# PTERION: A SITE FOR NEUROSURGICAL APPROACH

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## ABSTRACT

Pterion is defined as point of sutural confluence seen in the normal ateralis of the skull where frontal, parietal, temporal and sphenoid bones meet. It is a commonly used neurosurgical landmark. The anatomic location of the pterion is important in surgical interventions following surgical approaches to the anterior and middle cranial fossae, following extradural hemorrhage as well as tumors involving inferior aspects of the frontal lobe, such as olfactory meningioma, used in operations on the Broca's motor speech area and in repairing aneurysms of the middle cerebral artery as well as those of the upper basilar complex and also the anatomical varieties of the pterion, is of interest mainly to anthropologists and forensic pathologists, for assessing the location of the pterion in incomplete archeological remains or forensic materials. The pterion exhibits population-based variations. The aim of the study is to determine the position of the pterion using the midpoint of the zygoma (MPZ) and the frontozygomatic suture (FZS) as palpable points.In the present study seventy dry skulls (34 male and 36 female) were used. The dry skulls were obtained from the department of anatomy, K M C Mangalore, Manipal University. Only the intact skulls were included in the study. The sexing was done on the morphological basis. The Distance between pterion to FZS and pterion to MPZ of right and left side of the male skull bones when compared with the right and left side of female skull bones showed statistically significant side difference among male and female bones.

**Keywords:** Pterion; midpoint of the Zygoma; midpoint frontozygomatic suture

## 1. INTRODUCTION

The pterion, the most commonly used neurosurgical landmark, is defined as point of sutural confluence seen in the normal ateralis of the skull where frontal, parietal, temporal and sphenoid bones meet. The position of the pterion exhibits population-based variations. Location of this point is important in surgical approaches to the anterior and middle cranial fossae[1]. This craniometric point is related to structures in the cranial cavity. The pterion marks the anterior middle meningeal arterial ramus[2]. Pterional fractures may therefore tear the frontal branch of middle meningial artery leading to extra duralhaematoma[3]. Other structures related to the pterion include: middle cerebral artery, anterior pole of the Ínsula and the Broca'sárea[4]. Further, inferior border of the frontal lobe is represented by an oblique line drawn from the frontozygomaticsuture to the pterion [1].

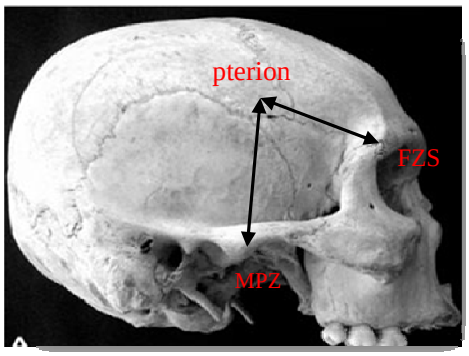
The pterional approach is commonly employed in surgical treatment of the anterior circulation and upper basilar artery aneurysms, as well as for the tumors of orbital, retroorbital, sellar, chiasmatic,

subfrontal and prepontine areas, lesions around the sella, and especially for lesions behind the clivus[5, 6,7,8,9;10,11,12]

In neurosurgery, it is important to have the most suitable bony aperture in order to be minimally invasive [1]. To achieve optimum craniotomy where neuronavigation devices are not available, the surgeon then relies on external landmarks, such as the pterion[13].

The anatomic location of the pterion therefore is important in surgical interventions following extradural haemorrhage as well as tumors involving inferior aspects of the frontal lobe, such as olfactory meningiomas[14]. The 'pterional approach' may also be used in operations on the Broca'smotor speech área[4] and in repairing aneurysms of the middle cerebral artery as well as those of the upper basilar complex [15].Also the anatomical varieties of the pterion, is of interest mainly to anthropologists and forensic pathologists, deserve further investigation in other geographical areas and different populations. Such findings could also be useful for assessing the location of the pterion in incomplete archeological remains or forensic materials[12].

The position of the pterion however cannot be discerned easily because it is usually covered by scalp [2]. This study therefore aimed at determining the position of the pterion using the midpoint of the zygoma and the frontozygomatic suture as palpable points.




## 2. MATERIALS AND METHODS

Seventy dry skulls (34 male and 36 female) were used for this study. The dry skulls were obtained from the department of anatomy, Kasturba Medical college, Mangalore, Manipal University.The damaged and diseased skulls were excluded from the study. Only the intact skulls were included in the study.The sexing of the skulls were done on the morphological basis.

Measurements were taken on both sides of the skull from the pterion to the midpoint of zygoma (MPZ) and to the frontozygomatic suture (FZS) using a Slidingvernier calipers. Data obtained were analysedusingSPSS 10 software. The Student's t-test was employed in the assessment of side and gender differences.The p-value < 0.05 was considered significant.

## 1. RESULTS

The means and associated standard deviations of the various measurements taken from the pterion are presented below.

Table: 1(a) The distance between pterion to frontozygomatic suture among male skulls on right and left side were compared. It showed statistically significant side differences among male skulls.

(p=0.041). The right side pterion (3.93±0.37) being more posterior than the left side **(**3.80±0.40).

**Table: 1(a) DISTANCE BETWEEN PTERION TO FRONTO ZYGOMATIC SUTURE**

| | SIDE | N | MEAN | STD. DEVIATION |
|---|---|---|---|---|
| MALE | RIGHT | 34 | 3.9324 | 0.3780 |
| | LEFT | 34 | 3.8029 | 0.4019 |

P-value:-0.041 (<0.05-sig)

**Table: 1(b)** The distance between pterion to frontozygomatic suture among female skulls on right and left side were compared. The right side pterion (3.53±0.42) being more posterior than the left side **(**3.47±0.37). It showed no statistically significant side differences among female skulls (p=0.248)

**Table: 1(b) DISTANCE BETWEEN PTERION TO FRONTO ZYGOMATIC SUTURE**

| | SIDE | N | MEAN | STD.DEVIATION |
|---|---|---|---|---|
| FEMALE | RIGHT | 36 | 3.5384 | 0.4291 |
| | LEFT | 36 | 3.4722 | 0.3784 |

P-value:-0.248 (<0.05-sig)

**Table: 2(a)** The distance between pterion to mid point of zygomatic arch among male skulls on right and left side were compared. The distance of right side (4.52±0.32) being more than the left side **(**4.45±0.37). It showed no statistically significant side differences among male skulls (p=0.180)

**Table: 2(a) DISTANCE BETWEEN PTERION TO MID POINT OF ZYGOMATIC ARCH**

| | SIDE | N | MEAN | STD. DEVIATION |
|---|---|---|---|---|
| MALE | RIGHT | 34 | 4.5206 | 0.3282 |
| | LEFT | 34 | 4.4588 | 0.3594 |

P-value:-0.180 (<0.05-sig)

**Table: 2(b)** The distance between pterion to mid point of zygomatic arch among female skulls on right and left side were compared. The distance of right side(4.10±0.44) being less than the left side **(**4.11±0.30). It showed no statistically significant side differences among male skulls (p=0.913).

**Table: 2(b) DISTANCE BETWEEN PTERION TO MID POINT OF ZYGOMATIC ARCH**

| | SIDE | N | MEAN | STD.DEVIATION |
|---|---|---|---|---|
| FEMALE | RIGHT | 36 | 4.1000 | 0.4491 |
| | LEFT | 36 | 4.1056 | 0.3014 |

P-value:-0.913 (<0.05-sig)

**Table: 3(a)** The distance between pterion to frontozygomatic suture on right side of male and female skulls were compared. The distance of male skulls on right side(3.93±0.37) being more than the female skulls**(**3.53±0.43). It showed statistically significant side differences among male and female skulls (p=0.0001).

**Table: 3(a) DISTANCE BETWEEN PTERION TO FRONTO ZYGOMATIC SUTURE ON RIGHT SIDE**

| | N | MEAN | STD. DEVIATION |
|---|---|---|---|
| MALE | 34 | 3.9324 | 0.3780 |
| FEMALE | 36 | 3.5389 | 0.4291 |

P-value:-0.0001 (<0.05-sig)

**Table: 3(b)** The distance between pterion to frontozygomatic suture on left side of male and female skulls were compared. The distance of male skulls on left side (3.80±0.40) being more than the female skulls **(**3.47±0.37). It showed statistically significant side differences among male and female skulls (p=0.001).

**Table: 3(b) DISTANCE BETWEEN PTERION TO FRONTO ZYGOMATIC SUTURE ON LEFT SIDE**

| | N | MEAN | STD. DEVIATION |
|---|---|---|---|
| MALE | 34 | 3.8029 | 0.4019 |
| FEMALE | 36 | 3.4722 | 0.3784 |

P-value:-0.001 (<0.05-sig)

**Table: 4(a)** The distance between pterion to mid point of zygomatic arch on right side of male and female skulls were compared. The distance of male skulls on right side(4.52±0.32) being higher than the female skulls **(**4.10±0.44). It showed statistically significant side differences among male and female skulls (p=0.0001).

**Table: 4(a) DISTANCE BETWEEN PTERION TO MID POINT OF ZYGOMATIC ARCH ON RIGHT SIDE**

| | N | MEAN | STD. DEVIATION |
|---|---|---|---|
| MALE | 34 | 4.5206 | 0.3282 |
| FEMALE | 36 | 4.1000 | 0.4491 |

P-value:-0.0001 (<0.05-sig)

**Table: 4(b)**The distance between pterion to mid point of zygomatic arch on left side of male and female skulls were compared. The distance of male skulls on left side (4.45±0.35) being more than the female skulls **(**4.10±0.30). It showed statistically significant side differences among male and female skulls (p=0.0001)

**Table: 4(b) DISTANCE BETWEEN PTERION TO MID POINT OF ZYGOMATIC ARCH ON LEFT SIDE**

| | N | MEAN | STD. DEVIATION |
|---|---|---|---|
| MALE | 34 | 4.4588 | 0.3594 |
| FEMALE | 36 | 4.1056 | 0.3014 |

P-value:-0.0001 (<0.05-sig)

## 2. DISCUSSION

In the present study, the pterion was located 4.52 ±0.32cm above the midpoint of the zygoma on right side and 4.45±0.35cm above the midpoint of zygoma on left side of the male skull. On the right side the pterion is situated slightly higher compared to the left side of the male skull but it is not statistically significant. In the female skull, the pterion was located 4.10±0.44cm above the midpoint of zygoma on both right and left sides. Our study coincides with the study done by Oquz O *et al*[13], where the distances on the right and left sides of the Turkish male skulls were compared from the center of the pterion to the midpoint of zygomatic arch was 4.05+/-0.39 cm and 3.85+/-0.25 cm respectively. The pterion in Koreans was reported to be positioned 36.9+3.8 mm from the MPZ[16]. The Nigerian skulls compared with those of Indians, they found the pteria in Nigerians were higher than those in Indian skulls[17]. The basis for these differences could be genetic or environmental.[18]

The distance between pterion to mid point of zygomatic arch on right side of male and female skulls were compared. The distance of male skulls on right side 4.52±0.32cmishigher than the female skulls 4.10±0.44cm.The distance between pterion to mid point of zygomatic arch on left side of male and female skulls were compared. The distance of male skulls on left side4.45±0.35cm is higher than the female skulls 4.10±0.30cm.The distance between pterion and midpoint of the zygoma in the present study varied significantly(p=0.0001) among males and females. Males had higher pteria than females.Our study coincides with the study done by Mwachaka P *et al*[19], where the distance between the pterion to the midpoint of zygomatic arch varied significantly among males and females. Males had higher pteria than female. This observation can be explained by morphometric studies on the skulls which have shown that female skulls are shorter and broader in proportion than the male ones [2]. According to Ikedo *et al*[18], the arch of the zygoma is more robust in males because they have stronger muscles of mastication than females.

The present study shown that the distance between pterion to frontozygomatic suture among male skulls on right and left side showed statistically significant side differences among male skulls (p=0.041). The right side pterion 3.93±0.37cm being more posterior than the left side 3.80±0.40cm.The distance between pterion to frontozygomatic suture among female skulls on right and left side were compared. The right side pterion 3.53±0.42cm is posterior than the left side 3.47±0.37cm. It showed no statistically significant side differences among female skulls (p=0.248).

The pterion was 30.35+3.61 mm posterior to the frontozygomatic suture on the right while the left pterion was 30.34+4.30 mm behind in Kenyans[19]. Conversely, the pterion among male Turks lie 33.0+4.0 mm and 34.4+3.9 mm behind the FZS on the right and left, respectively. The basis for the difference among these populations could be genetic or evolutionary [18]. The pterion lies 30 to 35 mm away from the FZS [2]. The pterion in Koreans lied 26.8+4.5 mm away from the frontozygomatic suture [16]

The distance between pterion to frontozygomatic suture on right side of male and female skulls were compared. The distance of male skulls on right side 3.93±0.37cm is more posterior than the female skulls 3.53±0.43cm. It showed statistically significant side differences among male and female skulls on the right side (p=0.0001).The distance between pterion to frontozygomatic suture on left side of male and female skulls were compared. The distance of male skulls on left side 3.80±0.40cm is more posterior than the female skulls 3.47±0.37cm . It showed statistically significant side

differences among male and female skulls on the left side (p=0.001).

Gender differences in the location of this craniometric point were significant; the male pterion is more posteriorly located on the right and left side compared to the female skulls. This could be because of the larger size of skull in males [20,2]. Population-based differences suggest that various genetic variations in humans underlie the different sutural patterns of the pterion [21]. Murphy reported that variations of the pterion are likely a result of a combination of environmental and genetic factors[12]. Asala&Mbajiorgu concluded that these variations are "epigenetic"[22].

The pterion has been reported to lie 4.0 cm above the arcuszygomaticus and 3.5 cm behind thesuturafrontozygomatica[2]. Ari Ilknur et al observed distances similar to the above values in both populations investigated. These results collectively suggest that the location of the pterion were not significantly different between the Anatolian populations of two different areas. Similar findings by Oguz *et al.* in other Anatolian skulls would further lend support to this assumption. In contrast, Saxena *et al.* reported a more superiorly situated pterion (its distance from the arcuszygomaticus is greater) in Nigerians on both sides and a more caudally situated pterion (its distance from the suturafrontozygomatica is greater) in Indians on the right side.

In the present study the pterion is located more superiorly(its distance from the midpoint of zygoma) and more posteriorly (its distance from the frontozygomatic suture) in males compared to that of the female on both sides.Since there was minimal side differences among the right side measurements of male skulls to that of left side measurements of the male skull and also incomparision to female right side measurements to female left side used to lócate the pterion, this landmark can reliably be located using the frontozygomatic suture and midpoint of the zygomaaccording to the sexual differences. This information may be useful in planning prior to surgery especially where neuronavigation devices equipments are scarce. Recognition of this anatomy may render pterional craniotomy safer.

## CONCLUSION

Gender differences in the location of this craniometric point were significant. In the present study the pterion is located more superiorly (its distance from the midpoint of zygoma) and more posteriorly(its distance from the frontozygomatic suture) in males compared to that of the female on both sides. There was minimal side differences among the right side to left side measurements of male skulls and also in comparision to female right side measurements to female left side used to lócate the pterion. This landmark can reliably be located using the FZS and MPZ according to the sexual differences. This information may be useful in planning prior to surgery and recognition of this anatomy may render pterional craniotomy safer.

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