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Morphometric Study of Pterion in Dry Human Skull Bones of Nigerians

Estudio Morfométrico del Pterion en Huesos del Cráneo Humano Secos de Nigerianos

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SUMMARY: The pterion is an important landmark on the side of the skull as it overlies both the anterior branch of the middle meningeal artery and the lateral cerebral fissure intracranially. The study was carried out to determine the pterion types and define its distances to some neighboring structures in dry human skulls of Southern Nigerians. The study comprised 50 dry human skulls of unknown sex and age obtained from selected Nigerian Universities. Sutural patterns of the pterion on both sides of each skull based on the description of Murphy (1956), were observed and recorded. Distances of the pterion to neighboring structures were also measured using digital vernial caliper. Data obtained were subjected to statistical analysis using descriptive statistics and chi-square contingency table with the aid of the statistical package for social sciences (SPSS) version 16. $P<0.05$ is considered statistically significant. Results showed that the most common type of Pterion in Nigerian skulls was sphenoparietal. There was no significant association between side of the head and pterion type. The mean distance of the pterion to the frontozygomatic suture was 31.56±2.47 mm taking both side together, (left side = 31.08±2.24 mm; right side = 32.06±2.62 mm). The mean distance of the pterion to the midpoint of the zygomatic arch was 39.87±3.16 mm taking both sides together (left side = 39.52±3.32 mm; right side = 40.22±2.98 mm). The mean distance of the pterion to the glabella was 77.51±4.08 mm taking both side together (left side = 76.74±4.27 mm; right side = 78.27±3.77 mm). This will be useful in Surgery, Anthropology and for assessing the location of the pterion in incomplete archeological remains or forensic materials.

KEY WORDS: Pterion; Temporal fossa; Sphenoparietal; Frontotemporal; Stellate, Epipteric.

INTRODUCTION

The temporal fossa is an important area of the skull that is bounded inferiorly by the zygomatic arch, superiorly and posteriorly by the temporal lines on the calvaria, and anteriorly by the frontal process of the zygomatic bone (Standring *et al*., 2005). The frontal and parietal bones, the greater wing of the sphenoid, and the squamous part of the temporal bones form the floor of the temporal fossa. These four bones meet on each side of the head at a small circular area of sutures called pterion (Standring *et al*.).

Standring *et al*. reported that the pterion is an important landmark on the side of the skull as it overlies both the anterior branch of the middle meningeal artery and the lateral (Sylvian) cerebral fissure intracranially. They also stated that it usually lies 3 cm above the zygomatic arch and 3.5 cm behind the frontozygomatic suture. Moore & Dalley (2006) reported that the pterion is two fingers' breadth superior to the zygomatic arch and a thumb's breadth posterior to the frontal process of the zygomatic bone. A hard blow to the side of the head may fracture the thin bones forming the pterion, with eventual rupture of this artery crossing the pterion. The hematoma resulting exerts pressure on the underlying cerebral cortex, with dire consequences if untreated for a few hours (Moore & Dalley). The pterion is also known as the Sylvian point. It corresponds to the site of the anterolateral (sphenoidal) fontanelle on the neonatal skull, which disappears about three months after birth (Standring *et al*.).

It has been reported that the pterion is also an important landmark for the anterior branch of the middle meningeal artery, Broca's area (44-45), the insula, and the stem of the lateral sulcus. It is also a primary site during surgery to gain access to the sphenoid ridge and optic canal (Saxena *et al*., 2003). The pterion is also commonly used in cranial suture closure methodology as an important guide

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for age estimation and sex determination in archeological and forensic specimens (Lovejoy *et al*., 1985).

Various classifications of pterion have been proposed (Murphy, 1956; Wang *et al*., 2006). The pterion was first classified into three types (sphenoparietal, frontotemporal and stellate) by Broca in 1875 (Saxena *et al*., 2003). Murphy defined four types (sphenoparietal, frontotemporal, stellate, and epipteric) while Wang *et al*. gave six classifications (sphenoparietal,frontotemporal, stellate, epipteric, zygomaticoparietal and zygomaticotemporal).

The present study was conducted to determine the pterion types and define its distances to neighboring structures in dry human skulls of Southern Nigerians. The study will be of interest to anthropologists and forensic pathologists. It will be useful for assessing the location of the pterion in incomplete archeological remains or forensic materials.

MATERIAL AND METHOD

This was a descriptive anthropometric study carried out between February and July, 2012, in the Department of Anatomy and Cell Biology, Delta State University, Abraka, Nigeria. The study comprised 50 dry human skulls of unknown sex and age, obtained from the museums of department of Anatomy in Anambra State University, Uli, NnamdiAzikiwe University, Owerri, University of Benin, Benin City, Ambrose Alli University, Ekpoma, Niger Delta University, Wilberforce Island and Delta State University, Abraka.

This study was done by determining the sutural patterns of the pterion on both sides of each skull based on the description of Murphy (Fig. 1A-D). The sphenoparietal type was defined as a sutural pattern in which the sphenoid

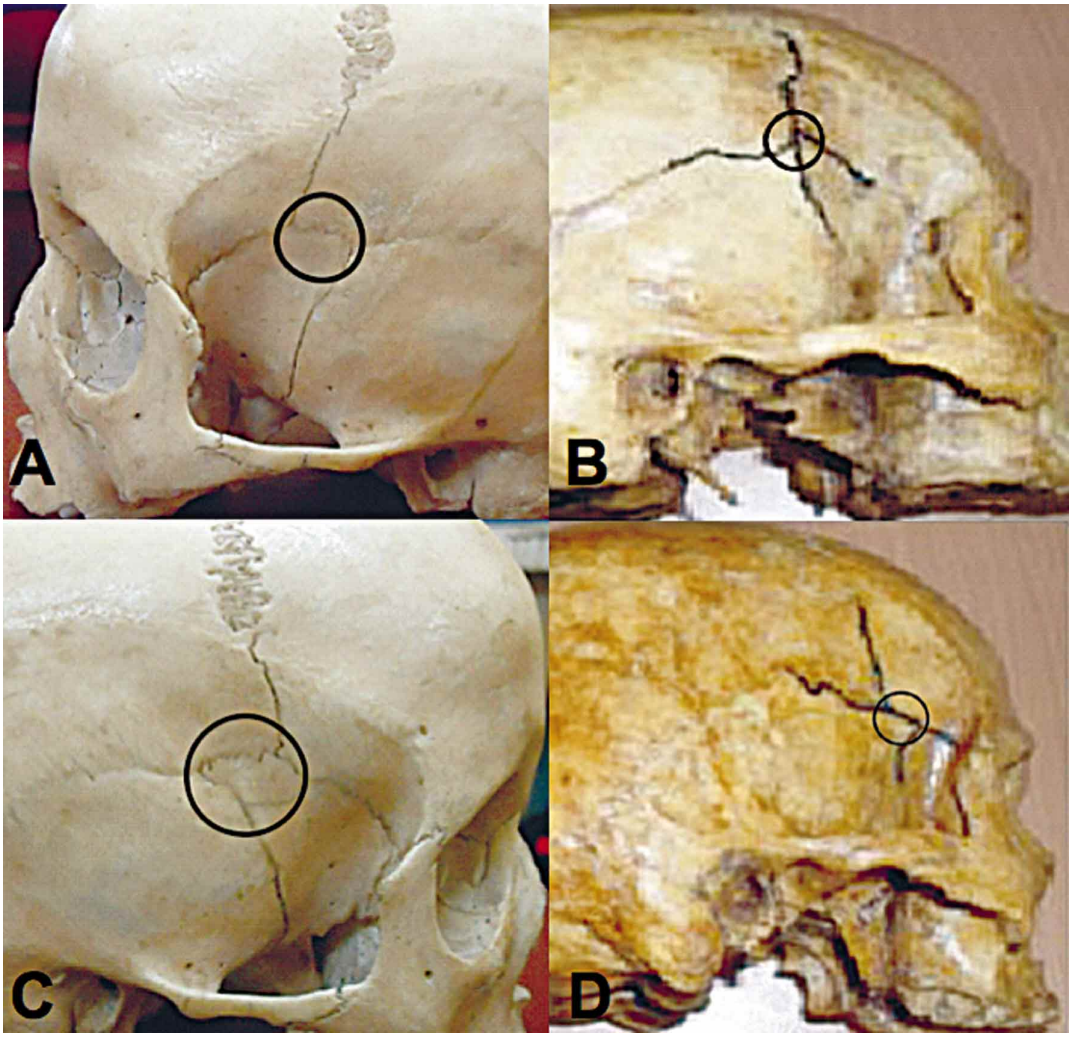

Fig. 1. A. Sphenoparietal type of pterion, B. Stellate type of pterion, C. Epipteric type of pterion and D. Frontotemporal type of pterion.

and parietal bones are in direct contact (Fig. 1A). The frontotemporal type is a sutural pattern in which the frontal and temporal bones are in direct contact (Fig. 1D). The stellate type is characterized by articulation of four bones (frontal, parietal, temporal and sphenoid) at a point (Fig. 1B). The epipteric type was defined by presence of a small sutural bone between the parietal bone and the greater wing of the sphenoid bone (Fig. 1C).

Measurements were taken in millimeters on both sides of the skull from the pterion (P) to the midpoint of the zygomatic arch (M); to the posterolateral aspect of the frontozygomatic suture (F); and to the glabella (G) (Fig. 2), using a digital vernier caliper (ORION, Japan). Each of the measurements was taken twice and the average taken to minimize error of measurements.

Skulls with regular shape, without obvious evidence of dystrophy, deformities and trauma were selected. Criteria of exclusion were those in which the pterion pattern could not be clearly identified, owing to breakage or fusion of adjacent bones (synostosis). Approval for this study was obtained from the Research Ethics Committee of the College of Health Sciences, Delta State University, Abraka, Nigeria.

The data obtained were subjected to statistical analysis using frequency distribution, descriptive statistics and chi-square contingency table with the aid of the statistical package for social sciences (SPSS) version 16. $P<0.05$ was considered statistically significant.

RESULTS

Table I shows the frequency distribution of the pterion types on both sides of the skull. The four types of pterion (sphenoparietal, frontotemporal, stellate and epipteric) were observed in the Nigerian skulls. The dominant pterion type was sphenoparietal (83.0%) taken when both sides of the skull were taken together (left side = 84.0%, right side = 82.0%). This is followed by stellate (6.0%), (left side = 6.0%, right side = 6.0%); epipteric (6.0%), (left side = 4.0%, right side 8.0%) and the frontotemporal (5.0%) (left side = 6.0%, right side = 4.0%).

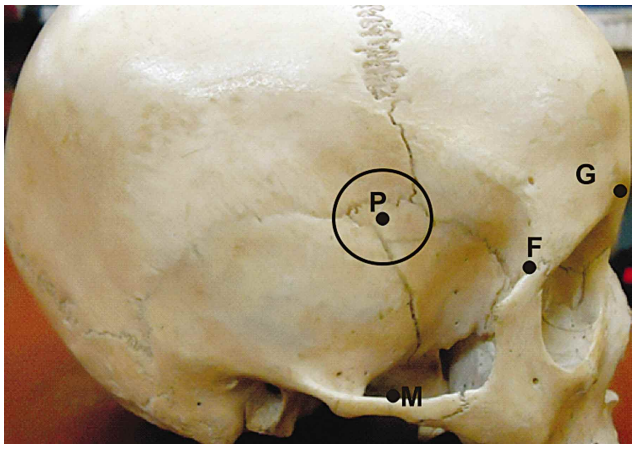

Fig. 2. Showing distances of pterion to neighbouring structures. PF = Pterion - Frontozygomatic Suture; PM = Pterion –Midpoint of Zygomatic Arch; PG = Pterion – Glabellar.

Table II shows the result of test of association between pterion type and side using chi-square contingency table. The chi-square test for degree of association between pterion type and side of the skull was not statistically significant ($P>0.05$).

Table III shows the descriptive statistics of the distance between the pterion and frontozygomatic suture (PFZS), midpoint of the zygomatic arch (PMPZ) and the glabella (PG). The mean distance between the pterion and the frontozygomatic suture was 31.56±2.47 mm taking both side together, (left side = 31.08±2.24 mm; right side = 32.06±2.62 mm). The mean distance of the pterion to the midpoint of the zygomatic arch was 39.87±3.16 mm taking both sides together (left side = 39.52±3.32 mm; right side = 40.22±2.98 mm). The mean distance between the pterion and to the glabella was 77.51±4.08 mm taking both side together (left side = 76.74±4.27 mm; right side = 78.27±3.77 mm).

Table I. Frequency distribution of types of pterion observed on both sides of the skull.

Pterion Type	Total	Side	
		Left	Right
Sphenoparietal	83 (83.0%)	42 (84.0%)	41 (82%)
Frontoptemporal	5 (5.0%)	3 (6.0%)	2 (4.0%)
Stellate	6 (6.0%)	3 (6.0%)	3 (6.0%)
Epipteric	6 (6.0%)	2 (4.0%)	4 (8.0%)

Table II. Chi-square contingency table between pterion type and side.

Pterion Type	Side		Total	X^2	df	P
	Left	Right				
Sphenoparietal	42 (50.6%)	41 (49.4%)	83 (100%)			
Frontotemporal	3 (60%)	2 (40%)	5 (100%)			
Stellate	3 (50%)	3 (50%)	6 (100%)	0.879	3	0.831
Epipteric	2 (33.3%)	4 (66.7%)	6 (100%)			
Total	50 (50%)	50 (50%)	100 (100%)			

Table III. Descriptive statistics of dimensions measured between the pterion and some structures.

Side	Parameters	n	Minimum	Maximum	Mean	SD
Total	PFZS (mm)	100	26.20	37.63	31.57	2.47
	PMPZ (mm)	100	30.22	49.10	39.87	3.16
	PG (mm)	100	65.13	87.23	77.51	4.08
Left	PFZS (mm)	50	26.20	36.92	31.08	2.24
	PMPZ (mm)	50	30.22	49.10	39.52	3.32
	PG (mm)	50	65.13	87.23	76.74	4.18
Right	PFZS (mm)	50	26.35	37.63	32.06	2.62
	PMPZ (mm)	50	33.31	47.79	40.22	2.98
	PG (mm)	50	68.48	86.38	78.27	3.77

DISCUSION

In the present study, four Types of pterion: sphenoparietal, frontotemporal, stellate and epipteric were observed in Nigerian skulls. The dominant type of pterion was Sphenoparietal (83%). This was followed by stellate (6.0%), epipteric (6.0%) and the least was frontotemporal (5.0%).

Previous studies also showed dominance of Sphenoparietal type in different populations. In South Indian, Manjunath *et al*. (1993), reported 93.55% while Praba & Venkatramanah (2012) reported sphenoparietal to be 76.5%; in North Indian, Saxena *et al*. (2003), reported 84.72%; in Western Indian, Zalawadia *et al*. (2010), reported 91.7%. In other Indian studies, Hussain Saheb *et al*. (2011), noted the sphenoparietal type of pterion to be 69.25% while Natekar *et al*. (2011), reported 85.33%. In a Korean study, Lee *et al*. (2001), reported 76.5%. In a Turkish study, Oguz *et al*. (2004), reported 88%. In a Thai study, Apinhasmit *et al*. (2011) reported sphenoparietal to be 81.2%. In a Kenyan study, Mwachaka *et al*. (2009), reported 66%. In a study, Saxena *et al*. (1988) reported 95.3% for Indians and 87.79% for Nigerians. In Nigeria, Asala & Mbajiorgu (1996), reported 82.1%. It has been opined that the high occurrence of the sphenoparietal pterion could have an evolutionary basis (Hussain Saheb *et al*.).

With regard to the other three type of pterion, the percentage distribution varies with population. Our findings are in accordance with Praba & Venkatramanah, who reported that stellate type was 6.0%, epipteric (6.0%) and the least was frontotemporal (3.0%). Others differ. Manjunath & Thomas (1993), reported epipteric (17.3%), frontotemporal (3.52%) and stellate (2.93%). Saxena *et al*. (2003), reported frontotemporal (10.01%), stellate (5.17%) and epipteric (0%). Zalawadia *et al*. reported epipteric (4.8%), frontotemporal (2.4%), stellate (1.2%). Lee *et al*. reported epipteric (40.3%) while frontotemporal stellate were nil. Oguz *et al*. reported frontotemporal (10%), stellate (0%) and epipteric (2%). Mwachaka *et al*. reported frontotemporal (15%), epipteric (12%) and stellate (7%). Saxena *et al*. (1988), reported epipteric (11.79%), frontotemporal (3.46%) and stellate (1.38%) for Indians; and frontotemporal (10.11%), stellate (5.06%) and epipteric (3.79%). Asala & Mbajiorgu (1996), reported frontotemporal (23.6%), epipteric (5.7%) and stellate was nil.

The chi-square test for degree of association between pterion type and side was not statistically significant (P=0.831). This indicates that side of the head has no influence on type of pterion. This result is in agreement with (Apinhasmit *et al*., 2011), who reported no statistically

significant association between pterion type and side. Also in agreement with Murphy, who carried out a study of pterion in the Australian aborigine and reported no side influence on the occurrence of pterion type.

In the present study, the mean distance between the pterion and the posterior aspect of the frontozygomatic suture was 31.56±2.47mm taking both sides together (31.08±2.24 mm on the left side and 32.06±2.62 mm on the right side). These findings are in tandem with (Williams *et al*., 1998) who described the pterion to lie between 30 to 35mm away from the frontozygomatic suture. This result is higher than that of (Mwachaka *et al*.) who reported that the pterion on was located 30.35±3.40 mm posterior to the frontozygomatic suture on the right while the left was 30.34±4.30 mm behind. It is also higher than that of Appinhasmit *et al*., who reported the pterion to be located 31.12±4.89 mm posterior to the frontozygomatic suture taken both side together. These findings are lower than of Oguz *et al*., who reported the pterion to lie 33.0±4.0 mm and 34.4±3.9 mm behind the frontozygomatic suture on the right and left side respectively in Turkish male skull. This result is also lower than Zalawadia *et al*., who observed in his study that the pterion was located 35.5±0.42 mm behind the frontozygomatic suture on the left side and 37.3±0.51 mm on the right side. The basis for the differences could be racial, geopolitical, genetic or evolutionary (Ikedo *et al*., 1999).

In the present study, the mean distance between the pterion and the midpoint of zygomatic arch was 39.87±3.16 mm taking both sides together; 39.52±3.32 mm on the left side; 40.22±2.98 mm on the right. These findings are higher than Mwachaka *et al*., who reported the pterion to be located 38.56±3.28 mm above the midpoint of the zygomatic arch. It is also higher than that of Apinhasnit *et al*., who reported the pterion to be located 38.48±4.38 mm superior to the midpoint of the zygomatic arch on both sides of the skulls of Thailand. It is also higher than Oguz *et al*., who reported the pterion to be located 3.85±0.25 cm on left side and 4.05±0.39 cm on right side from the midpoint of zygoma in Turkish skulls. It is also higher than Zalawadia *et al*., who reported the pterion to be 29.7±0.33 mm and 31.2±0.44 mm superior to the midpoint of the zygomatic arch on the left and right side of the skulls respectively in Gujarat region. The basis for these differences could be genetic or environmental. The variation in distance in the different studies may be due to genetics, nutrition, geographic and environmental factors.

In the present study, the mean distance of the pterion to the glabella was 77.51±4.08 mm taking both sides together, 76.74±4.27 mm on the left side; 78.27±3.77 mm on the right side.

CONCLUSION

The most common type of Pterion in Nigerian skulls was sphenoparietal. There was significant association between side of the head and pterion type. The mean distance of the pterion to the posterior aspect of the frontozygomatic suture was 31.56±2.47 mm. The mean distance of the pterion to the midpoint of zygomatic arch was 39.87±3.16 mm. The mean distance of the pterion to the glabella was 77.51±4.08 mm. This will be useful in Surgery and Anthropology.

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RESUMEN: El pterion es un importante marcador del lado del cráneo, ya que se superpone a la rama anterior de la arteria meníngea media y a la cisura cerebral lateral por vía intracraneal. El estudio se realizó para determinar el tipo de pterion y definir las distancias con algunas estructuras cercanas, en cráneos humanos secos de nigerianos del Sur. Se utilizaron 50 cráneos humanos sin información de sexo y edad, obtenidos de Universidades. Fueron observados y registrados los patrones suturales del pterion en ambos lados de cada cráneo, basados en la descripción de Murphy en 1956. También se midieron las distancias del pterion hacia estructuras cercanas utilizando un cáliper digital. Los datos obtenidos fueron sometidos a análisis estadístico mediante estadística descriptiva y prueba de chi cuadrado con el programa estadístico SPSS versión 16. Un valor P<0,05 se consideró significativo. El tipo más común de pterion en cráneos de Nigeria fue esfenoparietal. No hubo asociación significativa entre el lado del cráneo y el tipo pterion. La distancia media del pterion a la sutura frontocigomática fue 31,56±2,47 mm (al lado izquierdo = 31,08±2,24 mm, al derecho = 32,06±2,62 mm). La distancia media del pterion hasta el punto medio del arco cigomático fue 39,87±3,16 mm (al lado izquierdo = 39,52±3,32 mm; al derecho = 40,22±2,98 mm). La distancia media del pterion a la glabela fue 77,51±4,08 mm (al lado izquierdo = 76,74±4,27 mm, al derecho = 78,27±3,77 mm). Esta información es útil para la cirugía y antropología, así como también en la evaluación de la ubicación del pterion en restos arqueológicos incompletos o material forense.

PALABRAS CLAVE: Pterion; Fosa temporal; Esfenoparietal; Frontotemporal; Estrellado; Epiptérico.

REFERENCES

Apinhasmit, W.; Chompoopong, S.; Chaisuksunt, V.; Thiraphatthanavong, P. & Phasukdee, N. Anatomical consideration of pterion and its related references in Thai dry skulls for pterional surgical approach. *J. Med. Assoc. Thai., 94(2)*:205-14, 2011.

Asala, S. A. & Mbajiorgu, F. E. Epigenetic variation in the Nigerian skull: sutural pattern at the pterion. *East Afr. Med. J., 73(7)*:484-6, 1996.

Hussain Saheb, S.; Mavishetter, G. F.; Thomas, S. T.; Prasanna, L. C.; Muralidhar, P, & Magi. A study of sutural morphology of the pterion and asterion among human adult Indian skulls. *Biomed. Res., 22(1)*:73-5, 2011.

Ikeda, T.; Nakamura, M. & Itoh, M. Sex differences in the zygomatic angle in japanese patients analyzed by MRI with reference to Moiré fringe patterns. *Aesthetic Plast. Surg., 23(5)*:349-53, 1999.

Lee, U. Y.; Park, D. K.; Kwon, S. O.; Paik, D. J. & Han, S. H. Morphological analysis of the pterion in Korean. *Korean J. Phys. Anthropol., 14(4)*:281-9, 2001.

Lovejoy, C. O.; Meindl, R. S.; Mensforth, R. P. & Barton, T. J. Multifactorial determination of skeletal age at death: a method and blind tests of its accuracy. *Am. J. Phys. Anthropol., 68(1)*:1-14, 1985.

Manjunath, K. Y. & Thomas, I. M. Pterion variants and epipteric ossicles in South Indian skulls. *J. Anat. Soc. India, 42*:85-94, 1993.

Moore, K. L. & Dalley, A. F. *Clinical Oriented Anatomy.* 5th ed. Philadelphia, Lippincott Williams & Wilkins, 2006. pp.887-903.

Murphy, T. The pterion in the Australian aborigine. A*m. J. Phys. Anthropol., 14(2)*:225-44, 1956.

Mwachaka, P. M.; Hassanali, J. & Odula, P. Sutural morphology of the pterion and asterion among adult Kenyans. *Braz. J. Morphol. Sci., 26(1)*:4-7, 2009.

Natekar, P. E.; DeSouza, F. M. & Natekar, S. P. Pterion: An anatomical variation and surgical landmark. *Indian J. Otol., 17(2)*:83-5, 2011.

Oguz, O.; Sanli, S. G.; Bozkir, M. G. & Soames, R. W. The pterion in Turkish male skulls. *Surg. Radiol. Anat., 26(3)*:220-4, 2004.

Praba, A. M. A. & Venkatramaniah, C. Morphometric Study of different types of Pterion and It's relation with middle meningeal artery in dry skulls of Tamil Nadu. *J. Pharm. Biomed. Sci., 21(21)*:1-4, 2012.

Saxena, R. C.; Bilodi, A. K.; Mane, S. S. & Kumar, A. Study of pterion in skulls of Awadh area--in and around Lucknow. *Kathmandu Univ. Med. J. (KUMJ), 1(1)*:32-3, 2003.

Saxena, S. K.; Jain, S. P. & Chowdhary, D. S. A comparative study of pterion formation and its variations in the skulls of Nigerians and Indians. *Anthropol. Anz., 46(1)*:75-82, 1988.

Standring, S.; Ellis, H.; Healy, J. C. & Johnson, D. *Gray's Anatomy-The Anatomical Basis of Clinical Practice.* 39th ed. London, Elsevier Churchill Livingstone, 2005. pp.441-84.

Wang, Q.; Opperman, L. A.; Havil, L. M.; Carlson, D. S. & Dechow, P. C. Inheritance of sutural pattern at the pterion in Rhesus Monkey skulls. *Anat. Rec. Discov. Mol. Cell. Evol. Biol., 288(10)*:1042-9, 2006.

Williams, L. P.; Bannister, L. H.; Berry, M. M.; Collins, P.; Dyson, M.; Dussek, J. E.; & Ferguson, M. W. J. *Gray's Anatomy*. 38th ed. London, Churchill Livingstone, 1998.

Zalawadia, D. A.; Vadgama, D. J.; Ruparelia, D. S.; Patel, D. S. & Patel, D. S. V. Morphometric study of pterion In dry skull of Gujarat Region. *Natl. J. Integrated Res. Med., 1(4)*:25-9, 2010.

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