Original Article

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Anatomy Section

Epipteric Bones in the Pterion in Dry Human Crania from a Region of Northeastern Brazil: Morphological and Morphometric Study

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ABSTRACT

Introduction: Epipteric bones found in the pterion, the sutural confluence point on the lateral face of the cranium between the frontal, parietal, temporal and sphenoid bones, have a pattern of formation that varies according to the population. The anatomic location of the pterion is important in surgical interventions following surgical approaches to the anterior and middle cranial fossae.

Aim: To study the morphology and morphometry of the epipteric bones.

Materials and Methods: Total 256 crania were analyzed and epipteric bones were found in 64. Of these crania, 33 were male and 31 female. After careful analysis with the naked eye, seeking to identify the presence of epipteric bones, they were classified according to their shape. Their height and width were obtained by means of digital calipers.

Results: Among the 64 crania in which epipteric bones were found, 51.56% were male and 48.44% female. The frequency of epipteric bones in all the cases was 19.14%. Morphologically, the irregular type occurred most frequently, followed by the triangular type. The length and height were also greater in the irregular and triangular types.

Conclusion: Knowledge of the morphological and morphometric variations of the epipteric bones is important in neurosurgery, especially in relation to surgical accesses that use the pterion; and also for forensic anthropologists, in evaluating incomplete archeological remains.

Keywords: Anatomy, Forensic anthropologists, Skull, Surgical interventions

INTRODUCTION

The pterion corresponds to the site of the anterolateral fontanelle of the neonatal cranium, which disappears approximately three months after birth [1]. Wang et al., [2] classified the pterion into six types: Frontotemporal, in which the frontal and temporal bones are in direct contact; Sphenoparietal, in which there is contact between the sphenoid and parietal bones; Stellate, in which the frontal, parietal, temporal and sphenoid bones are connected at a single point; Zygomatic-parietal, in which the zygomatic bone has a tongue that connects to the parietal bone; Zygomatic-temporal, in which the zygomatic bone has an extension that connects to the temporal bone, thereby separating the sphenoid bone from the frontal and parietal bones; and Epipteric, in which a small sutural bone is found.

In relation to the development of sutural bones, there is still no unanimity regarding their occurrence. They are considered to be just a simple anatomical variation for which the mechanism of development is not fully understood [3]. When present in the region of the pterion, they are called epipteric ossicles, epipteric bones or even flower bones [4,5]. One or more epipteric bones may appear between the sphenoid angle, parietal bone and greater wing of the sphenoid bone [6].

According to Oguz et al., [7], exact knowledge of the location and relationships of the pterion on the left side of the cranium is of great importance in undertaking surgical interventions, particularly with regard to the course of the branches of the middle meningeal artery and the location of the speech motor area (Broca's area). With the aim of expanding the knowledge of pterion, the present study had the objective of studying the morphology and morphometry of the epipteric bones.

MATERIALS AND METHODS

An anatomical study of descriptive nature was carried in 256 dry human crania that had been identified regarding sex and age and belonged to the Laboratory in Anatomy and Forensic Anthropology (LAFA), at the University Tiradentes Brazil, where all the skulls were examined, over 12 months from January 2015 to February 2016. The sample was selected from skulls of men and women who were perfect state of preservation anatomic.

First the examiners, consensually, identify and recognize at each of the skulls anatomically known as pterion. There have been no variability among the observers. Following this, the crania were carefully analyzed with the naked eye, and were classified according to their shape. Morphometric measurements (height and width) were obtained by means of digital calipers of precision to 0.01mm [Table/Fig-1]. There have been no limitations to carry out the study.

[Table/Fig-1]: Morphometry of the epipteric bone.
H – Height of the epipteric bone W – Width of the epipteric bone

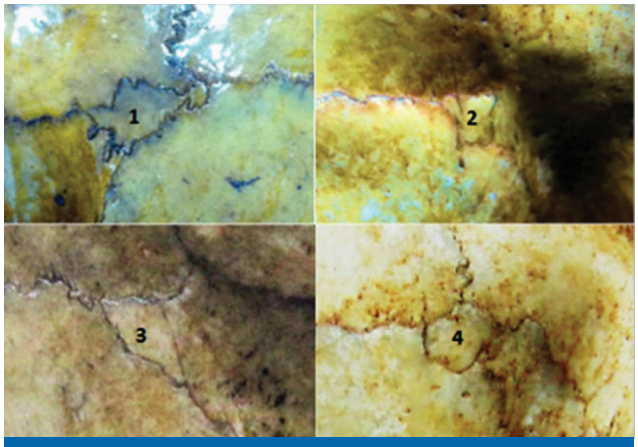
RESULTS

Among the 256 crania studied, 49 of them (19.14%) were seen to have epipteric bones (64 bones). Of these, 33 (51.56%) were in male crania and 31 (48.44%) in female crania. The frequency of epipteric bones was slightly higher in the male crania [Table/Fig-2].

The epipteric bones were classified into four morphological types: irregular, quadrangular, triangular and circular [Table/Fig-3]. The irregular type of morphological classification occurred most frequently, followed by the triangular type [Table/Fig-4].

Side	Sex		Total % (n)
	Male	Female	
	% (n)	% (n)	
Right	29.69 (19)	20.31 (13)	50 (32)
Left	21.87 (14)	28.13 (18)	50 (32)
Total	51.56 (33)	48.44 (31)	100 (64)

[Table/Fig-2]: Frequency of epipteric bones in relation to sex.



[Table/Fig-3]: Morphology of the epipteric bones.
1. Irregular 2. Quadrangular 3. Triangular 4. Circular

Morphological types	Sex				Total % (n)
	Male		Female		
	Side				
	Right	Left	Right	Left	
	% (n)	% (n)	% (n)	% (n)	
Irregular	15.63 (10)	14.06 (9)	12.50 (8)	14.06 (9)	56.25 (36)
Triangular	3.13 (2)	3.13 (2)	4.69 (3)	9.38 (6)	20.33 (13)
Quadrangular	7.81 (5)	1.56 (1)	3.13 (2)	3.13 (2)	15.63 (10)
Circular	3.13 (2)	3.13 (2)	0.0 (0)	1.56 (1)	7.82 (5)
Total	29.7 (19)	21.88 (14)	20.32 (13)	28.13 (18)	100 (64)

[Table/Fig-4]: Morphological types and frequencies of epipteric bones in relation to sex and side.

The morphometric data (height and width) of the epipteric bones were generally slightly larger in the irregular morphological type [Table/Fig-5].

DISCUSSION

The frequency of epipteric bones has ranged from 2 to 51.4% according to the population studied [Table/Fig-6]. In the present study was found a frequency of 19.14%. This finding was closer to 18.5% found by Murphy [8] and 20.8% by Lee et al., [9].The present findings are still very different compared to the ones found, in particular, in the Indian population [6]. The significance of the occurrence of such variation of pteric bones in the population, until now, has not found a satisfactory explanation.

Morphological types	Morphometry (cm)					
	Height			Width		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Irregular	0.30	2.50	1.12	0.25	2.40	1.03
Triangular	0.20	2.30	0.95	0.30	2.00	0.75
Quadrangular	0.40	1.40	0.78	0.30	1.70	0.73
Circular	0.25	1.00	0.52	0.25	1.10	0.69

[Table/Fig-5]: Morphometry (height and width) of the epipteric bones.
Centimeters (cm)

Study	Population	Sex	n	% with Epipteric Bones
Murphy [8]	Australian	Unknown	388	18.5
Lee et al., [9]	Korean	Unknown	298	20.8
Natekar et al., [6]	Indian	Both	150	51.40
Oguz et al., [7]	Turkish	Male	26	2.00
Seema and Mahajan [10]	Indian	Unknown	50	12.00
Zalawadia et al., [11]	Indian	Unknown	42	4.80
Mwachaka et al., [12]	Kenyan	Both	79	7.00
Eboh and Obaroefe [13]	Nigeria	Unknown	50	6.00
Present study, 2015	Northeastern Brazil	Both	256	19.14

[Table/Fig-6]: Frequencies of epipteric bones in different populations.

As regards formation Annam and Bajpe [14], agree with the hypothesis of Ranke [15], which can be the result of a possible failure to unite of the de um separate center of ossification with the greater wing of the sphenoid bone, during the ossification. The distribution and frequency of morphological types of ptericos bones concerning the sex and side of the skull has not occurred predominance among these variables. Bhargavi et al., [16] considered as minimum these differences aside the skull and sex.

The presence of sutural bones in the pterion may be a pitfall within surgical guidance and recognition of this anatomical feature may make pterion craniotomy safer [14,17]. Furthermore, it may also be taken as the false impression of fractures when present in pterion region. In case of the real presence of a fracture, It may also be interpreted as presence of epipteric bone [6]. For this reason, knowledge of the morphology and morphometry of epipteric bones may become especially important for radiologists, with the aim of making possible to avoid diagnostic errors, and also for anthropologists, neurosurgeons and forensic pathologists in cases of trauma in this region.

CONCLUSION

Epipteric bones were present in 19.14% of the crania studied and the irregular form predominated in both sexes. Knowledge of the morphological and morphometric variations of epipteric bones is important in neurosurgery, especially for surgical access to the anterior and middle cranial fossae, in operations in the speech motor area (Broca's area) and in repairs to aneurysms of the middle cerebral artery. Moreover, it is of interest in particular to forensic anthropologists, in evaluating incomplete archeological remains.

REFERENCES

[1] Standring S. Gray's Anatomy: The Anatomical Basis of Clinical Practice. 39th Edition. New York: Elsevier Churchill Livingstone; 2005. p. 667-77.
[2] Wang Q, Opperman LA, Havill LM, Carlson DS, Dechow PC. Inheritance of sutural pattern at the pterion in Rhesus monkey skulls. *Anat Rec A Discov Mol Cell Evol Biol*. 2006;288(10):1042-49.
[3] Marti B, Sirinelli D, Maurin L, Carpentier E. Wormian bones in a general paediatric population. *Diagn Interv Imaging.* 2013;94(4):428-32.
[4] Nayak BS, Soumya KV. Unusual sutural bones at pterion. *IJAV.* 2008;1:19-20.
[5] Nayak BS. Multiple wormian bones at the lambdoid suture in an Indian skull. *Neuroanatomy*. 2008;7(1):52-53.
[6] Natekar PE, de Souza FM, Natekar SP. Pterion: An anatomical variation and surgical landmark. *Indian Journal of Otology.* 2011;17(2):83-85.
[7] Oguz O, Sanli SG, Bozkir MG, Soames RW. The pterion in Turkish male skulls. *Surg Radiol Anat*. 2004;26(3):220-24.
[8] Murphy T. The pterion in the Australian aborigine. *Am J Phys Anthropol*. 1956;14(2):225-44.
[9] Lee UY, Park DK, Kwon SO, Paik DJ, Han SH. Morphological analysis of the pterion in Korean. *Korean J Phys Anthropol*. 2001;14(4):281-89.
[10] Seema A, Mahajan A. Pterion formation in North Indian population: an anatomico-clinical study. *Int J Morphol.* 2014;32(4):1444-48.
[11] Zalawadia A, Vadgama J, Ruparelia S, Patel S, Rathod SP, Patel SV. Morphometric study of pterion in dry skull of Gujarat region. *NJIRM*. 2010;1(4):25-29.
[12] Mwachaka P, Hassanali J, Odula P. Anatomic position of the pterion among Kenyans for lateral skull approaches. *Int J Morphol*. 2008;26(4):931-93.

[13] Eboh DEO, Obaroefe M. Morphometric study of pterion in dry human skull bones of Nigerians. *Int. J. Morphol*. 2014;32(1):208-13.
[14] Annam S, Bajpe R. A prospective anatomic study of epipteric bones in dry human skulls of Karnataka. *IJBAR*. 2016;7(6):262-64.
[15] Ranke J. Der Stirnfortsatz der Schlafenschuppebei den Primaten - Sitz, Mathem. *Phys Cl Akad Wiss.Munchen*. 1898;27:227 – 70.
[16] Bhargavi H, Saralaya V, Saralaya V, Kishan K, Kishan K. Pterion: a site for neurosurgical approach. *Int J Biomed Res*. 2011;2(12):588-94.
[17] Ruta B,Umarji BN. Study of the shapes of sutural bones in western india. *Int J Biol Med Res*. 2012;3(3):2269-70.

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