

British Journal of Neurosurgery

ISSN: 0268-8697 (Print) 1360-046X (Online) Journal homepage: www.tandfonline.com/journals/ibjn20

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To cite this article: Ozcan Gayretli, Ilke Ali Gurses, Aysin Kale, Funda Aksu, Adnan Ozturk, Bulent Bayraktar & Kayihan Sahinoglu (2011) The mendosal suture, British Journal of Neurosurgery, 25:6, 730-733, DOI: 10.3109/02688697.2010.544789

To link to this article: https://doi.org/10.3109/02688697.2010.544789

Published online: 23 Feb 2011.

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British Journal of Neurosurgery, December 2011; 25(6): 730–733

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ORIGINAL ARTICLE

The mendosal suture

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Abstract

Purpose. The knowledge regarding the mendosal suture is still on debate in the literature. Though reports of the closure of this childhood suture are variable, a few reports show the presence of the suture in the adults. This study was conducted to determine the occurrence and a better topographic location of the mendosal suture.

Methods. We used 129 dry skulls for this study. In the specimens, which were determined to have a mendosal suture, the morphometric traits of the mendosal suture and the angle between the mendosal suture line and lambdoidal suture line (α angle) were measured.

Results. We found mendosal suture on 18 specimens, 11 of them were bilateral and 7 were unilateral. The length of these sutures ranged from 10.4 to 23.8 mm on the right side and 10.8 to 31.6 mm on the left side, respectively. The angle between two suture lines ranged from 36 to 68° on the right side and 32 to 75° on the left side.

Conclusions. We believe that, these data will be of use to clinicians in order to avoid any misinterpretation of the mendosal suture with cranial fractures.

Key words: *Mendosal suture, biasterionic suture, cranial fracture, occipital bone.*

Introduction

The mendosal suture is an accessory suture of the occipital bone situated somewhat superior to the transverse sinus.[1] This suture usually originates above the asterion, although sometimes below it and runs horizontally from the medial portion of the lambdoidal suture.[2,3] The time of closure of this suture in children changes among authors from several days after birth till 10 years of age.[1,3–9] Although regarded as a childhood suture, a few researchers have observed its presence among adults with various frequencies.[2,10–12] In their detailed study, Hanihara and Ishida found that the frequency of the mendosal suture – also known as biasterionic suture – shows ethnic, racial and geographical differences.[2] Although there is an ongoing debate and a wide range of information regarding the frequency and time of closure of the mendosal suture, its topographic anatomy and characteristics has not been studied in detail yet. Therefore, we aimed to facilitate its location in the occipital squama and if possible, to determine a characteristic trait of this suture.

Materials and methods

We used 129 dry skulls from the laboratories of the Anatomy Departments of Istanbul University Istanbul Faculty of Medicine and Dokuz Eylul University Faculty of Medicine for this study. None of the specimens showed signs of bony malformation, prior cranial surgery or trauma. There was no information regarding the gender or the age of the skulls. Due to this handicap; all specimens were accepted as adults, regarding tooth eruption and rugosity of bone. We measured the length of the mendosal suture and the distance between the asterion and the origin of the suture with digital calipers and we evaluated the relationship between the asterion and the mendosal suture. To describe a more definite location of the suture, we defined an angle between the mendosal suture line and the lambdoidal suture line (α angle) (Fig. 1). To evaluate the α angle, we formed a right triangle between two suture lines and after measuring the neighbouring edges, we calculated the cosine α. In order to find the numeric value of the angle, we used a trigonometric chart to determine which value belongs to which angle. To facilitate a more reliable

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This study has been presented as a poster presentation in the 12th National Congress of Anatomy, 29 October–1 November 2008, Mersin, Turkey.

Received for publication 17 August 2010. Accepted 29 November 2010.

ISSN 0268-8697 print/ISSN 1360-046X online © 2011 The Neurosurgical Foundation
DOI: 10.3109/02688697.2010.544789

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information on the α angle, we excluded the specimens which had suture fusion. Kolmogorov–Simirnov test was used to evaluate the normal distribution, regarding the information obtained from each sides. The results were given as mean $\pm$ standard deviation (minimum–maximum). Mann–Whitney U test was used to compare the results of both sides and $p < 0.05$ was considered as statistically significant.

Results

Eighteen skulls out of 129 (13.9%) had mendosal suture. Eleven of them (8.5%) had sutures bilaterally, four (3.1%) had mendosal sutures only on the right side and three (2.3%) had mendosal sutures only on the left side. The length of the mendosal suture ranged between 10.4 and 23.8 mm (16.4 mm) on the right side and 10.8 and 31.6 mm (18.1 mm) on the left side. Among a total of 29 mendosal sutures, 11 of them originated from the asterion, 9 above the asterion and 9 below the asterion (Fig. 2). The distance between the origin of the suture and asterion ranged from 2.9 to 8.3 mm (5.3 mm) for the sutures below the asterion and from 2.5 to 12.8 mm (7.8 mm) for the sutures above the asterion. The calculated α angle ranged from 36 to 68° (56.1°) on the right side and from 32 to 75° (52.3°) on the left side. The normality test for the value of the α angle was considered significant ($p < 0.05$). The 95% confidence interval for the mean value of the α angle had a lower bound of 51° and an upper bound of 62° on the right side and a lower bound of 45.5° and an upper bound of 59° on the left side. There was no significant difference between right and left sides in regard of the value of the α angle and the length of the suture ($p > 0.05$). The results are outlined in Tables I and II. The comparison of the α angle values regarding both sides were presented with a boxplot curve (Fig. 3).

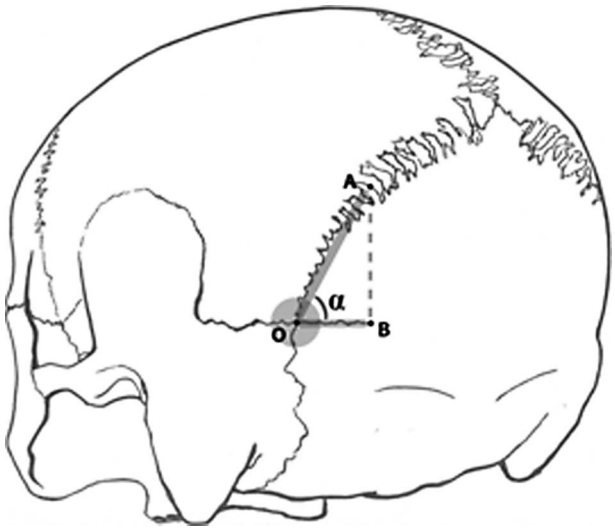


FIG. 1. Schematic illustration of the posterolateral aspect of the cranium, showing the methodology, mendosal suture and the α angle between two suture lines. O, asterion; OB, the length of the mendosal suture; OA, the hypotenuse formed on the lambdoidal suture.

Discussion

The occipital bone is formed from the union of four primary cartilaginous centres bordering the foramen magnum and from a fifth membranous element. Thus, the occipital bone has a dual origin from cartilage and membrane.[9] The basioccipital centre is located anterior to the foramen magnum, the paired exooccipital centres are located lateral to the foramen magnum, and the supraoccipital centre is located just posterior to the foramen magnum.[5,9] Superior to the supraoccipital centre, the membranous component gives rise to the interparietal bone which has paired ossification centers.[5,9] The two components of the occipital squama – supraoccipital and interparietal bones – are separated by the mendosal suture.[2,5,8,9] But Niida *et al.* stated that the tectum synoticum posterior, which is one of the three skull roof elements of the chondrocranium, temporarily exists within the territory of the interparietal bone bilaterally and always interferes with the growth of the interparietal bone.[13] Thus forms the lateral incisures in the bone. The location and length of these incisures are also decided by the tecta. This area remains unossified for a certain period, with the disappearance of the tecta, it is gradually replaced by the secondary bony plate with increasing postnatal age. In some cases it persists throughout life as the mendosal suture.[13]

The mendosal suture, which is related to the cranial vault, is affected by the growth of the cerebrum. As the growth of the cerebrum is greater than of cerebellum, a possibility exists that its fusion may be delayed when compared with the occipital and innominate sutures which are located in the lower occipital bone.[7]

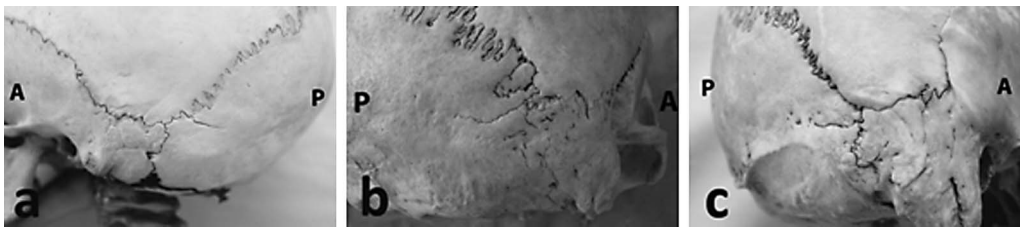


FIG. 2. Different origins of the mendosal suture, (a) shows origin above the asterion, (b) on the asterion and (c) below the asterion. P, posterior; A, anterior.

TABLE I. Summary of the measurements of the length of the mendosal suture and the α angle

Sides	Length of the mendosal suture (mm)	α angle (°)
Right	16.4±3.4 (10.4–23.8)	56.1±9.8° (36–68°)
Left	18.1±5.1 (10.8–31.6)	52.3±11.9° (32–75°)

Data are shown as mean, standard deviation (range).

TABLE II. Summary of the measurements of the distance between the point of origin of the mendosal suture and the asterion

Point of origin	Distance between the asterion and the origin of the mendosal suture (mm)
Above the asterion	5.3±2.5 (2.9–8.3)
Below the asterion	7.8±3.5 (2.5–12.8)

Data are shown as mean, standard deviation (range).

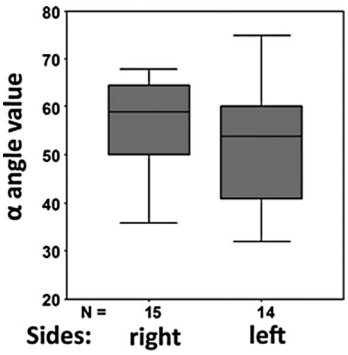


FIG. 3. Boxplot comparing the α angle value of right and left sides.

Therefore, the time of closure of the mendosal suture is variable. Podda *et al.* mentioned that this suture closes several days after birth, and according to Gooding (Newton and Potts as Editors), it closes several weeks after birth.[3,8] However, other researchers stated that the mendosal suture begins fusing before birth and the closure is completed between the second and fourth year.[4–6,9] Nakahara *et al.* did not observe the presence of the mendosal suture after 6 years of age, and Lang stated that this suture may still be identified in children up to 10 years.[1,7]

Pawlik found the mendosal suture in 10 % of skulls between the ages of 16 and 20.[11] The presence of the mendosal suture in the adults have been found as 16% (8 out of 50 skulls) by Tubbs *et al.* and 3% (15 out of 500) by Nayak *et al.*[10,12] In their detailed study, Hanihara and Ishida found the frequency of the mendosal suture as 18% in the Turkey/Cyprus samples.[2] Our study has the relative frequency of 13.9% for the anatolian population, which is very similar with the results of Tubbs *et al.* and Hanihara and Ishida.[2,12]

Clinically, radiographical identification of skull fractures in children is often difficult because of the numerous accessory sutures.[14] Especially normal variation in sutures may simulate fractures around the foramen magnum, an area unusually rich in accessory sutures and ossicles.[15] Nakahara *et al.* reported a child presented with head trauma who had bilateral mendosal sutures on radiographic examination.[16] Interestingly, Mann *et al.* stated that skull changes that took place until 2 years of age, such as fusion of the mendosal suture, provides additional protection to the skull from blunt trauma. Though, the frequency of intracranial haematomas increases.[6]

There are no clear points of differentiation between fracture lines and suture lines observed in the skull and the differential diagnosis may be difficult, especially if linear defects are present within the occipital bone.[17] Thus, a more definite knowledge of the topography of a normal variant such as the mendosal suture has clinical importance. In order to give a more accurate definition of this suture, we have used its relation to the asterion and the angle between this suture and the neighbouring lambdoidal suture (α angle). The point of origin of the mendosal suture in relation to the asterion has no statistical significance ($p > 0.05$), as 11 sutures originated from the asterion, 9 sutures above the asterion and 9 sutures below the asterion. Our results show that the point of origin of the suture may have a mean distance of 5.3±2.2 mm below or 7.8±3.6 mm above the asterion. We have used the α angle for determining the course of the mendosal suture, because we think that even the length of the suture shortens due to the growth of the occipital bone, the α angle would not be affected from this. In our study, the α angle has a mean value of 56.1±9.9° for the right side and 52.3±11.9° for the left side. The α angle also has a 95% confidence interval of 51–62° on the right side and 45.5–59° on the left side. Finally, even though individuals may represent variability, the results of our study indicate that the mendosal suture tends to be situated between these limits.

Conclusions

Our study has two drawbacks. Lack of paediatric specimens in our study is the first, as the occurrence of the mendosal suture in children is higher and has more clinical importance, regarding head trauma compared with adults. Second, by using imaging techniques (like digital X-ray and/or 3D-CT), characteristics of the mendosal suture and its comparison with cranial fractures in paediatric trauma patients could be ascertained with more detail. Another study regarding these handicaps has been planned. Nevertheless, this study determines a characteristic trait of the mendosal suture with significant statistical data.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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