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Falx and Interhemispheric Fissure on Axial CT: I. Normal Anatomy

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To determine the normal appearance of the falx and interhemispheric fissure, 200 consecutive normal CT scans were evaluated prospectively. On unenhanced scans, the normal falx is visualized in 90% of patients and therefore interhemispheric hyperdensity alone should not be considered a sign of subarachnoid hemorrhage. The falx is most often (88%) visualized in the posterior part of the interhemispheric fissure, as a hyperdense, pencil-thin line extending from the calvarium to the splenium of the corpus callosum. In the anterior part of the fissure, the falx is visualized in only 38% of patients, when its appearance differs significantly from that of the fissure. It is seen as a thin, hyperdense line extending posteriorly from the calvarium for a variable distance, but it never reaches the genu of the corpus callosum. The interhemispheric fissure is a hypodense structure broader than the falx with a zigzag configuration due to medial frontal sulci. The difference in configuration between the anterior part of the fissure and the anterior falx is very helpful in differentiating subarachnoid hemorrhage from normal falx visualization.

The falx cerebri and interhemispheric fissure, although recognized early on axial CT [1], received little attention in the literature. We have studied the normal anatomic configuration of these structures in detail and offer anatomic information for differentiation of a variety of pathologic processes that may affect the falx and interhemispheric fissure.

Materials and Methods

Two hundred scans performed without contrast opacification on an EMI 1005 were evaluated prospectively. The consecutive cases were interpreted as normal or showing only involutional changes consistent with age. Any patient with a history, physical findings, or laboratory data suggestive of intracranial hemorrhage, trauma, or surgery was eliminated from the study even when the scans were interpreted as normal. The patients were aged 8 days to 89 years; there were 96 males and 104 females.

On axial projection, at 10°–20° to the anthropologic baseline, the falx and interhemispheric fissure are seen as a unit divided into three segments by the interposition of the curved corpus callosum (fig. 1). Anterior (precallosal), posterior (retrocallosal), and superior (supracallosal) segments are identified.

The frequency of falx visualization on unenhanced scans was determined. Each segment of the falx and interhemispheric fissure was separately analyzed for frequency of visualization and appearance. Particular attention was paid to the effect of age on the appearance of the falx/fissure combination. The mean and peak density of the falx on unenhanced scans was determined for each case. Areas of obvious calcification were excluded from the quantitative analysis.

Contrast opacification was studied in 20 of the 200 cases. These were chosen because pre- and postcontrast scans were obtained at identical levels, allowing determination of the effect of enhancement on falx density and configuration.

Anatomic studies were performed on 10 brains bisected at the corpus callosum with the falx intact. The falx and its relation to the interhemispheric fissure and corpus callosum

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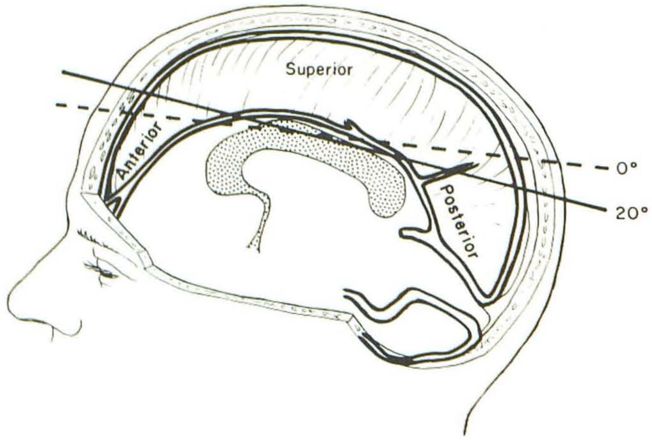


Fig. 1.—Drawing of falx and corpus callosum. On axial scans, corpus callosum divides falx and surrounding interhemispheric fissure into anterior (precallosal), posterior (retrocallosal), and superior (supracallosal) segments. Division of falx into these segments depends on scanning angle, which does not cause significant problems, since changes in falx and fissure are gradual.

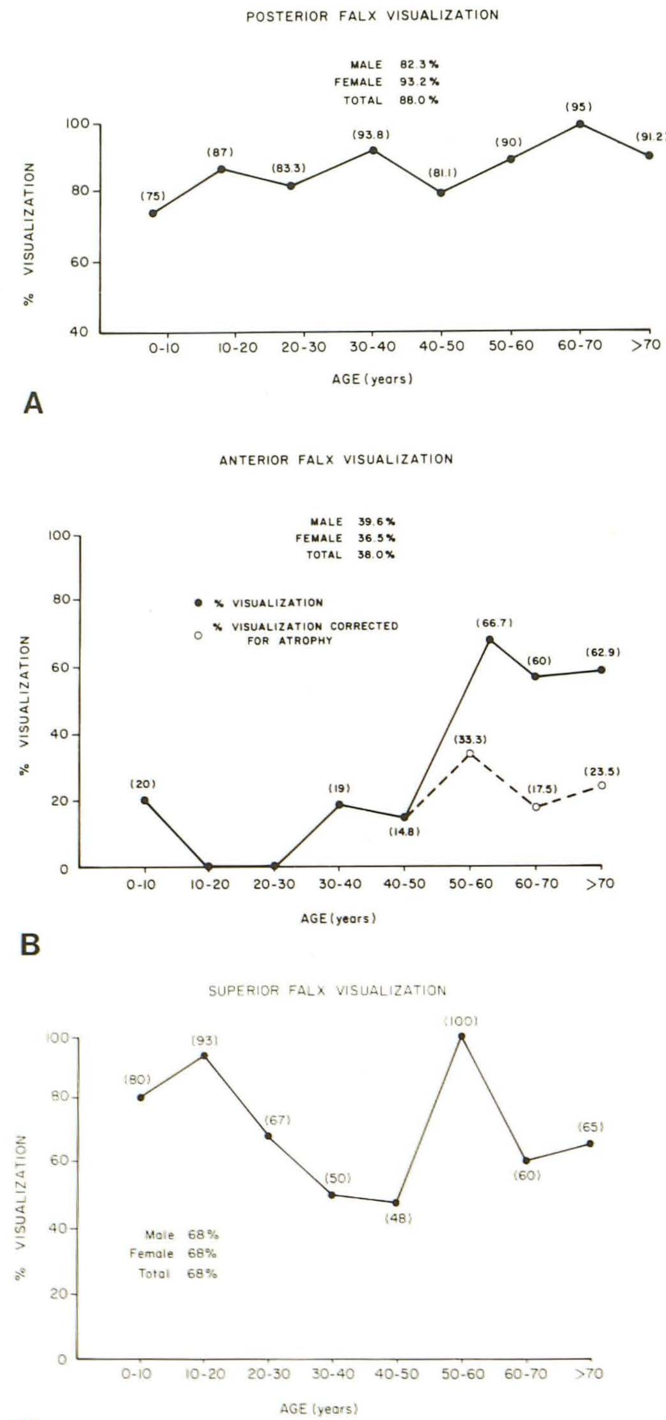


Fig. 2.—Rates of visualization of falx. **A**, Posterior falx visualization not significantly affected by age, varying between 75% and 95%. **B**, By contrast, anterior falx visualization is less frequent, and frequency increases dramatically (*solid line*) after age 40. Increase is due to progressive atrophic dilatation of anterior part of interhemispheric fissure. When cases in which falx visualization due to dilatation of anterior interhemispheric subarachnoid space are eliminated, rate of anterior falx visualization does not change with age (*dashed line*). **C**, Superior falx shows no consistent change in visualization rate.

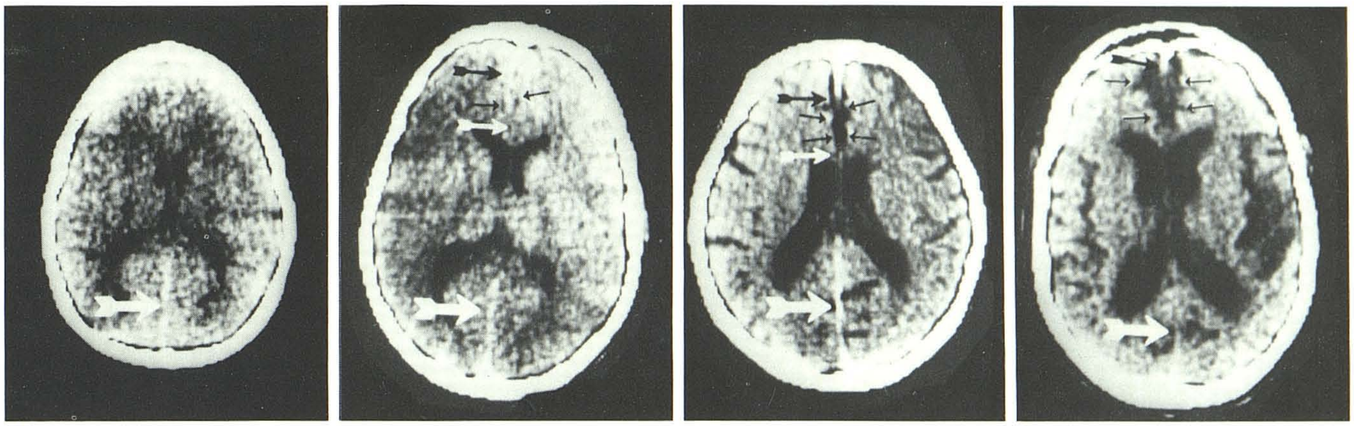
were examined. Four patients with typical falx visualization on unenhanced scans died of intercurrent disease, and the falx was evaluated pathologically for presence or absence of calcification.

Results

The falx was visualized in 90% of unenhanced scans. The frequency of visualization of each falx segment varied significantly. The retrocallosal falx was seen in 88% of patients regardless of age or gender (fig. 2A). It had the characteristic and virtually invariable appearance of a pencil-thin, hyperdense line extending from the calvarium to the splenium of the corpus callosum (fig. 3). Anatomic studies demonstrate that this falx segment is of uniform thickness and occupies the entire interhemispheric fissure (fig. 4). In this location, the fissure is extremely narrow and is almost invisible on CT, even in elderly patients with relatively severe atrophy affecting other segments of the fissure, especially its anterior part (figs. 3C and 3D).

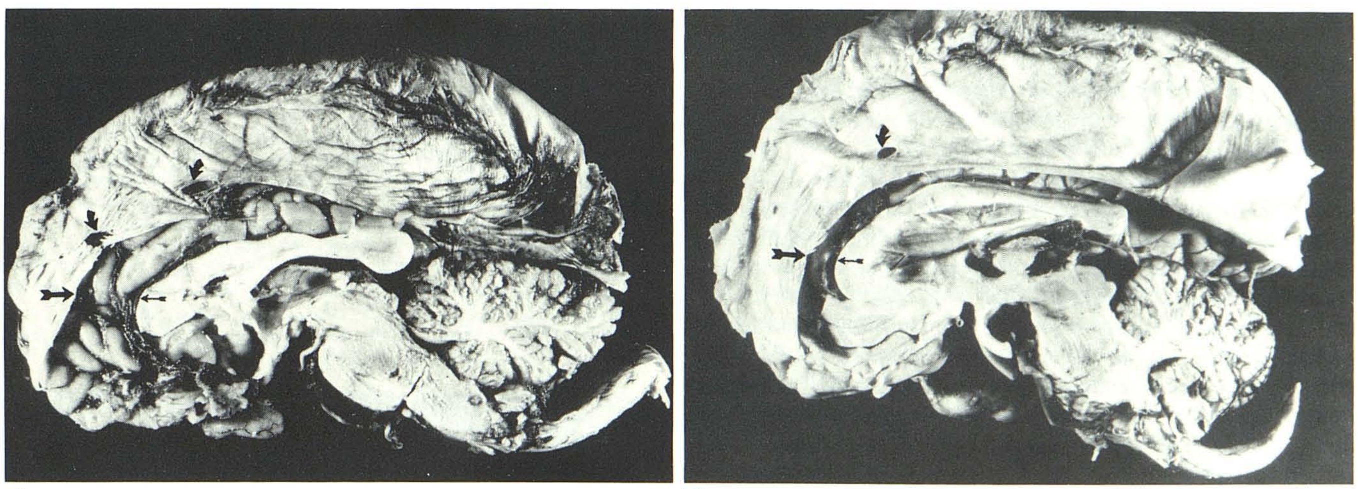
The anterior or precallosal segment of the falx was identified in only 38% of patients with more frequent visualization in patients over age 40 (fig. 2B). It extended posteriorly from the inner table of the skull toward the genu of the corpus callosum for a variable distance. In most cases it occupied only the anterior one-third to one-half of the interhemispheric fissure, but in the minority of cases, it extended further posteriorly, approaching but never reaching the genu of the corpus callosum. Anatomic studies confirm the variable depth and thickness of this falx segment, which was always thinnest along its inferior margin where fenestrations were commonly observed (fig. 4). In many specimens a large gap (fig. 4A) occurred between the thin shallow anterior falx and the genu of the corpus callosum. In other cases (fig. 4B) the falx was deep and thick but did not completely extend to the genu of the corpus callosum.

The precallosal part of the interhemispheric fissure was narrow and only intermittently visible in children and young



A B C D

Fig. 3.—Normal precallosal and retrocallosal falx and interhemispheric fissure at several ages. Scans in patients aged 3 (**A**), 22 (**B**), 46 (**C**), and 76 (**D**). Typical appearance of falx and surrounding fissure in these ages. In all examples, retrocallosal falx is thin hyperdense line extending from calvarium to splenium of corpus callosum (*large white arrow*). Precallosal part of falx is more variable. Anterior falx may be nonvisualized (**A**) or minimally seen (**B**) between frontal lobes (*large black arrow*). As fissure dilates, falx becomes more easily seen (*large black arrow*, **C** and **D**). Depth of anterior part of falx varies, as demonstrated by comparing short or shallow falx in **C** with poorly visualized but deep falx in **B**. In all cases, there is gap between free inferior margin of falx and genu of corpus callosum (*small white arrow*). Retrocallosal segment of interhemispheric fissure so narrow as to be virtually invisible (**A–D**), even in face of severe atrophy elsewhere, in particular, anterior part of interhemispheric fissure (**C** and **D**). In these figures, fissure (*small black arrows*) has configuration of hypodense zigzag line extending from calvarium to genu of corpus callosum. In younger patients, fissure is either not seen (**A**) or only intermittently seen as small focal areas of cerebrospinal fluid density (*small black arrows*).



A B

Fig. 4.—Anatomic specimens. Bisected cerebral hemispheres with falx intact. Uniformly thick and dense posterior falx fills virtually entire retrocallosal interhemispheric fissure. In precallosal segment, falx is more variable in depth. It may be shallow anteriorly (**A**), filling only anterior fissure with large gap between anterior inferior margin of falx (*large arrow*) and genu of corpus callosum (*small arrow*). In other specimens (**B**), precallosal falx is deeper and thicker, but gap remains between free margin of falx (*large arrow*) and genu of corpus callosum (*small arrow*). Fenestrations near inferior margin of falx in many cases (*curved arrows*).

adults (figs. 3A and 3B). It progressively dilated with age and became clearly visible in most patients over 30 (fig. 3C) and in all patients over 40 (fig. 3D). It produced the typical pattern of a zigzag hypodense line which extended intact from the inner table of the skull to the genu of the corpus callosum. As the fissure dilated with age, its anatomic configuration could be more clearly seen and the falx was more easily and more often visualized (fig. 2B) within it, surrounded by the relatively hypodense cerebrospinal fluid (figs. 3C and 3D).

The supracallosal falx was visualized in 68% of patients (fig. 2C) and was most often seen under age 10 or over 50. Just above the corpus callosum, the appearance of the falx and fissure is a combination of pre- and retrocallosal configurations (figs. 5A and 5B). Thus, anteriorly, the falx was thin or not visualized and the interhemispheric fissure visible

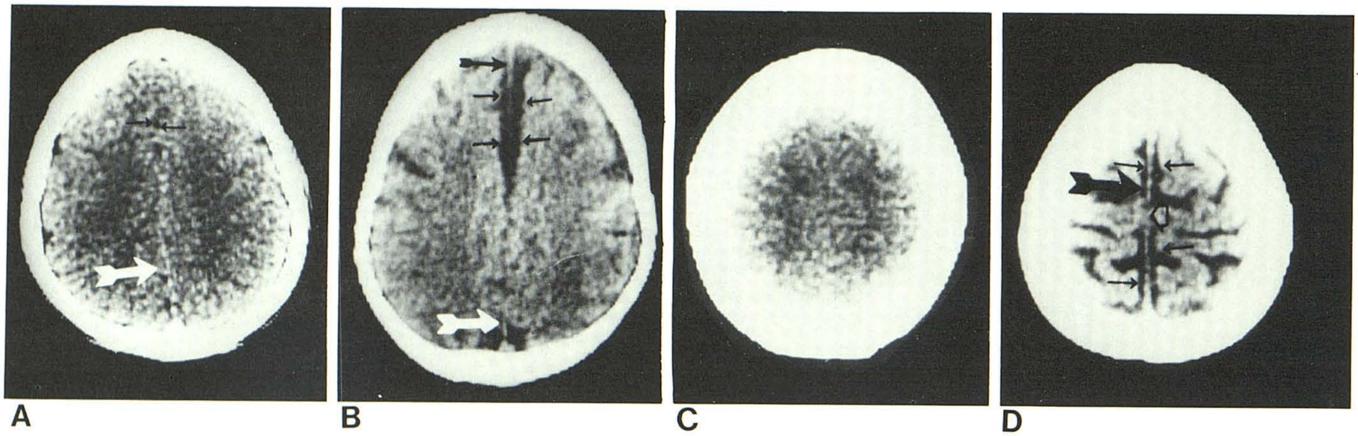


Fig. 5.—Superior falx. Just above corpus callosum, superior falx produces configuration that is combination of that seen in pre- and retrocallosal segments. **A**, Young patients. Fissure uniformly narrow (*small black arrows*) and only posterior part of falx is seen (*white arrow*). **B**, Older patient. Anterosuperior part of fissure (small *black arrows*) dilates and posterior segment remains narrow. Anterior falx (*large black arrow*) visualized because it is surrounded by cerebrospinal fluid. **C**, At the vertex, fissure is narrow and falx is rarely visualized in young patients. **D**, Older patients. Fissure shows uniform dilatation (*small arrows*) and falx is visualized throughout its course, except where interrupted by small fenestration (*open arrow*).

with its width dependent on age (figs. 5A and 5B). Posteriorly the falx was usually observed as a dense thin line (fig. 5A), and the fissure was either invisible or extremely narrow. At the vertex only, the fissure was seen to have a uniform width from the anterior to the posterior aspect of the calvarium (fig. 5D).

The mean density of the falx was 46 H and did not vary with age, although the maximum density did increase, peaking at 97 H in patients over age 70 (fig. 6).

After contrast infusion, the falx was visualized in every case (fig. 7). In the retrocallosal and supracallosal regions, it appeared to be slightly broader and denser, but was otherwise unchanged from its precontrast appearance. In the precallosal segment, the falx was thicker and more frequently seen. It appeared to extend further posteriorly within the fissure, often merging with a pericallosal vascular blush and thus producing a continuous dense line from the inner table of the skull to the corpus callosum (figs. 7B and 7D).

Four patients with typical falx visualization on enenhanced scans died of intercurrent disease. Pathologic evaluation demonstrated no calcification or ossification within the falx in these four cases.

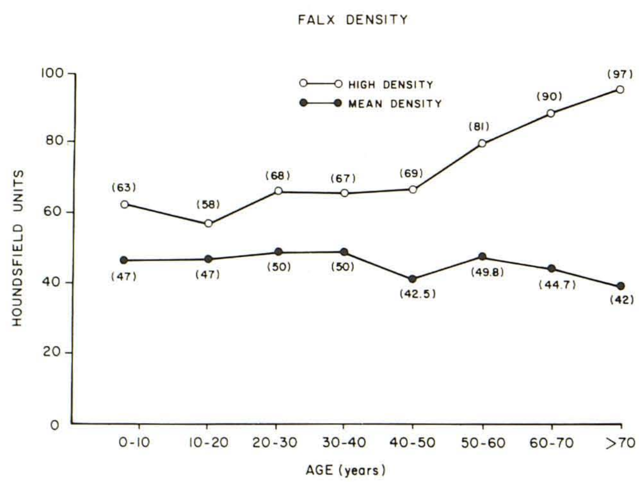


Fig. 6.—Density of falx. Mean density of falx (*closed circles*) does not change significantly with age, but peak density (*open circles*) does increase, especially in patients over age 50. This rise may be related to presence of foci of calcifications too small to visualize on CT.

Discussion

Limitations in spatial and density resolution of early CT scanners prevented routine visualization of the falx on unenhanced studies; it was seen only after contrast infusion [1]. In patients with subarachnoid hemorrhage, increased density in the interhemispheric fissure was identified on unenhanced scans and, because it mimicked the appearance of the enhanced falx, came to be called the "falx sign" of subarachnoid hemorrhage [2–5]. With improvements in density and spatial resolution, Osborn et al. [6] and Akimoto et al. [7] demonstrated increased density in the interhemispheric fissure in patients without subarachnoid hemorrhage. Those investigators came to a similar conclusion, that this was due to an intrinsic density difference between the falx and surrounding tissue. The frequency of falx visualization varied between the two series, and in fact was different from that obtained in our study. These differences can be explained on the basis of methods of patient selection and differences in scanner resolution. In our series, pathologic studies confirmed that falx visualization is not dependent on calcification (fig. 8A) and, therefore, must be accounted for by intrinsic density differences between the falx and surrounding brain. The observation that the falx has a greater radiographic density than surrounding brain was

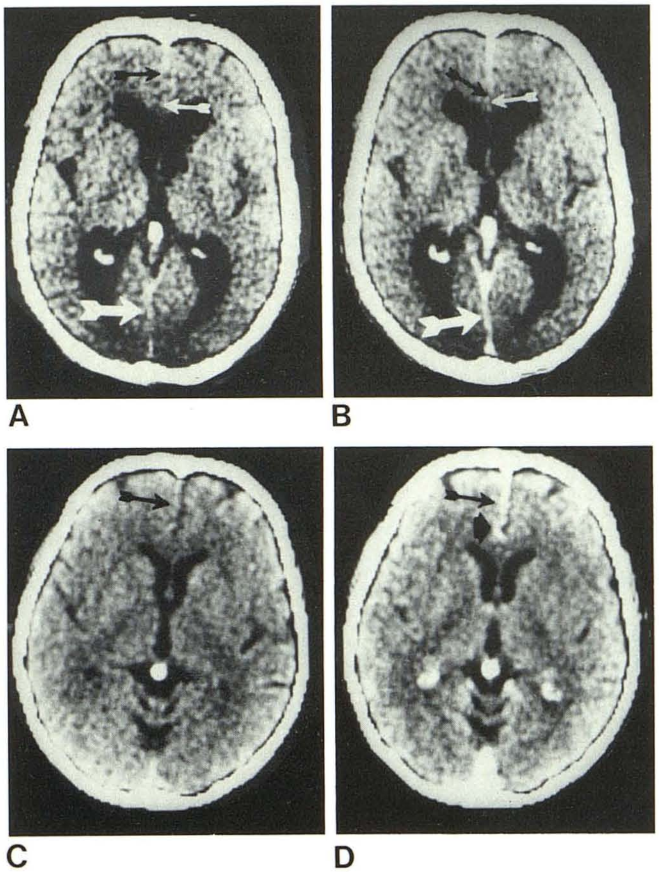


Fig. 7.—Contrast-enhanced scans. On contrast-enhanced scans (**B** and **D**), falx is thicker and denser than on comparable unenhanced scans (**A** and **C**). Configuration of posterior falx is unchanged (*large white arrows*) after contrast unfusion. Precallosal falx (*black arrows*) increases in density and depth due to better visualization of thin inferior margin of falx and visualization of pericallosal artery, whose shadow merges with anterior falx. When artery is straight, (**B**), it merges imperceptively with falx. When artery has slightly curved course (*black arrowhead*), it is more easily differentiated from falx.

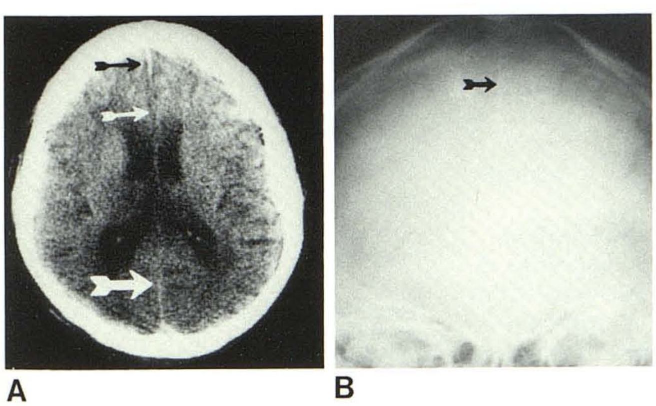


Fig. 8.—Normal uncalcified falx. **A**, Retrocallosal (*large white arrow*) and precallosal (*black arrow*) segments of falx are visualized in patient who subsequently died and in whom postmortem examination demonstrated no evidence of falx calcification. Thus, falx visualization is due to intrinsic density difference between this structure and the surrounding brain, rather than calcification. **B**, Frontal skull radiograph. Visualization of uncalcified falx as linear midline hyperdensity.

first made in 1946 by Robertson [8] who demonstrated visualization of the uncalcified normal falx on frontal radiographs taken so that the long axis of the falx was parallel to the axis of the x-ray beam (fig. 8B). Robertson [8] speculated that the "dense" fibrous nature of the falx was responsible. Insights into the factors that contribute to radiographic density gained since the advent of CT suggest the high vascularity of the falx [9, 10] makes it denser than surrounding brain tissue.

The key to an accurate understanding of the axial anatomy of the falx and interhemispheric fissure lies in viewing these structures as a single functional unit divided into three segments by the corpus callosum. Each segment has unique characteristics that are useful in the evaluation of pathologic processes that affect the falx and interhemispheric fissure [11]. The retrocallosal segment is characterized by its constant appearance. The falx is anatomically invariable (figs. 3 and 4) in this area, and the interhemispheric fissure is extremely narrow (fig. 3) and does not dilate with age, even with relatively severe atrophic dilatation of the subarachnoid spaces elsewhere in the brain, and in particular in the anterior part of the interhemispheric fissure (figs. 3C and 3D). Thus, the falx is virtually always seen as a pencil-thin hyperdense line without surrounding hypodensity (fig. 3).

The precallosal segment is as variable as the retrocallosal segment is constant (fig. 3). Anatomically the anterior part of the falx is thinner than the posterior segment and is of variable depth (fig. 4). This is reflected on CT by both the lesser frequency of visualization (fig. 2B) and the variability of appearance of the falx (fig. 3). The fissure is also variable in this area. It is narrow in children and young adults, but progressively dilates with age (fig. 3). This age-related dilatation accounts for the increase in rate of falx visualization in patients over age 40 (fig. 2B). The anterior falx is thin and straight and never extends completely from the calvarium to the corpus callosum. The anterior fissure is wider and zigzags (where medial gyri impinge on the fissure). It always extends from the calvarium to the corpus callosum. An understanding of these two configurations is the key to differentiation of normal falx visualization from subarachnoid hemorrhage in the interhemispheric fissure [11].

The supracallosal segment has two configurations. Above the corpus callosum, it is a combination of the pre- and retrocallosal segments. Thus, anteriorly the fissure is mild to moderately prominent, and the falx is minimally visualized. Posteriorly the falx is dense and the fissure so narrow, that it is virtually invisible (figs. 5A and 5B). Only at the vertex does the fissure have a symmetrical size (figs. 5C and 5D).

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