

## THE STUDY OF METOPISM IN HUMAN ADULT SKULLS IN WESTERN MAHARASHTRA REGION

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### ABSTRACT

The human forehead is formed by means of a singular, unpaired, median, and symmetrical bone called the Frontal bone. In process of development, this bone is formed in two symmetrical halves, being separated by a suture. This suture is called Metopic suture. The extent of metopic suture is from the anterior angle of the bregma to the nasion. After birth the two halves of the frontal bone are united to form a single, symmetrical median bone by obliteration/closing of the metopic suture. Normal physiological closing time of metopic suture is controversial, normally closed at birth while some does not fuse until the second year of the age. Persistence of metopic suture in adulthood is called as Metopism. The observation and knowledge of metopic suture is important for paleodemography, forensic medicine, radiologist and neurologist. In the present study, the objectives were to determine the incidence of metopism in human adult skulls of Maharashtra region.

**KEYWORDS :** Frontal, Metopism, Fusion

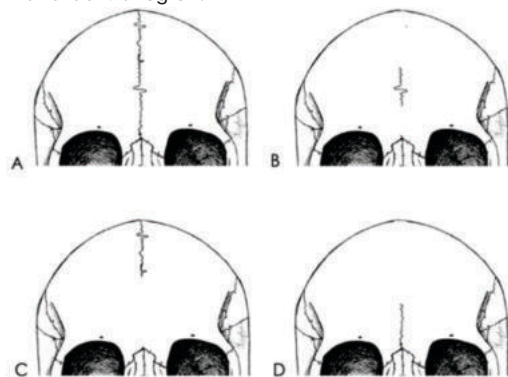
### INTRODUCTION:

The human forehead is formed by means of a singular, unpaired, median, and symmetrical bone called the Frontal bone (1). It is found to occupy the anterior most part of the Calvaria (2). The bone is pneumatic and consists of two parts. The vertical part is called as squamous part which helps in forming the forehead area and the horizontal part called the orbital part which helps in forming the roof of the orbit. In process of development, this bone is formed in two symmetrical halves, being separated by a suture. This suture is called Metopic suture. Metopic suture is dentate type of suture. Metopic is a Greek word which means "in the middle of the face" or "space between two eyebrows." Metopic suture is also known as frontal suture or median frontal suture or suture frontalis Persists. It is usually found between the two superciliary arches. Metopic suture is found nearly 2cms anterior to the coronal suture. The extent of metopic suture is from the anterior angle of the bregma to the nasion. After birth the two halves of the frontal bone are united to form a single, symmetrical median bone by obliteration/closing of the metopic suture. The fusion of the suture usually starts from the bregma and extends towards the nasion (3). Normal physiological closing time of metopic suture is controversial, some authors stated that the metopic suture normally closed at birth while some authors proposed that the metopic suture does not fuse until the second year of the age (4). Moore, Dalley, Agur (5) stated that frontal suture is obliterated by 8<sup>th</sup> year and in approximately 8% of the people, metopic suture persists. G.J. Romanes (3) says that the metopic suture closes by 5<sup>th</sup> or 6<sup>th</sup> year leaving traces above or below. Similar studies have also been made of Indian skulls and metopism has been found to be 5 % (Jit & Shah (6), 1948), 3.31 % (Das, Saxena & Beg (7), 1973) and 2.66% (Agarwal, Malhotra & Tewari (8), 1979). Many factors were attributed for persistence of metopic sutures into adult age which include hormones, cytokines, growth factors, cranial malformations, abnormal skull growth, hydrocephalus, atavism, genetic causes, etc (9). Hess (10) defined "metopica syndrome" of persistent metopic suture with associated cranial and finger anomalies, probably genetically determined.

Persistence of metopic suture in adulthood is called as Metopism (11). Metopism which is defined as a condition in which the two pieces of the frontal bone fail to merge in early childhood, displays varying degrees of incidence (12). According to Del Sol et al. (9), 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. It is essential to know about metopic suture failing to fuse which it can be easily misunderstood as fracture of frontal bone or even for the sagittal suture in radiological images (2,9). The basic difference between fracture and suture will help us to differentiate it. The differential diagnosis include suture has well defined edges while Fracture has irregular edges. Moreover, suture has interlocking edges. Suture is present in midline but fracture is not. So, the observation and knowledge of metopic suture is important for radiologist and neurologist (13). In a study by Hanihara et al. (14), it was observed that the cranial traits show distinctive patterns of geographic variations. Ossenberg (10) stated that the trait is presence slightly more often in females than in males.

It is also important for paleodemography and forensic medicine (11). In the present study, the objectives were to determine the incidence of metopism in human adult skulls of Maharashtra region.



**Figure 1.** A. Complete metopic suture (metopism), B-D Incomplete metopic suture variant location, B. at the middle part, C. at the upper part and D. at the lower part of the frontal bone (incomplete MS-only found at the lower part in all cases)

### MATERIAL AND METHODS:

This study was conducted on 142(Male-79, Female-63) dry human adult skulls in the Department of Anatomy, Ashwini Medical College & research centre, Solapur, Maharashtra. The skulls with signs of diseases, visible abnormalities and damaged skulls were excluded from the study. The age of the skulls was not taken into consideration. The skulls were macroscopically inspected for the presence of the metopic

suture and these skulls were divided into three groups as normal skulls without any metopic suture, complete metopic suture and with incomplete metopic suture. A suture which is found 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 bregma or from the nasion, it is termed as incomplete type (Figure 1)(15) The incidences of complete and incomplete metopic suture were calculated and the data obtained was compared with those from earlier studies.

**RESULTS: (Photograph 1)**

In our study, fifty-seven (40.14%) out of 142 skulls had neither complete nor incomplete metopic suture. Out of these fifty-seven skulls, 22 were of males and 35 were of females. Metopic suture either in the form of complete or incomplete was found to be present in eighty-five skulls (59.85%). Complete metopic suture (metopism) was found in four skulls (2.81%) with equal distribution in males and females ie. In each 2skulls. Incomplete suture was observed in eighty-one (57.04%) skulls. Out of which, fifty-five male skulls and twenty-six female skulls showed the incomplete metopic suture.



**Photograph 1:** Showing Complete Metopic Suture



**Photograph 2:** Showing Incomplete Metopic Suture



**Photograph 3:** showing absence of metopic suture

**DISCUSSION:**

Cranial variants have aroused the curiosity of anatomists for many decades. Cranial variants like all other variants have been studied by many workers; most of them are recognized only by mention in anatomical text books, being described in terms such as rare or occasionally found. Some variants are consequences of disease or other extrinsic influences (16,17,18); however, most of these variants result from normal developmental processes and are genetically determined (19).

In our study, Metopic suture was observed in the eighty-five dry human adult skulls (59.86%) in which complete persistent metopic suture (or Metopism) was observed in four skulls (2.81%) and partially obliterated or incomplete metopic suture was seen in eighty-one skulls (57%).

Maximum incidence was reported by Agrawal et al(8) (1979) as 38.17% in Indian skulls but the incidence of metopism observed by him was 2.66%. Fakruddin & Bhalerao (20) reported same as 2%, 3.31% by Das et al(7), 2.53% in UP skulls by Dixit & Shukla (21) suggesting an overall low incidence in the tropical regions. Nirmale et al (22) documented 3.07% incidence of metopism. Khamanarong et al(23) reported 2.8% incidence of metopism in Thai population. Our study can be compared with the above studies.

In our study, we also studied the persistence of metopic suture in males as well as females. We found out of 142 dry human adult skulls 22 (15.49%) male skulls and 35(24.65%) female skulls were neither having metopism nor metopic suture. Metopism was seen in 2 (1.41%) male and 2(1.41%) female skulls. Incomplete metopic suture was seen in 55 (38.73%) male & 26(18.31%) female skulls. But there is not any data for comparison. The probable mechanisms behind persistence of metopic suture are still unclear. According to Pitchard (24) (1956) during fetal life the two halves of the frontal bones are separated by space mainly consisting of fibrous tissue and mesenchymal cells may get differentiated into either cartilage or bone. These cells are mainly responsible for further growth of the frontal bone. Modern genetic evidence suggested that a network of atleast 10 key genes mediates neurocranial suture fusion and that these genes act differently on different cranial sutures (25). Recently the sequencing of the Neanderthal genome provides evidence for the positive selection of one of the key genes RUNX2 which is known to affect metopic suture fusion in the modern human variant (26). The relatively low frequency of the metopic suture in human population naturally adds to the difficulty of studying the relationship between metopic suture morphology and craniofacial morphology in adults (19).

**CONCLUSION:**

The study was carried out on 142 adult human skulls in western Maharashtra region and incidence of the metopic suture was found 57.04% and metopism was seen in 2.81% skulls.

Incidence of metopic suture in males was 38.73% and in females, it was 18.31%. Metopism was 1.41% in males as well as females. There is however difference in the incidence of metopic suture in different races and regions as mentioned in the literature. The information about metopic suture is enlightening for the medicolegal consultants and forensic experts. Their morphological details are important for the clinician from the radiological and surgical point of view. While reading X-ray/CT/MRI films, the possibility of the metopic suture should be kept in mind. This will prevent confusion and a wrong diagnosis in emergency situations. Nevertheless, more studies demanding large sample size, comparison between sexes, different age groups and distribution in different geographic areas remains to be studied. We believe that the present study has provided some

important data which will contribute to the scientific literature, providing the anatomical data of metopic suture in the Indian adult population.

**Conflict Of Interest:** On behalf of all authors, the corresponding author states that there is no conflict of interest.

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