

**Original Article****Metopic Suture –A Study in South Indian Population**

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Abstract

Background: The skull bones in the humans are separated from one another by sutures. The two halves of the frontal bone is separated by a suture. This suture is ossified in later stages of life. The persistence of the metopic suture in adult skull separating the frontal bone into two symmetrical halves is called as Metopism.

Materials and Methods: 300 adults skull were examined in the Institute of Anatomy, Madurai. About 10 skulls showed features of metopism.

Result: 10 skull out of the 300 skulls examined showed features of complete metopism, thus showing an incidence of 3.3%

Conclusion: Metopic sutures could mimic fractures of the skull. They also have a varied presentation. Hence a thorough knowledge about metopic suture is important in paleodemography, radiology and forensic medicine.

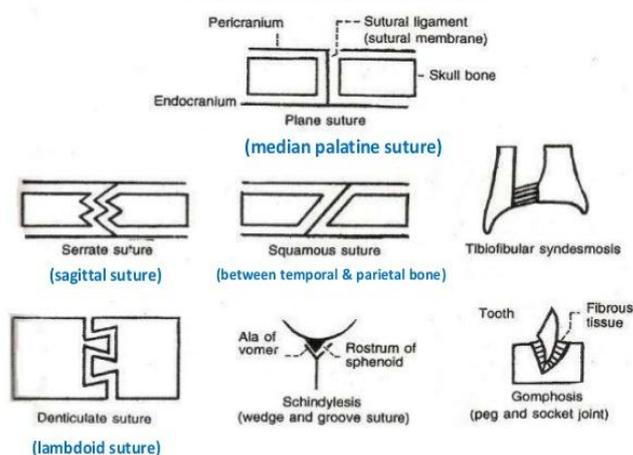
Keywords: Sutures, Ossification, Frontal sinus, Craniosynostosis, Nasion, Bregma.

Introduction

The skull bones are joined by dense connective tissue framework mainly made up of collagen.¹ These bones are joined to each other by immovable joints. These joints are called as sutures or synarthroses. There are many types of sutures. They are Plane sutures, Limbous sutures, Serrate sutures, Dentate sutures, Schindylesis.

Dentate Sutures

A suture with small tooth like projection, often widening towards their ends to interlock even more effectively are called Dentate sutures³.

TYPES OF SUTURES

The human forehead is formed by means of a singular, unpaired, median, and symmetrical bone called the Frontal bone.⁴ It is found to occupy the anterior most part of the Calvaria.⁵ 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 type of Dentate suture. Metopic is a Greek word which means "in the middle of the face" or "space between two eyebrow".

Metopic suture is also known as frontal suture or median frontal suture or suture frontalis Persistens. 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.² Sometimes remnants of this suture may be found around the Glabella. Wormian bones are sometimes found at the site of the suture.

The closure of the suture starts around 2 yrs and completes within 7-8 yrs. However there varied opinion about the time of completion of closure of metopic suture. Persistence of metopic suture in adulthood is called as Metopism.

The metopic suture usually closes from the endocranial side to the ectocranium. The anterior end of the metopic suture does not exactly meet at the internasal suture, in the similar fashion the posterior end of the suture also does not exactly meet at the sagittal suture. It is at an interval of about 1.5cms from the sagittal suture. The posterior part of the suture is direct and simple and is called as Pars bregmatica.²⁸

Metopism may be of the following types. Complete and Incomplete types. The incomplete may be superior, middle or lower in types depending upon the region remaining unfused. The incomplete type can also be further classified into nasion incomplete and bregma incomplete. Depending on the shape of the metopic suture present, the incomplete sutures can be classified into Linear type, U – type and the V –type.

Materials and Methods

About 300 adult skull bones of both the sexes were studied in the Institute of Anatomy, Madurai medical college, Madurai over a period of 1 year. The presence of metopic suture was found in 10 skulls. They were all complete in type stretching from the bregma to the nasion. The incidence was found to be about 3.3%.

Observation

10 skulls showed metopic sutures extending from the anterior angle of bregma to the nasion. All were complete in type. Incomplete type was not noted. The posterior part of the metopic suture did not meet exactly at the sagittal suture in some skulls and met exactly in some skulls, similarly the anterior part did not meet exactly at the internasal suture in some skulls and met exactly in some skulls. No wormian bone was found in the territory of the suture.

Embryology

The flat bones of the skull are formed by mesenchymal ossification. The single frontal bone is formed by fusion of two halves of the frontal bone¹⁴. Ossification of each ½ of the frontal bone starts from the frontal tuber where the primary ossification centre appears at about 8th week of Intra uterine life. Thus there are two primary ossification centres. (one on each side of either frontal tuber). The ossification starts from this centre and spreads radially in all directions. It spreads superiorly, Inferiorly and posteriorly thus forming each 1/2 of the frontal bone separated from each other by the metopic suture extending

from the anterior angle of bregma to the Nasion. Sonography reveals the presence of metopic sutures between 17-32 weeks of gestation. In the second trimester there is a continuous, radial expansion of the frontal bone. This delineates the metopic suture. Some authors are of the view that the closure of metopic suture starts in the third trimester radiating from the glabella and extending upwards towards the anterior fontanelle.

Significance of Metopic Suture

The skull is made up a large number of sutures, some being large like the coronal, sagittal and lamdoid suture and some smaller suture like the metopic suture. The presence of these suture in the fetal skull along with the fontanelles help in the malleability and moulding of the fetal skull which enable the movement of the fetal head through the cervical canal and the vagina during process of normal delivery. The presence of the suture also helps to increase the breadth of the skull, due to the growth occuring at the metopic suture. The suture site is marked by the presence of dense connective tissue between the two ½ of the frontal bone which then replaced by bone, by the appearance of secondary ossification centre. The secondary ossification centre appears between ½ - 2 years, the time around which growth in breadth of the skull is almost complete. Premature fusion of the metopic suture and sutures of skull usually results in a narrow elongated skull, tower shaped

skull, scaphocephaly and dolichocephaly. These are the most common forms of craniosynostosis.

Genetics

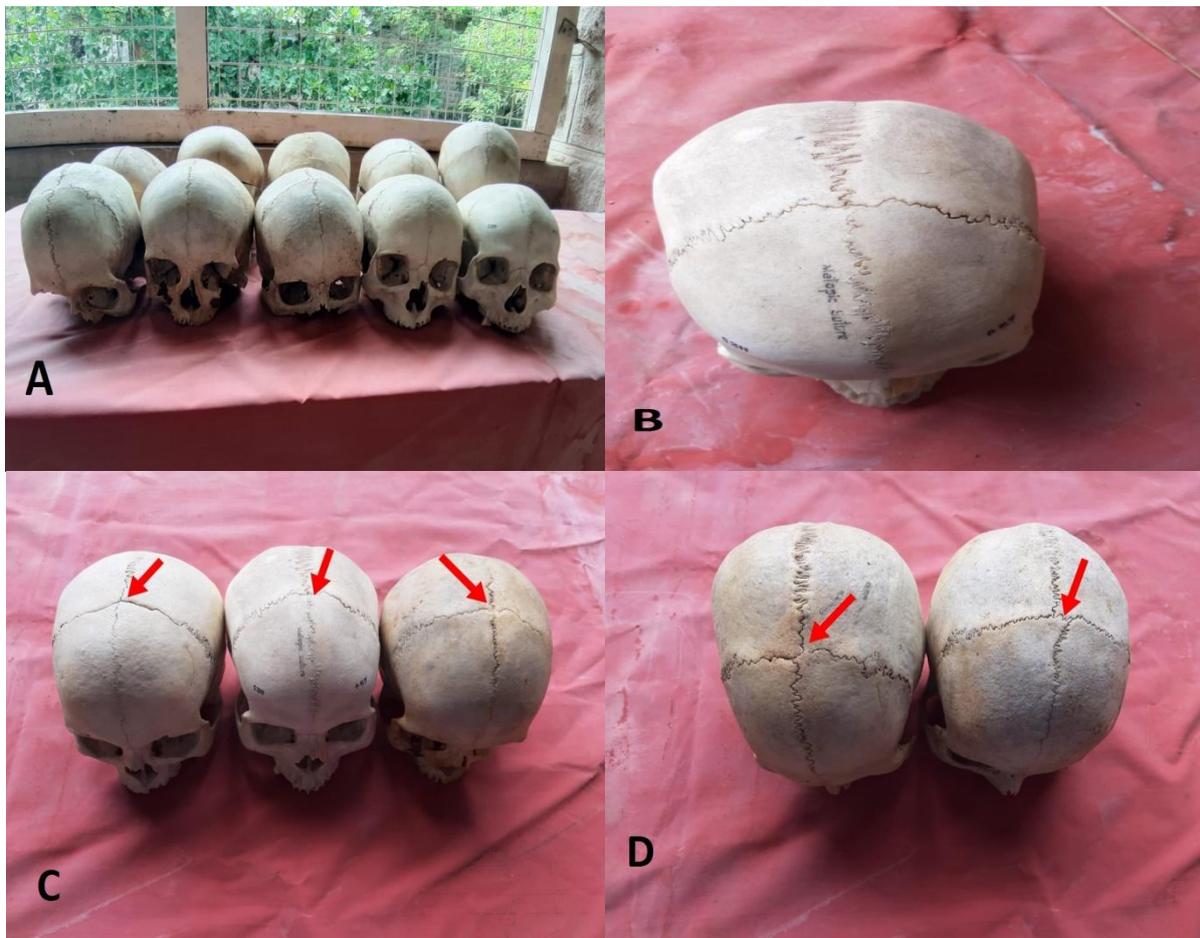
The obliteration of the calvarial suture is usually associated with decreased sutural cell apoptosis, increased proliferation of the osteoblast .It is induced by factors like transforming growth factor-beta2 (Tgf-B2)^{26,27}, bone morphogenetic protein 4 (BmP4)and fibroblast growth factor 2(Fgf2) transforming growth factor –beta(Tgf-B3) might be involved in the closure of metopic suture. Impaired closure of metopic suture is seen in Apert's syndrome²⁵.

Discussion

The presence of metopic suture is not always pathological.¹⁶ Normally it begins to ossify by 2years and the ossification in complete by 10 years. Various authors specify various times for completion of ossification. The condition is more common in males than females. It is more common in dolichocephalic type of skull than brachycephalic type of skull. Bryce⁶ however states the cephalic index plays no role in its incidence, and it has equal occurrence in both types of skulls.Castilho¹¹ states that it is more common in brachycephalic skulls. It was stated by Guerram¹³ that persistence of metopic suture was associated with aplasia/hypoplasia of frontal sinus .Bilgin³⁴ and Baaten²⁴ however contradict this view.

AUTHOR'S NAME	YEAR OF STUDY	NUMBER OF SKULLS EXAMINED	INCIDENCE	RACE	TIME OF CLOSURE
Bryce ⁶	1915		8.7%	European	
Bryce ⁶	1915		5.1%	Mongolian	
Bryce ⁶	1915		1.2%	Negro	
Bryce ⁶	1915		1%	Australian	
Bryce ⁶	1915		9.5%	Scottish	
Keith ²³			3-8%		
Jit and Shah ¹⁸	1948		5%	Indian-Punjab	
Woo ¹⁹	1945		10%	Mongolians	
Woo ¹⁹	1945		2%	Negroids	
Breathnach ⁹			7-10%	European	
Breathnach ⁹			4-5%	Yellow races	
Breathnach ⁹			1%	Africans	
G.J Romanes ²	1972		0.8%	Europeans	5-6 years

Das ¹²	1973		3.3%	Indians	
Agarwal ¹⁰			2.6%	Indians	
Ajmani ⁵			3.4%	Nigerians	
B.V.Muralimanju ⁷			1.2%	Indians	
Hussain Saheb ⁸			3.2%	Indians	
Chanwit Maneenin ²⁰			10.12%	North eastern Thailand	
Pankaj ¹⁷	2014	80	1.25%-23.75%	Indians	6-8 years
Castilho ¹¹	2006	71	7.04%	Brazilian	2months of
Berry and Berry ²⁹⁻³²	1975		0-7%	Nigerian	
Dutta ³					2 years
Ravikumar ⁴⁰	2016	115	5%	Indian	
Chandrasekaran ¹⁴	1985		3%	South Indians	
Fakhruddin S ³²	1967		7-10%	European	
Herker ³⁹	1981		1%	African	
Bilodi A K ²²	2003		11.46%	Nepal	
William F Masih ¹⁵	2013	200	6.5%	Indian	
Sunara Shresta ³⁶	2017		26.3%	Nepal	
Roghith Kannan ³⁵	2017		20%	Indian	
Seth Gardener ⁴²	2016	1	1%	USA	
Radha ⁴¹	2015	70	3%	Indian	
Sangeetha ³⁷	2018	70	5.71%	Indian	
Vikram ³³	2014	1	1%	Indian	
Anjoo Yadav ²¹	2010	1020	18.04%	Indian	
Akbar ³⁸	2015	100	2 skulls	Indian	



A) Total number of skulls showing Metopic suture. B) Metopic suture. C) Sutures meeting directly in the midline. D) Sutures not meeting in the midline.

Conclusion

The causes of metopism are varied. It could be due to growth interruption, heredity, sexual, hormonal influence, hydrocephalus, cranial malformation (Abnormal growth of cranial bones), Racial, Regional (increased incidence in rural than in urban areas),

Climatic factors (increased incidence in temperate region than tropical region).

A complete knowledge of metopism aids the radiologist, orthopedician, neurosurgeon and an forensic expert in their clinical diagnosis.

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