Hemispherotomy Landmarks

Last Updated: July 5, 2021

ABSTRACT

OBJECT: The authors introduce the surgical concept of the central core of a hemisphere, from which anatomical structures are disconnected during most current hemispherotomy techniques. They also propose key anatomical landmarks for hemispherotomies that can be used to disconnect the hemisphere from its lateral surface around the insula, through the lateral ventricle toward the midline.

METHODS: This anatomical study was performed in five adult cadaveric heads following perfusion of the cerebral arteries and veins with colored latex. Anatomical landmarks were used in five hemispheric deafferentations. The central core of a hemisphere consists of extreme, external, and internal capsules; claustrum; lentiform and caudate nuclei; and thalamus. Externally, this core is covered by the insula and surrounded by the fornix, choroid plexus, and lateral ventricle. During most hemispherotomies, the surgeon reaches the lateral ventricle through the frontoparietal opercula or temporal lobe; removes the mesial temporal structures; and disconnects the frontal lobe ahead, the parietal and occipital lobes behind, and the intraventricular fibers of the corpus callosum above the central core. After a temporal lobectomy, the landmarks include the choroid plexus and posterior/ascending portion of the tentorium to disconnect the parietal and occipital lobes, the callosal sulcus or distal anterior cerebral artery (ACA) to sever the intraventricular fibers of the corpus callosum, and the head of the caudate nucleus and ACA to detach the frontal lobe.

CONCLUSIONS: These landmarks can be used in any hemispherotomy during which a cerebral hemisphere is disconnected from its lateral

surface. Furthermore, they can be used to perform any resection around the central core of the hemisphere and the tentorial incisura.

INTRODUCTION

The term "hemispherotomy" was introduced by Delalande and colleagues1 in 1992 to describe a modified functional hemispherectomy,7,8 in which cortical resection is minimized and the rest of the hemisphere is functionally isolated by disconnecting the neuronal fibers. Indications for a hemispherotomy are the same as those for a hemispherectomy, namely hemiconvulsion-hemiplegia-epilepsy syndrome; Sturge–Weber disease; Rasmussen syndrome; atrophic cerebral hemisphere caused by vascular disorder, trauma, or infection; and cortical dysplasia involving a broad area of the cerebral hemisphere. Because of its technical peculiarities—intraventricular callosotomy—the hemispherotomy is especially indicated in those cases with an enlarged lateral ventricle.[10,11,14]

Recently, several technical variations of hemispherotomy have been described.[2–4,10–12,14] As stated by Morino, et al.,[5] however, all of these variations have four principles in common: disruption of the descending and ascending fibers through the corona radiata and internal capsule; removal of the mesial temporal structures; intraventricular callosotomy; and disruption of the frontal horizontal fibers, including the occipitofrontalis fasciculus and uncinate fascicle. The main differences among these hemispherotomy variants lie in how the lateral ventricle is accessed—whether access starts from the temporal horn or from the body of the lateral ventricle—and the extent of brain resection necessary to gain access. Other minor differences include the removal or preservation of the insula and the preservation or ligation of branches of the MCA.

Because both hemispherotomy and hemispherectomy are essentially anatomy-oriented procedures, we endeavored to demonstrate through dissections the anatomical landmarks that are relevant in performing hemispherotomy as well as the practical applications of those landmarks during the procedure. The anatomical aspects considered important for hemispherotomy include the concept of the central core of the hemisphere, the anatomy of the tentorium cerebelli and the falx as well as their relationship to the corpus callosum and the central core of the hemisphere, and the relationship between the ACAs and the corpus callosum from an intraventricular perspective.

CLINICAL MATERIAL AND METHODS

This anatomical study was performed in five adult cadaveric heads following perfusion of the cerebral arteries and veins with colored latex at the Laboratory of Microanatomy, Department of Neurosurgery, University of Florida. The anatomical landmarks have been fully applied by one of the authors (H.T.W.) in five hemispheric deafferentations and partially applied in another 12 cases during the last 5 years at the Hospital das Clínicas, University of São Paulo, Brazil.

RESULTS

Anatomical Considerations

Central Core. The central core of each hemisphere consists of the basal ganglia; thalamus; internal, external, and extreme capsules; claustrum; and insula. Externally, it is covered by the insula and surrounded by the fornix and lateral ventricles (Fig. 1). Anteriorly, the central core connects to the frontal lobe by the very anterior portion of the internal capsule, which separates the bottom of the anterior limiting sulcus of the insula (in the sylvian fissure) from the frontal horn of the lateral ventricle, in front of the head of the caudate nucleus. Furthermore, the core connects posteriorly to the temporal and parietal lobes by the retrolenticular portion of the internal capsule, which separates the atrium of the lateral ventricle from the retroinsular region of the sylvian fissure. Inferiorly, the core connects to the temporal lobe by the sublenticular portion of the internal capsule, which separates the inferior limiting sulcus of the insula in the sylvian fissure from the temporal horn of the lateral ventricle. Superiorly, the core connects to the frontal and parietal lobes by the corona radiata, a superior continuation of the internal capsule separating the superior limiting sulcus of the insula (in the sylvian fissure) from the frontal horn, body, and upper portion of the atrium of the lateral ventricle (Fig. 2).

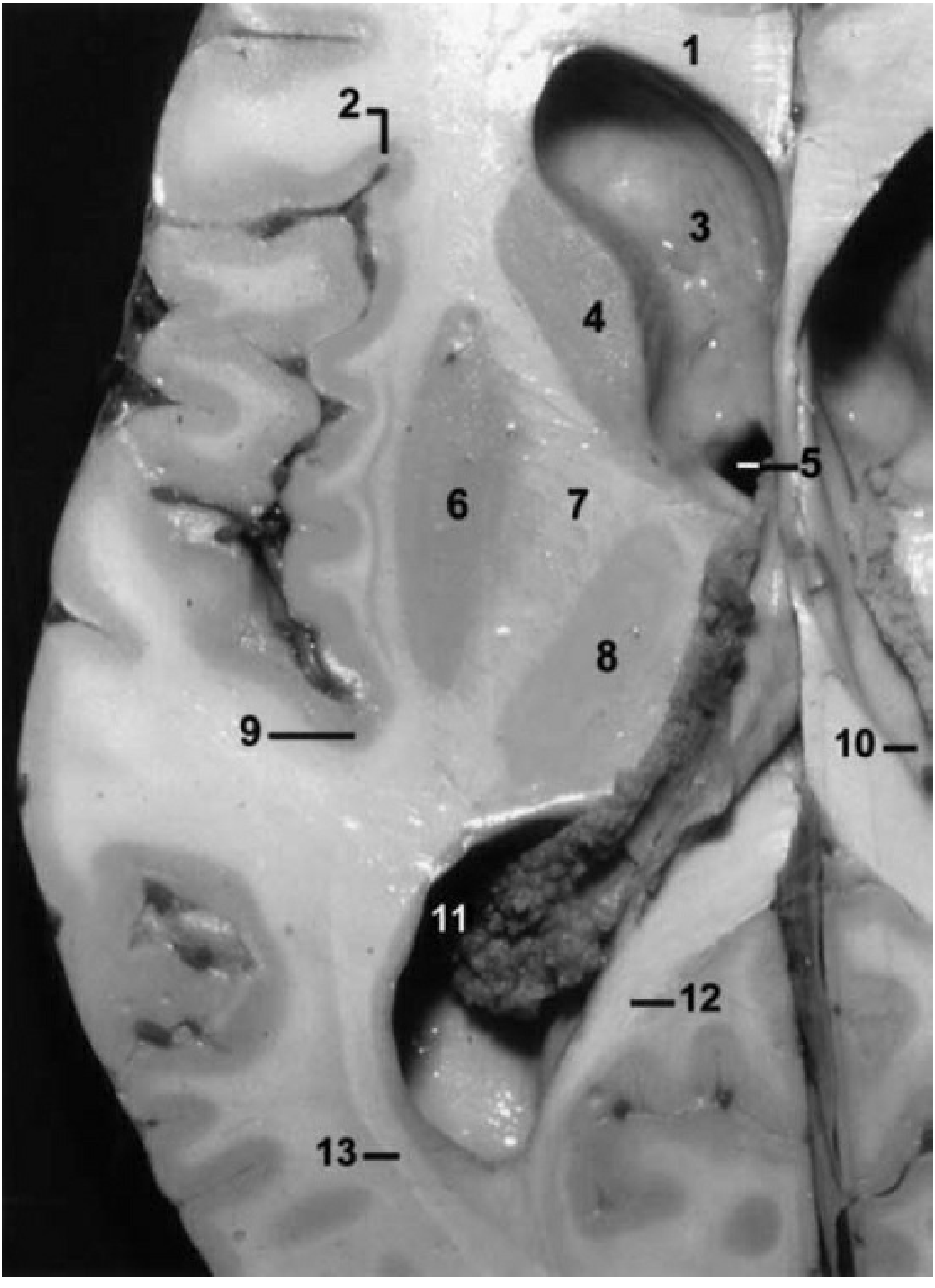


Figure 1. Photograph (superior view) depicting the central core of the left hemisphere, which has been cut axially. 1 = genu of the corpus callosum; 2 = anterior limiting sulcus of the insula; 3 = frontal horn; 4 = head of the

caudate nucleus; 5 = foramen of Monro; 6 = lentiform nucleus; 7 = internal capsule; 8 = thalamus; 9 = inferior limiting sulcus of the insula, retroinsular region; 10 = fornix; 11 = atrium; 12 = splenium of the corpus callosum; 13 = tapetum of the corpus callosum. (Image courtesy of AL Rhoton, Jr.)

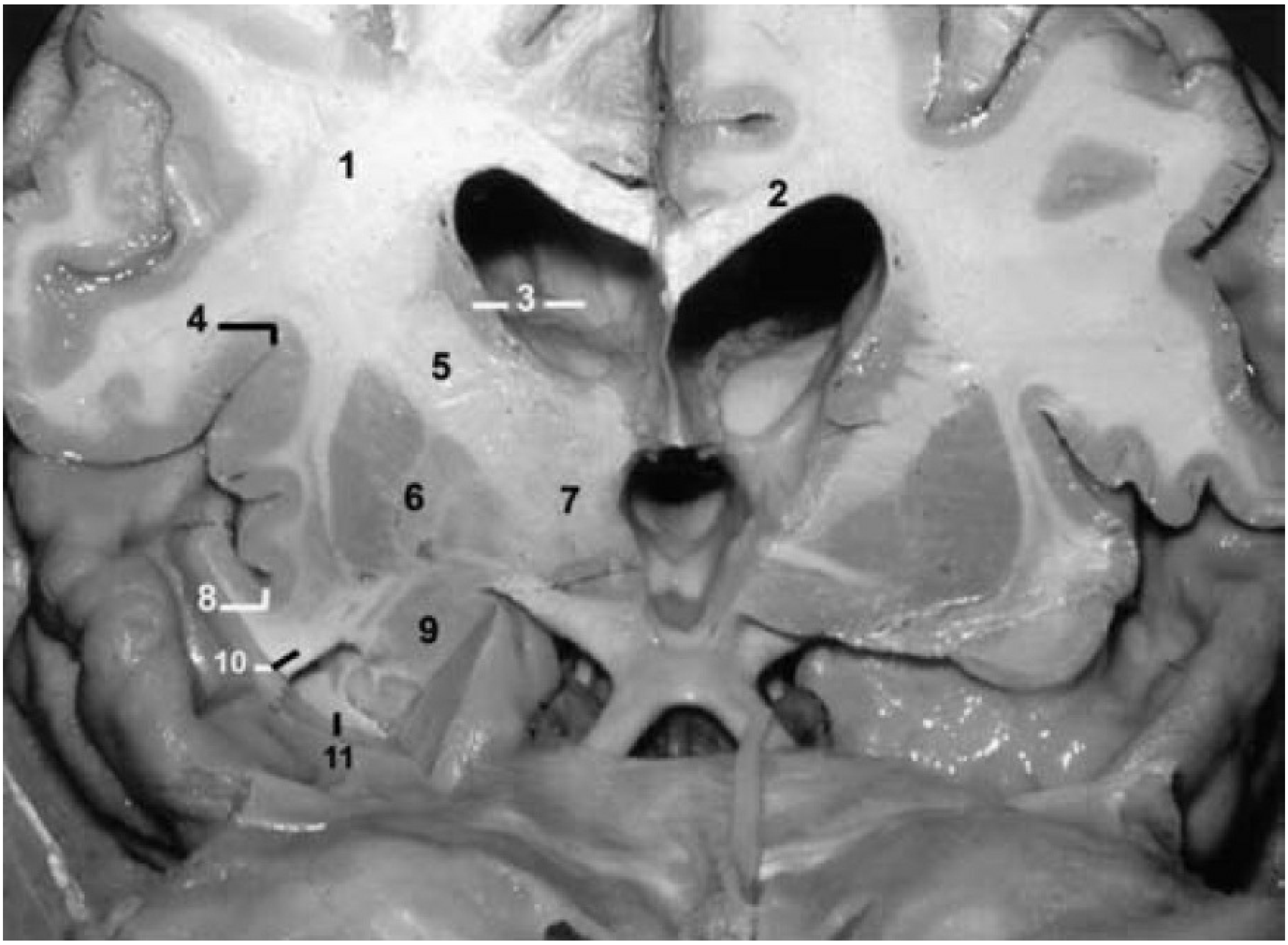


Figure 2. Photograph (coronal view) showing the central core of both cerebral hemispheres. The right hemisphere has been sectioned at the body of the lateral ventricle, the left hemisphere at the frontal horn. 1 = corona radiata; 2 = corpus callosum; 3 = bodies of the caudate nucleus and the lateral ventricle; 4 = superior limiting sulcus of the insula; 5 = internal capsule; 6 = lentiform nucleus; 7 = thalamus; 8 = inferior limiting sulcus of the insula; 9 = temporal amygdala; 10 = sublenticular portion of the internal capsule; 11 = collateral eminence of the temporal horn. (Image courtesy of AL Rhoton, Jr.)

From a lateral perspective, the superior, inferior, anterior, and posterior limits in the central core correspond to those same limits of the insula, namely the superior, inferior, and anterior limiting sulci of the insula (Fig.

3). Also from the lateral perspective, the central core of the hemisphere is covered by the frontal, parietal, and temporal opercula.[9,15]

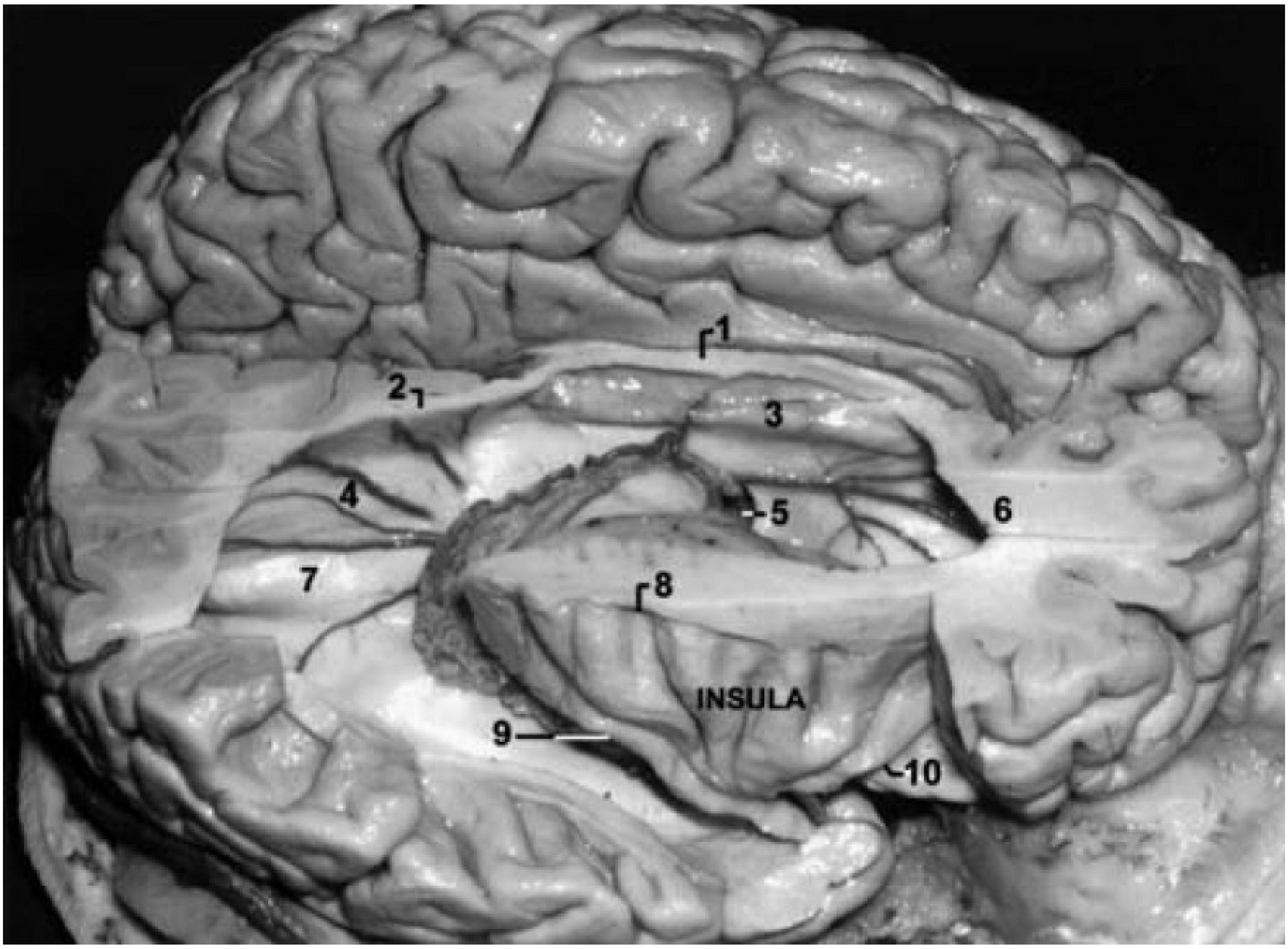


Figure 3. Photograph (lateral view) demonstrating the right insula. The overlying gyri of the lateral surface of the hemisphere have been removed to expose the lateral ventricle. 1 = body of the corpus callosum; 2 = splenium of the corpus callosum; 3 = septum pellucidum; 4 = bulb of the callosum and the medial atrial veins; 5 = foramen of Monro; 6 = genu of the corpus callosum; 7 = calcar avis; 8 = superior limiting sulcus of the insula; 9 = inferior limiting sulcus of the insula; 10 = anterior limiting sulcus of the insula. (Image courtesy of AL Rhoton, Jr.)

Tentorium Cerebelli. The free edge of the tentorium cerebelli extends from the dorsum sellae anteriorly to its junction with the falx posteriorly. From a surgical viewpoint, this free edge has two portions: an anterior/horizontal portion and a posterior/ascending portion. The anterior/horizontal portion is attached to the petrous apex and the anterior and posterior clinoid processes.[6] From its anterior attachment the anterior/horizontal portion is directed posteriorly (Fig. 4). The ascending/posterior portion of the tentorium cerebelli begins at the level of the lateral mesencephalic sulcus of the midbrain, where it arches posteriorly, superiorly, and medially to join its contralateral mate behind the splenium of the corpus callosum to form the falx (Figs. 4 and 5).

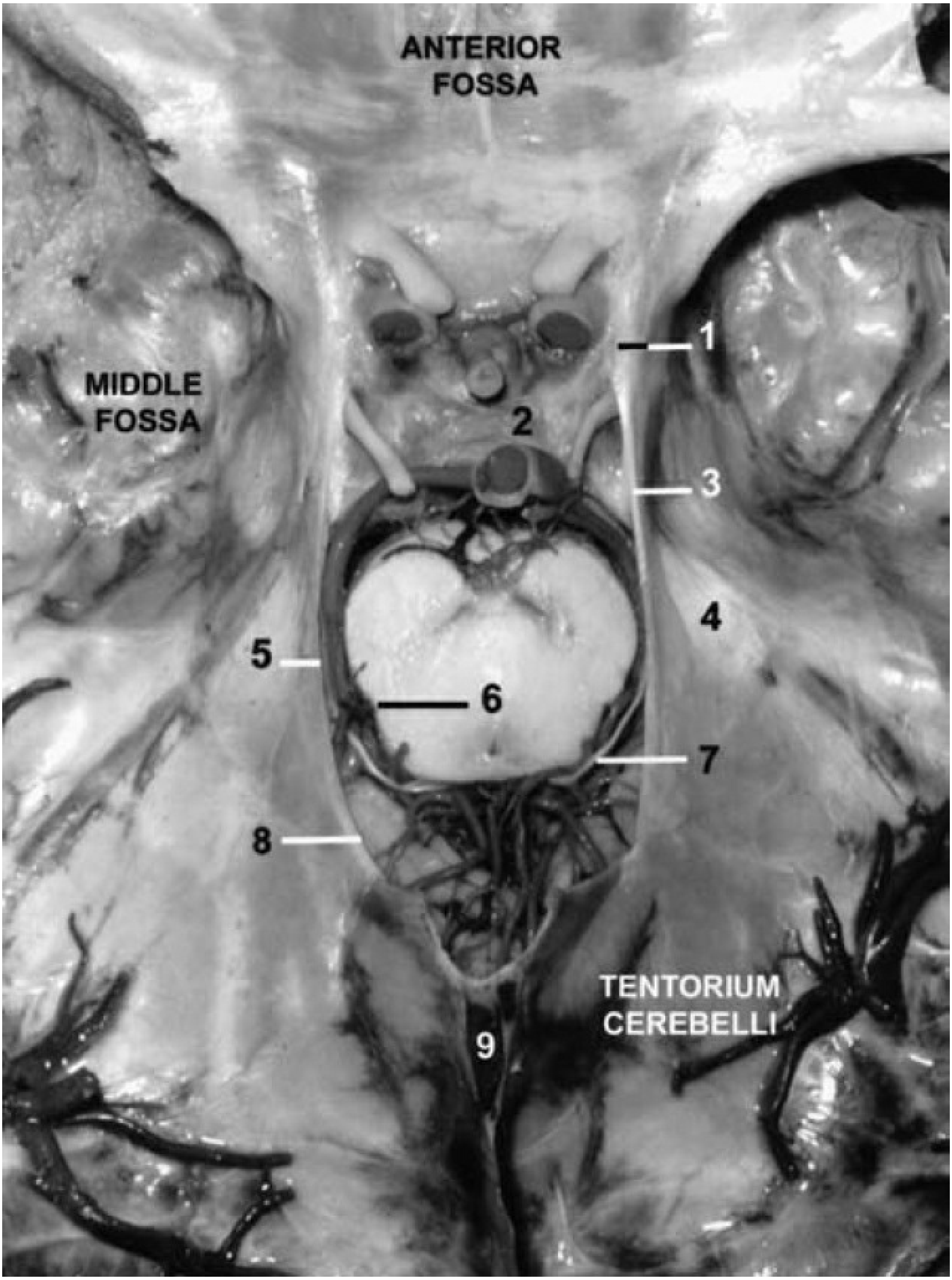


Figure 4. Photograph (superior view) depicting the tentorial incisura. The cerebrum has been removed at the pontomesencephalic junction. The free edge of the tentorium cerebelli is attached to the petrous apex. The petrous apex is attached to the anterior and posterior clinoid processes by the anterior and posterior petroclinoid folds. 1 = anterior clinoid process; 2 = posterior clinoid process; 3 = anterior petroclinoid fold; 4 = petrous apex; 5 = anterior/horizontal portion of the free edge of the tentorium; 6 = lateral mesencephalic sulcus; 7 = trochlear nerve; 8 = posterior/ascending portion of the tentorium; 9 = straight sinus. (Image courtesy of AL Rhoton, Jr.)

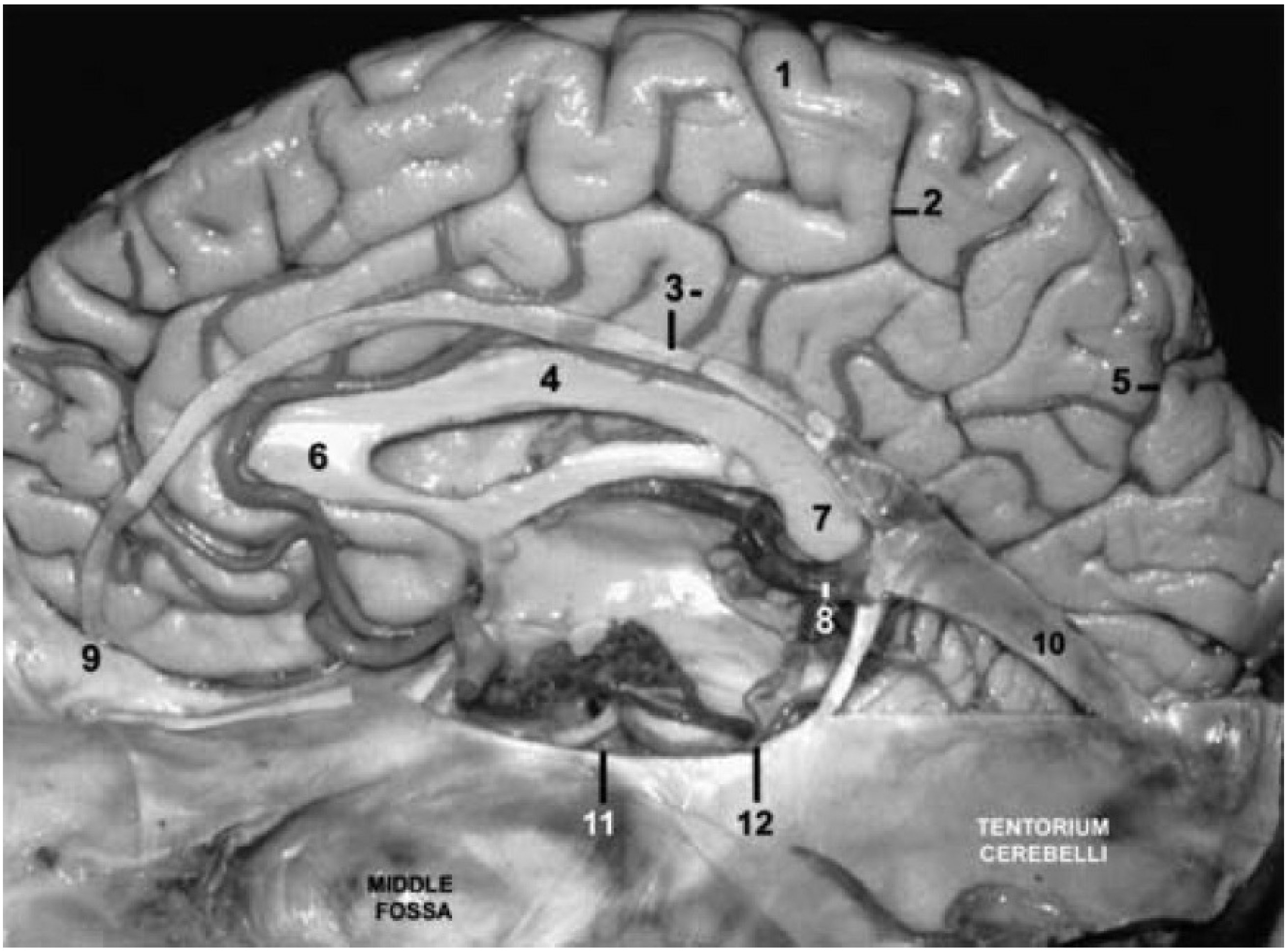


Figure 5. Photograph (midsagittal view) demonstrating the free edges of the tentorium and the falx, which have been preserved to display their relationship to the brainstem and the corpus callosum. 1 = precentral gyrus; 2 = marginal ramus of the cingulate sulcus; 3 = cingulate gyrus and free edge of the falx; 4 = body of the corpus callosum; 5 = parietooccipital sulcus; 6 = genu of the corpus callosum; 7 = splenium of the corpus callosum; 8 = vein of Galen; 9 = crista galli; 10 = straight sinus; 11 = horizontal portion of the free edge of the tentorium; 12 = beginning

of the ascending portion of the free edge of the tentorium. (Image courtesy of AL Rhoton, Jr.)

The anterior/horizontal portion of the free edge of the tentorium is related superiorly to the anterior portion of the parahippocampal gyrus, where it is naturally herniated anteriorly and medially to the oculomotor nerve, posteriorly and medially to the crus cerebri and the contents of the crural and ambient cisterns, and laterally to the parahippocampal gyrus.

Initially, the posterior/ascending portion of the free edge of the tentorium is related medially to the tegmentum of the midbrain and the contents of the ambient cistern, laterally to the parahippocampal gyrus, and superiorly to the pulvinar of the thalamus. As the tentorium arches almost vertically toward the falx, the free edge becomes related to the pulvinar of the thalamus and the contents of the quadrigeminal cistern anteriorly and the parahippocampal gyrus laterally (Figs. 6 and 7). The parahippocampal gyrus is positioned laterally to the free edge of the tentorium cerebelli throughout its entire course and also arches posteriorly, superiorly, and medially to form the cingulate gyrus and the isthmus of the cingulate gyrus (Fig. 8).

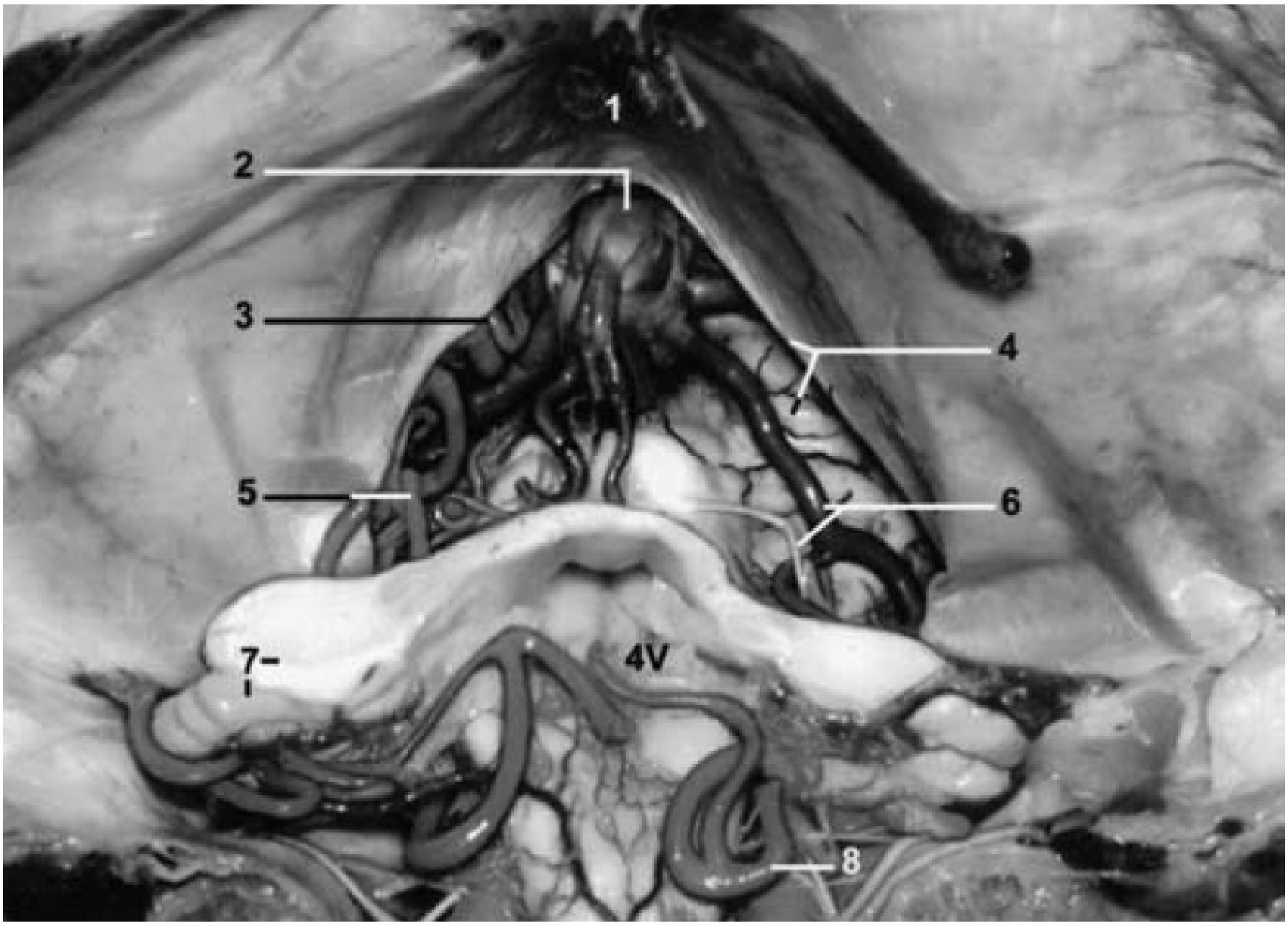


Figure 6. Photograph (inferior view) exhibiting the posterior portion of the tentorial hiatus. The cerebellum has been removed by sectioning the superior, middle, and inferior cerebellar peduncles. The arteries on the right side have also been removed. Initially, the posterior/ascending portion of the free edge of the tentorium cerebelli is related superiorly to the pulvinar of the thalamus and the contents of the ambient cistern. As it approaches the falx, it then becomes related anteriorly to the contents of the quadrigeminal cistern. 1 = straight sinus; 2 = vein of Galen; 3 = posterior cerebral artery; 4 = posterior/ascending portion of the free edge of the tentorium and the pulvinar of the thalamus; 5 = superior cerebellar artery; 6 = basal vein and trochlear nerve; 7 = middle cerebellar peduncle and flocculus; 8 = posterior inferior cerebellar artery; 4V= fourth ventricle. (Image courtesy of AL Rhoton, Jr.)

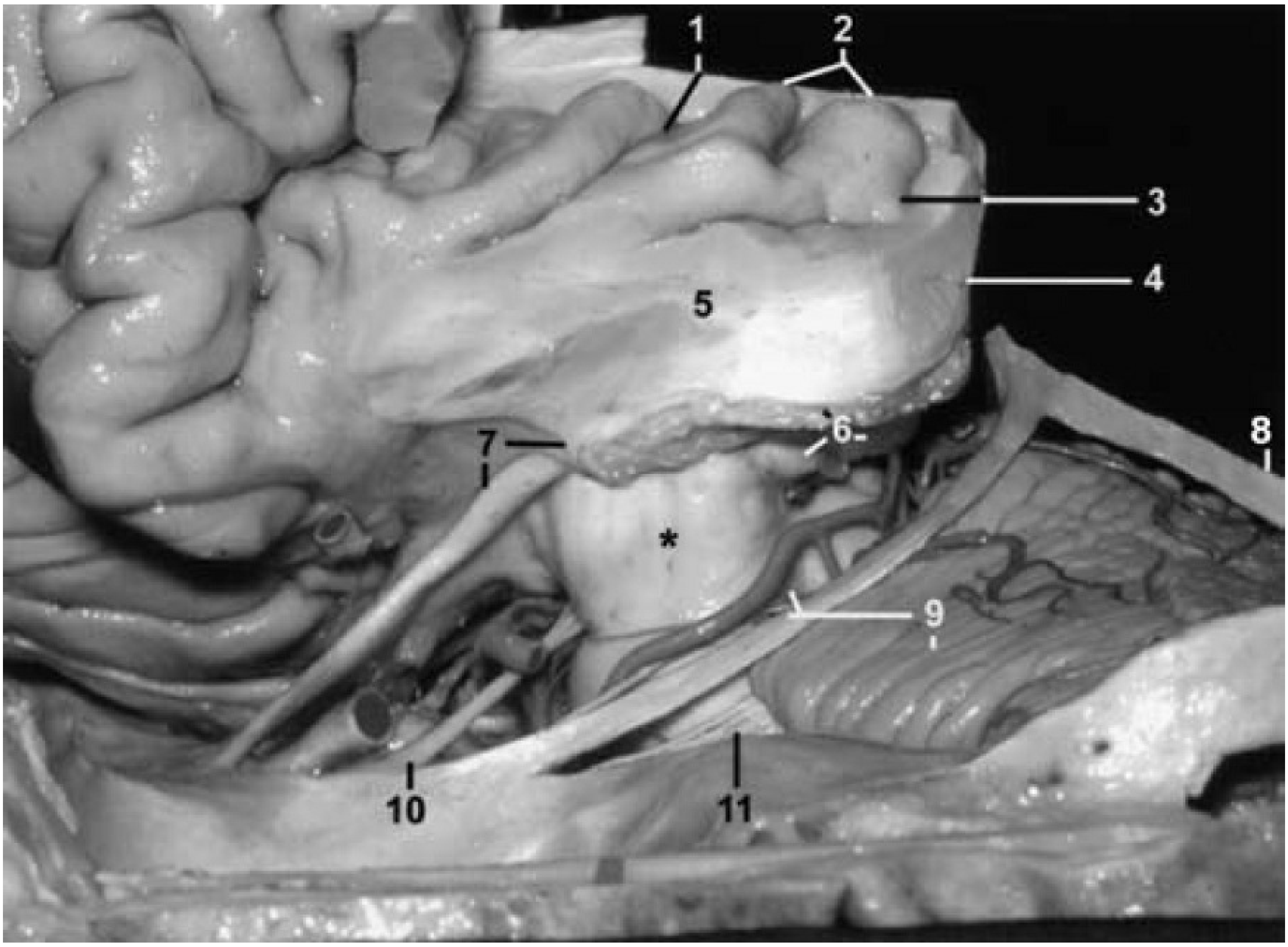


Figure 7. Photograph (lateral view) displaying the left tentorium cerebelli and its medial relationships. The temporal and occipital lobes have been removed. The temporal lobe was removed by sectioning the temporal stem from the inferior circular sulcus of the insula to the choroidal fissure. 1 = central sulcus of the insula; 2 = long gyri of the insula; 3 = posterior end of the inferior circular sulcus of the insula; 4 = pulvinar of the thalamus; 5 = temporal stem; 6 = choroidal fissure, pulvinar of the thalamus, and medial geniculate body; 7 = optic tract, lateral geniculate body, and inferior choroidal point; 8 = straight sinus; 9 = beginning of the ascending portion of the free edge of the tentorium and the lateral mesencephalic sulcus; 10 = oculomotor nerve; 11 = trigeminal nerve; * = crus cerebri. (Image courtesy of AL Rhoton, Jr.)

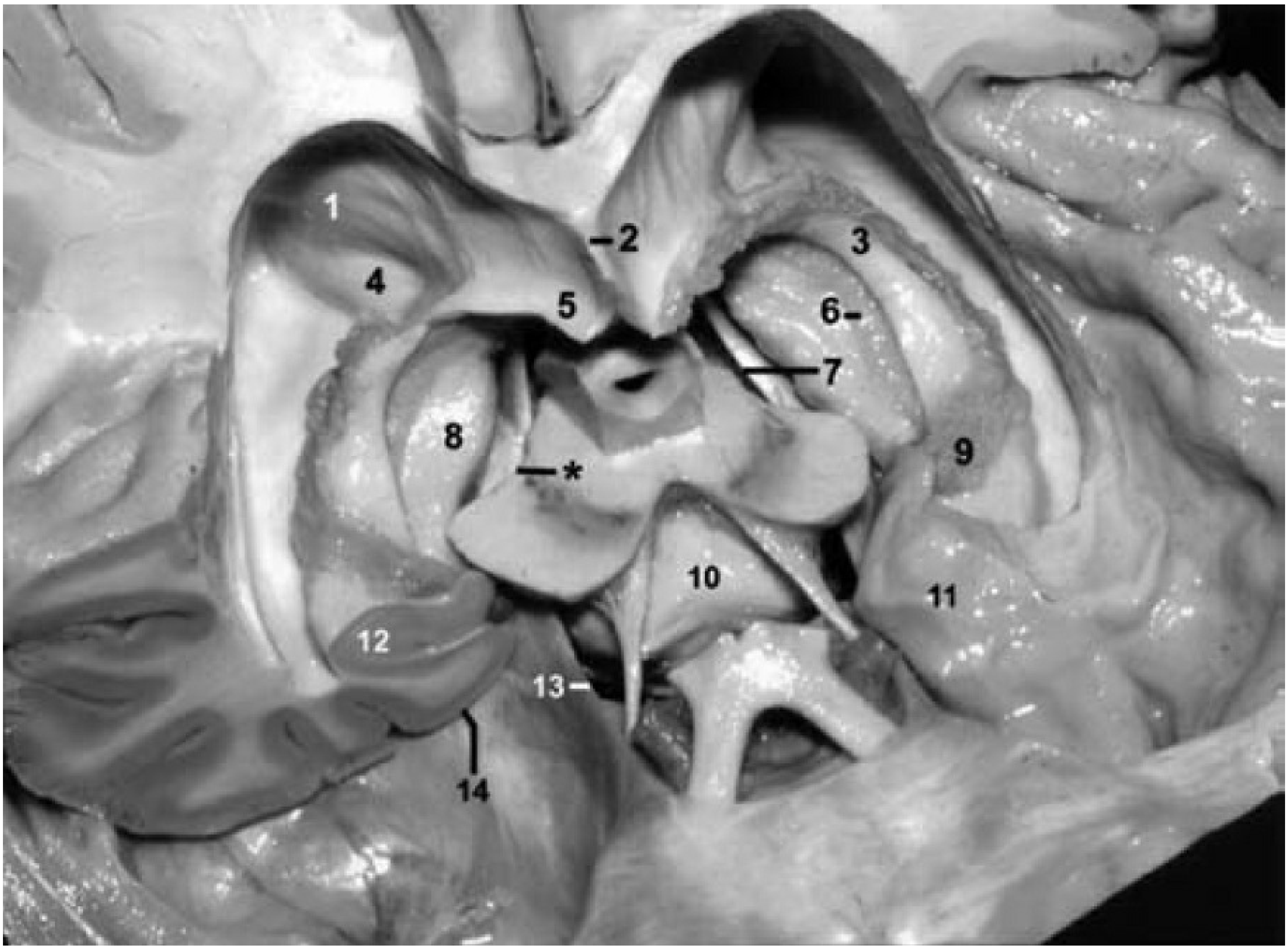


Figure 8. Photograph (right anterolateral view) obtained following removal of the basal ganglia, thalamus, and frontal lobe on both sides. Additional coronal sectioning of the right temporal lobe has been performed to show the relationship between the free edge of the tentorium and the parahippocampal gyrus. 1 = bulb of the callosum (splenium of the corpus callosum); 2 = septum pellucidum; 3 = crus fornicis; 4 = calcar avis; 5 = body of the fornix; 6 = dentate gyrus; 7 = ascending portion of the free edge of the tentorium; 8 = parahippocampal gyrus; 9 = choroid plexus; 10 = pons; 11 = uncus; 12 = hippocampus; 13 = horizontal portion of the free edge of the tentorium; 14 = parahippocampal gyrus; * = lateral mesencephalic sulcus. (Image courtesy of AL Rhoton, Jr.)

From a lateral perspective, the posterior/ascending portion of the tentorium cerebelli is located more anteriorly than the choroid plexus of the atrium, because the glomus is inserted at the most posterior end of the pulvinar of the thalamus, which bulges into the atrium and because the ascending portion is located under and then behind the posteromedial portion of the pulvinar, which forms the roof of the quadrigeminal cistern

(Fig. 9).

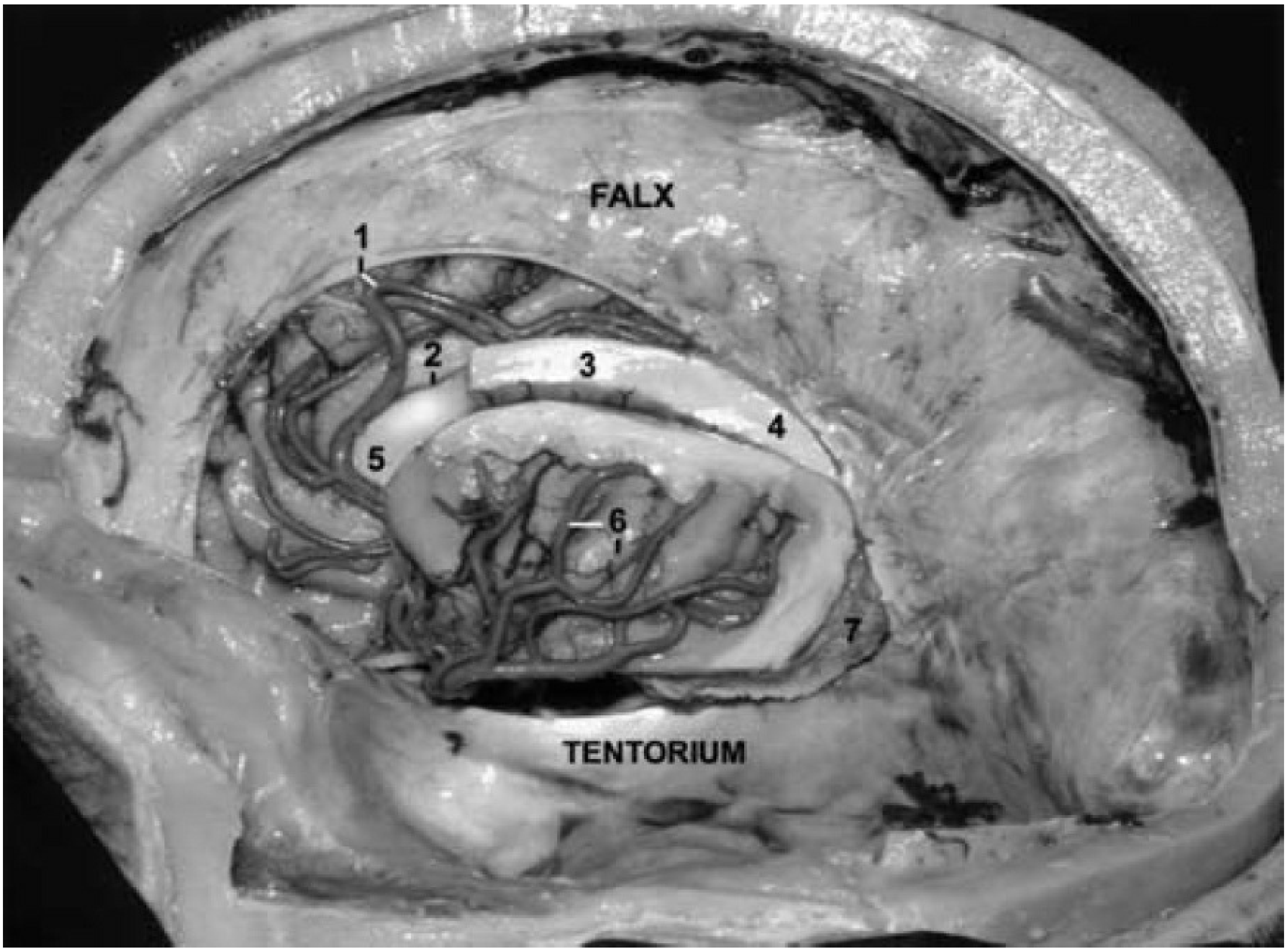


Figure 9. Photograph (lateral view) of the left insula. Most of the left hemisphere has been removed except the central core to display the relationship among the central core, corpus callosum, free edge of the tentorium, and falx. The ascending portion of the tentorium is hidden by the choroid plexus. 1 = ACA; 2 = callosal sulcus; 3 = body of the corpus callosum; 4 = splenium of the corpus callosum; 5 = genu of the corpus callosum; 6 = insula and branches of the M2 segment of the left MCA; 7 = glomus (choroid plexus of the atrium of the lateral ventricle). (Image courtesy of AL Rhoton, Jr.)

Falx. The falx is a crescent-shaped sheet of dura mater that is attached anteriorly to the crista galli. Posteriorly, the falx blends into the midline with the tentorium cerebelli and is located above the straight sinus and behind the splenium of the corpus callosum. It then arches anteriorly and superiorly, bordering the upper portion of the splenium of the corpus callosum. At the transition between the splenium and the body of the corpus callosum, however, in most cases the free edge of the falx arches anteriorly at a higher level—no longer on the edge of the corpus callosum (Figs. 5 and 9).

Anterior Cerebral Artery. The important segments of the ACA are those coursing around the corpus callosum, especially those extending from the genu to the splenium of the corpus callosum. These segments are usually located in the callosal sulcus, which is situated between the corpus callosum and the cingulate gyrus (Fig. 5); however, some portions of these segments can be tortuous and related more to the cingulate gyrus than the corpus callosum (Figs. 5 and 9).

Basal Surface of the Frontal Lobe. The basal surface of the frontal lobe is divided by the olfactory tract and the sulcus into two uneven portions: the smaller, medial portion is the rectus gyrus, whereas the larger, lateral portion is the orbital surface. Both the rectus gyrus and the orbital surface are limited posteriorly by the anterior perforated substance. From a surgical viewpoint, the anterior perforated substance is not only the entry and exit site for lenticulostriate arteries and veins, but it also represents the site where the anteroinferior portion of the basal ganglia rises to the surface. The frontal horn and the head of the caudate nucleus are located inside the frontal lobe, anterior to the anterior perforated substance (Fig. 10).

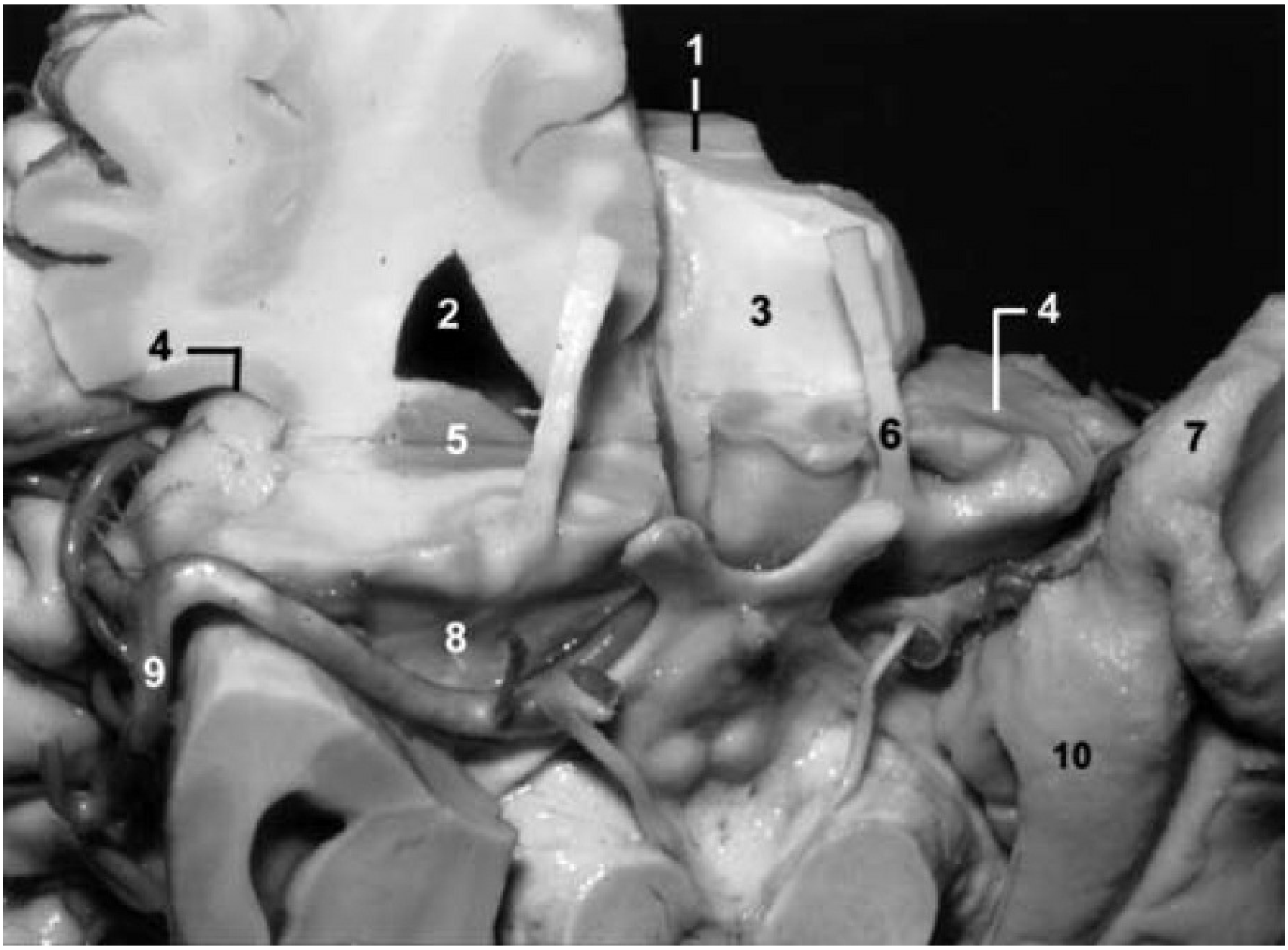


Figure 10. Photograph (basal view) of the frontal lobe displaying the direction of the disconnection of the fibers from the frontal lobe. The superficial sulci and gyri have been removed. 1 = genu of the corpus callosum; 2 = cavity of the frontal horn; 3 = rostrum of the corpus callosum; 4 = posterior wall of the anterior limiting sulcus of the insula (anterior surface of the insula); 5 = head of the caudate nucleus; 6 = olfactory tract; 7 = temporal lobe; 8 = anterior perforated substance; 9 = MCA (M2 segment); 10 = anterior portion of the parahippocampal gyrus. (Image courtesy of AL Rhoton, Jr.)

Surgical Application of the Anatomical Landmarks

Among the varieties of hemispherotomy, we chose that described by Schramm and colleagues[10] as a hemispheric deafferentation because it starts with the removal of the mesial temporal lobe structures and access to the lateral ventricle is gained through the temporal horn. Given that amygdalohippocampectomy and anterior temporal lobectomy are familiar procedures to most epilepsy surgeons, it seemed safer and easier to start the hemispherotomy from the temporal lobe.

We demonstrated the practical application of the anatomical landmarks during a hemispherotomy performed in a 16-year-old girl who had suffered from left hemiparesis since birth and refractory epileptic seizures since the age of 3 years. The electroencephalography recordings showed continuous spikes originating from the right cerebral hemisphere, mainly from the posterior quadrant, and preoperative MR images demonstrated atrophy and an enlarged lateral ventricle (Fig. 11). The patient was placed supine with a cushion under the shoulder ipsilateral to the right hemisphere. The skin incision consisted of a combination of segments, as displayed in Fig. 12. The craniotomy was large enough to expose the cerebral hemisphere—usually 3 to 4 cm away from the midline and 2 cm away from the transverse sinus. We avoided the frontal sinus.

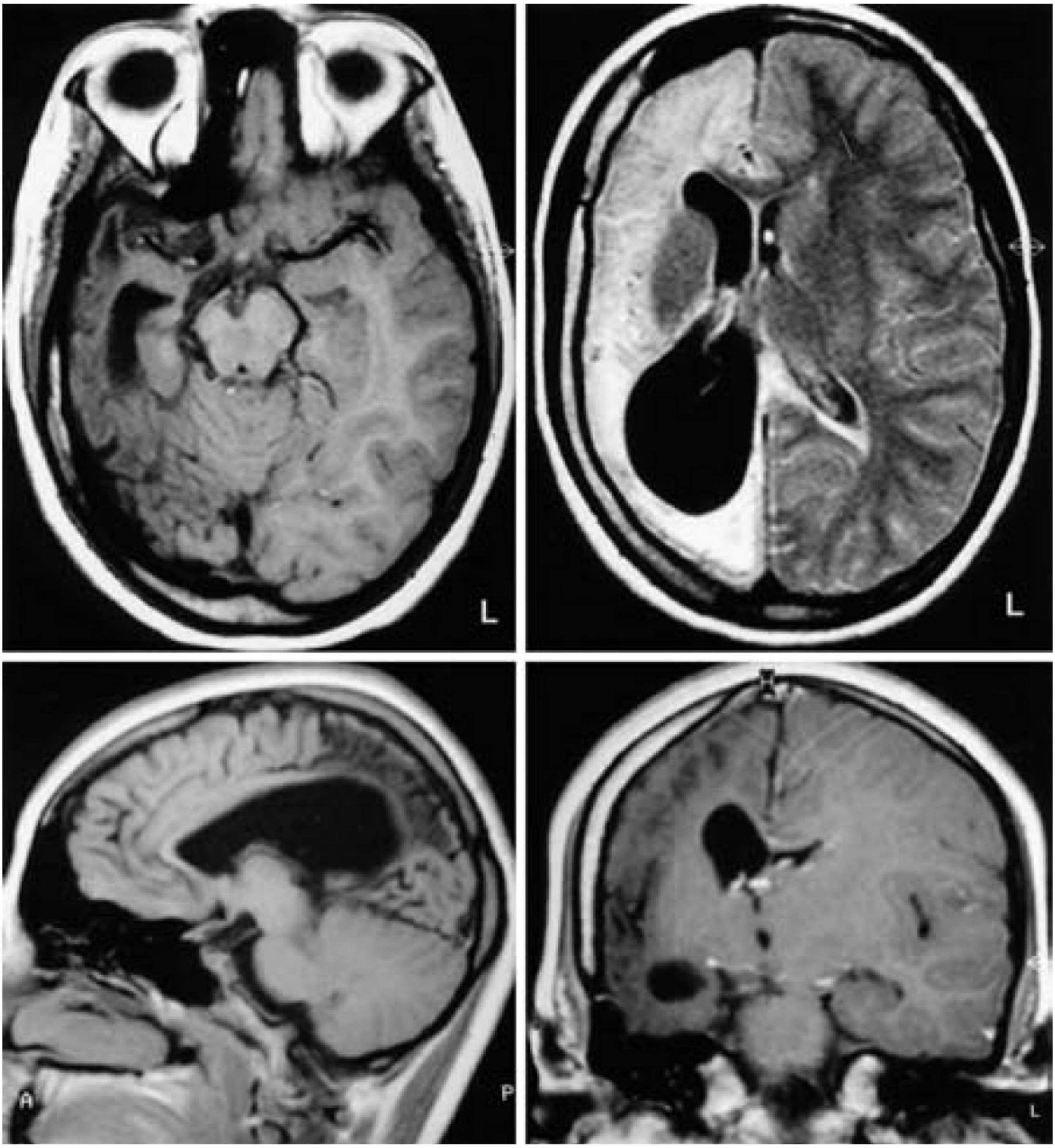


Figure 11. Preoperative MR images obtained in a 16-year-old girl, demonstrating atrophy of the right hemisphere and an enlarged right lateral ventricle. (Images courtesy of AL Rhoton, Jr.)

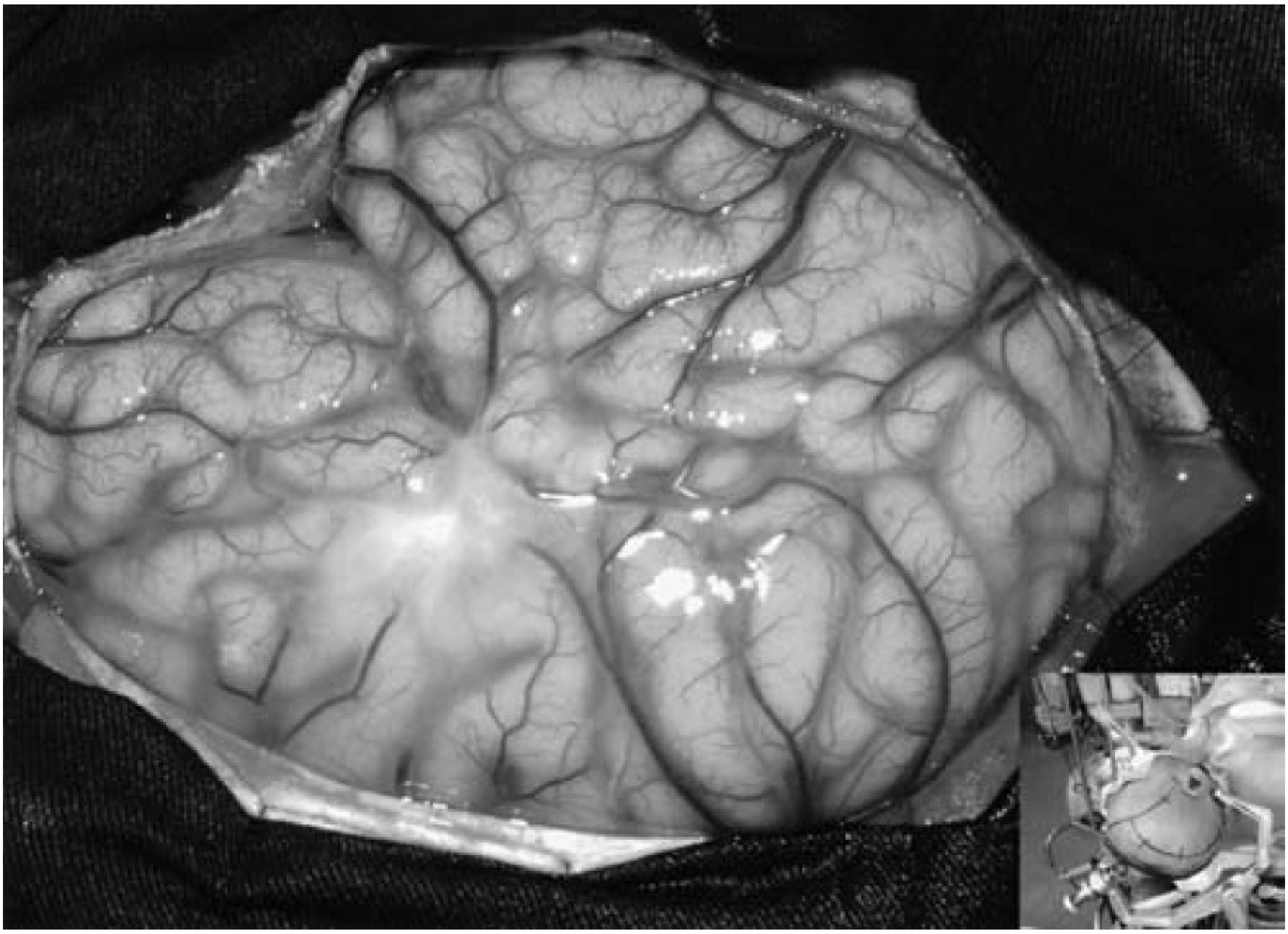


Figure 12. Photograph depicting exposure of the right hemisphere after performing the craniotomy and dural opening. *Inset:* Position of the patient; marks indicate the skin incision. (Image courtesy of AL Rhoton, Jr.)

Whenever possible in our cases, we split the sylvian fissure and exposed the insula. The inferior circular or limiting sulcus of the insula is then identified, and a dissection through that sulcus is conducted toward the floor of the middle fossa until the dilated temporal horn is reached. Thereafter, a selective amigdalohippocampectomy[18] or an anterior temporal lobectomy[13] is performed. Suitable anatomical landmarks for an amygdalohippocampectomy have been reported previously.[16,17]

While exposing and removing the mesial temporal lobe structures, the entrance into the atrium is identified. The dissection proceeds with the removal of the operculum of the supramarginal gyrus laterally overlying the atrium of the lateral ventricle to expose the atrium (Fig. 13). During this stage, important branches of the MCA that supply the parietal and occipital lobes and large draining veins are preferably preserved.

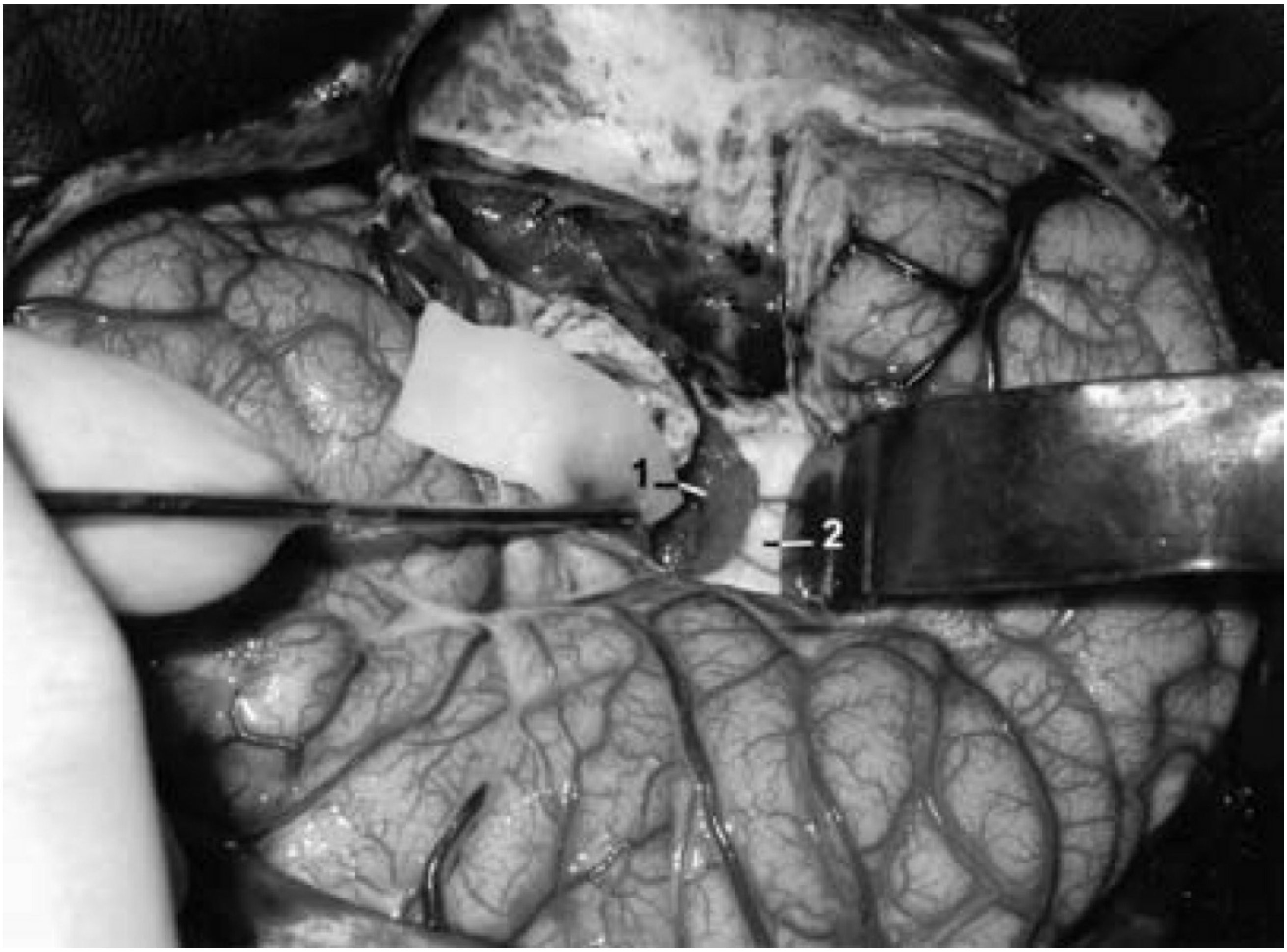


Figure 13. Photograph illustrating exposure of the medial wall of the atrium following an anterior temporal lobectomy and removal of the supramarginal gyrus. 1 = choroid plexus; 2 = medial wall of the atrium. (Image courtesy of AL Rhoton, Jr.)

The horizontal portion of the tentorium cerebelli exposed after removal of the mesial temporal structures is followed posteriorly to reveal its ascending portion. After identifying the ascending edge of the tentorium, several structures—the medial wall of the atrium (calcar avis and bulb of the callosum), the tail of the hippocampus, the crus fornicis, the precuneus, and the cuneus—are disconnected behind the choroid plexus of the atrium by following the free edge of the tentorium up to its junction with the falx (Figs. 14 and 15). During this stage, it is wise to preserve important inferior temporal, calcarine, and parietooccipital arteries, which will ultimately supply the posterior portion of the cerebral hemisphere. Disconnecting the medial wall of the atrium by following the ascending free edge of the tentorium is continued up to the roof of the atrium, which is formed by the splenium of the corpus callosum.

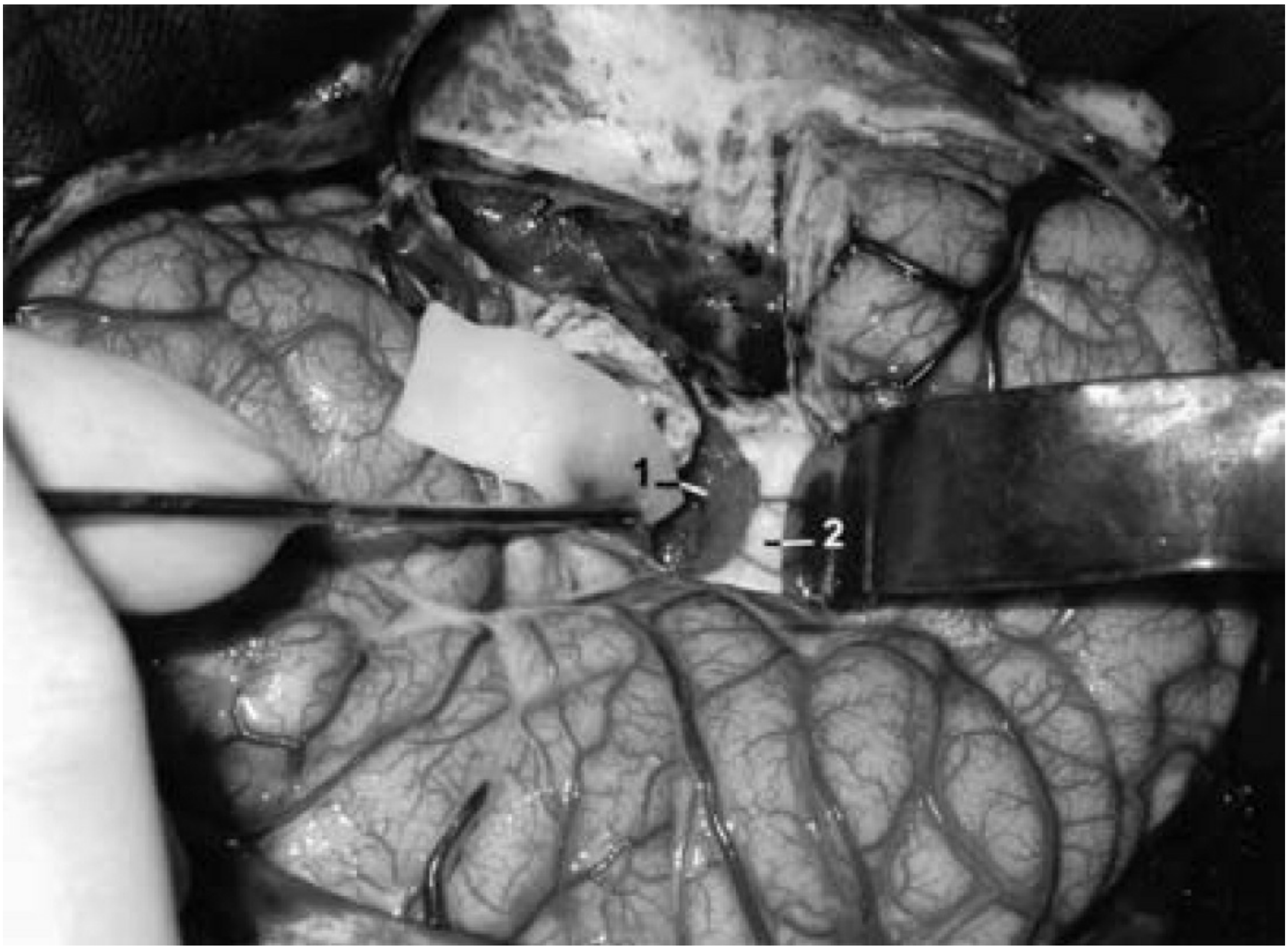


Figure 14. Photograph (overall surgical view) exhibiting the free edges of the tentorium and falx after disconnecting structures through the medial wall of the atrium. *Black arrow* indicates the horizontal portion of the free edge of the tentorium and *white arrows* indicate the ascending portion. (Image courtesy of AL Rhoton, Jr.)

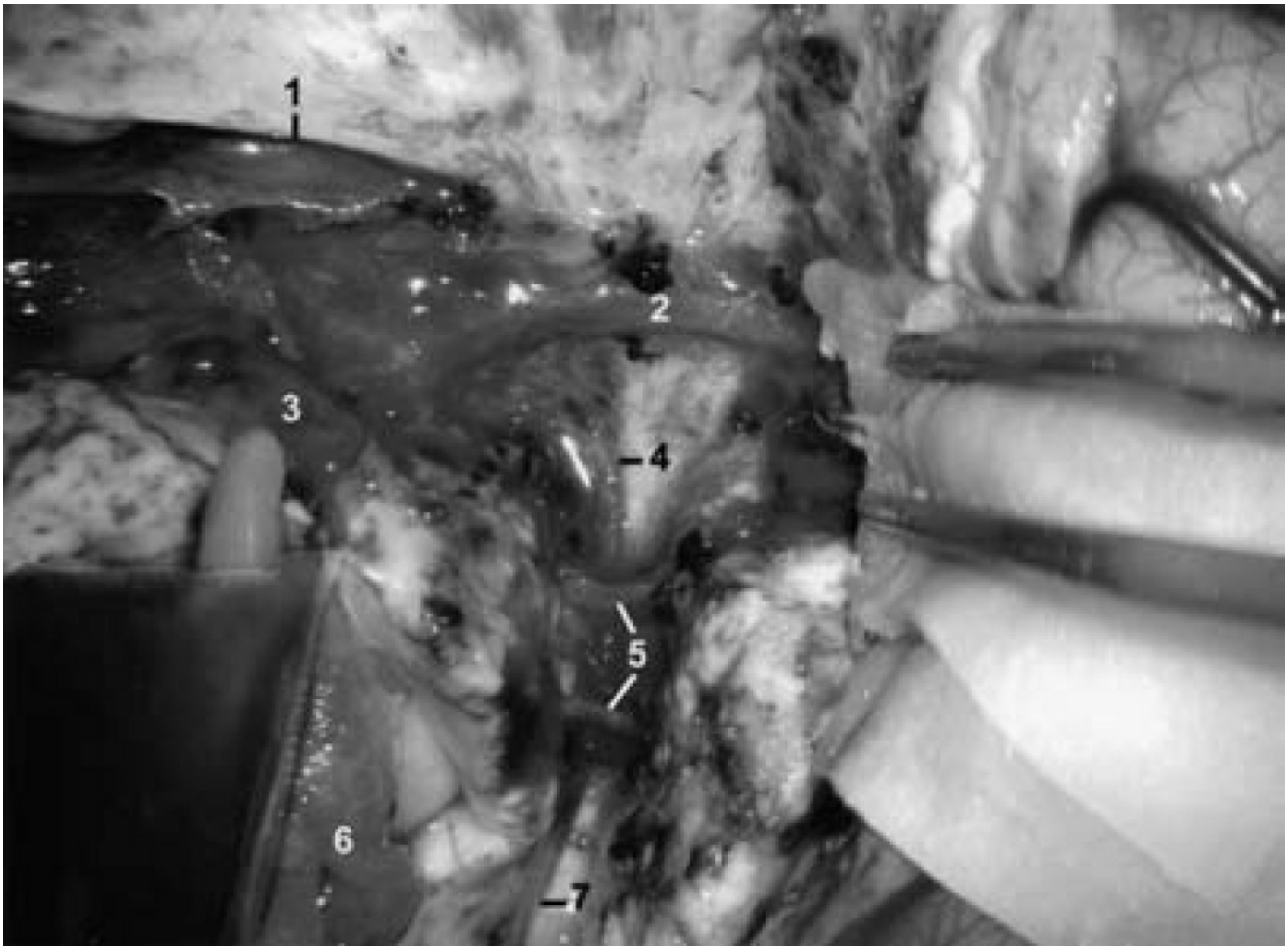


Figure 15. Magnified view of photograph in Fig. 14. 1 = horizontal portion of the free edge of the tentorium; 2 = inferior temporal artery; 3 = choroid plexus of the temporal horn; 4 = ascending portion of the free edge of the tentorium and arachnoid membrane of the quadrigeminal cistern; 5 = branches of the posterior cerebral artery, probably the calcarine and parietooccipital arteries; 6 = choroid plexus of the atrium; 7 = free edge of the falx and arachnoid membrane of the quadrigeminal cistern. (Image courtesy of AL Rhoton, Jr.)

The next step requires removal of part of the postcentral, precentral, and inferior frontal gyri that overlie the lateral ventricle to expose the body and frontal horn of the lateral ventricle (Fig. 16) and to perform an intraventricular callosotomy. The angle formed by the septum pellucidum and corpus callosum, which constitutes the roof of the lateral ventricle, can be easily identified. Considering the working angle of the surgeon, however, the intraventricular callosotomy must be performed 4 to 5 mm off the midline (Fig. 17). After reaching the ACA and the callosal sulcus, either of these landmarks can be followed throughout the body, around the genu, and down to the rostrum of the corpus callosum (Figs. 18 and

19).

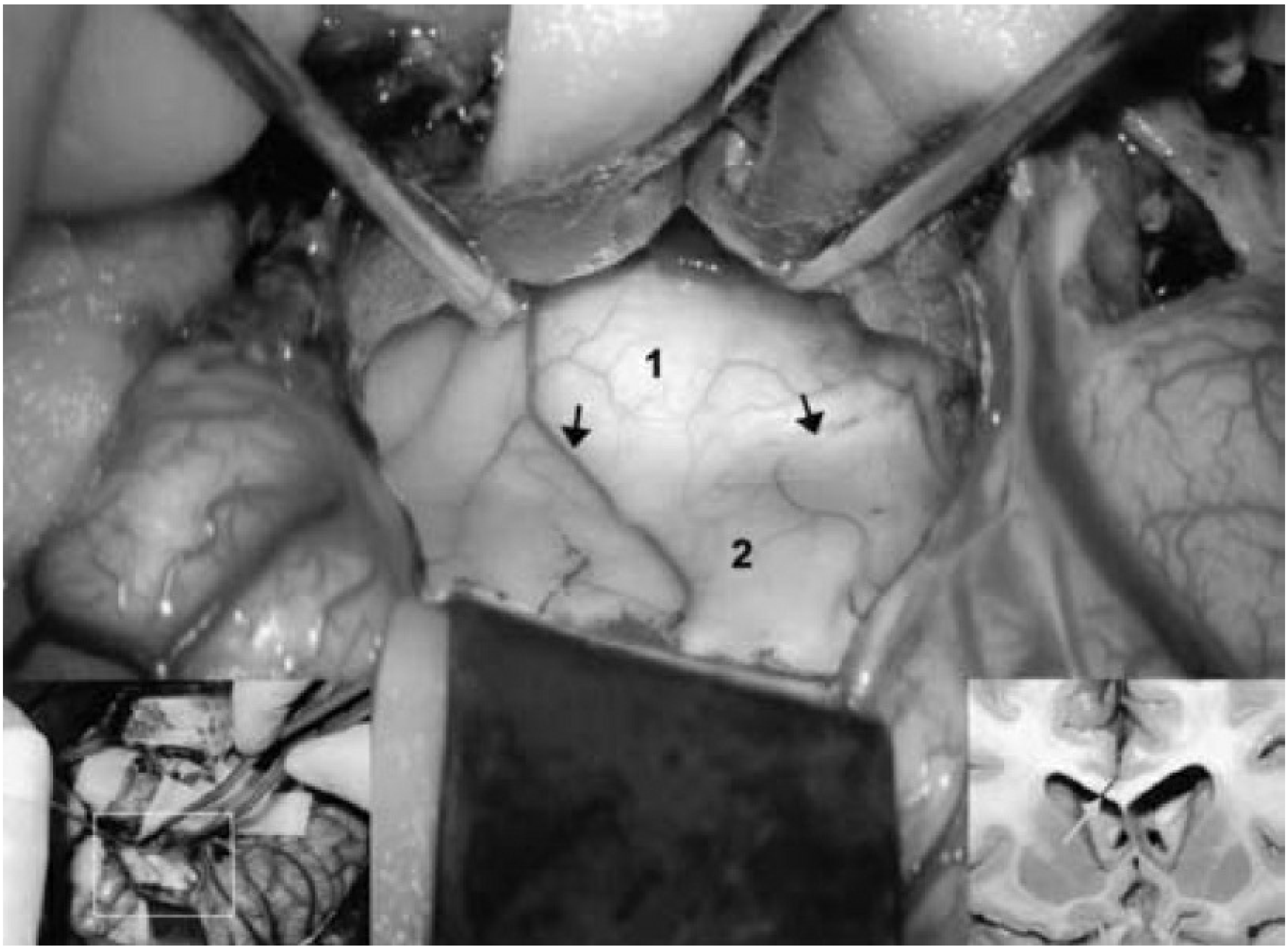


Figure 16. Photograph exposing the body of the lateral ventricle. The overall view is displayed in the lower left inset, and the angle required to perform the intraventricular callosotomy is featured in the lower right inset. *Arrows* indicate the transition line between the septum pellucidum (midline) and the corpus callosum. 1 = septum pellucidum; 2 = corpus callosum. (Image courtesy of AL Rhoton, Jr.)

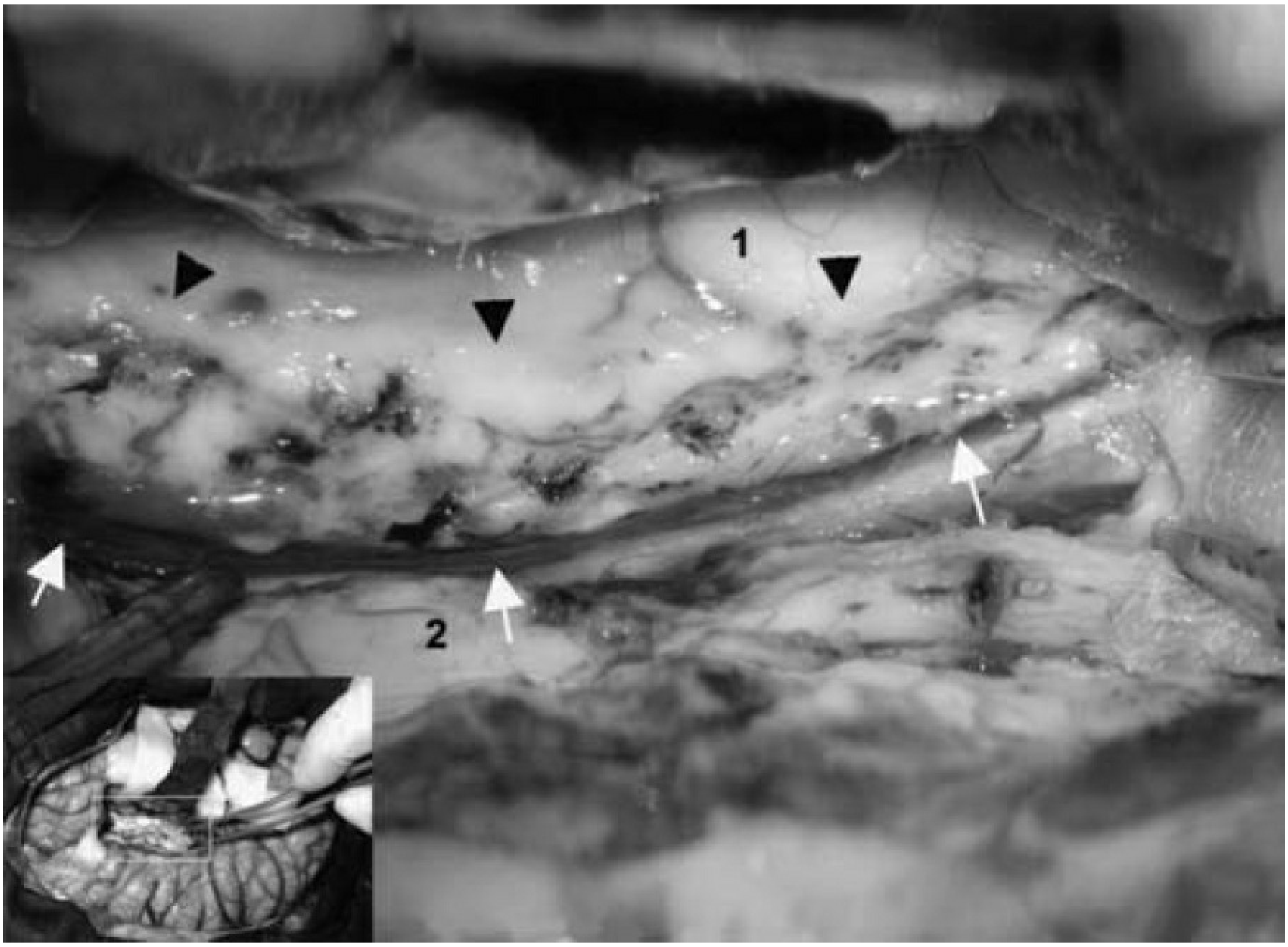


Figure 17. Photograph demonstrating the intraventricular callosotomy at the body of the lateral ventricle. *White arrows* indicate the line of the callosotomy and the ACA. *Black arrowheads* indicate the angle formed by the septum pellucidum and corpus callosum. *Inset:* Overall view. 1 = septum pellucidum; 2 = corpus callosum. (Image courtesy of AL Rhoton, Jr.)

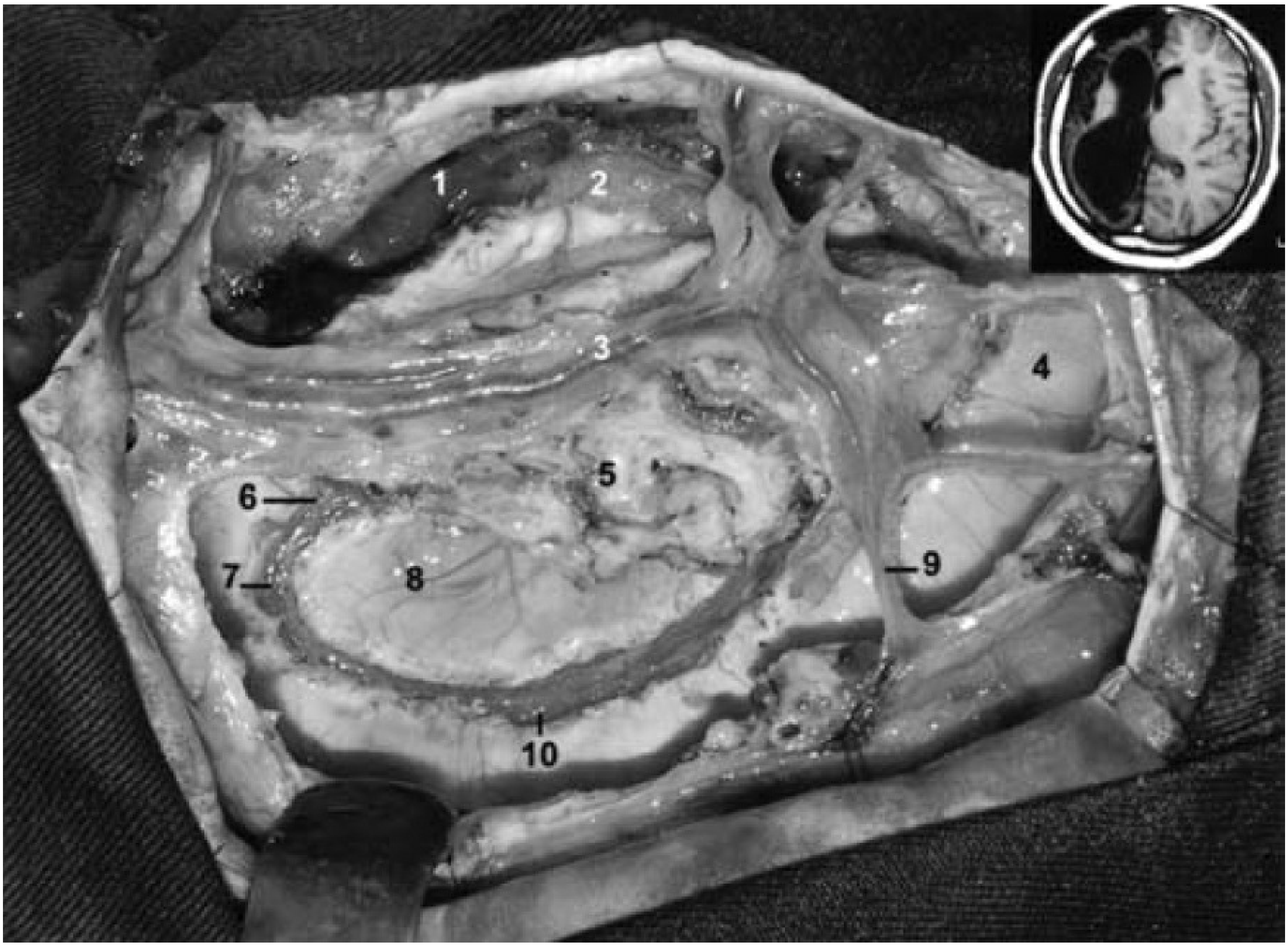


Figure 18. Intraoperative photograph obtained in a patient with extreme ventriculomegaly, showing the trajectory of the intraventricular callosotomy from the splenium to the rostrum. *Inset:* Preoperative MR image. 1 = arachnoid membrane of the floor of the middle fossa after selective amygdalohippocampectomy; 2 = choroid plexus of the temporal horn; 3 = superficial sylvian vein; 4 = atrium; 5 = central core; 6 = ACA under the rostrum of the corpus callosum; 7 = ACA ahead of the genu of the corpus callosum; 8 = septum pellucidum; 9 = branch of the MCA; 10 = ACA above the body of the corpus callosum. (Image courtesy of AL Rhoton, Jr.)

The intraventricular callosotomy is complete after disconnecting the rostrum of the corpus callosum, which is the floor of the anterior horn, and reaching the interhemispheric fissure. Note that the interhemispheric fissure can be identified either by the arachnoid membrane or the ACAs. The disconnection then proceeds inferiorly toward the basal surface of the frontal lobe and anteriorly to the anterior edge of the head of the caudate nucleus, which bulges as the lateral wall of the frontal horn.[15] The lesser wing of the sphenoid is also a good landmark to follow because it indicates that one is close to the posterior limit of the basal surface of the frontal lobe (Fig. 19). The hemispherotomy is complete with the removal of the frontal and parietal opercula overlying the insula, within the boundaries of the disconnection lines (Fig. 20).

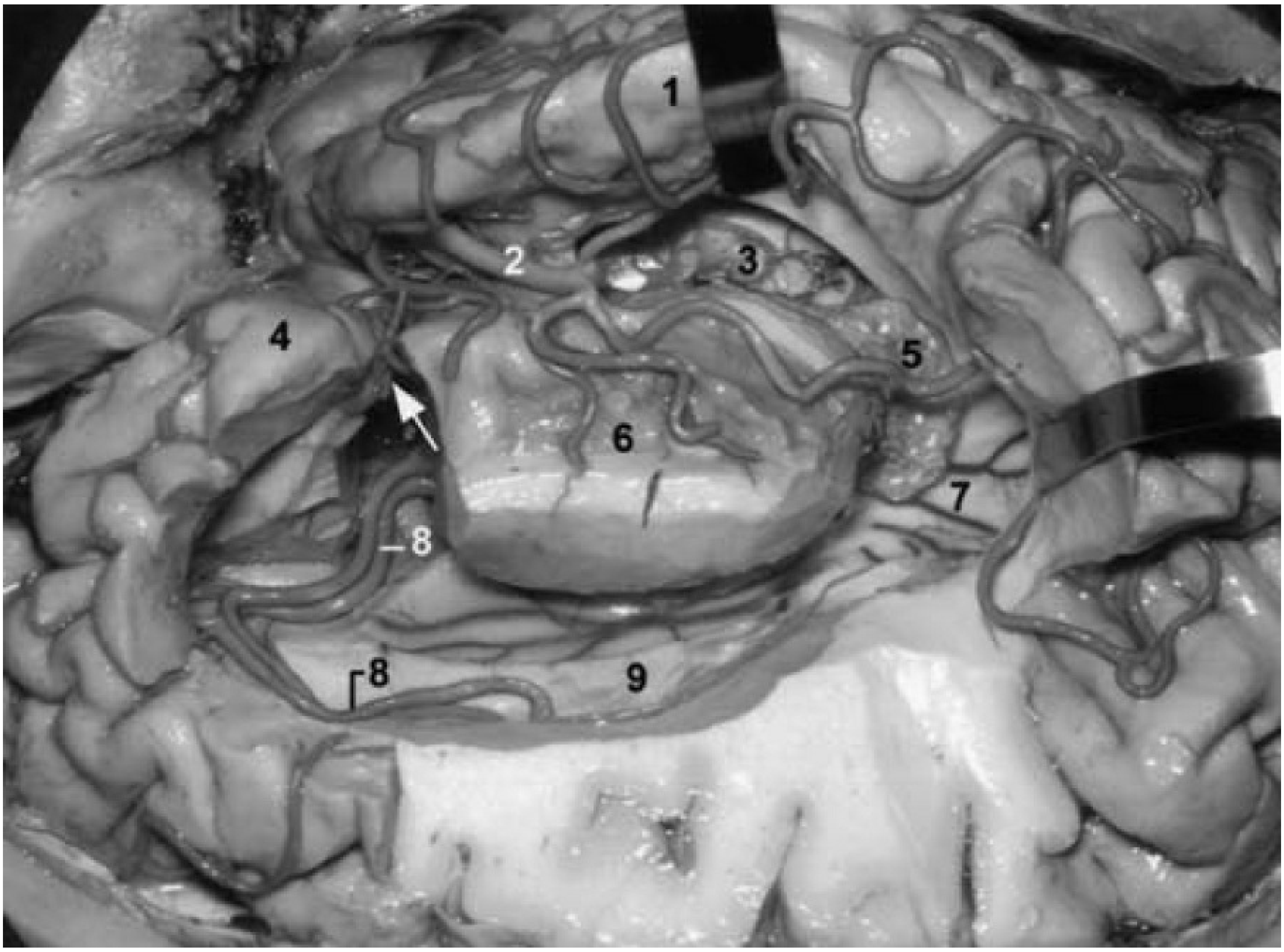


Figure 19. Photograph of an anatomical dissection displaying the effects of an intraventricular callosotomy. In this specimen, the disconnection of the medial wall of the atrium has not been performed. *Arrow* indicates the direction for the disconnection of the basal portion of the frontal lobe. 1 = temporal lobe; 2 = MCA; 3 = arachnoid membrane over the middle fossa floor (after selective removal of the hippocampus); 4 = frontal lobe; 5 = choroid plexus of the atrium; 6 = insula; 7 = medial wall of the atrium; 8 = ACA; 9 = corpus callosum. (Image courtesy of AL Rhoton, Jr.)

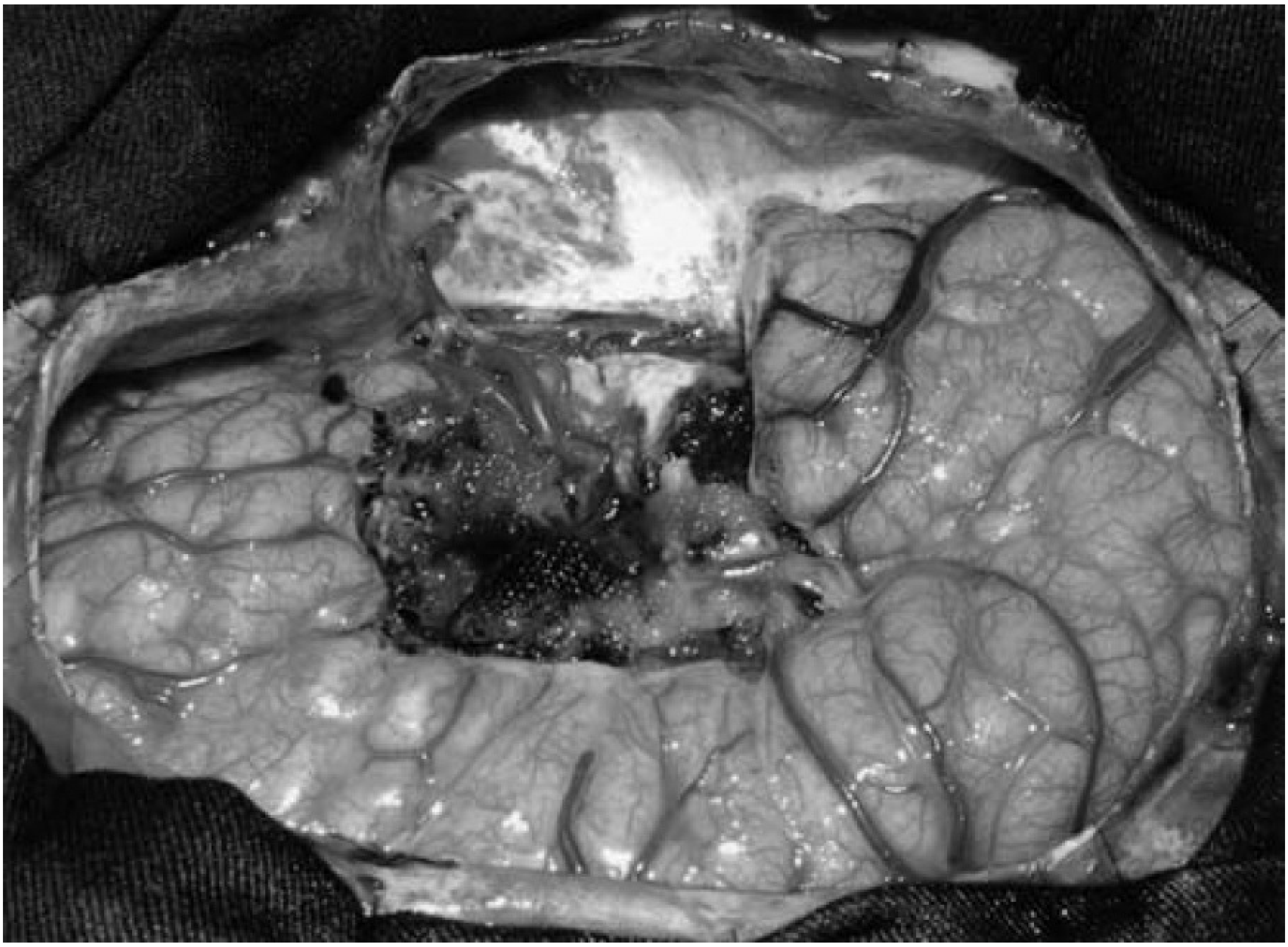
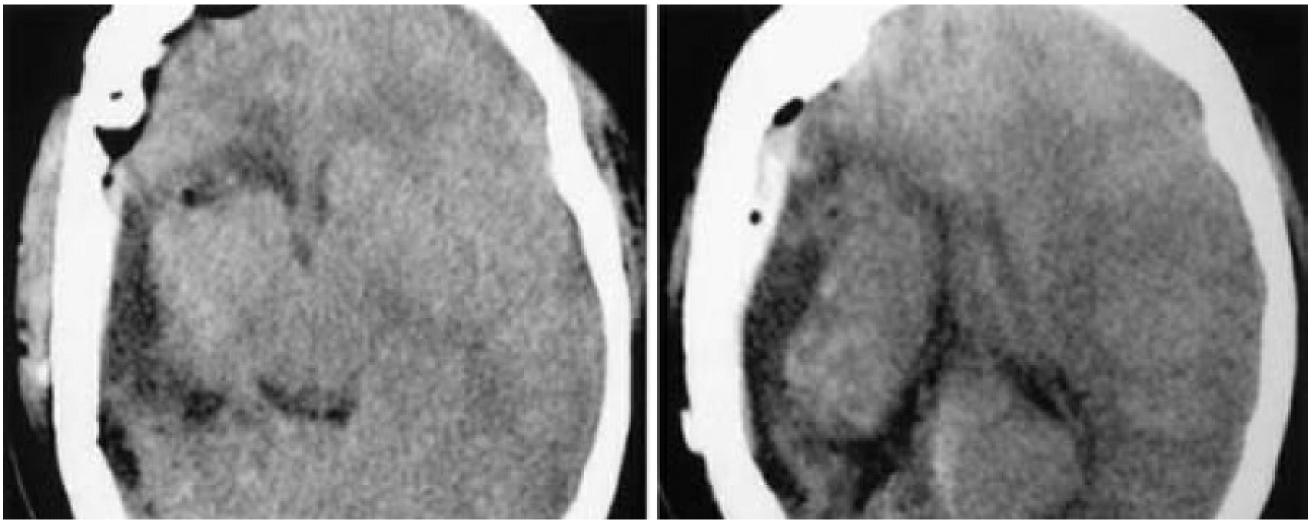


Figure 20. Photograph depicting the final aspect of the brain after a hemispherotomy was performed. The frontal and parietal opercula overlying the insula and situated within the limits of the disconnection lines have been removed. The surface of the insula has been covered with oxidized cellulose. (Image courtesy of AL Rhoton, Jr.)

Postoperative images obtained in the case of the 16-year-old girl are featured in Fig. 21. She had an uneventful postoperative course and was discharged 5 days after surgery. She has been free of seizures ever since (14-month follow-up period), although she continues to take medication.



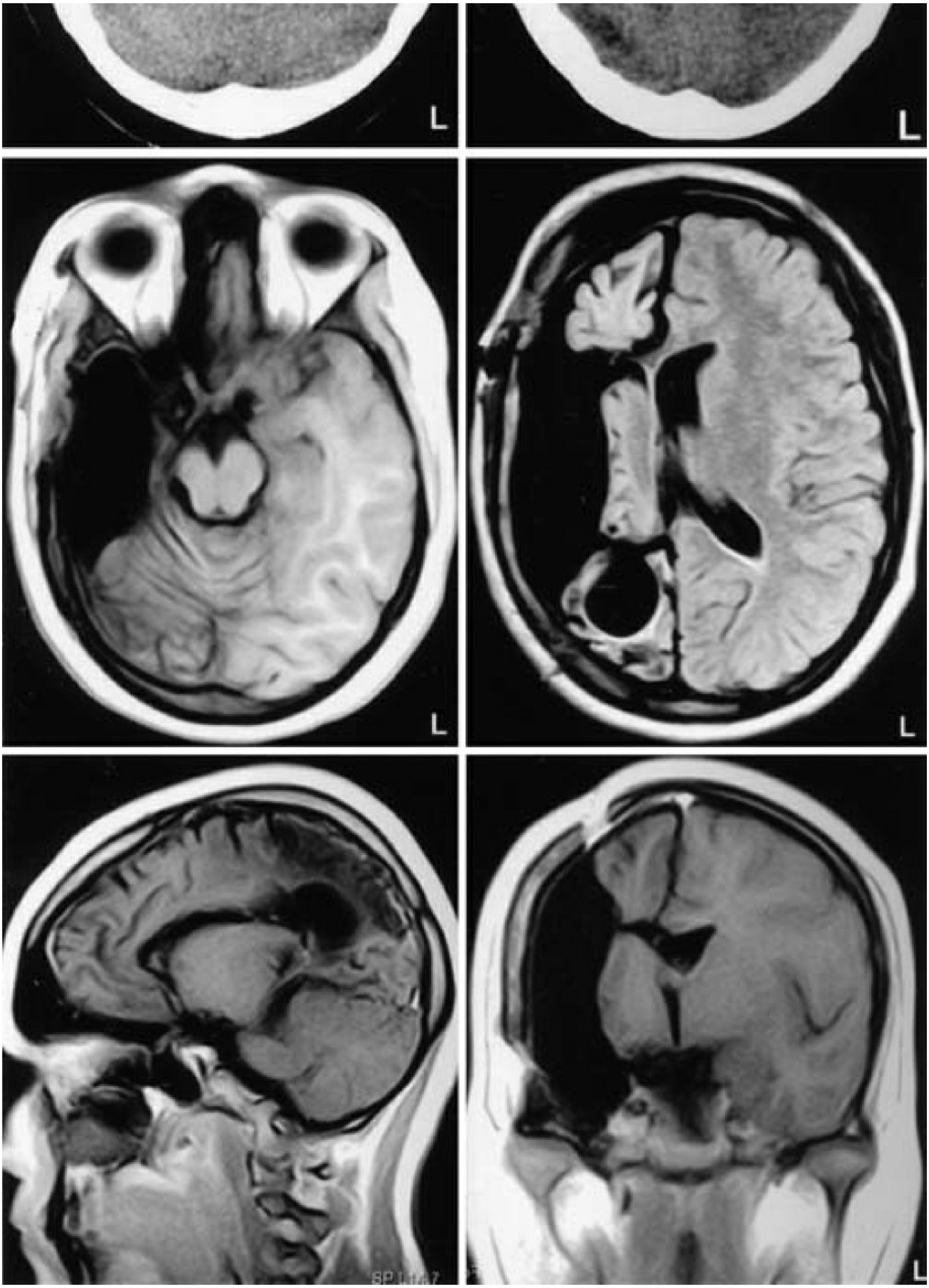


Figure 21. *Upper*: Computerized tomography scans obtained 4 hours after surgery. *Center and Lower*: Postoperative MR images obtained 5 months after surgery. (Images courtesy of AL Rhoton, Jr.)

DISCUSSION

Except for the procedures described by Delalande, et al.,[1] who introduced the term “hemispherotomy,” the surgical techniques of most hemispherotomies share basically the same principles.[2–5,10–12,14] The methods differ mainly in how the lateral ventricle is accessed, the extent of removal or preservation of the insula, the degree of preservation or ligation of the branches of the MCA, and the size of the craniotomy. In essence, all of the techniques are periinsular or transopercular in nature and promote deafferentation of the hemisphere. Note that the anatomical landmarks presented in this paper can be useful in all aforementioned techniques.

The sequence introduced by Schramm and colleagues,[10] which starts from the temporal lobe, seemed to be the easiest because most epilepsy surgeons are familiar with an anterior temporal lobectomy or a selective amygdalohippocampectomy and because during that stage of surgery, opening the temporal horn is mandatory. Once the temporal horn has been identified, localization of the other parts of the lateral ventricle is straightforward. During a temporal lobectomy or selective amygdalohippocampectomy, the free edge of the tentorium is easily located and can be followed up to the splenium of the corpus callosum. The choroid plexus is also an important landmark because it denotes the location of the choroidal fissure, which separates the thalamus and the fornix. Disconnecting the medial wall of the atrium must be performed a few millimeters behind the glomus to avoid injury to the thalamus. The free edge of the falx is an excellent landmark for disconnecting up to the transition between the splenium and the body of the corpus callosum. There, the intraventricular callosotomy must be performed by following other landmarks described earlier; either the ACA or the callosal sulcus can be useful landmarks.

Another issue is whether one should preserve or ligate the branches of the MCA during removal of the frontal and parietal opercula. Undoubtedly, the ligation of these branches will shorten the operation time, reduce blood loss, and provide more room for the intraventricular callosotomy. Ligation of these branches, however, will cause devascularization of disconnected brain tissue, which will ultimately be absorbed. In the long run, there will probably be little difference between the results of a hemispherotomy and those of an anatomical hemispherectomy regarding remaining brain tissue.

CONCLUSIONS

Hemispherotomy is an effective procedure aimed to isolate the entire hemisphere functionally with minimal removal of brain tissue and is primarily indicated for refractory hemispheric epilepsy. Although considered to be part of functional neurosurgery, epilepsy surgery—especially hemispherotomy or hemispherectomy—is an anatomy-based microsurgery. The anatomical landmarks presented in this paper can serve as an intraoperative guide in disconnecting an entire cerebral hemisphere and can be used in most hemispherotomy procedures.

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Content from Wen HT, Rhoton AL, Jr, Marino R, Jr. Anatomical landmarks for hemispherotomy and their clinical application. *J Neurosurg* 2004;101:747–755. doi.org/10.3171/jns.2004.101.5.0747.

The Neurosurgical Atlas is honored to maintain the legacy of Albert L. Rhoton, Jr, MD.

REFERENCES

1. Delalande O, Pinard JM, Basdevant C, et al: Hemispherotomy:a new procedure for central disconnections. Epilepsia 33(Suppl 3):99–100, 1992 (Abstract)
2. Kanev PM, Foley CM, Miles D: Ultrasound-tailored functional hemispherectomy for surgical control of seizures in children. J Neurosurg 86:762–767, 1997
3. Kestle J, Connolly M, Cochrane D: Pediatric peri-insular hemispherotomy. Pediatr Neurosurg 32:44–47, 2000

4. Morino M, Shimizu H, Matsusaka Y, et al: Microsurgical anatomy for transopercular hemispherotomy, in Ohata K (ed): Surgical Anatomy for Microneurosurgery XIII—Principles of Neurosurgical Approaches Based on Microneurosurgical Anatomy—. Tokyo: 2000, pp 127–136
5. Morino M, Shimizu H, Ohata K, et al: Anatomical analysis of different hemispherotomy procedures based on dissection of cadaveric brains. J Neurosurg 97:423–431, 2002
6. Ono M, Ono M, Rhoton AL Jr, et al: Microsurgical anatomy of the region of the tentorial incisura. J Neurosurg 60:365–399, 1984
7. Rasmussen T: Cerebral hemispherectomy: indications, methods, and results, in Schmidek HH, Sweet WH (eds): Operative Neurosurgical Techniques. Indications, Methods, and Results, ed 2. Orlando: Grune & Stratton, 1988, Vol 2, pp 1235–1241
8. Rasmussen T: Hemispherectomy for seizures revised. Can J Neurol Sci 10:71–78, 1983
9. Rhoton AL Jr: The cerebrum. Neurosurgery 51 (Suppl 4):S1-1–S1-51, 2002
10. Schramm J, Behrens E, Entzian W: Hemispherical deafferentation: an alternative to functional hemispherectomy. Neurosurgery 36:509–516, 1995
11. Schramm J, Kral T, Clusmann H: Transsylvian keyhole functional hemispherectomy. Neurosurgery 49:891–901, 2001
12. Shimizu H, Maehara T: Modification of peri-insular hemispherotomy and surgical results. Neurosurgery 47:367–373, 2000
13. Spencer DD, Spencer SS, Mattson RH, et al: Access to the posterior medial temporal lobe structures in the surgical treatment of temporal lobe epilepsy. Neurosurgery 15:667–671, 1984
14. Villemure JG, Mascott CR: Peri-insular hemispherotomy: surgical principles and anatomy. Neurosurgery 37:975–981, 1995
15. Wen HT, Mussi ACM, Rhoton AL Jr: Surgical anatomy of the brain, in Winn HR (ed): Youmans Neurological Surgery, ed 5. Philadelphia:

Saunders, 2003, Vol 1, pp 5–44

16. Wen HT, Rhoton AL Jr, de Oliveira E, et al: Microsurgical anatomy of the mesial temporal lobe as applied to amygdalohippocampectomy, in Ohata K (ed): Surgical Anatomy for Microneurosurgery XIII—Principles of Neurosurgical Approaches Based on Microneurosurgical Anatomy—. Tokyo: 2000, pp 3–20
17. Wen HT, Rhoton AL Jr, Oliveira E, et al: Microsurgical anatomy of the temporal lobe: part 1: mesial temporal lobe anatomy and its vascular relationships as applied to amygdalohippocampectomy. Neurosurgery 45:549–592, 1999
18. Yaşargil MG, Teddy PJ, Roth P: Selective amygdalo-hippocampectomy. Operative anatomy and surgical technique. Neurosurgery 12:93–123, 1985