Heights of the cerebral falx

Surgical and clinical implications

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ABSTRACT

Objectives: Variations in the shape and size of the cerebral falx can embarrass the surgical treatment of lesions in and around the falx. In this study, anatomy and morphometry of the cerebral falx in adult cadaveric specimens were examined to enable easy approach during surgery.

Methods: Fifty-two adult cadaver cerebral hemispheres with dura from the cadaver collection of the Department of Anatomy, Ege University, Faculty of Medicine were examined in 2003. The cerebral falx was observed in 3 different types. The heights of the cerebral falx and the heights of interspace between the lower margin of the cerebral falx and corpus callosum were measured.

Results: The most frequently observed type of cerebral falx was Type I based on the classification of Jiang and Jia. The average heights of the cerebral falx measured 21.3 mm anteriorly, 25.7 mm in the middle and 45.6 mm posteriorly in Type I; 27.9 mm anteriorly, 30.5 mm in the middle and 47 mm posteriorly in Type II; 28.7 mm anteriorly, 36.5 mm in the middle and 44.1 mm posteriorly in Type III. The average heights of the interspace between the lower margin of the cerebral falx and corpus callosum were 14.1 mm anteriorly, 12.4 mm in the middle and 2.1 mm posteriorly in Type I; 6.3 mm anteriorly, 7.2 mm in the middle and 1 mm posteriorly in Type II; 2.3 mm anteriorly, 1.8 mm in the middle and 0.6 mm posteriorly in Type III. Natural defects were found on the cerebral falx in 12 (23%) specimens.

Conclusion: Measurements of the cerebral falx provide useful information for neurosurgeons in treatment of lesions involving the region. This study presents more detailed data compared to those reported in the few previously published papers, results differing due to differences of the populations investigated.

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The cerebral falx is a sickle-like tough fibrous dural fold, lying in the longitudinal fissure and separating the brain into 2 cerebral hemispheres. It is fixed in front to the crista galli of the ethmoid bone and the frontal crest of the frontal bone in the median plane and in behind to the internal occipital protuberance and the cerebellar tentorium. Its upper margin is attached to the groove for superior sagittal sinus of the skull, its lower margin being free.[1,2] The cerebral falx was divided into 3 subgroups according to existence and shape of this interspace as shown in **Figures 1-3** based on the classification of Jiang and Jia.[1] In Type I, the interspace between the lower free margin of the cerebral falx and the corpus callosum is wide in front and narrow behind, the distance between the lower margin of the cerebral falx and corpus callosum being larger than 10 mm. In Type II, the lower margin of the cerebral falx is closely approximated to genu and splenium of the corpus callosum, the distance between the lower margin of the cerebral falx and corpus callosum being 3-10 mm. The distance between the

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lower margin of the cerebral falx and corpus callosum is smaller than 3 mm or with no interspace in Type III.[1] Hypoplasia of the anterior part of the cerebral falx as a part of middle interhemispheric fusion was reported as a congenital anomaly.[3] Krauss et al[4] observed an accessory dural septum in the direction of the corona, the temporo-occipital base upward to the lower parietal area, and defined it as ‘accessory cerebral falx’. Solitary fibrous tumors may also arise from the cerebral falx.[5] Space-occupying lesions, or cerebral edema may increase intracranial pressure leading to displacement of the affected brain portion into the dura mater or intracranial spaces producing brain herniation. The space between the cerebral falx and corpus callosum is one of these intra-cranial spaces, others being between the tentorial notch and the midbrain, and between the foramen magnum and medulla oblongata.[1] Severe craniocerebral trauma may also be a cause of dislocation of the brain under the cerebral falx with incarceration of the cingulate gyrus. High intracranial pressure or trauma may also cause corpus callosum impingement by the cerebral falx. Falxotomy must be performed for prevention or correction of incarceration of brain portions around the falx.[6] Variations in the shape and size of the cerebral falx can embarrass the surgical approach to the region. This study presents different measurements of the cerebral falx in adult Turkish cadaver specimens to enable easy identification.

Methods. Fifty-two male adult cadaver cerebral hemispheres with dura fixed with 10% formaldehyde for several months were obtained from the cadaver collection of the Department of Anatomy, Faculty of Medicine, Ege University, Izmir, Turkey in 2003. The height of the cerebral falx and the distance between the lower margin of the cerebral falx and corpus callosum were measured anteriorly (at the anterior end of genu of corpus callosum), middle (at the midpoint of truncus of corpus callosum), and posteriorly (at the posterior end of corpus callosum) (**Figures 1-3**). All measurements were taken using a steel caliper. The means and the standard deviation values were calculated for each parameter.

Results. Type I cerebral falx was observed in 27 cases (52%), type II in 21 (40%) and type III in 4 (8%) specimens. The mean heights of the cerebral falx were 21.3±5.1 (5–28.3) mm anteriorly, 25.7±5.6 (12.4–37.1) mm in the middle and 45.6±3.6 (38.7–52.9) mm posteriorly in Type I; 27.9±3.3 (20.4–33.5) mm anteriorly, 30.5±4.9 (23.2–41) mm in the middle and 47± 4.7 (38.3–61) mm posteriorly in Type II; 28.7± 5.3 (25.6–34.9) mm anteriorly, 36.5±3.7 (33.8–42) mm in the middle and 44.1±2.7 (41–47.1) mm posteriorly in

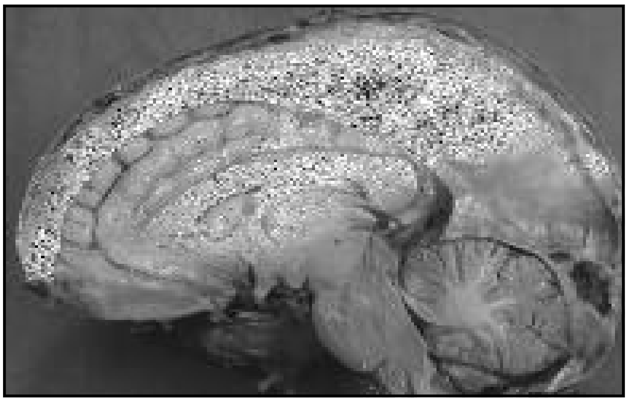

Figure 1 - Type I cerebral falx.

Figure 2 - Type II cerebral falx with natural defects.

Figure 3 - Type III cerebral falx.

Type III. The distance between the lower margin of the cerebral falx and corpus callosum was measured 14.1±5.6 (8.6–34.9) mm anteriorly, 12.4±4.7 (1.1–24.9) mm in the middle and 2.1±1.8 (0–7.2) mm posteriorly in Type I; 6.3±1.7 (3.2–8.8) mm anteriorly, 7.2±2.2 (1.9–10.7) mm in the middle and 1±1.5 (0–5.1) mm posteriorly in Type II; 2.3±1.3 (1.9–3) mm anteriorly, 1.8±1.2 (0–3) mm in the middle and 0.6±1.2 (0–2.4) mm posteriorly in Type III. Natural defects were found on the cerebral falx in 12 (23%) specimens (**Figure 2**). The size of the defects varied from 0.31 x 0.18 cm to 1.7 x 0.7 cm.

Discussion. Variations of the shape and size of the cerebral falx are presented, although not so many studies have been made on this region. In a former study by Jiang and Jia[1] on a Chinese population, Type I cerebral falx was observed in 47%, Type II in 21% and Type III in 32% of 87 male and 13 female specimens. We observed Type I in 52%, Type II in 40% and Type III in 8% of our specimens. The incidence of Type I in the Chinese population is close to that of the Turkish population, whereas Type II is observed more frequently in the Turkish and Type III in the Chinese population. No gender and age related differences were observed in both of these studies.

The distance between the lower free margin of the cerebral falx and corpus callosum ranged from 9-26 mm in Type I, 3-10 mm in Type II, no interspace was observed in Type III in the study of Jiang and Jia.[1] The results of this study are more detailed, giving this distance at the anterior, middle and posterior parts of the cerebral falx. The interspace between the lower free margin of the cerebral falx and corpus callosum is important as a site of predilection for gyrus cinguli herniation (subcerebral falx hernia). A space-occupying lesion or cerebral edema may wedge the gyrus cinguli on the medial surface of the hemisphere into the interspace below the cerebral falx so it herniates contralaterally.[1]

There are no studies in the literature giving the height of the cerebral falx at the anterior, middle and posterior portions as in our study, except for one study by Dausacker[7] giving the average height of the posterior portion of the cerebral falx as 40 mm, which is close to our findings ranging from 38.3-61 mm. Size and shape of the cerebral falx are important in the state of hydrocephalus, cerebral trauma, in resection of tumors of the region, and also in corpus callosum impingement, incarceration of the cingulate gyrus and contralateral herniation of cerebral hemispheres.[1,6,8] Trauma or high intracranial pressure as in hydrocephalus may result in localized dorsal flattening and thinning of the posterior part of the corpus callosum (impingement) by the rigid free surface of the cerebral falx.[8] Severe craniocerebral trauma may also cause incarceration of the cingulate gyrus with dislocation of the brain under the cerebral falx.[6]

Olfactory groove meningiomas are resected with a frontal interhemispheric approach, resecting the tumor through the gap between the falx and the medial aspect of the frontal lobe, anteriorly to the genu of the corpus callosum. It provides a better surgical approach if the interspace between the lower free margin of the cerebral falx and corpus callosum is large.[9]

Natural defects of the cerebral falx are sites of contralateral herniation of cerebral hemispheres in case of high intracranial pressure, because of their tenuous, weak structure.[1] Jiang and Jia[1] observed natural defects in 31% of their specimens, which is 23% in our specimens. The size of the defects varied from 0.6 x 0.3 cm to 2.7 x 1.4 cm in the study of Jiang and Jia in the Chinese population. In our study on Turkish specimens, the sizes of the defects were larger, varying from 0.31 x 0.18 cm to 1.7 x 0.7 cm. In both studies, the majority of the defects were localized at the frontal part and were round or oval in shape. Fat deposits[10] and ossifications due to hypertension may be observed within the falx.[11] Gross anatomic observation of the falx in this study was unable to define any fat deposits.

The anatomical extension of the cerebral falx should be carefully evaluated by all physicians working on the region, especially on tumors of the region. This anatomical morphometric study is intended as a guide for the safe surgical approach to the region and aids in development of new strategies by precisely defining the anatomy of the cerebral falx. The results of our measurements differ from those of the former investigators due to the populations investigated.

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