

# Complete metopism in adult craniological material

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## Abstract.

The material for the study was 60 male and 91 female skulls with known age and gender and belonging to the adult age period (21-60 years). The study used the cranioscopic method. Only cases with complete metopism, i.e., uninterrupted metopic suture between nasion and bregma points, were investigated. For analyzing the obtained arithmetic data, the Pearson Chi-Square Test and the Mann-Whitney U test were used. Statistical analysis was carried out using the program "IBM Statistics SPSS-26". In the 60 male skulls studied, the metopic suture was absent in 56 (93.3%) cases. Complete metopism was found on four (6.7%) of the male skulls. A study of 91 female skulls showed that 82 (90.1%) had no metopic suture. On nine adult female skulls, a metopic suture was found, which amounted to 9.9%. In all cases with complete metopism, the metopic suture was continuous and followed between the nasion and bregma points. The use of the Pearson Chi-Square Test and the Mann-Whitney U test showed that the difference in frequency between the male and female skulls was not statistically significant  $Px^2 = 0.490$ ;  $PU=0.491$ .

**Introduction.** Metopism is a partially or completely persistent suture running from the nasion to the anterior angle of the bregma [1, 2]. The study of such a phenomenon as the presence of a metopic (frontal) suture in adulthood covers a significant period. With the development of research techniques and, most importantly, the approach, more and more new prospects are opening up in the study of the permanent metopic suture. So, as early as the end of the XIX century, it was noted that the metopic suture normally begins to close already at the 9<sup>th</sup> month of postnatal life, and the closure ends approximately by the end of the second year. Thus, the persistence of the metopic suture is clearly an abnormal phenomenon. However, it is hardly possible to interpret the persistence of the suture in the sense of reversion because the suture is already obliterated in monkeys, insectivores, bats, and platypuses [3]. There is some uncertainty as to when normal fusion of the metopic suture occurs [4]. The time of physiological closure of the metopic suture varies from birth to 8 years. The generally accepted age of closure is approximately 2 years. The surgeon must be aware of this anatomical condition during primary and secondary observation of an injured patient and during surgical interventions, especially frontal craniotomies [1]. Almost a similar opinion is shared by [5]; according to them, an approximate range of physiological fusion has been found to be 3-19 months, and fusion patients in this range can be considered normal. The complete fusion of the sutures is expected in 19 months. Suture fusion before 3 months is abnormal and diagnostically indicative of metopic synostosis.

## Key words:

complete metopism, metopic suture, skull, nasion, bregma.

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Results of [6] indicate that normal or physiological closure of the metopic suture occurs much sooner than previously described. Metopic fusion can usually occur as early as 3 months of age, and complete fusion occurred by 9 months of age in all patients in our series. Thus, 3D CT showing complete closure of the metopic suture at an early age (3 to 9 months) cannot be considered evidence of metopic synostosis and therefore should not be a deciding factor for early surgical intervention.

The anthropological significance of metopism and the identification of a persistent metopic suture on the skull of a Taung child are described in the literature, as is the physiological significance of the metopic suture for the genus *Homo sapiens*. The timing of the closure of the metopic suture indicates some major morphogenetic changes in the frontal bone that occurred very early in the natural history of hominins. The anterior fontanelle and open metopic suture of newborns facilitate childbirth. The increase in the incidence of trigonocephaly appears to be parallel to the decrease in the prevalence of metopism. The increased use of caesarean sections may have eliminated a powerful selection factor in favor of postnatal metopic suture retention [7-9]. According to [10], the persistence of the metopic suture is not an isolated variation limited to the frontal bone. Moreover, a slight modification of the skull morphology is observed in these cases. It is a rather complex condition associated with a combination of certain phenotypic traits. In the metopic series, the shape change was mainly mediolateral widening and anteroposterior shortening, which contributed to a more rounded overall skull shape.

The distribution of the persistent metopic suture in various races and ethnic groups has been the subject of a large number of studies. Beginning with Welcker, who, according to Petri [3], first gave this question a scientific formulation, research of this kind continues to the present. [11] Welcker found on 497 skulls 70 with metopism (1:7.1). The study of [12] was conducted on 134 dry crania from adult Brazilians, of whom 95 were male and 39 were female. Metopic sutures were present in 4.48% (6/134) of the skulls examined, of which 50% (3/134) were male and 50% (3/134) were female. There was no predominance of metopism between the sexes. A study of 968 x-rays of the skull was conducted to determine the incidence of metopic sutures in the Lebanese population [13]. Complete and incomplete metopism were present in 0.82% and 0.93% of cases, respectively, resulting in an overall incidence of 1.75%. In both categories, the incidence was relatively higher in men (1.84%) than in women (1.62%). According to the results of the study, individuals living in rural areas had a higher frequency

of complete and incomplete metopism compared with those living in urban areas, with a ratio of 4:1 and 4:2, respectively.

The prevalence of persistent metopic sutures in the Australian population is 4.8% and is evenly distributed between the sexes. The assessment of the metopic suture was performed in patients aged 24 to 252 months [14].

Knowledge of the morphology of the metopic suture is important for radiologists and neurosurgeons in their daily practice. When reading radiographs, CT, and MRI, the possibility of a metopic suture should be kept in mind. This will prevent confusion and misdiagnosis in emergency situations [15]. Thus, metopism has been studied in these investigations from many angles and thoroughly. At the same time, many aspects still need to be investigated, in particular the frequency of detection of a persistent metopic suture at the gender level and the special emphasis on complete metopism. We believe that the clinical significance of such studies is very high because they provide the theoretical material that is needed in neurosurgical practice and help to avoid surgical errors. Based on the foregoing, we have undertaken a study to study the complete metopism in the craniological material of the Museum of the Department of Human Anatomy and Medical Terminology of the Azerbaijan Medical University.

**Materials and research methods.** The material for the study was 60 male and 91 female skulls with known age and gender and belonging to the adult age period (21-60 years). These skulls are stored in the craniological collection of the Museum of the Department of Human Anatomy and Medical Terminology of Azerbaijan Medical University. The study used the cranioscopic method. Only cases with complete metopism, i.e., uninterrupted metopic suture between nasion and bregma points, were investigated. For analyzing the obtained arithmetic data, the Pearson Chi-Square Test and the Mann-Whitney U test were used. Statistical analysis was carried out using the program "IBM Statistics SPSS-26".

**Results.** In the 60 male skulls studied, the metopic suture was absent in 56 (93.3%) cases. Complete metopism was found on four (6.7%) of the male skulls. A study of 91 female skulls showed that 82 (90.1%) had no metopic suture. On nine adult female skulls, a metopic suture was found, which amounted to 9.9%. In all cases with complete metopism, the metopic suture was continuous and followed between the nasion and bregma points (fig. 1). The use of the Pearson Chi-Square Test and the Mann-Whitney U test showed that the difference in frequency between the male and female skulls was not statistically significant  $Px^2 = 0.490$ ;  $PU=0.491$ .

Figure 1. Skulls with complete metopism. Female (A-D) and male (E) skulls.



**Discussion.** The metopic suture lies along the midline of the forehead and runs from the frontal bone to the root of the nose. One hundred and sixty skulls of inhabitants of Western Anatolia of unknown age and gender were examined in the study [2]. Complete (metopism) and incomplete metopic sutures were found in 7.50% and 67.50% of the skulls, respectively. In our study, the frequency of detection of complete metopism on male and female skulls was 16.6% in total, which exceeds the data obtained in this study.

As noted, the academic study of metopism spans over a hundred years. More than a century later, clinicians face the more practical problem of metopic craniosynostosis, which ranks second in frequency [16-18].

According to [19], in addition to being confused with a frontal bone fracture, a persistent metopic suture may be associated with other clinically significant anatomical changes, including frontal sinus anomalies. [20] S.Bilgin et al, showed that no significant results were detected due to the frontal sinus agenesis or dimorphism associated with persistent metopic sutures. It was concluded that these findings were all incidental. According to [21], of the 245 dry skulls, 17 had metopism. The length of the metopic suture of the skulls, taking into account the distances between the craniometric landmarks of the nasion and bregma, ranged from 114 to 137 mm. Only one skull (6.25%) had no frontal sinus. In addition to agenesis, the present study also identified four (12.5%) skulls with aplasia and eight (25.0%) with frontal sinus hyperplasia in metopism-dry skulls. The study revealed

a low prevalence of frontal sinus agenesis in dry skulls with metopism.

In [13], it was indicated that metopism is more common on male skulls than on female ones (1.84% versus 1.62%). This is inconsistent with our data; according to our study, the incidence of persistent metopic sutures on female skulls was higher, although this difference was not statistically significant.

Metopism in the South Indian population was studied in the investigation [22]. Out of 70 dry adult cadaveric skulls, 4 (5.71%) showed complete metopism. In the study of S.Eroğlu [23], the change in the frequency of metopism over different historical periods is examined on the skulls of 487 adults from 12 different ancient Anatolian populations dating from different periods of history, from the Neolithic to the first quarter of the 20th century. No significant relationship was found between metopism and skull shape or gender. The absence of a statistical difference between the sexes is consistent with our data. It has been established that the frequency of metopism in Ancient Anatolia had a distribution range of 3.3-14.9%.

**Conclusion.** According to the results of our study, complete metopism was found in 13 of the 151 skulls studied. The number of female skulls with complete metopism was higher, although this difference was not statistically significant. In our opinion, against the background of the growing interest in the metopic suture, the study of the metopic suture in racial and ethnic sources, the timing of its closure, and isolated and combined pathological conditions associated with an acceleration in the rate of its obliteration, our study will be useful for further work in this area.

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