A roentgen-anatomic study of association between persistent inter-frontal Suture with varied presence of frontal sinus

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Abstract
Introduction: The suture that persist between frontal bones beyond 8 years of life is termed as “Metopism”. This metopic suture has been shown to exhibit ethnic variability in its incidence with an Asian incidence of up to 5.5%. Previous studies had morphologically classified metopism into complete and incomplete types. The presence of this inter-frontal suture is claimed to alter the development of frontal sinus from asymmetry to complete absence.

Methodology: Occurrence of metopic suture among 180 adult skulls was studied. The observed suture was further classified morphologically into complete and incomplete types. The skulls with either of the types were further studied radiologically for the presence and symmetry of the frontal sinus.

Result: Complete and incomplete metopism was observed in 3.88% and 46.66% of the skulls studied respectively. On radiological analysis, absence of frontal sinus was seen more with complete metopism while asymmetry of frontal sinus was noted mainly with incomplete type.

Conclusion: The presence of inter-frontal suture in adults with its associated variation in the development of frontal sinuses is of interest for anatomist and significant for radiologist, neurosurgeon and forensic pathologist while examining, operating and reporting of frontal fractures.

Keywords: Metopism, Frontal sinus, Inter frontal suture, Metopic suture

Introduction
The persistence of inter-frontal suture in adults is termed as “Metopism”.1-3 Previous studies claim widely varying time period, from end of one year to 8 years of age for normal disappearance of this inter-frontal suture.4-9 Metopism is also reported to exhibit ethnic variation in its incidence. The European ethnicity stand in the upper end of the spectrum with a range of 7-10%,6,10,11 while Africans and Australians form the lower range of 1% incidence.10 Whereas the Indians who belong to Asian ethnicity shows 4-5.5% incidence.12-25

The extent of persistence of inter-frontal suture forms the basis for classifying metopism into complete and incomplete types. The presence of continuous suture from Bregma to Nasion is termed complete, while its presence in either upper, middle or lower part alone is called incomplete metopism.13,16,17,20-22,24,25

Few earlier reports suggested an association between existence of complete and incomplete metopism to absence of frontal sinus, asymmetry of sutures, presence of extra bones or prominence of existing bones and asymmetry of frontal sinuses respectively.26-27

A radiological study verified that the frontal sinuses were quite bigger in males compared to females, and emphasized that the presence of metopic suture is associated with absence of the frontal sinuses.28 Meanwhile, another study with 27% incidence of persistent metopic suture stated that there exist no correlation between presence of metopism and frontal sinus asymmetry or absence.29 This contradicting reports necessitated this roentgen anatomical association study of metopism with frontal sinus in Indian ethnicity.

Methodology
Presence of metopic suture and classification of observed suture morphologically was done in 180 skulls from departments of Anatomy, across different medical colleges in Tamil Nadu. The skulls that exhibited complete and incomplete metopism were further studied by x-ray and Computerised tomography for the presence or absence of frontal sinus. If present, the symmetry of the sinus was additionally noted.

Results
Complete metopic suture was found in 7 Out of 180 (3.88%) Skulls studied (Fig. 1). While 84 out of 180 (46.66%) were observed to be of incomplete type (Fig. 2). On radiological analysis, total absence of frontal sinus was observed in 57.1% of complete (Fig. 3) and 7.1% of incomplete metopic skulls (Fig. 4). Asymmetry of frontal sinus was also noticed in 92.9% of incomplete metopic skulls with predominantly
smaller sinus on the right side and extensive sinus on left side (Fig. 5).

Fig. 1: Showing complete metopic suture (CMS)

Fig. 2: Showing incomplete Metopic suture (ICMS)

Fig. 3: X-Ray skull showing complete metopic suture (CMS) with bilateral absence of frontal air sinuses (*)

Fig. 4: Coronal CT of incomplete metopic skull showing bilateral absence of frontal sinuses

Fig. 5: Coronal CT of incomplete metopic skull showing asymmetrical frontal sinuses with small right sinus

Discussion

Anatomi Capitis Humani by Johannes Dryander in 1536 exhibited the first illustration of metopic suture.\textsuperscript{30} Since then, many illustrations and descriptions about this inter-frontal suture had been put forth with its classification and incidence among different ethnicities.\textsuperscript{1-25} Similarly, from the times of Galen (130-201AD) the query about the presence of sinuses and their exact function continues on till today with varied explanations.\textsuperscript{31}

The reported incidence of metopism was noticed to be higher in European’s in comparison to Australian and African populations, while the Asians occupy the mid-range.\textsuperscript{6,10-25} The present study also observed incidence of metopism equivalent to the literature reporting on Asian ethnicity. Differing views had been proposed as the probable etiology for this persistence. The causes may be either active resorption of chondroid tissue of suture, role of dura mater in keeping the suture patent, altered expression of active cranial suture fusion cytokines, increased osteoclastic resorption maintaining open suture.\textsuperscript{32-35}
The association between persistent inter-frontal suture and developmental variation in frontal sinus had been analysed and reported by few studies with contradicting claims,26,28,29,36 These studies had shown spectrum of findings ranging from total absence to presence of fully formed frontal sinuses in skulls with complete metopism. In cases with incomplete type also, previous literature exhibits varying reports of existence of well-formed frontal sinuses to marked asymmetrical sinuses.26,27 One study reported no correlation between existence of metopic suture and absence of frontal sinuses.29

In midst of this contradictions, the current study has observed absence of frontal sinuses in both morphological types. Where in, total absence of frontal sinuses was noticed to be proportionately more in complete metopism when compared to incomplete type. More over the present study also found incomplete type to be associated closely with asymmetrical frontal sinuses in majority of the incomplete skulls studied with a marked right side ill formed sinuses.

The reason for this association had been forwarded by a couple of studies by reviewing the development of the frontal region.37,39 Among them a study regarded metopism as a normal evolutionary progressive phenomenon rather than atavistic feature by rejecting theories of compensatory development, weakened extra cranial muscular pressure and endocrine pathology. Persistence of normally closing sutures form particular significance in descriptive and experimental studies rather than in clinical studies where they are mere insignificant rarities. Still the persistent inter frontal suture holds varied prominence in forensic, neurosurgical and radiological differentiation from vertical frontal fractures and during performing perionial or supraorbital craniotomy.40-43

This significant proportion of absence of frontal sinus in cases of metopism in Indian ethnicity observed in present study induced the authors to put forth a hypothesis of possible associated developmental defect of midline structures which needs further detailed elucidation in larger population. The author also opine that the impact of frontal sinus asymmetry as seen in incomplete type warrants detailed clinical study.

Conclusion

The incidence of 3.88% complete and 46.66% incomplete inter frontal suture with a strong association between absence and asymmetry of frontal sinuses respectively was noticed in this study. This frequent occurrence of metopism and its association with either absence or asymmetry of frontal sinuses in Indian ethnicity in this study serves as an alert to clinicians to the fact that this is not a simple anatomical anomaly but a significant differential diagnosis in frontal trauma and imaging.

References


