

CASE REPORT

PEER REVIEWED | OPEN ACCESS

Metopism: An anatomical variant that the physician should take into account

Yamili Morales Vega, Adelina Rojas-Granados, Esteban Arellano-Rivera, Aurelia Martínez-Díazaa, Octavio Lescas Méndez, Manuel Angeles-Castellanos

ABSTRACT

Introduction: During childhood these sutures close, forming the characteristic sutures of the skull, one of these is the frontal suture, which joins the two frontal bones perfectly, simulating a single frontal bone. However, this suture can persist into adulthood, giving an anatomical variant known as metopism.

Case Report: A 19-year-old Mexican male presented with high-energy trauma related to a traffic accident while riding a motorcycle without wearing a safety helmet. A simple skull computed tomography (CT) was considered due to moderate risk factors for traumatic brain injury (TBI), based on the Master's classification, progressive headache, presence of hematoma, facial injuries. When performing the simple skull tomography, persistence of the metopic suture was observed.

Conclusion: Metopism has generally been reported as a postmortem finding in population studies aimed at its search. This report has special attention because it was identified as a differential diagnosis of a skull fracture following a traumatic brain injury. The important finding that differentiates metopic suture from a fracture is the

presence of serrated and sclerotic edges. A persistent metopic suture can be easily diagnosed by an anterior-posterior radiograph.

Keywords: Anatomical variant, Fracture, Metopic suture, Skull

How to cite this article

Vega YM, Rojas-Granados A, Arellano-Rivera E, Martínez-Díazaa A, Méndez OL, Angeles-Castellanos M. Metopism: An anatomical variant that the physician should take into account. Int J Case Rep Images 2024;15(1):82–86.

Article ID: 101451Z01MY2024

doi: 10.5348/101451Z01MY2024CR

INTRODUCTION

The joints of the bones at the top of the skull are flexible fibrous types, which is important since they fulfill at least two main functions during and after birth. At birth, during expulsion through the birth canal, these bones can cross one over the other, and this helps reduce the circumference of the head. Second, these fibrous joints, or sutures, slowly close at different times after birth allowing the skull to grow as the brain increases [1].

The metopic suture joins the two frontal bones (Figure 1), is a fibrous suture-type joint that extends from the nasion to the bregma, they begin to ossify at approximately eight weeks of gestation, until the two frontal bones fuse approximately two years [2], the other sutures (coronal, sagittal, and lambdoid) are closed much later. However, the metopic suture sometimes does not

Yamili Morales Vega¹, Adelina Rojas-Granados², Esteban Arellano-Rivera², Aurelia Martínez-Díazaa², Octavio Lescas Méndez¹, Manuel Angeles-Castellanos³

Affiliation: ¹Cabinet KOSMA, Oaxaca, C.P. 71244, Mexico; ²Department of Anatomy, Faculty of Medicine, Universidad Nacional Autónoma de México, C.P. 04510, Mexico; ³Department of Innovation in Human Biological Material and Department of Anatomy, Faculty of Medicine, Universidad Nacional Autónoma de México, C.P. 04510, Mexico.

Corresponding Author: Manuel Angeles-Castellanos, Faculty of Medicine, Universidad Nacional Autónoma de México, C.P. 04510, Mexico; Email: mangesles_castellanos@unam.mx

Received: 22 February 2024

Accepted: 01 April 2024

Published: 08 May 2024

close during childhood and continues into adulthood, as a joint that separates the frontal bone into two symmetrical halves. When the metopic suture persists into adulthood it is commonly known as: “metopism,” “persistent metopic suture,” or “middle frontal suture.” It can be found incompletely (partially) or completely; although it is rare to find this suture in adults, its presence is not considered pathological, it is considered a normal variant of cranial sutures [3, 4] (Figure 2).

The term “metopism” refers to the persistence of the metopic suture in adulthood, and comes from the Latin *metōpa* and from the Greek *metópē* which means “in the middle of the face” [1]. Metopism is generally a clinically significant radiological finding, since in addition to being confused with a frontal bone fracture, a persistent metopic suture can be associated with other important anatomical variations, including frontal sinus anomalies [5].

The finding of a persistent metopic suture is important from a clinical point of view since it should be included, as mentioned above, in the differential diagnosis of suspected skull fracture, especially if there is a history of cranioccephalic trauma. It is not a pathological entity but should certainly be noted as an incidental finding on a radiograph, the suture is best identified on an anteroposterior (AP) view of the skull, as it can help differentiate it from a vertical skull fracture [5, 6], as exemplified in the following clinical case.

CASE REPORT

This is a 19-year-old Mexican male, who presented a high-energy trauma related to a traffic accident while riding a motorcycle, without wearing a safety helmet. During the initial physical examination, an epicranial (subgaleal) hematoma was observed in the left parietal region; no crepitus was palpable during the skull examination.

During the neurological examination, he showed no motor, sensory, or cranial nerve alterations, isochoric pupils with preserved photomotor and consensual reflexes, and eye movements were normal. Evaluated with a Glasgow Coma Scale of 15/15 points, referring moderate to severe headache only. A simple skull computed tomography (CT) was considered due to moderate risk factors for traumatic brain injury (TBI), based on the Master’s classification, progressive headache, presence of hematoma, and facial injuries. When performing the simple skull tomography and 3D reconstruction, persistence of the metopic suture was observed, without observing any fracture trace in the bones of the skull and without evidence of intracranial lesions (Figure 3). The evolution was favorable and did not require in-hospital management.

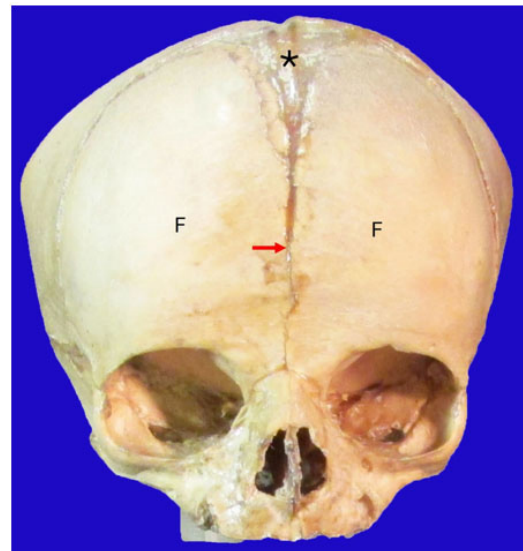


Figure 1: A skull of a 16-week gestation product is shown where the metopic articulation cartilage that joins the frontal bones (F). The asterisk indicates the anterior fontanel (bregma), and the arrow indicates the future metopic suture. (Image is taken from human biological material, property of DIMBH-UNAM)

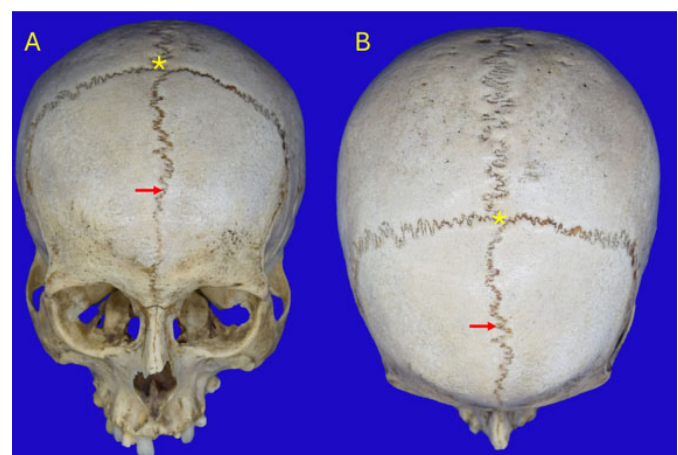


Figure 2: An adult skull is shown where the persistence of the metopic suture is observed. (A) Anterior view and (B) superior view. The asterisk indicates the anterior fontanel (bregma), and the arrow indicates the future metopic suture. (Image is taken from human biological material, property of DIMBH-UNAM)

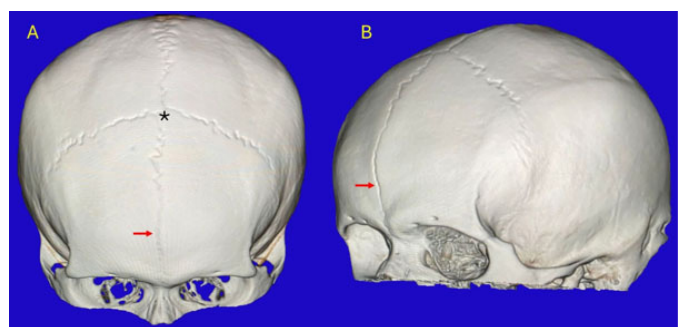


Figure 3: Computed axial tomography (CT) image of the skull and 3D reconstruction, where the persistence of the metopic suture is observed. (A) Anterior view and (B) Left oblique view. The asterisk indicates the anterior fontanel (bregma), and the arrow indicates the future metopic suture.

DISCUSSION

Metopism has generally been reported as a postmortem finding in population studies aimed at its search. This report has special attention because it was identified as a differential diagnosis of a skull fracture following a TBI. The persistence of the metopic suture can lead the treating doctor to make a diagnostic error, since, if it is not known or kept in mind, the probable existence of this anatomical variant can be misinterpreted as a medial frontal fracture, in patients with craniocerebral trauma. However, in the radiographic image, the characteristic serrated edges of the suture are generally observed, which allows the distinction to be made and helps the radiologist and neurosurgeon to make the differential diagnosis [7].

On some occasions, the radiological image may show a suspicion of a linear fracture, so meticulous imaging examinations should be performed, including, if possible, CT or three-dimensional magnetic resonance imaging (MRI) to ensure the correct diagnosis, without forgetting the complete neurological examination [7]. This is important because such a misdiagnosis can lead to wrong therapies and unnecessary surgical interventions.

On the other hand, it is known that metopism can coexist with some other clinical situations, such as cleft lip and/or palate, frontal sinus variation, cretinism, as well as the presence of multiple wormian bones in the skull [8]. It has also been suggested that metopism may be related to abnormal growth of skull bones, hydrocephalus and genetic factors. The incidence of metopism has been reported in 5% of Asians, 9% of European Caucasians, and 1% of blacks. There are no reports in the Latin population, only the report of two studies in the Brazilian population, in the first one they studied metopism in 400 adult skulls, finding that only 2.75% of the skulls showed this characteristic, of which 36.3% correspond to women and 63.6% to men [9]. In the second work they studied a sample of 71 skulls, reporting the presence of metopism in 7.04% of cases, of which 80% corresponded to women and only 20% to men [10].

On the other hand, we know that normal craniofacial development depends on the precise contribution of tissue derived from neural crest cells and paraxial mesoderm, together with a regulation controlled by specific genes. Failure at any level of control could result in premature closure of sutures (craniosynostosis) or delayed suture closure, known as metopism [11–13].

At least four different genes have been found to be associated with this condition, such as fibroblast growth factor receptors (FGFRs), transcription factors for MSX2 and TWIST, fibrillin-1, and Sox9.

Sox9 corresponds to one of the main regulators of chondrogenesis, and a marked presence has been observed during the initiation of suture closure. Experimentally, depletion of Sox9 by haploinsufficiency in neural crest cell-derived tissues has resulted in delayed frontal suture closure. These results demonstrate a unique development of the sutural complex and the role of Sox9 as an essential

contributor to the timely and adequate closure of the suture between the frontal bones [13].

CONCLUSION

Although metopism is not classified as a pathology, knowledge of its presence has clinical importance, since as we mentioned previously it can be confused with a traumatic vertical cranial fracture in radiological images. The important finding that differentiates metopic suture from a fracture is the presence of serrated and sclerotic edges. A persistent metopic suture can be easily diagnosed by an anterior-posterior radiograph. Although simple radiography is sufficient to diagnose this anatomical variation, an imaging study with 3D reconstruction is always recommended.

REFERENCES

- Çakin H, Kazan S. Chapter 9. Metopism: Anatomical, clinical and surgical aspects. In: Turgut M, Tubbs RS, Turgut AT, Dumonts AS, editors. *The Sutures of the Skull*. Cham: Springer; 2021. p. 77–96.
- Roa I, Moraga JI, Cantin M. Metopismo: Bases morfológicas, implicancias clínicas y reporte de caso. *Int J Morphol* 2011;29(3):992–9.
- Gardner S. A persistent metopic suture: A case report. *Austin J Anat* 2016;3(1):1049–50.
- Sangeeta V, Sundar G. Morphology of metopic suture and its clinical significance in human adult skull. *Int J Anat Var* 2018;11(2):40–2.
- Zdilla MJ, Russell ML, Koons AW, Bliss KN, Mangus KR. Metopism: A study of the persistent metopic suture. *J Craniofac Surg* 2018;29(1):204–8.
- Sindel M, Sindel T, Ozkan O, Luleci E. Incidence of metopic sutures in adult crania. *Akd Med J* 1989;6(4):85–91.
- Bademci G, Kendi T, Agalar F. Persistent metopic suture can mimic the skull fractures in the emergency setting? *Neurocirugia (Astur)* 2007;18(3):238–40.
- Nikolova SY, Toneva DH, Yordanov YA, Lazarov NE. Multiple wormian bones and their relation with definite pathological conditions in a case of an adult cranium. *Anthropol Anz* 2014;71(3):169–90.
- del Sol M, Binignat O, Bolini PD, Prates JC. Metopism in Brazilians. [Article in Portuguese]. *Rev Paul Med* 1989;107(2):105–7.
- Castilho SMA, OdaYJ, Santána GDM. Metopismo en cráneos del sur de Brasil. *Int J Morphol* 2006;24(1):61–6.
- Opperman LA. Cranial sutures as intramembranous bone growth sites. *Dev Dyn* 2000;219(4):472–85.
- Rice DPC, Rice R, Thesleff I. Molecular mechanisms in calvarial bone and suture development, and their relation to craniosynostosis. *Eur J Orthod* 2003;25(2):139–48.
- Sahar DE, Longaker MT, Quarto N. Sox9 neural crest determinant gene controls patterning and closure of the posterior frontal cranial suture. *Dev Biol* 2005;280(2):344–61.

Acknowledgments

This study was supported by grants PAPIME-UNAM: PE202123 to Adelina Rojas-Granados and 83/2023 FacMed-UNAM to Manuel Angeles-Castellanos.

Author Contributions

Yamili Morales Vega – Acquisition of data, Analysis of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Adelina Rojas-Granados – Analysis of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Esteban Arellano-Rivera – Analysis of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Aurelia Martínez-Díazaa – Analysis of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Octavio Lescas Méndez – Conception of the work, Acquisition of data, Revising the work critically for important intellectual content, Final approval of the

version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Manuel Angeles-Castellanos – Conception of the work, Analysis of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Guarantor of Submission

The corresponding author is the guarantor of submission.

Source of Support

None.

Consent Statement

Written informed consent was obtained from the patient for publication of this article.

Conflict of Interest

Authors declare no conflict of interest.

Data Availability

All relevant data are within the paper and its Supporting Information files.

Copyright

© 2024 Yamili Morales Vega et al. This article is distributed under the terms of Creative Commons Attribution License which permits unrestricted use, distribution and reproduction in any medium provided the original author(s) and original publisher are properly credited. Please see the copyright policy on the journal website for more information.

ABOUT THE AUTHORS

Article citation: Vega YM, Rojas-Granados A, Arellano-Rivera E, Martínez-Díazaa A, Méndez OL, Angeles-Castellanos M. Metopism: An anatomical variant that the physician should take into account. Int J Case Rep Images 2024;15(1):82–86.

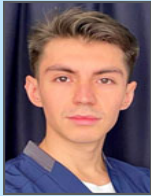


Yamili Morales Vega is a radiology specialist attached to the Radiology Department at the Tehuacán Puebla General Hospital in Mexico. She obtained a university degree in general medicine from the UABJO in the city of Oaxaca and a postgraduate degree in radiology specialist from the Universidad Veracruzana in Xalapa, Veracruz. Her research interests include radiology applications, anatomical variants, and case reports. She has not published articles. She intends to continue researching and publishing for residents/PhDs/Postdocs in the future.
Email: dramorave@gmail.com



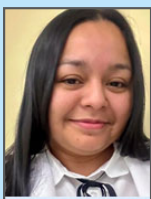
Adelina Rojas-Granados, PhD, is Professor and Researcher at Department of Anatomy, Faculty of Medicine, Universidad Nacional Autónoma de México. She earned the undergraduate degree Medical Doctor from Universidad Nacional Autónoma de México and postgraduate degree form PhD (Cardiomorphology and Human Anatomical Variants) from Universidad Autonoma Benito Juárez de Oaxaca, Mexico. She has published 19 research papers in national and international academic journals. Her research interests include human anatomy, morphology, and development of the heart. She intends to pursue writing about human anatomy for residents in future.

Email: rojas.adelina@comunidad.unam.mx



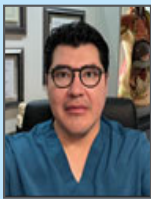
Esteban Arellano-Rivera is Medical Student at Faculty of Medicine, Universidad Nacional Autónoma de México. He has published 2 research papers in national and international academic journals.

Email: stbari@outlook.com



Aurelia Martínez-Díazaa is Medical Student at Faculty of Medicine, Universidad Nacional Autónoma de México. She has published 1 research paper in national and international academic journals.

Email: amd2509@gmail.com



Octavio Lescas Méndez A is MD in Intensive Care Medicine and emergency room at Instituto Mexicano del Seguro Social of Oaxaca City, Director of Kosma Group, Diagnostic Cabinet in the Oaxaca city. He earned the undergraduate degree in Emergency physician from Universidad Politecnica Nacional and postgraduate degree form Intensive Care Medicine from Universidad Nacional Autonoma de México. He has published 12 research papers in national and international academic journals. He intends to pursue of implement continuing education programs, stabilish specialized clinics, participate in clinical research, and promote preventive healthcare in future.

Email: lescasmendez@gmail.com



Manuel Angeles-Castellanos, PhD, is a Researcher at Department of Innovation in Human Biological Material, Faculty of Medicine, National Autonomous University of Mexico. He obtained a bachelor's degree in Medicine from the Universidad Autonoma Benito Juárez de Oaxaca, Mexico and a postgraduate degree (PhD in Neurobiological and Neuroanatomical Aspects of Behavior) from Biomedical Sciences of the Universidad Nacional Autonoma de México. He has published 82 research articles in national and international academic journals and authored one book. His research interests include neuroscience, circadian rhythms and development. He intends to pursue writing for residents and doctoral students in the future.

Email: mangesles_castellanos@unam.mx

Access full text article on
other devices



Access PDF of article on
other devices





INTERNATIONAL JOURNAL OF
CASE REPORTS AND IMAGES



VIDEO JOURNAL OF
CLINICAL RESEARCH



VIDEO JOURNAL OF
BIOMEDICAL SCIENCE



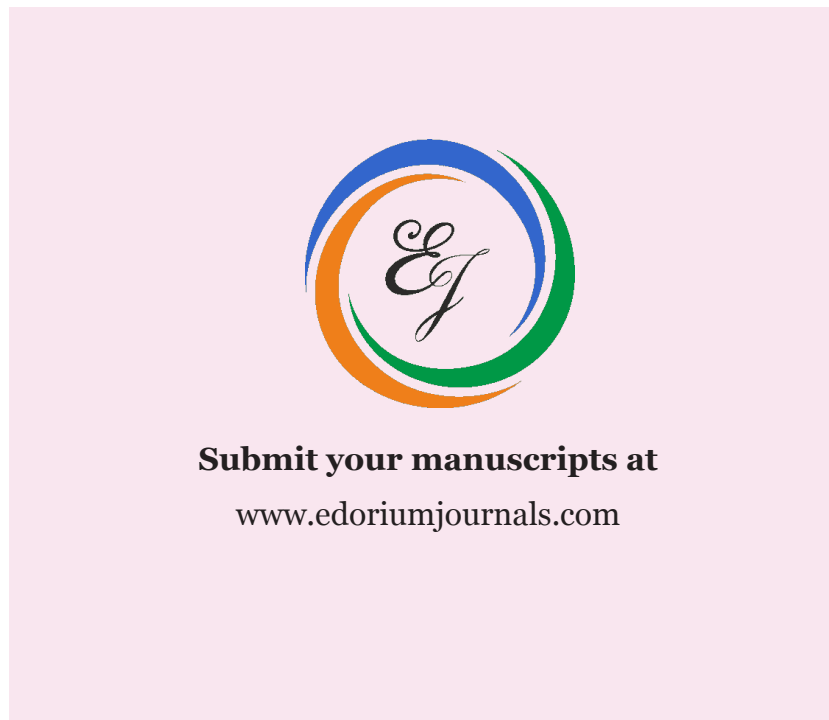
INTERNATIONAL JOURNAL OF
HEPATOBIILIARY AND
PANCREATIC DISEASES



INTERNATIONAL JOURNAL OF
BLOOD TRANSFUSION AND
IMMUNOHEMATOLOGY



EDORIUM JOURNAL OF
OPHTHALMOLOGY



EDORIUM JOURNAL OF
MEDICINE



EDORIUM JOURNAL OF
CARDIOTHORACIC AND
VASCULAR SURGERY



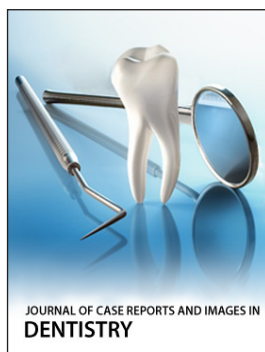
JOURNAL OF CASE REPORTS
AND IMAGES IN ORTHOPEDICS
AND RHEUMATOLOGY



EDORIUM JOURNAL OF
PSYCHOLOGY



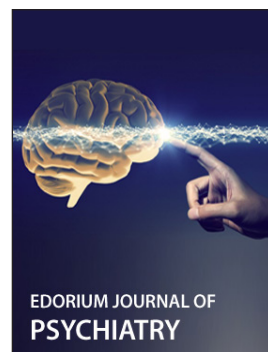
EDORIUM JOURNAL OF
CELL BIOLOGY



JOURNAL OF CASE REPORTS AND IMAGES IN
DENTISTRY



EDORIUM JOURNAL OF
CANCER



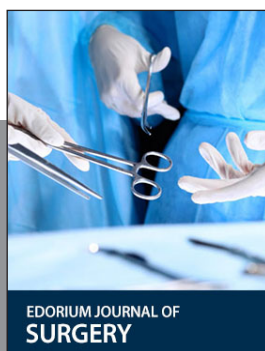
EDORIUM JOURNAL OF
PSYCHIATRY



JOURNAL OF CASE REPORTS AND
IMAGES IN INFECTIOUS DISEASES



EDORIUM JOURNAL OF
ANATOMY AND EMBRYOLOGY



EDORIUM JOURNAL OF
SURGERY



JOURNAL OF CASE REPORTS
AND IMAGES IN PATHOLOGY



EDORIUM JOURNAL OF
ANESTHESIA