

# Metopism in Dried Human Skulls from Northeastern Brazil and Review of the Literature

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## ABSTRACT

**Introduction:** the metopic suture separates the frontal bone into two halves in the sagittal plane throughout fetal life and infancy. This suture can close or persist throughout life, partially or completely. Traces left at both the lower and upper ends of the frontal bone characterize an incomplete metopic suture. Metopism, also called complete metopic suture, extends from the nasion to the anterior angle of bregma.

**Objective:** to determine the occurrence of metopism and incomplete metopic suture in dry skulls in a region of northeastern Brazil.

**Materials and Methods:** 291 dry skulls from the ossuary of the Human Anatomy Laboratory of the Tiradentes University and the Metropolitan Union of Education and Culture were analyzed macroscopically.

**Results:** the metopic suture was present in 85.6% (249) of the skulls. Metopism was observed in 4.12% (12/291) of cases. Most metopic sutures were incomplete at 81.44% (237/291). Of these, 22% (64/291) were linear; 24.05% (70/291) 'V' shaped; 26.80% (78/291) in 'U' shape; 2.75% (8/291) in 'H' shape; 3.43% (10 /291) in an inverted 'V' shape; 1.71% (5/291) in 'Y' shape; 0.34% (1/291) in 'W' shape and 0.34% (1/291) in 'M' shape.

**Conclusion:** the incidence of metopism was 4.12%, with a higher prevalence of incomplete sutures in a U, V and linear shapes.

**Keywords:** Metopism; Metopic suture; Skull; Frontal bone; Metopic synostosis.

## Introduction

The metopic suture separates the frontal bone into two halves in the sagittal plane throughout fetal life and childhood.<sup>1-3</sup> This suture appears approximately at the end of the second month of pregnancy and its closure occurs during adulthood<sup>4-6</sup>. Maintenance of the suture in the first year of life is an important prerequisite for continued bone growth and normal skull growth, as early closure of the metopic suture results in a cranial deformity known as scaphocephaly<sup>7,8</sup>. For Manzanares, Goret-Nicaise, Dhem,<sup>1</sup> the metopic suture may disappear at the end of the first year of life, or beginning of the second year, or begin to unite in this period<sup>9</sup> and obliterate completely in subsequent years<sup>2,10,11</sup> until the child is ten years old<sup>12</sup>. However, traces can be left at both the lower and upper ends of the frontal bone,

characterizing an incomplete metopic suture<sup>3,9</sup>. In some cases, it persisted completely for life, extending from the nasion to the anterior angle of bregma, which is called a complete metopic suture or metopism<sup>2,6</sup>.

The persistence of the metopic suture has definite characteristics, that is, the margins of the two bones are finely serrated from the nasion to a point about two centimeters anterior to the coronal suture, where it becomes simpler and more direct<sup>9,13</sup>.

Metopism can be caused by several factors, such as: abnormal growth of the cranial bones, hydrocephalus, growth retardation, sexual influence, heredity, atavism (reappearance of a certain characteristic in the organism after several generations of absence), plagiocephaly (asymmetric distortion of the skull that results from premature unilateral fusion of the coronal

or lambdoid sutures), scaphocephaly (characterized by a long, narrow head that results from premature fusion of the sagittal suture), mechanical causes, and hormonal dysfunction<sup>12,13</sup>. Despite these factors, genetic influence has been considered as the most accepted by the scientific community<sup>12-14</sup>.

Incomplete metopic suture can be classified as: linear, when it appears in a single, shallow and located in the lower part of the frontal bone; in U shape, when it is formed by a double course of parallel linear sutures, originating from the fronto-nasal suture and resembling a “U” in the inferior part of the frontal bone; in V shape, when it is bifurcated and takes the form of a “V” whose apex is found in the lowest part of the frontal bone, but not necessarily in the nasion<sup>9,15</sup>. Castilho, Oda, Sant’ana<sup>13</sup>, reported that incomplete metopic sutures in skulls from southern Brazil are linear in 69.57%, V-shaped in 17.39%, and U-shaped in 13.04%. Agarwal, Malhotra, Tewari<sup>15</sup>, Ajmani, Mittal, Jain,<sup>9</sup> and del Sol *et al.*,<sup>12</sup> reported other forms of incomplete metopic suture such as the “Y” and “H” type, with an incidence of 1.96% and 3.88%, respectively.

In general, the incidence of metopism can vary from 1% to 12%, and it is slightly more prevalent among men<sup>16,17</sup>.

Knowledge of the metopic suture is of immense importance, as metopism or remnants of the metopic suture, in radiological images, can be confused with a fracture of the frontal bone or even with a sagittal suture<sup>9,12</sup>. It can also provide new information for other professionals, such as forensic experts and anthropologists<sup>12</sup>.

Despite this, there are still few reports about the incidence of metopism in different regions of Brazil. According to del Sol *et al.*,<sup>12</sup> the incidence of metopism in Brazil would be approximately 2.75%. In southern Brazil, metopism was observed in 7% of the skulls, in which 80% were female and 20% male<sup>13</sup>. In Maceió, according to da Silva *et al.*,<sup>17</sup> the occurrence of metopism was 4.48%. These data are relevant considering the territorial dimension of Brazil and the existing population diversity. The Brazilian population, due to its formation, has unique physical characteristics, so we believe that studies are needed to contribute to the knowledge about metopism.

The aim of the present study was to seek to determine the occurrence of metopism and incomplete metopic suture in dry skulls in a region of northeastern Brazil.

## Materials and Methods

291 dry skulls available in the ossuary of the Human Anatomy Laboratories of the Federal University of Sergipe and Tiradentes University were macroscopically analyzed. The skulls were obtained in accordance with Law 8501 of November 30, 1992, which provides for the use of unclaimed corpses for the purposes of scientific studies or research and other provisions. Those skulls

in which there were morphological alterations or some type of bone disease, macroscopically visible, were excluded.

Of the 291 skulls, 162 were male, 104 female and 25 had no gender identification. The age range ranged from 11 to 95 years old and the average was 56 years old.

Sutures that were unique in shape and extended from the nasion to bregma were considered metopism, and those that did not extend along this entire path were considered incomplete metopism and were classified according to their morphology. All sutures had their length measured using a digital caliper with a precision of 0.01 mm.

## Results

The metopic suture was found in 85.56% (249/291) of the skulls. Of these, 82 were female, 150 male and 17 had no gender identification. The length of the sutures ranged from 5 to 140 mm, with an average of 17 mm. And in 14.44% (42/291) skulls no traces of the metopic suture were found.

Metopism was observed in 4.12% (12/291) of the skulls (Figure 1), with the same prevalence in both sexes. The age range in these cases varied from 28 to 80 years, with an average of 54 years; and the length of the sutures ranged from 110 to 140 mm, with an average of 126 mm.

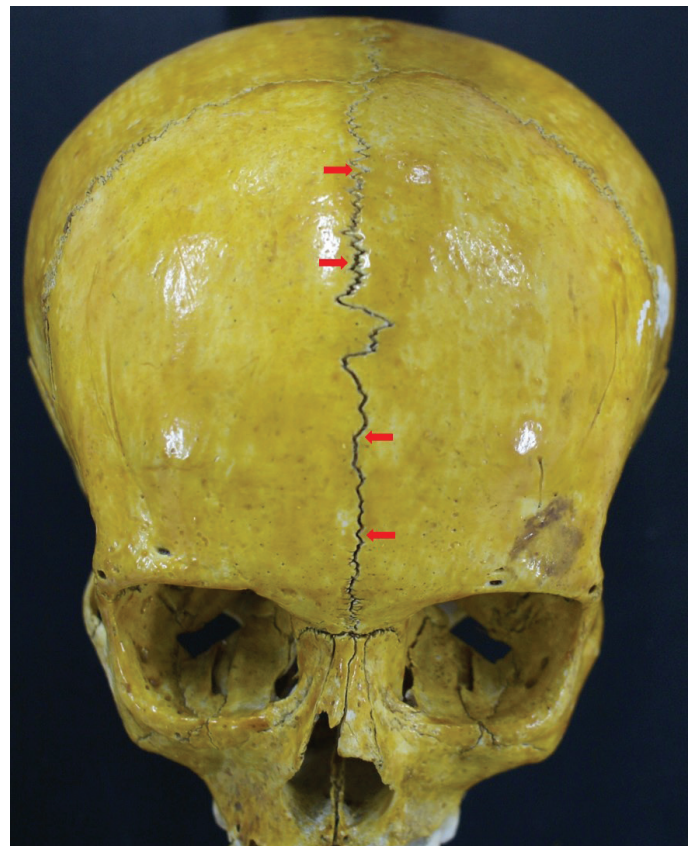


Figure 1. Metopism.



Metopic sutures were incomplete in 81.44% of cases (237/291) (Figure 2). Of these, their shapes were distributed as follows: 'U' shaped, 26.80% (78/291); 'V' shaped 24.05% (70/291); linear, 22% (64/291); 'inverted V' shaped 3.43% (10/291); 'H' shaped 2.75%, (8/291); 'Y' shaped 1.72% (5/291); 'W' shaped 0.35% (1/291) and 0.35% (1/291), 'M' shaped.

## Discussion

The incidence of metopism, in the general population, would occur according to ethnicity and its population, and has been reported with a prevalence ranging from 1 to 15.38% (Table 1). In the present study, the occurrence of metopism was 4.12% of the cases, a finding similar to that reported among Punjabi Indians<sup>10</sup>, Mumbai<sup>25</sup>, Uttar Pradesh<sup>36</sup> and in the northeast of Brazil<sup>17</sup>. It was smaller compared to skulls from Scots<sup>18</sup>, Mongoloids<sup>19</sup>, Bulgarians<sup>23</sup>, Chinese<sup>35</sup>, Asians<sup>30</sup>, southern Brazil<sup>13</sup>, and larger, when compared to skulls of Indians from Uttar Pradesh<sup>20</sup>, Kanpur<sup>15</sup>, Mangalore<sup>22</sup>, Assam<sup>26</sup>, Tamil Nadu<sup>31</sup>, Marathwada<sup>32</sup>, in populations of Nepalese and Koreans<sup>33</sup>, Egyptians, Bengalis<sup>30</sup>, Lebanese<sup>21</sup>, Nigerians<sup>9</sup>, Australians<sup>18</sup> and southeastern Brazil<sup>12</sup>.

In Brazil, del Sol *et al.*<sup>12</sup>, studying 400 skulls from Southeast Brazil; Castilho, Oda, Sant'Ana<sup>13</sup>, 71 skulls from Southern Brazil and da Silva *et al.*<sup>17</sup>, 134 skulls in the State of Alagoas, found an occurrence of metopism of

2.75%, 7% and 4.48 %, respectively. In the present study, it can be noticed that the occurrence of metopism was higher than that found by del Sol *et al.*<sup>12</sup>, lower than the results of Castilho, Oda, Sant'Ana<sup>13</sup>, and similar to that found by da Silva *et al.*<sup>17</sup>. These differences in our country could be explained by the number of samples used and the different geographic regions of Brazil. Through these factors, we realize that the larger the sample, the lower the occurrence of metopism. Furthermore, the Southeast region has a very varied population, characterized by internal migrations; the southern region was colonized by Europeans and Caucasians; the northeast region is composed of a mixed population of indigenous, european and black peoples. Despite belonging to the same country, the origin of their populations are different. Therefore, as the geographic region of the present study is similar to the work carried out by da Silva *et al.*<sup>17</sup>, the results were quite similar.

In skulls with metopic suture, the occurrence rate was higher in males, which corroborates the results of studies carried out by del Sol *et al.*<sup>12</sup>, Skrzat, Walocha, Zawiliński,<sup>16</sup> Murlimanju *et al.*,<sup>22</sup> van der Meulen,<sup>37</sup> and da Silva *et al.*,<sup>17</sup>. However, the results of the present study differ from the conclusions of Castilho, Oda, Sant'Ana,<sup>13</sup> who observed an 80% incidence of metopism in females.

Regarding incomplete metopic suture, in our study the most common form found was in 'U'

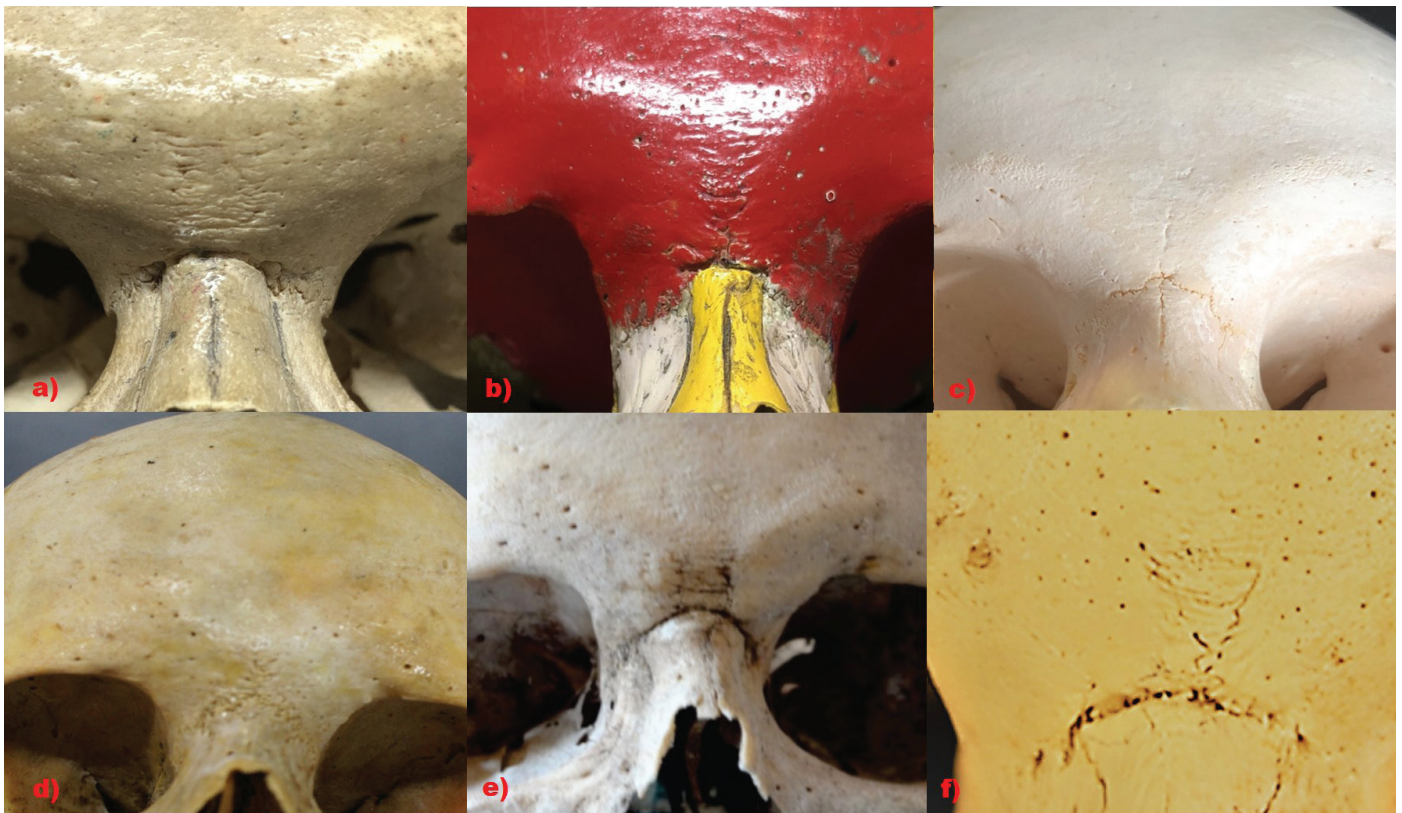


Figure 2. Incomplete metopic sutures.

a) U shaped; b) V shaped; c) Llinear shaped; d) Inverted V shaped; e) H shaped; f) Y shaped.

shape. This finding differs from most authors, who reported the linear form as the most prevalent (Table 2)<sup>2,3,13,15,26,28,32,33,38,39</sup>. To date, we have not found descriptions of the finding of 'W', 'M' and 'inverted V' shapes.

**Table 1.** Occurrence of metopism.

Authors	Population	Occurrence %
Bryce et al., <sup>18</sup>	European	8.70
	Mongolian	5.1
	Black	1.2
	Australian	1.0
	Scottish	9.5
Jit, Shah, <sup>10</sup>	Indian (Punjabi)	5.0
Woo et al., <sup>19</sup>	Mongoloids	10.0
	Black	2.0
Das, Saxena, Beg, <sup>20</sup>	Indian (Uttar Pradesh)	3.31
Agarwal, Malhotra, Tewari, <sup>15</sup>	Indian (Kanpur)	2.66
Ajmani, Mittal, Jain, <sup>9</sup>	Nigerians	3.4
del Sol et al., <sup>12</sup>	Brazilian (Southeast)	2.75
Baaten et al., <sup>21</sup>	Lebanese	0.82
Castilho, Oda, Sant'Ana, <sup>13</sup>	Brazilian (South)	7.04
Chandrasekaran, Shastri, <sup>2</sup>	Indian (Tamil Nadu)	5.0
Murlimanju et al., <sup>22</sup>	Indian (Mangalore)	1.2
Chakravarthi, Venumadhav, <sup>3</sup>	Indian (Karnataka)	6.25
Nikolova, Toneva, <sup>23</sup>	Bulgarian	9.11
da Silva et al., <sup>17</sup>	Brazilian (Northeast)	4.48
Masih et al., <sup>24</sup>	Indian (Ajmer)	6.5
Khandare, Shinde, Punpale, <sup>25</sup>	Indian (Mumbai)	4.0
Saikia, <sup>26</sup>	Indian (Assam)	3.17
Aksu et al., <sup>27</sup>	Turkish	7.5
Jayarani, <sup>28</sup>	Indian (Tamil Nadu)	5.8
Çalışkan et al., <sup>29</sup>	Turkish	8.1
Zdilla et al., <sup>30</sup>	Asian	15.38
	European	8.06
	Bengali	2.86
	Egyptian	2.20
Kalaivannan, Selvi, <sup>31</sup>	Indian (Tamil Nadu)	2.0
Kirwale, Sukre, <sup>32</sup>	Indian (Marathwada)	3.44
Maskey et al., <sup>33</sup>	Nepali and Korean	1.65-2.88
Chaisrisawadisuk et al., <sup>34</sup>	Australian	4.8
Li et al., <sup>35</sup>	Chinese	10.18
Gupta et al., <sup>36</sup>	Indian (Uttar Pradesh)	4.52
Present study	Brazilian (Northeast)	4.12

Table 2. Incomplete metopic sutures.

Authors	Morphology %										
	Linear	U	V	Inverted V	U	Inverted U	H	Y	W	M	Total
Das, Saxena, Beg, <sup>20</sup>	-	-	1.01	-	-	1.93	-	0.28	-	-	17.57
Agarwal, Malhotra, Tewari, <sup>15</sup>	23.12	5.25	2.43	-	-	-	1.57	1.96	-	-	35.51
Ajmani, Mittal, Jain, <sup>9</sup>	24.27	-	0.49	-	-	0.97	3.88	-	-	-	31.57
Castilho, Oda, Sant'Ana, <sup>13</sup>	22.53	-	5.63	-	-	-	-	-	-	-	32.4
Chandrasekaran, Shastri, <sup>2</sup>	17.0	15.0	7.5	-	-	-	-	-	-	-	40.0
Chakravarthi, Venumadhav, <sup>3</sup>	18.75	10.0	10.0	-	-	-	-	-	-	-	38.75
Saikia, <sup>26</sup>	16.66	12.69	3.96	-	-	-	-	-	-	-	33.33
Wadekar et al., <sup>38</sup>	16.25	1.25	5.0	-	-	-	-	-	-	-	22.5
Jayarani, <sup>28</sup>	7.5	-	2.5	-	1.7	1.7	0.8	0.8	-	-	15.0
Nirmale et al., <sup>39</sup>	15.38	6.15	3.84	-	-	-	1.53	-	-	-	27.69
Kirwale, Sukre, <sup>32</sup>	7.75	6.03	3.44	-	-	-	-	1.72	-	-	20.68
Maskey et al., <sup>33</sup>	6.61		8.26	-	-	-	-	-	-	-	27.27
Present study	22.0	26.80	24.05	3.43			2.75	1.72	0.35	0.35	81.4

## Conclusion

The occurrence of metopism in northeastern Brazil was 4.12%. The incomplete metopic suture had an occurrence of 81.44%, and its most common morphology was in 'U', 'V' and linear shapes.

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