

Original article

Study of incidence of metopic suture in adult skulls

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Date of submission: 12 November 2014; Date of Publication: 15 December 2014

Abstract:

Introduction: In the fetal skull, the two halves of the frontal bone are separated by the frontal suture, and they remain separate until approximately 6 years of age. In some adults the separation line persists as the metopic suture. The metopic sutures are vertical sutures occurring as a result of failure of ossification between the two halves of frontal bone.

Methods: This study was conducted with 80 human adult dry skulls. The skulls were inspected at the norma frontalis for the presence of the metopic suture. The sutures were classified as complete and incomplete. The incomplete ones were classified as linear type, 'V' shape and 'U' type.

Observations and results: Out of 80 skulls studied, a complete metopic suture was found only in one case (1.25 %), whereas an incomplete suture was observed in 18 cases (22.5 %). Among the incomplete ones, 13 were linear, 4 were 'V' shaped and 1 skull had 'U' shaped metopic suture. The remaining 76.25% of the skulls did not show a metopic suture.

Conclusion: The present study showed the incidence of metopic sutures in Indian adults, useful for the fields of neurosurgery, radiology and forensic medicine.

Keywords: Metopic suture, Metopism, Frontal bone

Introduction:

The frontal bone forms the skeleton of forehead, articulating inferiorly with the nasal and zygomatic bones. In the fetal skull, the two halves of the frontal bone are separated by the frontal suture, and they remain separate until approximately 6 years of age. In some adults the separation line persists as the metopic suture in the midline of the glabella, the smooth, slightly depressed area between the superciliary arches. A persistent metopic suture in radiographic images must not be mistaken for a fracture line¹. Williams state that the frontal bones are separated by the metopic suture at birth; this is obliterated by 6-8 years². According to Hamilton the metopic suture disappears by the seventh year³. The

metopic sutures are vertical sutures occurring as a result of failure of ossification between the two halves of frontal bone. It was described that the obliteration of metopic sutures begins at the level of frontal tuber and extends both upwards and downwards, and sometimes traces may be left either at the bregma or nasion if the fusion is not complete⁴. When the metopic sutures are complete and extend from nasion to bregma, the condition is called as metopism⁵. If the suture is not present throughout and occupies a small area between these two points, they are considered as incomplete metopic sutures. They are also called as median frontal sutures and usually present between the two super ciliary arches.

Divergences are observed in the scientific literature concerning the exact period of the closure. The period of maintenance of sutures in general has been suggested as a pre-condition for the continuous growth of the bones⁶ and as an indirect factor for the normal growth of the skull; because of that the early closure of the metopic suture results in cranial morbid deformities known as scaphocephaly.

The knowledge of the anatomy of the metopic suture is important because its permanence can be mistaken for a cranial fracture in radiological images, or even for the sagittal suture. It is also important for paleodemography and forensic medicine⁷. According to the classical anatomic literature, there are different incidences when ethnic groups are compared. The incidence of metopism in Alpine skulls is 63.2%, the largest reported, while the smallest was described in Australian and Scottish skulls (1.0%)⁸.

Aims & Objectives:

The purpose of this work was to contribute to the scientific literature, providing anatomical data on the persistence and variations of the metopic suture.

Material and Methods:

This study was conducted with 80 human adult dry skulls which were obtained from department of Anatomy GMC Akola and GMC Mumbai (during 2009 to 2014). The skulls were inspected at the norma frontalis for the presence of the metopic

suture. The sutures were classified as complete and incomplete. A suture which extends completely between the bregma and nasion is termed as the complete metopic suture or metopism. If it extends to a smaller distance either from the nasion or from the bregma, it is termed as incomplete type. The incomplete ones were classified as linear type, ‘V’ shape and ‘U’ type. The method of classification of the metopic sutures is based on the reports of Agarwal et al.⁹, Ajmani et al.¹⁰ and Castilho et al.¹¹. The incidence of complete and incomplete metopic sutures were calculated, the data obtained were compared with those from earlier studies.

Observations and results:

Out of 80 skulls studied, a complete metopic suture (Figure 1a & 1b) was found only in one case [1.25 %], whereas an incomplete suture was observed in 18 cases [22.5 %]. Among the incomplete ones, 13 [16.25%] were linear, 4 [5%] were ‘V’ shaped (Figure 2) and 1 [1.25%] skull had ‘U’ shaped metopic suture (Figure 3). The remaining 76.25% of the skulls did not show a metopic suture. The morphological distribution of the metopic sutures of the present study is represented in Table 1. The other morphological types like ‘H’ shape and ‘N’ were not found in the present study. The data as compared with previous studies and the racial variability of the metopism is shown in Table 2.

Table 1 Incidence of Metopic suture

Type of suture	Number	Percentage
Complete	1	1.25%
Incomplete		
Linear	13	16.25%
‘V’ Shaped	4	5%
‘U’ Shaped	1	1.25%
Total	19	23.75%

Table 2 Racial Variations in the Incidence of Metopism.

Authors	Population	Incidence
Bryce ¹²	European	8.7%
Bryce	Mongolian	5.1%
Bryce	Negro	1.2%
Bryce	Australian	1%
Bryce	Scottish	9.5%
Keith ¹³	Subject to race	3 – 8%
Jit & Shah ¹⁴	Indian – Punjab	5%
Woo ¹⁵	Mongolians	10%
Woo	Negroids	2%
Breathnach ¹⁶	European	7 – 10%
Breathnach	Yellow races	4 – 5 %
Breathnach	Africans	1%
Romanes ¹⁷	Europeans	0 – 8 %
Das ¹⁸	Indians – U.P	3.31%
Agarwal ⁹	Indians	2.66%
Ajmani ¹⁰	Nigerians	3.4%
B. V. Murlimanju ¹⁹	Indians	1.2%
Hussain Saheb S ²⁰	Indians - South	3.2%
Chanwit Maneenin ²¹	Northeastern Thai	10.12
Present Study	Indians	1.25

Discussion:

This study describes the incidence of metopic sutures in Indian adults (23.75%), which was similar to that of northern Indians²² and to that of northeastern Thai adults²¹. Ajmani M. L.¹⁰ et al observed the presence of a metopic suture in 34.97%. The metopic suture was present in 52 (64.1%) cases in the study conducted by B.V. Murlimanju¹⁹ and was present in 29.6% in study conducted by Hussain Saheb S et al²⁰. Lower incidence rates were reported in Nepalese²³ at only 11.46% & Lebanese²⁴ at 1.75%. Demographics and race might affect this phenomenon of metopism. Cavalial suture obliteration is associated with increased osteoblast proliferation and reduced suture

cell apoptosis, which is induced by growth factors such as fibroblast growth factor 2 (Fgf2), bone morphogenic protein4 (Bmp4) and transforming growth factor-beta2 (Tgf-β2)²⁵⁻²⁸. Conversely, the cause of metopic suture in humans might stem from transforming growth factor-beta3 (Tgf-β3). A previous study revealed that in vivo Tgf-β3 delayed fusion of the posterior inter-frontal suture in Sprague-Dowley rats²⁹. According to del Sol et al.³⁰, the causative factors of metopism include the abnormal growth of cranial bones, hydrocephalus, growth retardation, sexual influence, heredity, atavism, stenocrotaphia (abnormal narrowing of the temporal area of the

head), plagiocephaly (cranial malformation causing a twisted and asymmetrical head because of the synostosis of the cranial sutures), scaphocephaly (deformed head, projecting forward like the keel of a boat), mechanical causes and hormonal dysfunction. The genetic influence is the most currently accepted factor among the scientific community¹¹. It was reported that the impaired closure of the metopic suture is common in Apert's Syndrome³¹.

In a head injury patient, there is a chance that the persistent metopic suture may be erroneously interpreted as a vertical fracture. It was reported that reconstructed tomography scans are superior to the plain X- ray films in the emergency setting³². The information about metopic sutures is enlightening for the medico legal consultants and forensic experts. Their morphological details are important for the clinician from radiological and surgical point of view. While reading the X-ray/ CT and MRI films, the possibility of the metopic suture should be kept in mind. This will prevent confusion and a wrong diagnosis in emergency situations.

Conclusion:

This study was carried out on 80 human adult dry skulls for the incidence of the metopic suture. Metopism was present in 1.25 % of cases, and a metopic suture (complete or incomplete) was observed in 22.5 % of the skulls. The detail knowledge of the metopic suture is important for the neurosurgeons and radiologists in routine practice. Vertical frontal bone fractures may be easily misdiagnosed with persistent metopic sutures. This anatomical knowledge of metopic sutures is very useful for the doctors while treating the traumatized patient and during surgical intervention including frontal craniotomy. The present study was an effort to provide some important anatomical data of metopic

suture in the Indian adult population. Obtaining more conclusive results demands study of more number of the skulls, as well as carrying out comparative studies between the different regions.



Figure 1a. Complete metopic suture (Frontal view)



Figure 1b. Complete metopic suture (Superior view)



Figure 2. 'V' Shaped metopic suture



Figure 3. 'U' Shaped metopic suture

Acknowledgement:

The author is grateful to authors / editors /publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

Conflict of Interest: Nil.

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