

# Metopism in Adult Skulls from Southern Brazil

## Metopismo en Cráneos del Sur de Brasil

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**SUMMARY:** The metopic suture is found between the frontal bone tubers, there being divergences concerning the precise time of its closure, varying from the first to tenth year of life, and it can persist until adult age (metopism).

A study was conducted in 71 dry skulls of adult Brazilian subjects of both sexes (43 males and 28 females), with ages ranging from twenty five to eighty years from the bone collection of the Laboratory of Human Anatomy of the Paranaense University – UNIPAR, Brazil.

It was observed the occurrence of metopism in 7.04% (05/71) of the studied skulls, of which 80% (4/5) were female and only 20% (1/5) male. The incomplete metopic suture was found in 32.39% (23/71), with higher frequency in female skulls, 60.86% (14/23), when compared to the male ones, that reached 31.13% (9/23). Sutures showed variations of morphology, the linear type being the most frequent, with 69.56% (16/23). Different incidences of metopic suture were found in the different anthropometric types of skulls. Incomplete metopic sutures were predominant in the brachyranics, while complete metopic sutures had the same incidence in mesocranics, 40% (2/5) and dolichocranics, 40% (2/5).

**KEY WORDS:** Human Anatomy; Metopic suture; Metopism.

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## INTRODUCTION

The metopic suture is found between the tubers of the frontal bone, and undergoes intramembranous ossification from two primary centers, one from each half, that appear by the end of the second month of fetal life (Gray, 1988) and fuse first at the inner face of the skull (Moore, 1994), with the closure provided by chondroid tissue (Manzanares *et al.*, 1988). Divergences are observed in the scientific literature concerning the exact period of the closure, with fusions being reported between the first and the early second year of life (Keith, 1948), generally before the second year of life (Chopra, 1957 *apud* Manzanares *et al.*), between the fifth and sixth year (Romanes, 1972 *apud* Ajmani *et al.*, 1983), between the sixth and eighth year (Ajmani *et al.*) and between the sixth and the tenth year of age (Jit & Shah, 1948 *apud* del Sol *et al.*, 1989).

The period of maintenance of sutures in general has been suggested as a pre-condition for the continuous growth of the bones (Watzek *et al.*, 1982) and as an indirect factor

for the normal growth of the skull (Hinton *et al.*, 1984 *apud* Manzanares *et al.*), because of that the early closure of the metopic suture results in cranial morbid deformities known as scaphocephaly (Plese *et al.*, 1990; Moore). It is observed, however, that in some instances this suture persists until an advanced age, after the disappearance of other sutures (Piersol, 1916 *apud* Agarwal *et al.*, 1979), this being named metopism (Madeira, 1995). Metopism is more often present in races where longilineal individuals predominate; on the other hand, it had no defined relation with brachicephaly (Bryce, 1917). The closure of the other sutures of the skull begin between 26 and 30 years of age, with subsidiary periods of activity by the age of 50 and being completely closed at the end of the seventh decade of age (Todd & Lyon, 1924 *apud* Manzanares *et al.*).

The knowledge of the anatomy of the metopic suture is important because its permanence can be mistaken for a cranial fracture in radiological images (del Sol *et al.*), or

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even for the sagittal suture (Ajmani *et al.*). It is also important for paleodemography and forensic medicine (Hauser *et al.*, 1991).

According to the studies of del Sol *et al.*, metopism can be related to varied causes, such as: abnormal growth of the cranial bones, pathologic metopism triggered by hydrocephalus, growth interruption, heredospecific factors, sexual influence, heredity, atavism (emergence of a feature supposedly present in a remote ancestral, as a function of random recombination of genes or environmental conditions favorable to its expression in the embryo), 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 currently the factor most accepted by the scientific community.

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 (Comas *et al. apud del Sol et al.*), while the smallest was described in Australian and Scottish skulls (1.0%), (Bryce *et al.*, 1915 *apud del Sol et al.*). In Brazil, according to del Sol *et al.*, the incidence of metopism is close to the minimum world index, 2.75%. Reports were not found concerning the incidence of metopism in different regions of Brazil. These data would be important in view of the large territorial dimensions of Brazil and the different populational structures present. Its colonization from different nations led to the formation of a population with unique physical features and it is believed that complementary studies are necessary to demonstrate the morphologic features of the bones of Brazilians from different regions, enlarging the literature devoted to the anatomy of our people.

The purpose of this work was to contribute to the scientific literature, providing anatomical data on the persistence and variations of the metopic suture in the adult population of Southern Brazil and its relations with the gender and the anthropometric types of skull.

## MATERIAL AND METHOD

Seventy-one dry skulls from adult individuals of both sexes, being 43 male and 28 female according to the criteria of sexual dimorphism (Gray), and age range from 25 and 80 years, were studied. The skulls were from the bone collection of the Laboratory of Human Anatomy of the Paranaense University – UNIPAR. None of them showed visible abnormalities or signs of disease.

The analysis and description of the sutures were made by macroscopic observation of the skulls. Then, these skulls were divided into three initial groups for each sex: those having a complete metopic suture (Fig. 1); those with incomplete suture and those without apparent signs of the suture. The metopic sutures were considered complete when they extended from the nasion to the bregma uninterruptedly (Fig. 1) and incomplete when extending from the nasion to varied points of the frontal bone anterior to the bregma (Agarwal *et al.*; Ajmani *et al.*) (Fig. 2). The complete and incomplete sutures had their length measured with a millimetered tapeline. The shape of the complete sutures was observed and described. It was also verified the anterior and posterior ends of the suture and the existence of continuity with the internasal and sagittal sutures.

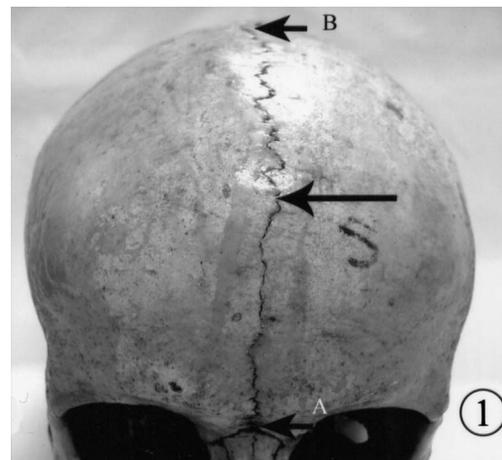


Fig. 1. Arrow indicating a complete metopic suture. The metopic suture extends from the nasion (A) to the bregma (B).



Fig. 2. Linear type of incomplete metopic suture (arrow).

The incomplete sutures of both sexes were classified according to their morphology as: linear, those single and shallower sutures; V-shaped, those bifurcated; and double, those being independent from their origin. This classification was based on the descriptions of Agarwal *et al.* and Ajmani *et al.*

The skulls were classified according to their anthropometric characteristics using the criteria of cranial indices put forward by Gray. The male and female skulls were further divided into brachicranic, mesocranic and dolichocranic and the previous classifications were correlated with these anthropometric types.

All the measures were obtained by the same investigator and represent the simple arithmetic means of three repetitions for each parameter analyzed. The data obtained were tabulated and analyzed through descriptive statistics.

## RESULTS

The incidence of metopism (Fig. 1) was observed in 7% (5/71) of the skulls studied, being 80% (4/5) female and 20% (1/5) male. On the other hand, the incomplete metopic suture was found in 32.4% of the skulls (23/71), being more frequent in females (64.28%, 14/23) than in males (39.1%, 9/23). In 60.6% (43/71) of the skulls studied vestiges of the metopic suture were not found.

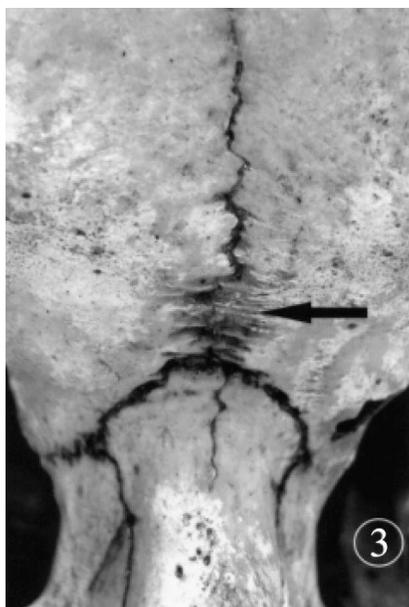


Fig. 3. Interdigitations of fine bridges above the nasion (arrow).

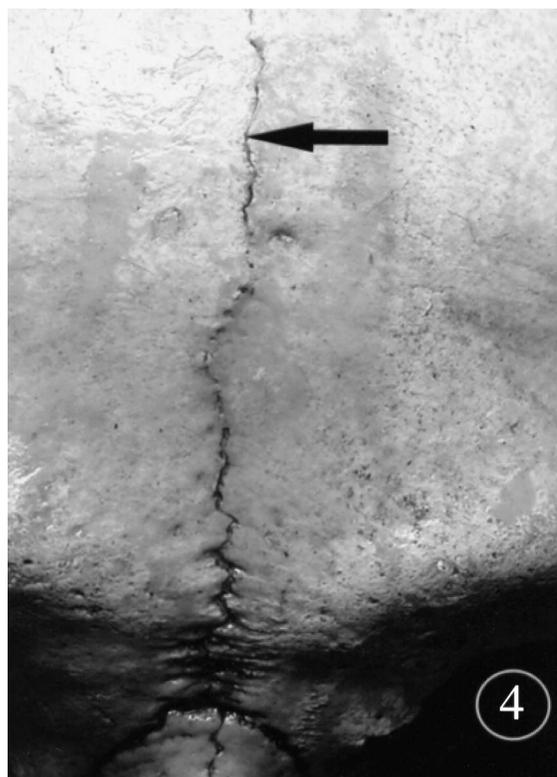


Fig. 4. Rectilinear region of the complete metopic suture near the ophrion (arrow).

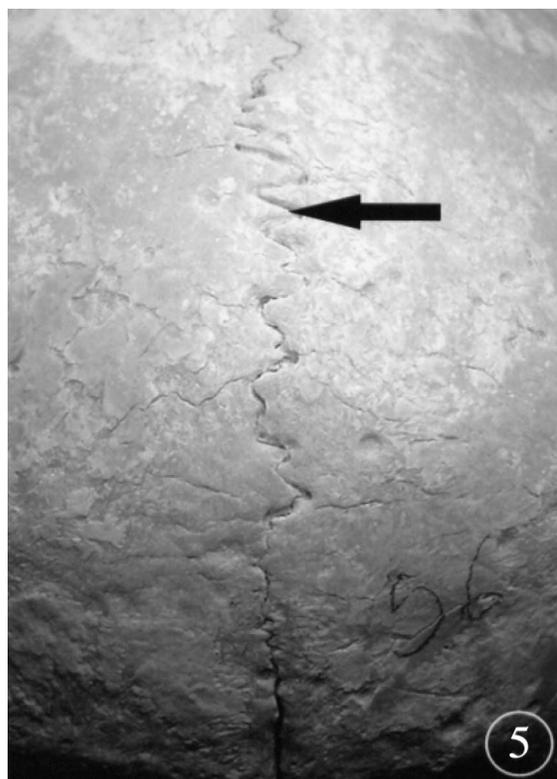


Fig. 5. Metopic suture showing “zig-zag” shape near the ophrion (arrow).

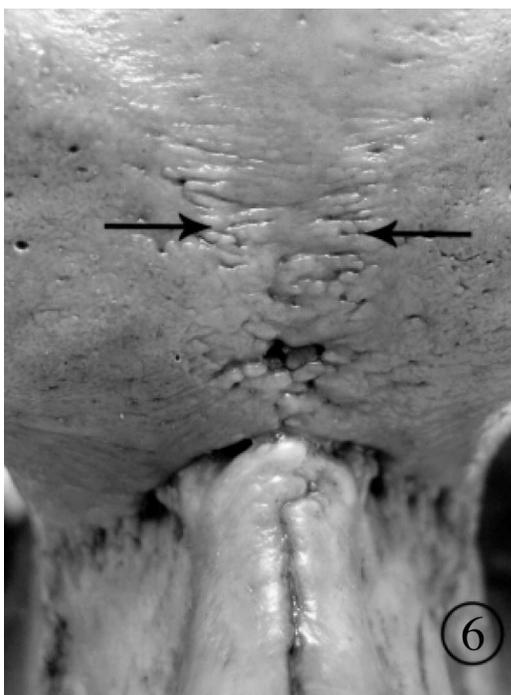


Fig. 6. V-shaped incomplete metopic suture (arrows).

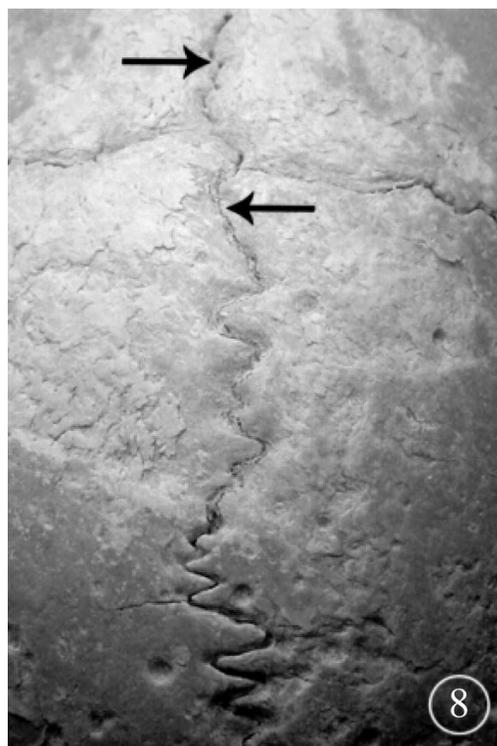


Fig. 8. Arrows showing the distance between the metopic and sagittal sutures.

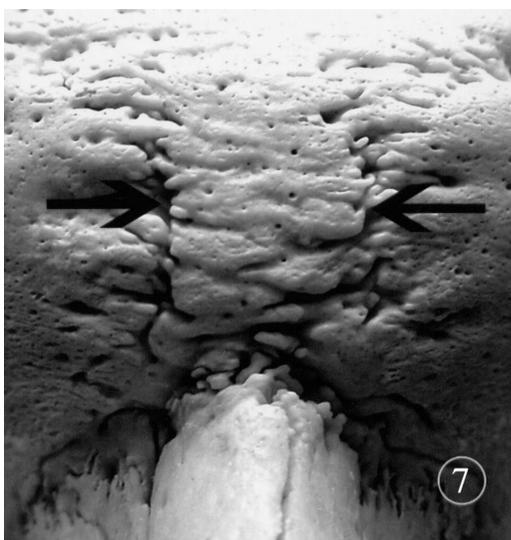


Fig. 7. Double-type incomplete metopic suture (arrows).

The mean length of the complete metopic suture was 12.92 cm. On its portion immediately superior to the nasion it was linear and interdigitated by fine and simple “zig-zag”-type bridges with width ranging from four to five mm (Fig. 3). Anteriorly and posteriorly to the ophryon (meeting point between the facial median line and a transverse line through the narrower portion of the forehead) the suture was rectilinear (Fig. 4), with a zig-zag appearance increasing towards the bregma in a typical serrated suture (Fig. 5); in its final portion

it again becomes rectilinear in a more simple and direct manner. At the anterior end of the complete metopic suture there was not a continuity with the internasal suture in any of the cases. As for the posterior end, only one skull showed continuity with the sagittal suture.

The incomplete metopic sutures demonstrated shape variations (Table I). The most common shape was linear (Fig. 2) followed by the V-shape (Fig. 6). It was also found a type of incomplete metopic suture of double shape (Fig. 7) that was not found in the literature and that differed from the V-shaped because it had a double course all along its extension.

When the incidence of the different shapes of sutures was analyzed according to the anthropometric type of skull, it was verified that the incomplete sutures, in general, were found

| Skull  | Male       | Female      | Total       |
|--------|------------|-------------|-------------|
| Linear | 5 (55,55%) | 11 (78,58%) | 16 (69,57%) |
| "V"    | 2 (22,22%) | 2 (14,28%)  | 4 (17,39%)  |
| Double | 2 (22,22%) | 1 (7,14%)   | 3 (13,04%)  |
| Total  | 9 (100.0%) | 14 (100%)   | 23 (100%)   |

Table I. Shape and incidence of the incomplete metopic suture in skulls from Southern Brazil according to sexual dimorphism.

in larger numbers in brachicranics, while the double sutures were present only in the mesocranics (Table II). When the incidence of complete metopic suture was analyzed according

to the anthropometric types it was observed that the mesocranic and dolichocranic represented the greatest incidence (40%, 2/5), followed by the brachicranic (20%, 1/5).

Table II. Incidence of the shapes of incomplete metopic sutures and the cranial index of skulls from Southern Brazil.

|                 | Linear     | "V"      | Double   | Total      |
|-----------------|------------|----------|----------|------------|
| Brachycephalic  | 10 (62,5%) | 2 (50%)  | –        | 12 (52,2%) |
| Mesocephalic    | 5 (31,25%) | 1 (25%)  | 3 (100%) | 9 (39,1%)  |
| Dolichocephalic | 1 (6,25%)  | 1 (25%)  | –        | 2 (8,7%)   |
| Total           | 16 (100%)  | 4 (100%) | 3 (100%) | 23 (100%)  |

## DISCUSSION

The cranial sutures influence the growth of the whole skull and despite having been studied for decades there is no consensus about the correlation between cranial development and suture closure.

Baaten *et al.* (2003) showed that it is more likely to detect metopism directly on the organic piece, specially incomplete metopism when it is rudimentary and near the nasion, than in studies through radiographs, because X-ray studies can mistake the metopic suture for vertical fractures close to the central line, as well as the incomplete sutures can go unnoticed.

As for the complete suture this study detected five instances of complete metopism, 7.4% (female 14.28% and male 2.32%). In a study carried out by del Sol *et al.* in 400 skulls of Brazilians, the incidence of metopism found was of 2.75% (female 2.96% 4/135 and male 2.64% 7/265). In the present study it can be noticed that the incidences of sex-independent metopism obtained were greater than those of del Sol *et al.* Even greater differences were observed when the sexes were analyzed separately, because the metopic suture was found in 14.28% of the female skulls analyzed (4/28) while del Sol *et al.* found 2.96%. For the male sex, only one metopic suture was found (2.32% 1/43) in opposition to the 2.64% observed by del Sol *et al.* Considering that both studies were made with Brazilian skulls it is believed that these data can be explained by two factors: first, the reduced size of the sample used here as compared to that of del Sol *et al.* and second, there is a difference between the geographic regions of Brazil. In their study, del Sol *et al.* obtained the skulls from the bone collection of the Paulista School of Medicine of the São Paulo University, Southeast of Brazil, and in the present work the skulls studied are from Southern Brazil. The Southeast region has a very miscellaneous population, characterized by internal migrations of Northeast Brazilians. The Southern region was colonized by Europeans (Camargo, 1998; Fausto, 2002), then Caucasians when longilineal types predominate. This hypothesis is reinforced by Bryce, who states that metopism is more frequent in populations of greater height.

The numbers obtained in this study were similar to those of Breathnach (1958) *apud* Baaten *et al.* with incidence of 7% in European skulls and those described by Czarnetzki (1972) *apud* del Sol *et al.*, who found metopism in 11.2% of German female skulls. On the other hand, the smaller incidences were among blacks (Bryce, 1915 *apud* del Sol *et al.*), Nigerians (Ajmani *et al.*), and fell to 1.0% in Africans. (Breathnach, 1958 *apud* Baaten *et al.*).

Data greater than those of this work were obtained by other investigators, such as Ashley-Montagu (1937) *apud* del Sol *et al.* in Bolivians (20.24%); Arensburg *et al.* (1977) in Bedouins (23%); Comas *et al.* (1942) *apud* del Sol *et al.* in Alpine skulls (63.2%) and in Genoese skulls (41.6%).

As for the shape of the complete sutures, our results were similar to those of Agarwal *et al.* and Ajmani *et al.* The length of these sutures was greater than that described by del Sol *et al.*

For the incomplete sutures, the most common shape was linear, with 69.57% (16/23), close to the observed by del Sol *et al.* in Brazilian skulls, with 64.35% (74/400), but differed from those in other races; for instance, Ajmani *et al.* studied skulls from Nigerians and observed linear sutures in 24.27% (50/206) and the Hindu skulls studied by Agarwal *et al.* the incidence of this type of suture was of 23.12% (295/1276). The observation of the V shape was superior to those described in the literature, which in Hindus was 3.25% (Agarwal *et al.*), and in Nigerian skulls was of 0.49% (Ajmani *et al.*). As for the Brazilian skulls del Sol *et al.* when referring to the V shape, grouped it with other less common shapes of incomplete metopic sutures, obtaining a total of 6.95%, so that a direct comparison with the present data was precluded.

Other shapes of incomplete metopic sutures were mentioned by Agarwal *et al.*; Ajmani *et al.* and del Sol *et al.*, such as "n" type, "H" type and "U" type; these shapes were not found in this study.

Bryce, studying the incidence of metopism, stated that there is no definite relation with brachicranic, in disagreement with the data of this study, because a high index (52.71%) of brachicranics was obtained among the skulls with incomplete metopism and a small percentage of 20% (1/5) had complete metopism. In the literature there is no correlation with the anthropometric type of skull.

Agarwal *et al.* reported that the anterior and posterior ends of the complete metopic sutures did not meet the sagittal and internasal sutures (Fig. 8). This was confirmed in this work but in one out of five skulls studied, where the metopic suture directly contacted the sagittal suture.

In this work it is noted that wider studies are needed concerning the sub-populations of Brazil, enlarging the clinical fundamentals which in some areas is based on data of foreign populations. Deeper investigations will clarify the populational and regional differences within a country.

According to the international standards reported in the scientific literature it is concluded that the index of metopism found is within the global patterns and above those described for another Brazilian region. Obtaining more conclusive results demands the amplification of the number of skulls evaluated, as well as carrying out comparative studies between the different regions of Brazil.

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**RESUMEN:** La sutura metópica se encuentra entre las tuberosidades del hueso frontal, existiendo variaciones en relación a la fecha exacta de su cierre, ocurriendo entre el primero y el décimo año de vida, pudiendo persistir hasta la vida adulta (metopismo).

Se realizó un estudio en 71 cráneos secos, de individuos adultos, brasileños, de ambos sexos (43 masculinos y 28 femeninos), con edades variando entre 25-80 años de edad, pertenecientes a los osarios del Laboratorio de Anatomía Humana de la Universidad Paranaense - UNIPAR, Brasil.

La presencia de metopismo fue observada en el 7,04% (05/71) de los cráneos estudiados, siendo 80% (4/5) femeninos y sólo 20% (1/5) masculinos. La sutura metópica incompleta fue encontrada en el 32,39% de los casos (23/71), siendo más frecuente en el sexo femenino, 60,86% (14/23) que en el sexo masculino 39,13% de los casos (9/23). Las suturas metópicas presentaron variaciones en su morfología, siendo la forma más frecuente la del tipo linear, 69,56% (16/23). Fueron observadas distintas suturas metópicas en los diversos tipos antropométricos de cráneo. Las suturas incompletas predominaron en los braquicráneos y las suturas metópicas completas tuvieron la misma incidencia en los mesocráneos de 40% (2/5) y doliocráneos de 40% (2/5).

**PALABRAS CLAVE:** Anatomía Humana; Metopismo; Sutura metópica.

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