±1.68 mm in male and female skulls respectively. Table 1 shows the side-wise variations in the ZAP and FZSP of the right and left sides of all 86 skulls. The p-value was <0.001. Table 2 shows the comparison of ZAP and FZSP of all 86 skulls. The ZAP of the right-side male skull is 38.34±1.62 mm and 33.34±1.67 mm in female skulls. The p-value showed statistically significant. The ZAP of the left-side male skull is 37.39±1.76 mm and in female skulls, it is 33.28±1.07 mm. The p-value was less than 0.001. The FZSP of male and female skulls of left was 31.48±1.65 mm and 29.30±1.09 mm respectively. The p value was less than 0.001. The FZSP of male and female skulls of left side was 30.73±1.61 mm and 28.78±1.03 mm respectively. Table 3 shows the gender wise comparison of right and left side skulls. In male skulls the ZAP of right and left side was 38.34±1.62 mm and 37.39±1.76 mm and FZSP was 31.48±1.65 mm and 30.73±1.61 mm respectively. The p value was less than 0.001. In female skulls, the ZAP of right and left side 33.34±1.67 mm and 33.28±1.07 mm. This was not statistically significant with the p value more than 0.05. However, the FZSP in female skulls of right and left side was 29.30±1.09 mm and 28.78±1.03 mm. The p value was statistically significant.

Dimension	side	N	mean	SD	p value
ZAP	right	86	36.0778	2.98936	p<0.001
	left	86	35.5295	2.53672	
FZSP	right	86	30.4937	1.79298	p<0.001
	left	86	29.8533	1.68627	

Table 1: Shows the ZAP and FZSP in male skulls of right and left side. P value is significant. p<0.001

	Sex	N	mean	SD	p value
ZAP right	Male	47	38.3419	1.62350	p<0.001
	Female	39	33.3492	1.67840	
ZAP left	Male	47	37.3919	1.76467	p<0.001
	Female	39	33.2851	1.07912	
FZSP right	Male	47	31.4802	1.65989	p<0.001
	Female	39	29.3049	1.09613	
FZSP left	Male	47	30.7391	1.61443	p<0.001
	Female	39	28.7856	1.03194	

Table 2: Comparison of ZAP and FZSP between males and females

Gender	Dimension	Side	Mean	N	Std. Deviation	p value
Male	ZAP	right	38.3419	47	1.62350	p<0.001
		left	37.3919	47	1.76467	
	FZSP	right	31.4802	47	1.65989	p<0.001
		left	30.7391	47	1.61443	
Female	ZAP	right	33.3492	39	1.67840	p>0.05
		left	33.2851	39	1.07912	
	FZSP	right	29.3049	39	1.09613	p<0.001
		left	28.7856	39	1.03194	

Table 3: Comparison of ZAP and FZSP bilaterally in male and female skulls

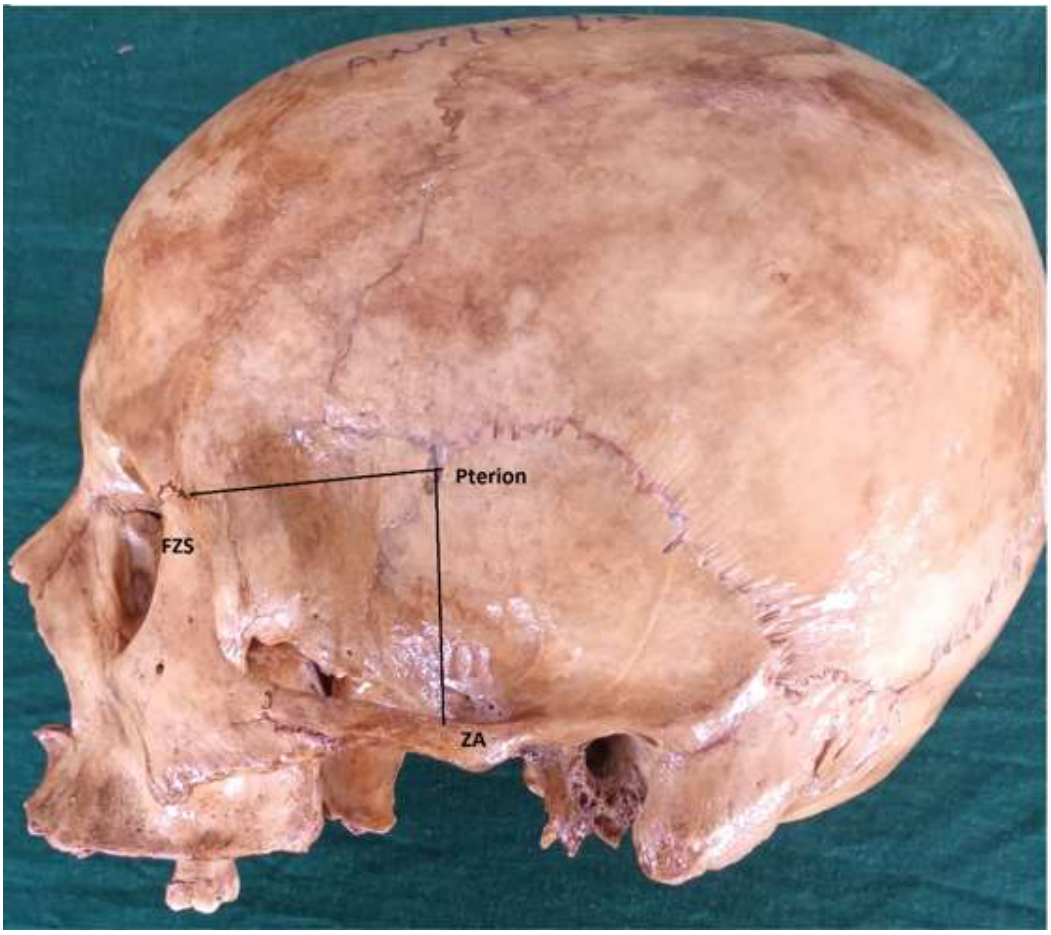

Fig 1: showing the position of pterion

DISCUSSION:

Pterional craniotomy is one of the most common neurosurgical procedures adapted to approach neurological structures. In order to access the tumors and the lesions in different areas of the brain, understanding the morphometry of the pterion is very important. The pterion is considered to be the weakest part of the skull beneath which lies the anterior branch of the middle meningeal artery. Pertaining to its clinical significance, the knowledge of knowing the variations in the pterion is utmost important in human identification and anthropology (19). The linear distance of centre of pterion and the midpoint of zygoma and frontozygomatic suture describes the location of pterion externally. But internally, the location of pterion is described as the linear distance from sphenoidal ridge to the optic canal (12). The variations in the position of pterion and its morphology have been studied in the different ethnic population. In a study by Ogus et al., in Turkish population found that the ZAP of right side skull was 40.5±3.9 and of left side was 38.5±2.5 and FZSP of right and left side skull was 33.0±4 and 34.4±3.9 respectively (20). The ZAP and FZSP of right and left side skulls were 38.88±3.49 and 38.24±3.47 and 30.34±4.30 and 30.35±3.40 respectively in the Kenyan population in 90 skulls (21). In the study by Ilknur et al., Anatolian population, found that ZAP of right and left skulls was 38±4 and 39±4 and FZSP of right and left side skulls were 35±5 and 35±5 respectively (22). The study by Ukoha et al., in Nigerian population the ZAP of right and left side skulls were 40.2±0.5 and 40.1±0.3 and FZSP of right and left side skulls were 27.4±0.7 and 27.4±0.6 respectively (23). In these studies, the position of the pterion varied significantly. In a study conducted by Urzi et al., in Italian population involving 506 skulls, the pterion position was reconstructed on a polythene sheets and morphologic features were observed. Apart from observing the morphological features, they also evaluated the length of the sphenoparietal suture the minimum gaps between the temporal and frontal bones, the sutural bones influence on the position of pterion and correlations between the measurements and cranial indexes (24). The bilateral variation in the position of pterion was statistically insignificant in the study done by Adejuwon et al., in Nigerian ethnic group (25). The pterion is an area rather than a point of meeting of four bones. It is evident from the previous studies, that there are researchers who have applied different methods to locate the position of pterion (12). In the present study, we have followed the same method as was followed by other authors (6,7,8). But there are researchers who described the position of the pterion as the location within a circle of 1 cm diameter 2.6 cm behind and 1.3 cm above the postero-lateral margin of the frontozygomatic suture (26). The location of pterion was described as the mean distance of the center of the pterion from the external acoustic meatus, mastoid process, zygomatic arch, and the frontozygomatic suture by Aksu et al., (27).

CONCLUSION:

With the advancement of surgical techniques, craniotomy which was the old technique used is now reduced to keyhole surgeries. The position of the pterion has to be very accurately located by the neurosurgeons to burr hole in the keyhole

surgery to approach the neurological structures. In order to avoid surgical complications, it is very important to know the variations in the position of the pterion.

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