# Chapter 2
# Introduction to Brain Anatomy

**Wieslaw L. Nowinski**

## 2.1 Introduction

The human central nervous system (CNS), having been evolved over the last 600 million years, is the most complex living organ in the known universe. It has been extensively investigated over centuries, and a vast body of materials has been gathered in the print form and more recently also in electronic format. Neuroanatomy is presented in numerous textbooks [1–22], print brain atlases [23–51], and electronic brain atlases [52–74]. Several textbooks combine text with atlases [14, 15, 43, 44], and some provide neuroanatomy for various specialties including neurosurgery [1, 19, 22], neuroradiology [8, 17, 20], neurology [2], and neuroscience [18].

The comprehension of neuroanatomy is crucial in any neurosurgical, neuroradiological, neuro-oncological, or neurological procedure. Therefore, CNS anatomy has been intensively studied by generations of neuroanatomists, neurosurgeons, neurologists, neuroradiologists, neurobiologists, and psychologists, among others, including Renaissance artists. This resulted, however, in neuroanatomy discrepancies, inconsistencies, and even controversies among various communities in terms of parcellation, demarcation, grouping, terminology, and presentation.

The present work differs from existing neuroanatomy primers. Our overall objective is to make the presentation of brain anatomy easy. To achieve this objective:

- The presentation of neuroanatomy is in three dimensions (3D) with additional supportive planar images in the orthogonal (axial, coronal, and sagittal) planes.
- The brain is subdivided into structure, vasculature, and connections (white matter tracts); consequently, we consider structural, vascular, and connectional neuroanatomies.

W.L. Nowinski (✉)
Biomedical Imaging Lab, ASTAR, Singapore
e-mail: wieslaw@sbic.a-star.edu.sg

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- 3D cerebral models of structure, vasculature, and tracts are mutually consistent because they were derived from the same brain specimen.
- 3D cerebral models and the planar images are fully parcellated; each parcellated object is uniquely colored.
- 3D cerebral models and the planar images are completely labeled; as a terminology, we use the *Terminologia Anatomica* [75].
- 3D cerebral models are electronically dissectible into groups and individual components.

In this work, we use the digital brain atlases developed in our laboratory for nearly 2 decades [63–69]. The 3D cerebral models have been created from multiple 3 and 7 Tesla magnetic resonance scans of the same brain specimen (WLN) [69]. The development of the atlases is addressed in [76–80], tools for their development in [81], techniques for modeling of cerebral structures in [76, 82, 83], and atlas-based applications in [77–80, 84–92].

## 2.2 Structural (Gross) Neuroanatomy

We present parcellation of the brain in 3D followed by sectional neuroanatomy. The stereotactic target structures and functional (Brodmann's) areas also are outlined.

### *2.2.1 Brain Parcellation*

The CNS consists of the ***brain*** and the ***spinal cord***. The brain encases the fluid-filled ***ventricular system*** and is parcellated into three main components (Fig. 2.1a):

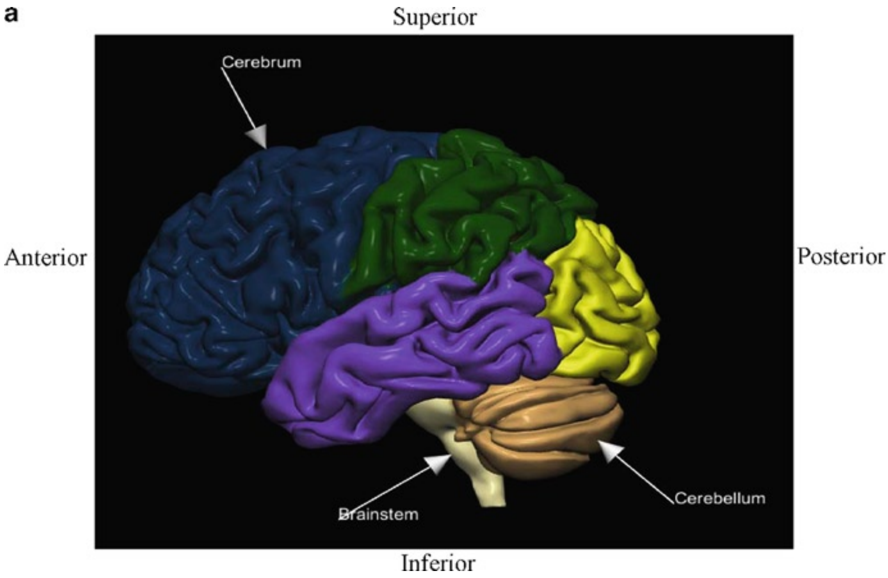
- ***Cerebrum***
- ***Cerebellum (the little brain)***
- ***Brainstem***

The cerebrum comprises:

- Left and right ***cerebral hemispheres***
- Interbrain between the cerebrum and the brainstem termed the ***diencephalon***
- ***Deep gray nuclei***

The cerebral hemispheres are the largest compartment of the brain and are interconnected by white matter fibers (see Sect. 2.4.2). The hemispheres are composed of:

- Outer *gray matter* termed the ***cerebral cortex***
- Inner *white matter* encompassing the deep gray nuclei



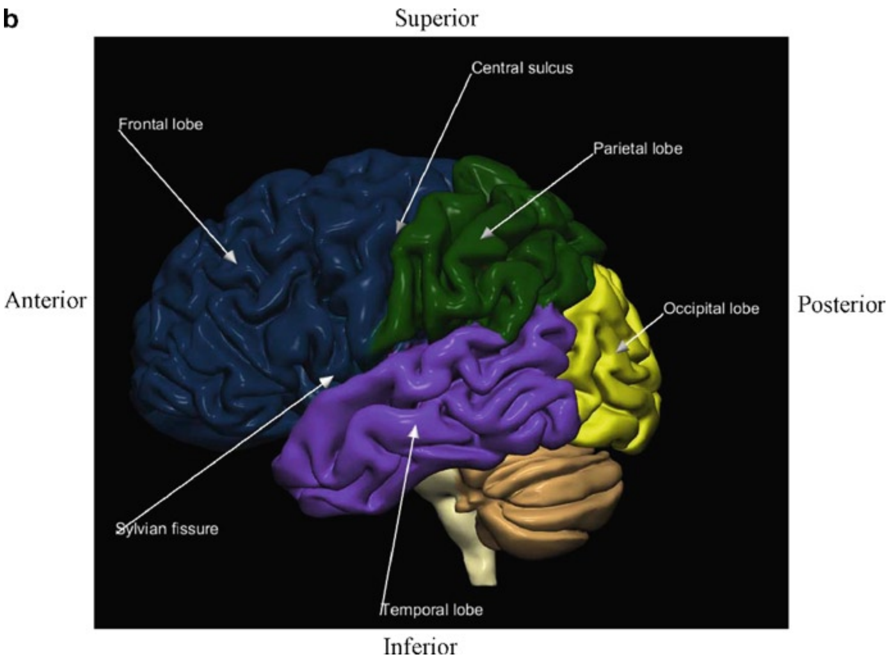




**Fig. 2.1** Gross anatomy of the left cerebral hemisphere: (**a**) brain parcellation; (**b**) lobes: lateral view; (**c**) lobes: medial view

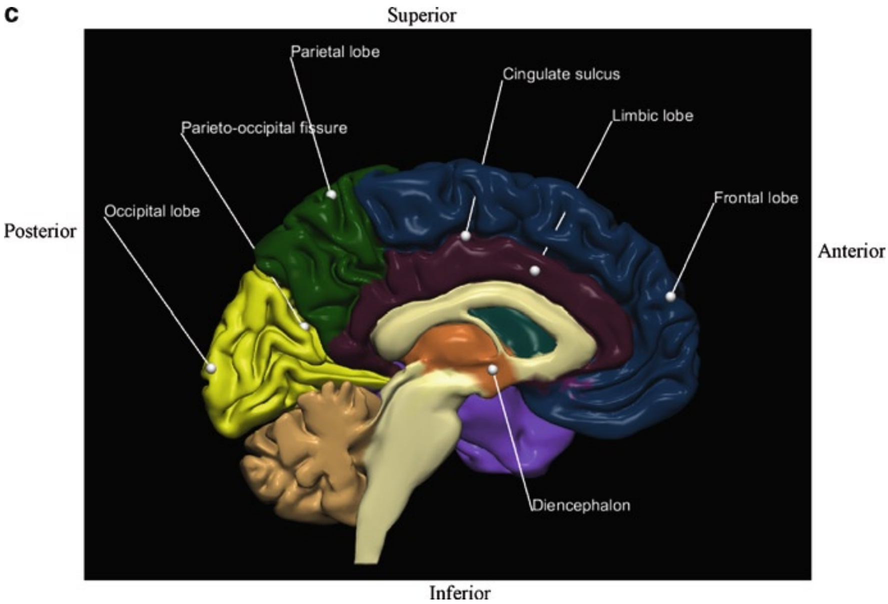



**Fig. 2.1** (continued)

The gray matter contains mainly nerve cell bodies, while the white matter is made up predominantly of nerve fibers (axons). The cerebral cortex is highly convoluted. The folds form *gyri* that are separated by grooves called *sulci* or *fissures* (deep sulci). The cerebral hemispheres are parcellated into five *lobes* (Fig. 2.1b, c):

- ***Frontal lobe***
- ***Temporal lobe***
- ***Parietal lobe***
- ***Occipital lobe***
- ***Limbic lobe***

The ***insula*** is sometimes classified as the *central* or *insular lobe*. The lobes are partly demarcated by the sulci/fissures, Fig. 2.1. The ***central sulcus*** separates the frontal lobe anterior from the parietal lobe posterior, Fig. 2.1b. The ***Sylvian (lateral) fissure*** demarcates the temporal lobe below from the frontal and parietal lobes above, Fig. 2.1b. The ***parieto-occipital fissure*** separates the parietal lobe anterior from the occipital lobe posterior, Fig. 2.1c. The ***cingulate sulcus*** separates the frontal lobe above from the limbic lobe below, Fig. 2.1c.

The diencephalon contains (Fig. 2.1c):

- ***Thalamus*** (see also Fig. 2.6)
- ***Subthalamus*** including the *subthalamic nucleus* (see Sect. 2.2.6)
- ***Hypothalamus*** (see also Fig. 2.10a)

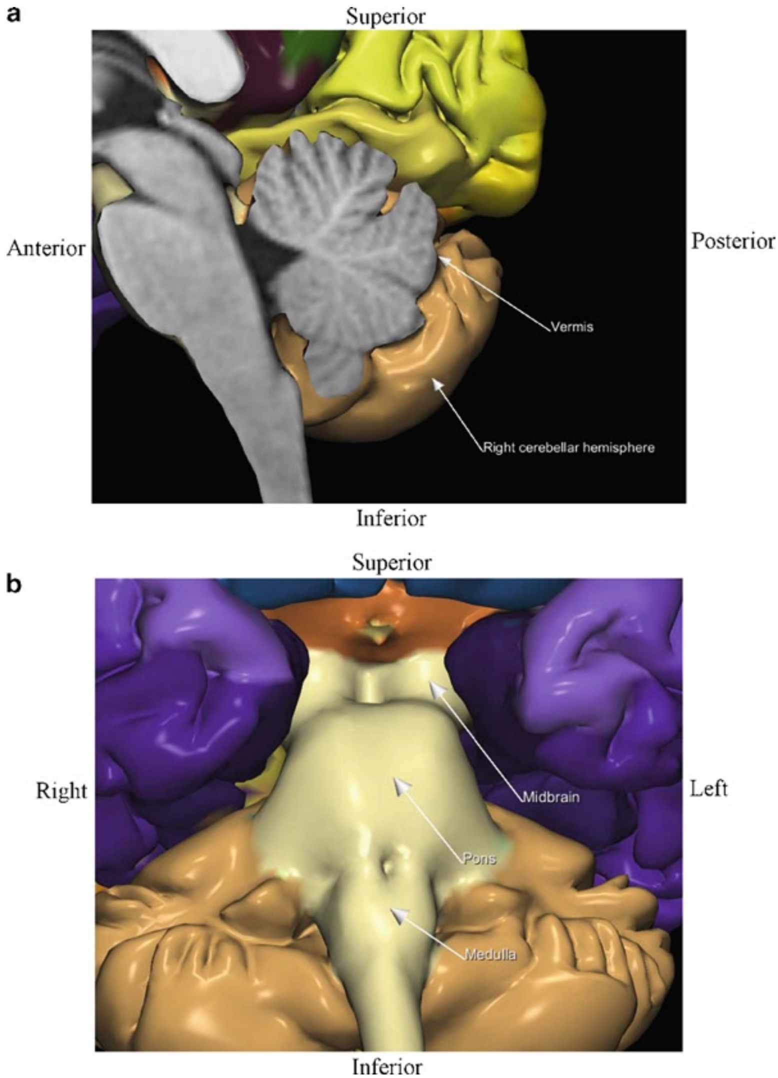



**Fig. 2.2** Cerebellum and brainstem: (**a**) cerebellum (medial view); (**b**) midbrain, pons, and medulla of the brainstem (infero-anterior view)

The cerebellum is composed of (Fig. 2.2a):

- Left and right ***cerebellar hemispheres***
- Midline ***vermis*** which unites them

The brainstem is subdivided into (Fig. 2.2b):

- ***Midbrain***
- ***Pons***
- ***Medulla***

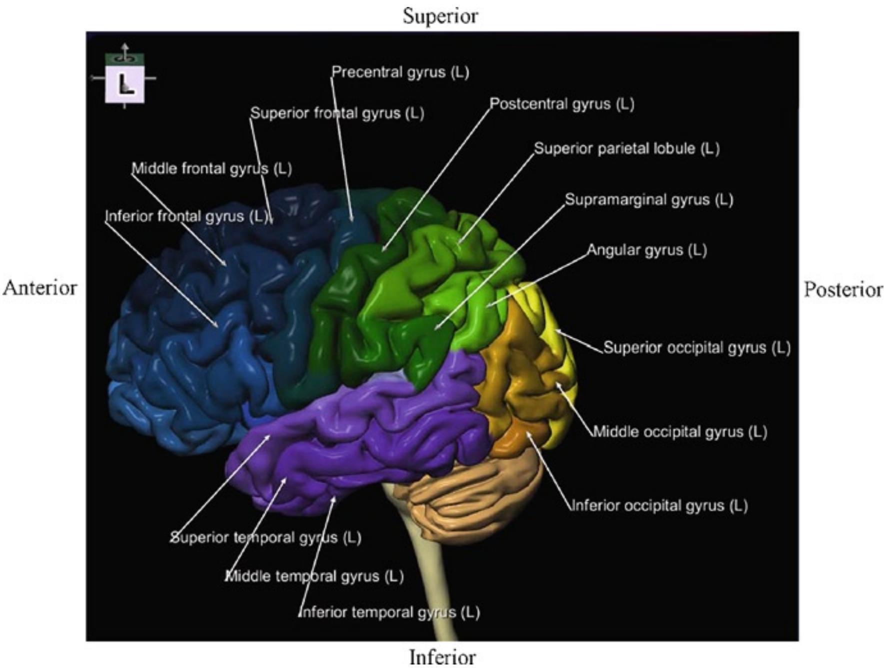



**Fig. 2.3** Cortical areas of the left (L) hemisphere: lateral view. The orientation cube in the *top-left corner* indicates the viewing direction (*L* left; *R* right; *S* superior (dorsal); *I* inferior (ventral); *A* anterior; *P* posterior). Each gyrus is assigned a unique color

### *2.2.2 Cortical Areas*

The cortex has three surfaces: lateral, medial, and inferior (also called basal or ventral). Moreover, the transitional areas form the *frontal, temporal,* and *occipital poles* (see, e.g., Figs. 2.5 and 2.27).

#### 2.2.2.1 Lateral Surface

Four lobes are present on the lateral surface: frontal, temporal, parietal, and occipital, Fig. 2.1b. The lateral surface of the frontal lobe is subdivided by three sulci (superior frontal sulcus, inferior frontal sulcus, and precentral sulcus) into four gyri (Fig. 2.3):

- ***Superior frontal gyrus***
- ***Middle frontal gyrus***
- ***Inferior frontal gyrus***
- ***Precentral gyrus***

The lateral surface of the temporal lobe is subdivided by two sulci (superior temporal sulcus and inferior temporal sulcus) into three gyri (Fig. 2.3):

- ***Superior temporal gyrus***
- ***Middle temporal gyrus***
- ***Inferior temporal gyrus***

The lateral surface of the parietal lobe is subdivided by the intraparietal sulcus into three gyri (Fig. 2.3):

- ***Postcentral gyrus***
- ***Superior parietal gyrus (lobule)***
- ***Inferior parietal gyrus (lobule)***
  - ***Supramarginal gyrus***
  - ***Angular gyrus***

The lateral surface of the occipital lobe is subdivided by two sulci (superior occipital sulcus and inferior occipital sulcus) into three gyri (Fig. 2.3):

- ***Superior occipital gyrus***
- ***Middle occipital gyrus***
- ***Inferior occipital gyrus***

#### 2.2.2.2 Medial Surface

The frontal, parietal, occipital, and limbic lobes are present on the medial surface, Fig. 2.1c. The limbic lobe contains the gyri located at the inner edge (or *limbus*) of the hemisphere including (Fig. 2.4):

- ***Subcallosal gyrus*** (*areas*)
- ***Cingulate gyrus***
- ***Isthmus*** (*of cingulate gyrus*)
- ***Parahippocampal gyrus***

The superior frontal gyrus (separated from the limbic lobe by the cingulate sulcus, Fig. 2.1c) occupies most of the medial surface of the frontal lobe, Fig. 2.4. The parietal lobe includes the ***precuneus***, Fig. 2.4 (separated from the occipital lobe by the parieto-occipital fissure, Fig. 2.1c). The occipital lobe comprises the ***cuneus*** and the ***lingual gyrus***, Fig. 2.4.

#### 2.2.2.3 Inferior Surface

The inferior surface includes the frontal, temporal, and occipital lobes. The frontal lobe comprises (Fig. 2.5):

- ***Straight gyrus***
- ***Orbital gyri*** parcellated by the approximately *H-shape sulcus* into the *anterior, medial, lateral, and posterior orbital gyri*

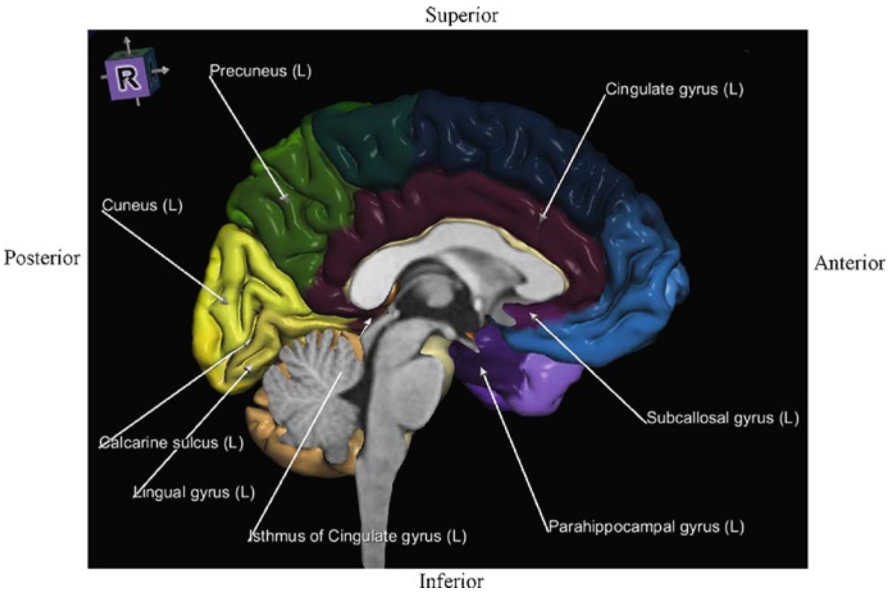



**Fig. 2.4** Cortical areas of the left hemisphere: medial view

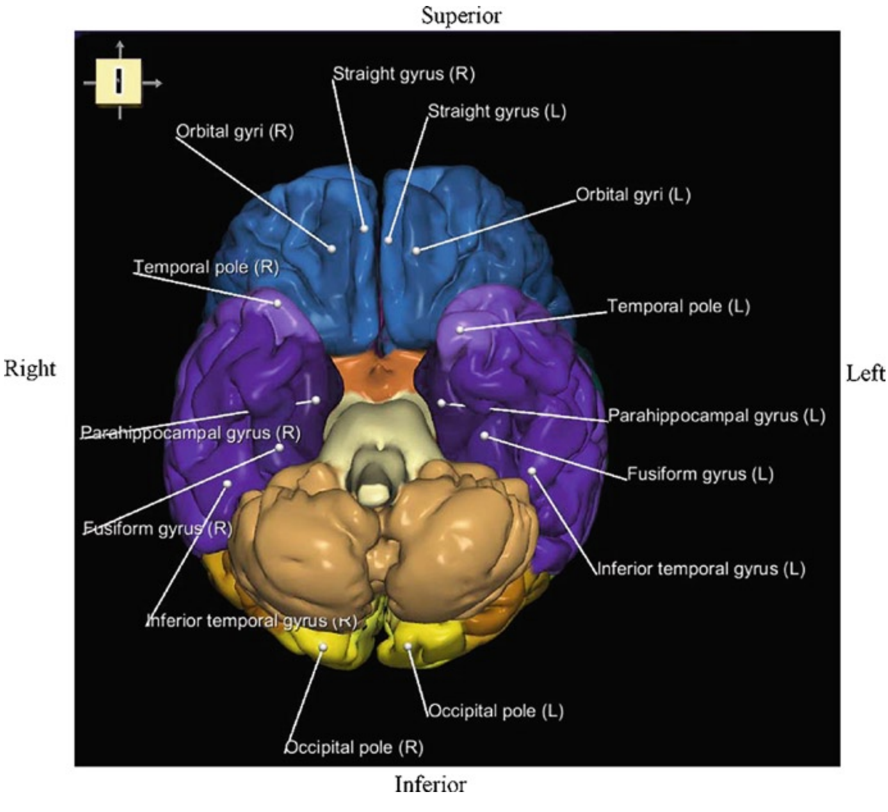



**Fig. 2.5** Cortical areas: inferior view

The temporal and occipital lobes are subdivided by two sulci (lateral occipitotemporal sulcus and medial occipitotemporal (collateral) sulcus) into three gyri, Fig. 2.5:

- ***Medial occipitotemporal gyrus*** whose temporal part constitutes the ***parahippocampal gyrus*** and the occipital part the ***lingual gyrus***
- ***Lateral occipitotemporal gyrus*** (called also the ***fusiform gyrus***)
- ***Inferior temporal gyrus***

The lingual gyrus is separated from the cuneus by the ***calcarine sulcus*** (***fissure***).

### 2.2.3 Deep Gray Nuclei

The deep gray nuclei are paired gray matter structures. The main deep gray nuclei are (Fig. 2.6):

- ***Basal ganglia (nuclei)***
  - ***Caudate nucleus***
  - ***Lentiform nuclei***
    - ***Putamen***
    - ***Globus pallidus***
      - ***Lateral (or outer) segment***
      - ***Medial (or inner) segment*** (see also Sect. 2.2.6)
- ***Thalamus***
- ***Hippocampus***
- ***Amygdala (amygdaloid body)***

The lentiform nuclei and the caudate nucleus form the ***striatum***.

### 2.2.4 Ventricular System

The ventricular system contains four interconnected cerebral ventricles (cavities) filled with cerebrospinal fluid (CSF) (Fig. 2.7a):

- Left and right ***lateral ventricles***
- ***Third*** *ventricle*
- ***Fourth*** *ventricle*

CSF is secreted mainly in the *choroid plexus* (a network of vessels) and circulates from the lateral ventricles through the paired ***interventricular foramina*** (of Monro) to the third ventricle, and then via the ***aqueduct*** to the fourth ventricle, Fig. 2.7a. The lateral ventricles are the largest and each contains (Fig. 2.7b):

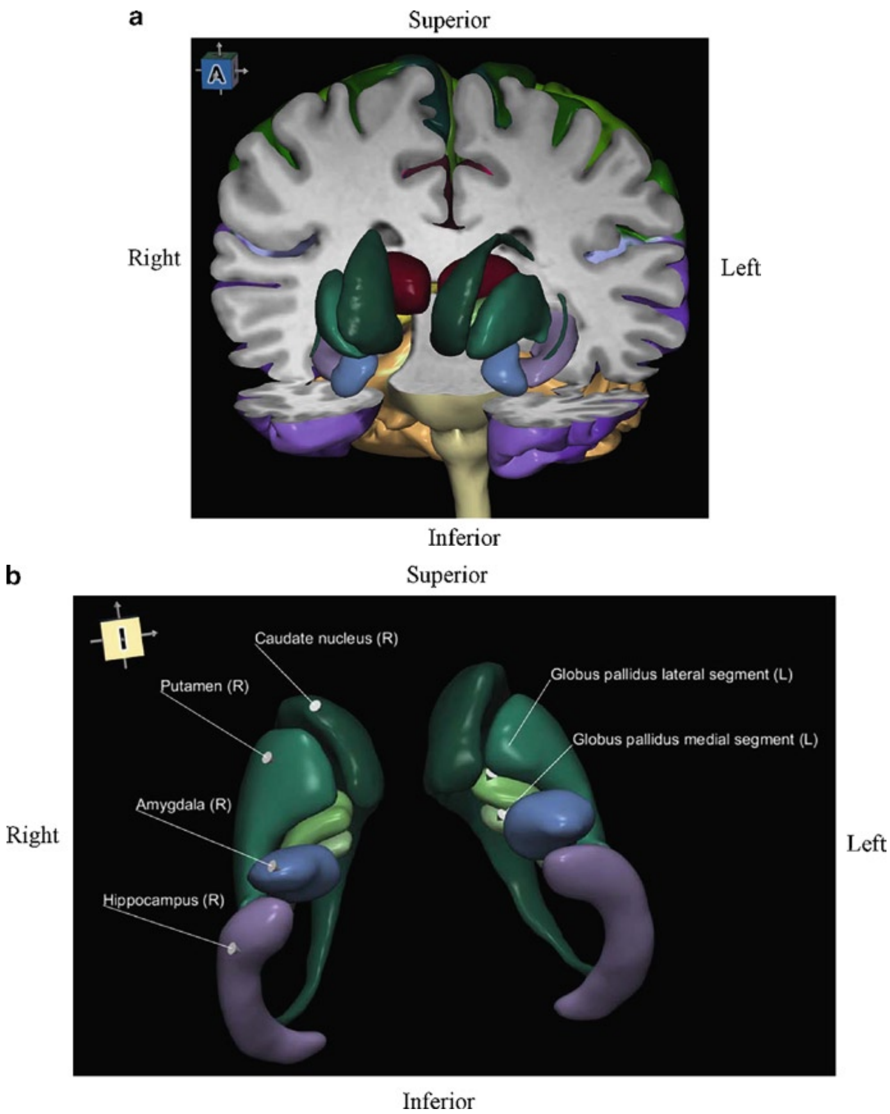



**Fig. 2.6** Deep gray nuclei: (**a**) embedded into the brain; (**b**) shown in isolation

- ***Body*** (or *central portion*)
- ***Atrium*** (or *trigon*)
- ***Horns***
  - ***Frontal*** (*anterior*)
  - ***Occipital*** (*posterior*)
  - ***Temporal*** (*inferior*)

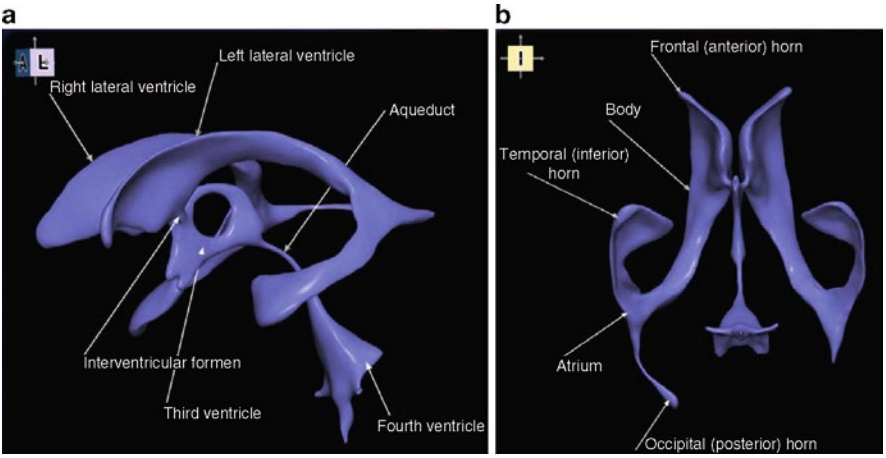



**Fig. 2.7** Ventricular system: (**a**) interconnected ventricles; (**b**) components of the lateral ventricle

## *2.2.5 Sectional Neuroanatomy*

Sectional (planar) neuroanatomy is typically presented on orthogonal (axial, coronal, and sagittal) images. To spatially locate the orthogonal images, we place them in the Talairach coordinate system [48], which is a stereotactic reference system based on the anterior and posterior commissures (see also Fig. 2.28a) with the origin at the center of the anterior commissure (see also Figs. 2.8–2.10).

Four axial images located at −12, +1, +12, and +24 mm (where "−" denotes the level below and "+" above the anterior commissure) with the cortical areas and deep gray nuclei segmented and labeled are shown in Fig. 2.8.

Two coronal images passing through the anterior and posterior commissures are presented in Fig. 2.9.

Two sagittal images located at 3 and 21 mm from the midline are shown in Fig. 2.10.

## *2.2.6 Main Stereotactic Target Structures*

Several subcortical structures (and more recently also cortical areas) are therapeutic stimulation targets in stereotactic and functional neurosurgery [84] to treat movement disorders (mainly Parkinson's disease), epilepsy, pain, and mental disorders (psychosurgery). The main stereotactic target structures are:

- ***Subthalamic nucleus***, Fig. 2.11
- ***Ventrointermediate nucleus of the thalamus***, Fig. 2.12
- ***Globus pallidus interna*** (medial segment), Fig. 2.13

The subthalamic nucleus presented on the triplanar (the axial, coronal, and sagittal planes) is shown in Fig. 2.11.

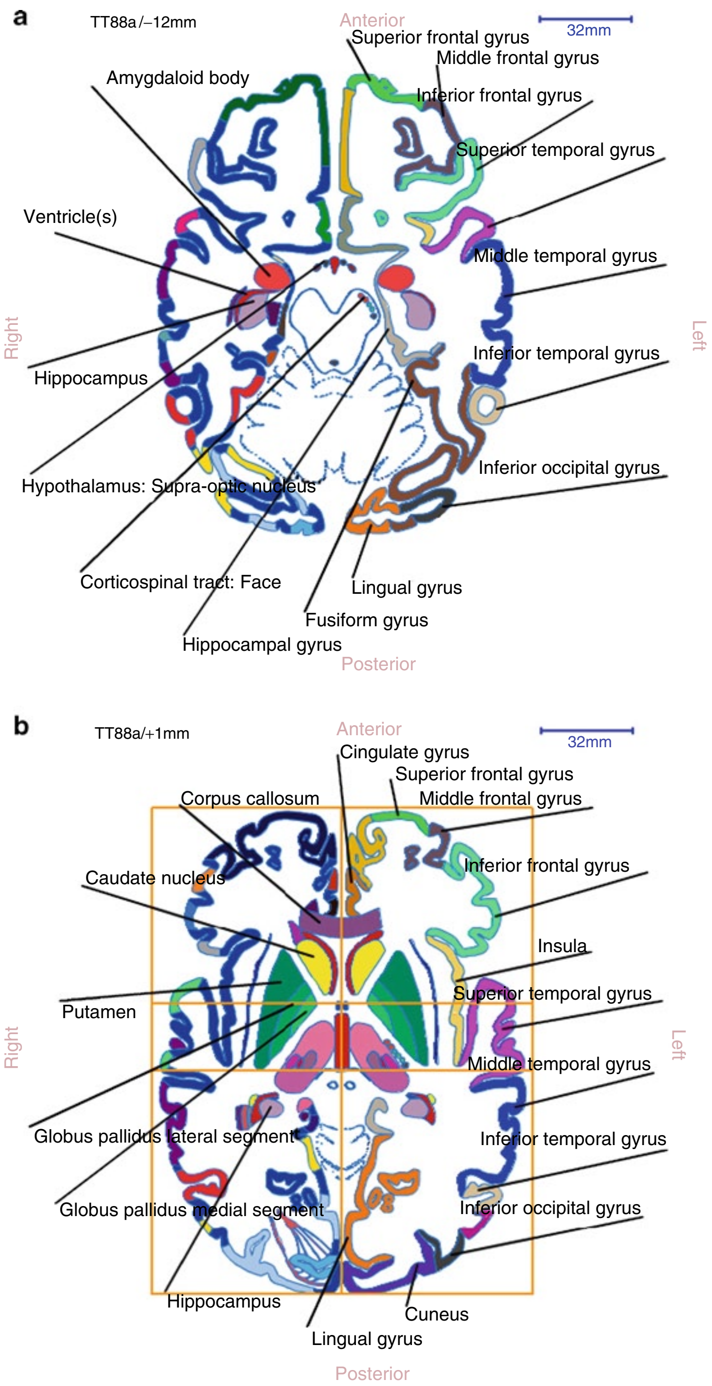
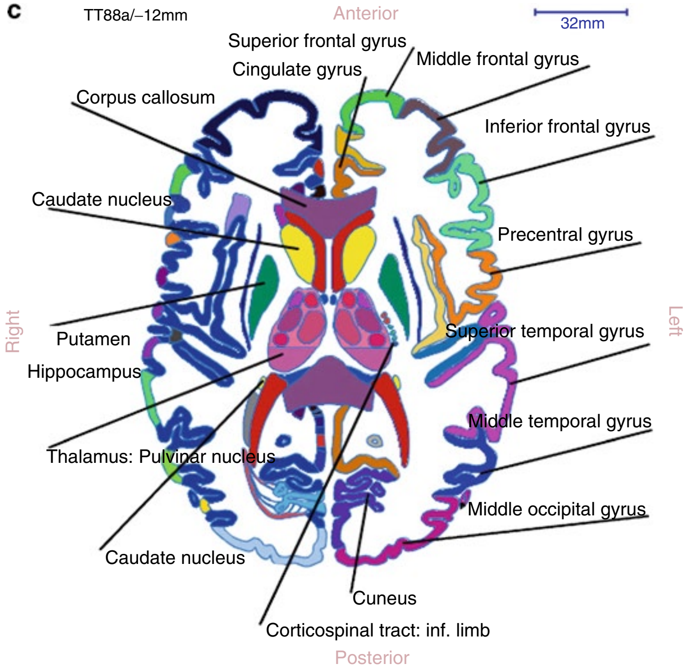



**Fig. 2.8** Planar neuroanatomy in axial orientation at: (**a**) −12 mm; (**b**) +1 mm (along with the Talairach grid); (**c**) +12 mm; (**d**) +24 mm ("–" denotes the level below and "+" the level above the anterior commissure)

c

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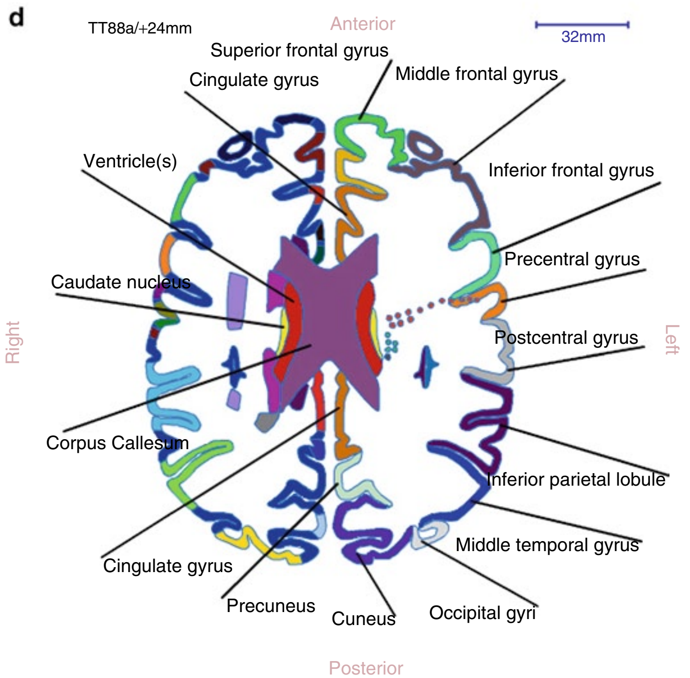
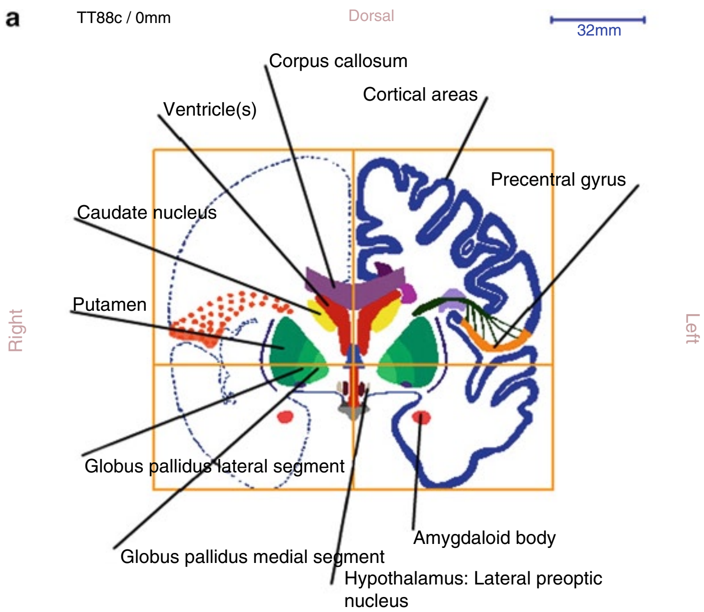



**Fig. 2.8** (continued)



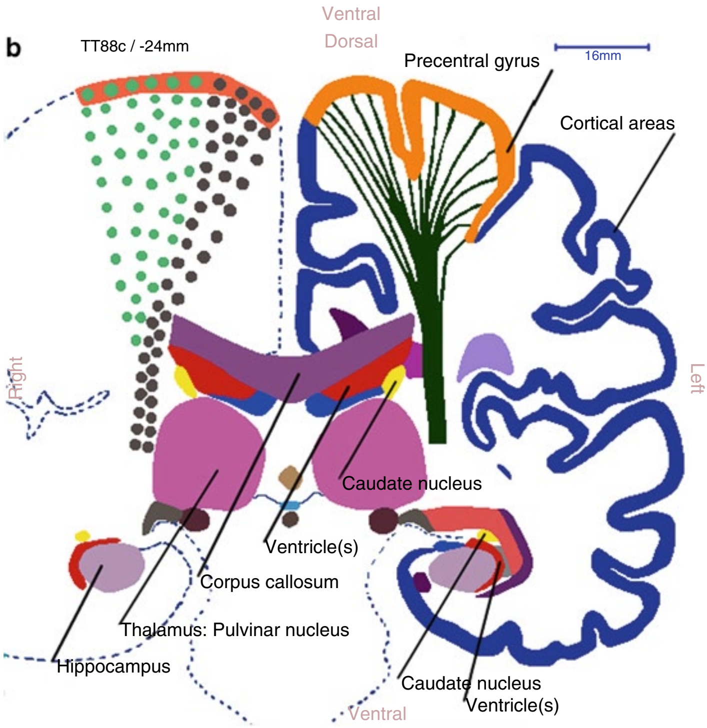




**Fig. 2.9** Planar neuroanatomy in coronal orientation at: (**a**) 0 mm passing through the anterior commissure (point), i.e., the location on the coronal plane where the horizontal and vertical planes of the Talairach system intersect; (**b**) −24 mm passing through the posterior commissure (point)

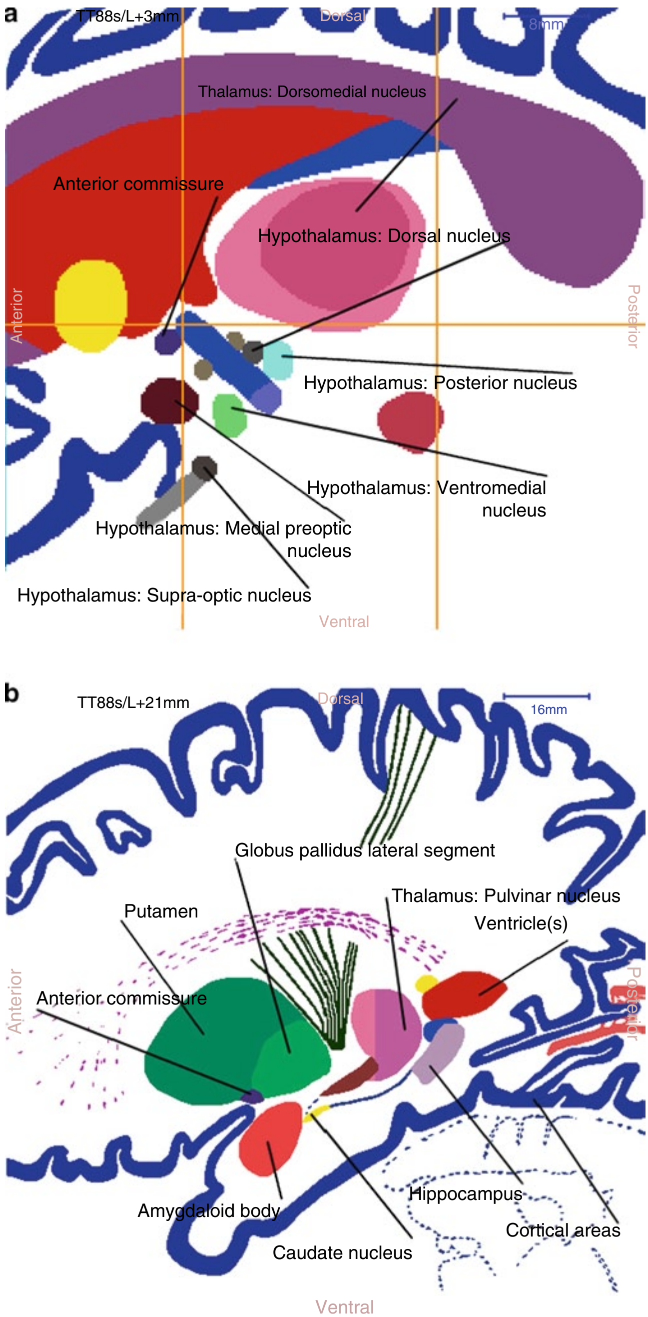



**Fig. 2.10** Planar neuroanatomy in sagittal orientation at: (**a**) 3 mm (along with the Talairach grid); (**b**) 21 mm from the midline

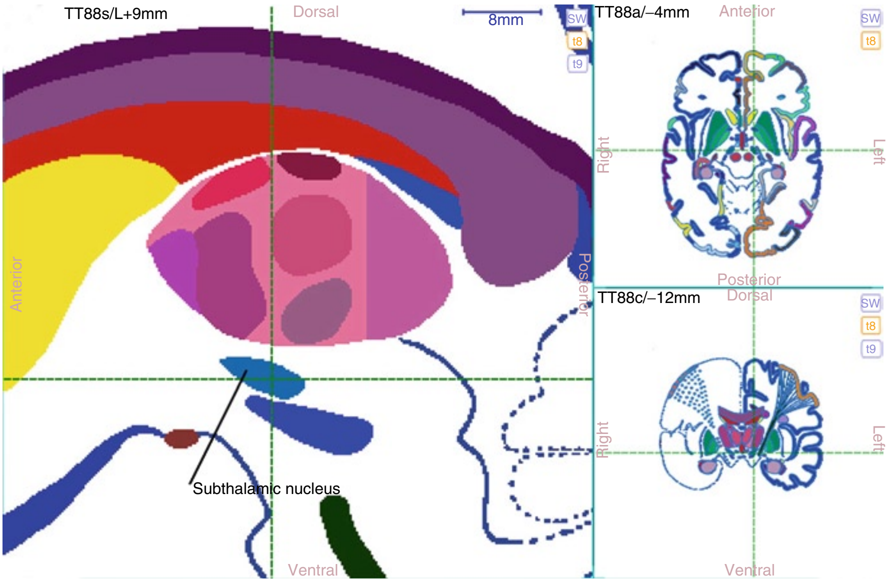



**Fig. 2.11** Subthalamic nucleus on sagittal, axial, and coronal planes (the location of the triplanar is marked by the *green dashed lines*)

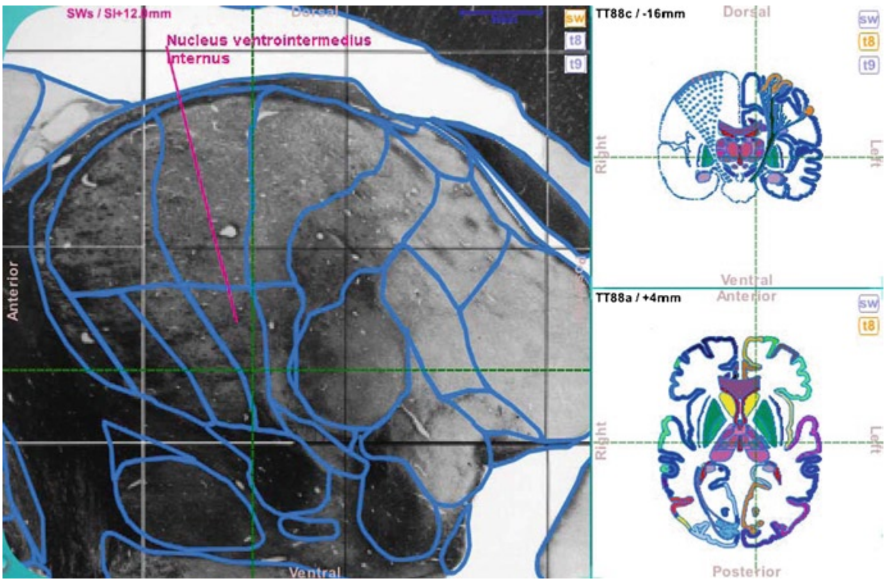



**Fig. 2.12** Ventrointermediate nucleus of the thalamus: sagittal, coronal, and axial planes

The ventrointermediate nucleus of the thalamus on the triplanar is presented in Fig. 2.12.

The globus pallidus interna on the triplanar is illustrated in Fig. 2.13.

All three structures in 3D placed in the Talairach stereotactic coordinate system are shown in Fig. 2.14.

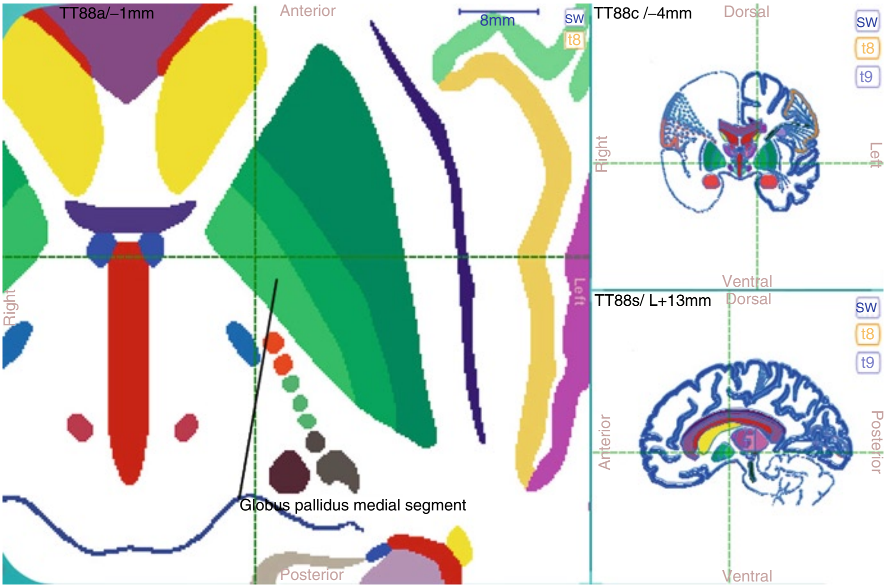



**Fig. 2.13** Globus pallidus interna (medial segment): axial, coronal, and sagittal planes

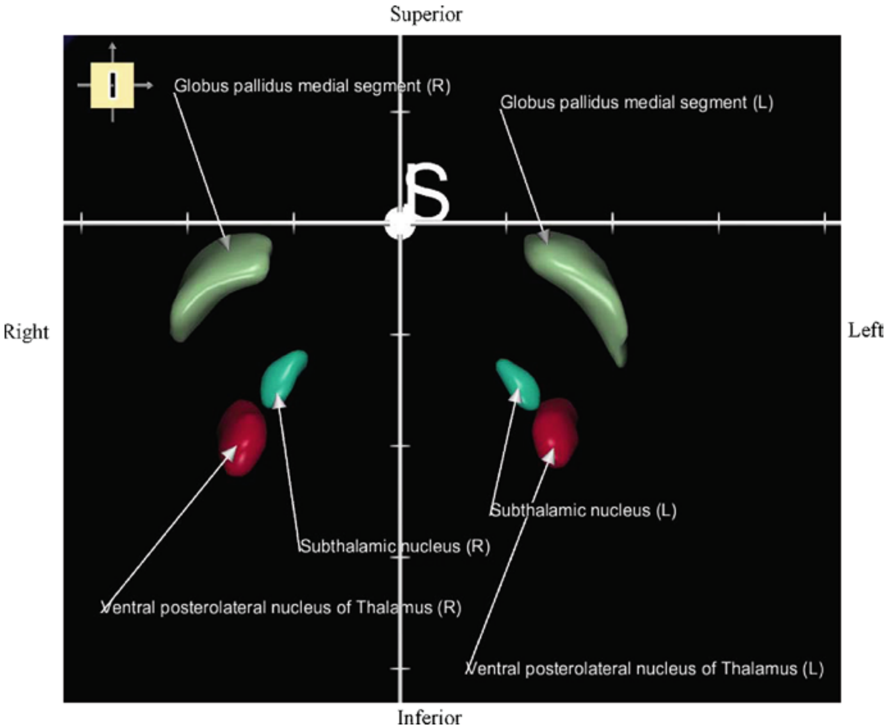



**Fig. 2.14** Stereotactic target structures in 3D. The marks on the axes are placed at 10-mm intervals

### 2.2.7 *Functional Areas*

Several parcellations are introduced to subdivide the cortical regions into functional areas [16]. Brodmann's parcellation based on histology is the most widely used and it is illustrated in axial orientation in Fig. 2.15. ***Brodmann's areas*** are useful in neuroscience and functional studies.

## 2.3 Vascular Neuroanatomy

The knowledge of cerebrovasculature is crucial in stroke, vascular and tumor surgery as well as interventional neuroradiology. The complete cerebrovasculature is highly complex and variable, Fig. 2.16. It is subdivided into:

- ***Arterial system***
- ***Venous system*** with the ***cerebral veins*** and ***dural sinuses***

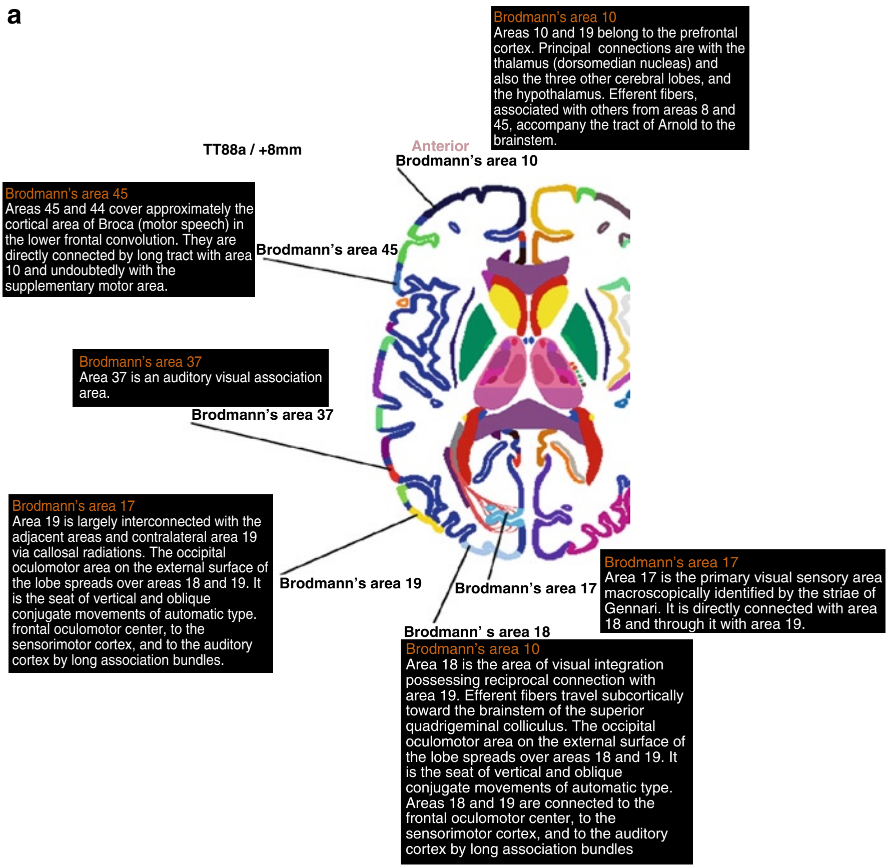



**Fig. 2.15** Brodmann's areas in axial orientation: (**a**) vision and speech areas (+8 mm); (**b**) motor and sensory areas (+40 mm). The areas are uniquely color-coded

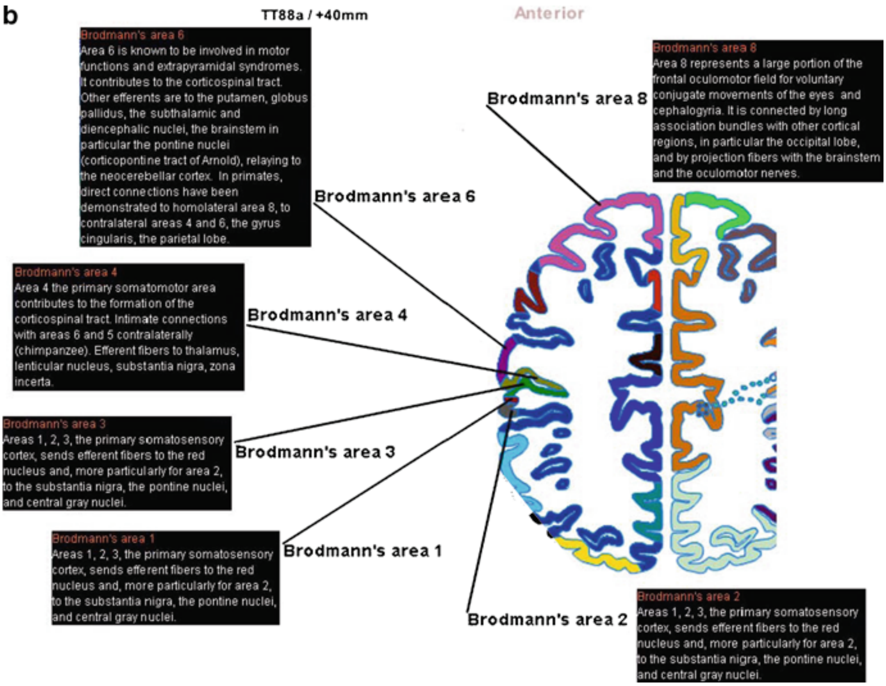



**Fig. 2.15** (continued)

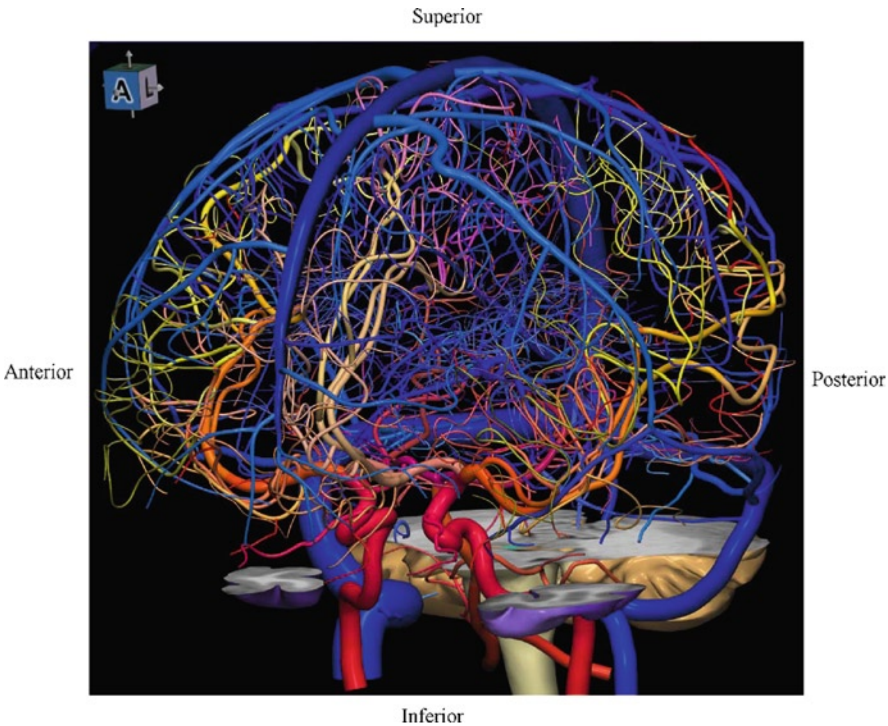



**Fig. 2.16** The cerebral vasculature with arteries, veins, and dural sinuses. The vessels are uniquely color-coded such that all vessels with the same name have the same color

## 2.3.1 Arterial System

### 2.3.1.1 Parcellation of Arterial System

The brain is supplied by two pairs of arteries:

- Left and right ***internal carotid arteries*** anteriorly
- Left and right ***vertebral arteries*** posteriorly forming the ***basilar artery*** (Fig. 2.17a)

interconnected by the ***circle of Willis*** (Fig. 2.21).

The internal carotid artery (ICA) branches into the ***anterior cerebral artery*** (Fig. 2.17c) and the ***middle cerebral artery*** (Fig. 2.17d). The left and right ***posterior cerebral arteries*** originate from the basilar artery (Fig. 2.17e).

### 2.3.1.2 Anterior Cerebral Artery

The anterior cerebral artery has the following main branches (Fig. 2.18):

- ***A1 segment*** (*precommunicating part*)
- ***A2 segment*** (*postcommunicating part*)
  - ***Pericallosal artery***
  - ***Callosomarginal artery***

### 2.3.1.3 Middle Cerebral Artery

The middle cerebral artery is subdivided into four segments (Fig. 2.19a):

- ***M1 segment*** (*sphenoid part*)
- ***M2 segment*** (*insular part*)
- ***M3 segment*** (*opercular part*)
- ***M4 segment*** (*terminal part*)

Its main branches for the left hemisphere are shown in Fig. 2.19b.

### 2.3.1.4 Posterior Cerebral Artery

The posterior cerebral artery is parcellated into four segments (Fig. 2.20):

- ***P1 segment*** (*precommunicating part*)
- ***P2 segment*** (*postcommunicating part*)
- ***P3 segment*** (*lateral occipital artery*)
- ***P4 segment*** (*medial occipital artery*)

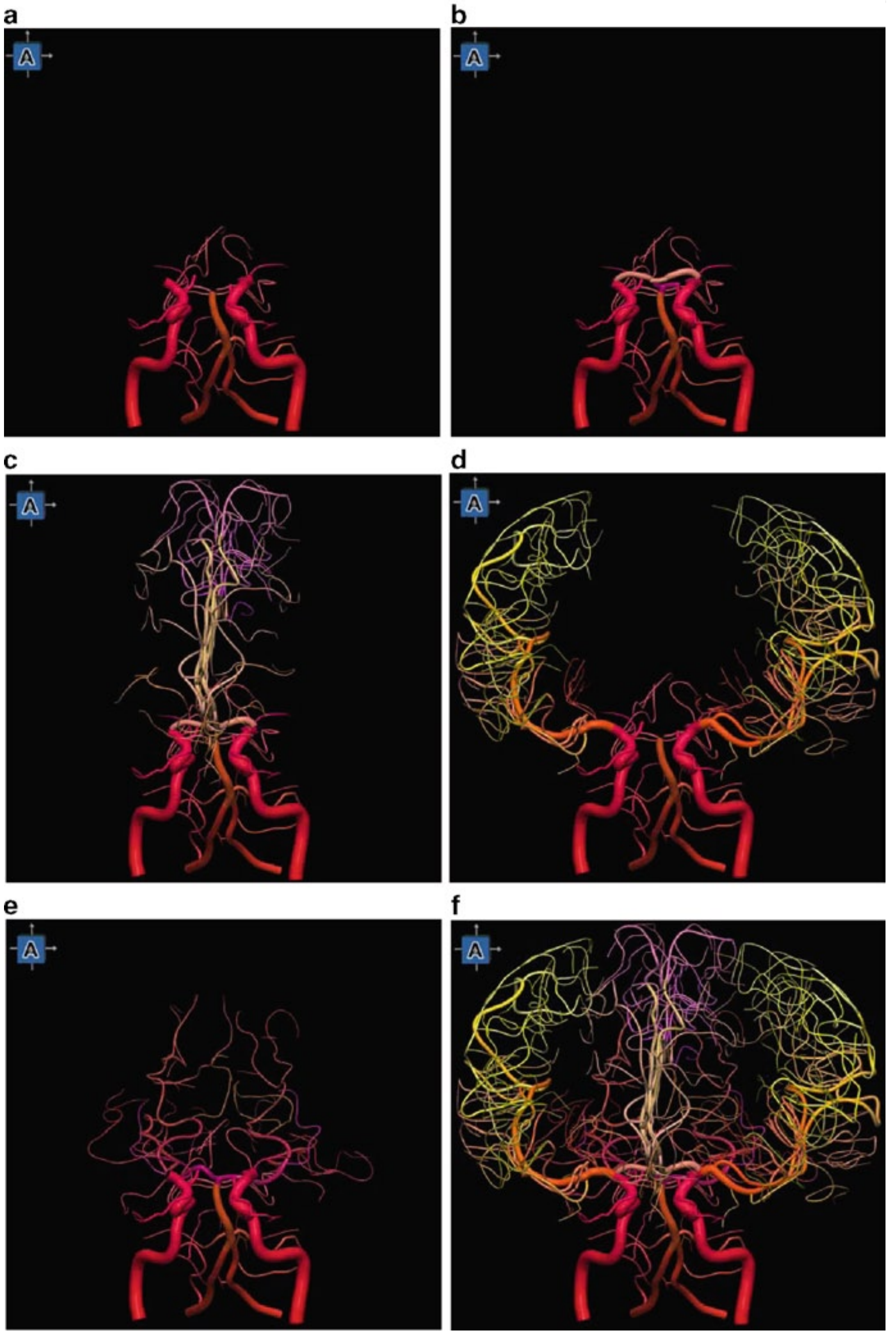


**Fig. 2.17** The cerebral arteries: (**a**) blood supply to the brain by the internal carotid artery (ICA) anteriorly, and the vertebral artery (VA) and the basilar artery (BA) posteriorly; (**b**) ICA and VA connected by the circle of Willis; (**c**) anterior cerebral artery along with the ICA, VA, and BA; (**d**) middle cerebral artery along with the ICA, VA, and BA; (**e**) posterior cerebral artery along with the ICA, VA, and BA; (**f**) complete arterial system

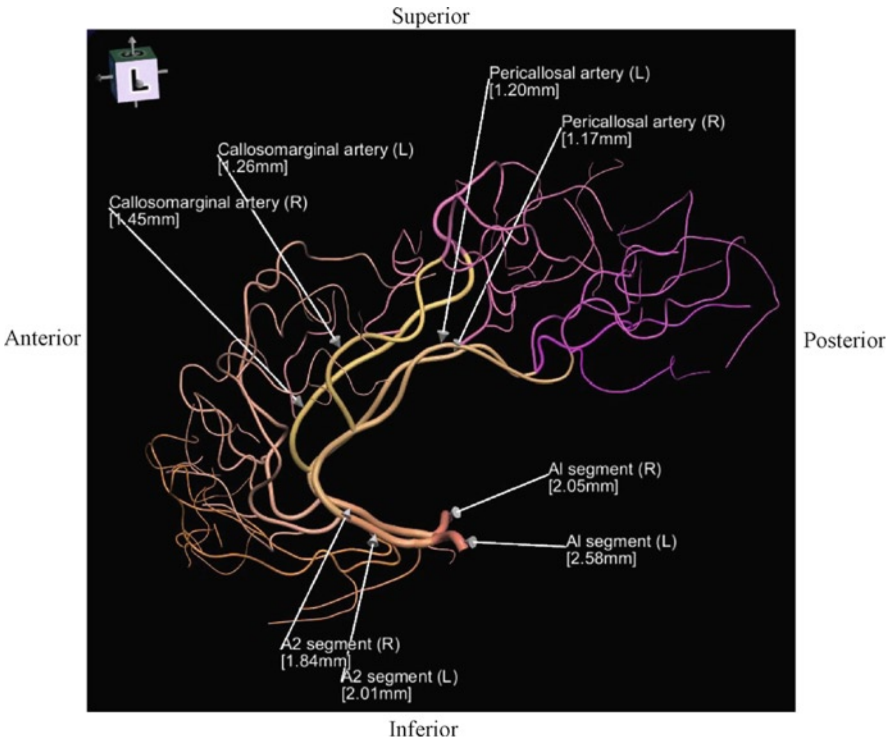



**Fig. 2.18** Anterior cerebral artery

#### 2.3.1.5 Circle of Willis

The circle of Willis connects the anterior and posterior circulations. It includes the following vessels (Fig. 2.21):

- ***Anterior communicating artery***
- Left and right ***posterior communicating arteries***
- Part of the left and right ***internal carotid arteries***
- Left and right ***A1 segments*** of the anterior cerebral arteries
- Left and right ***P1 segments*** of the posterior cerebral arteries

### *2.3.2 Venous System*

#### 2.3.2.1 Parcellation of Venous System

The main components of the venous system are, Fig. 2.22:

- ***Dural sinuses***

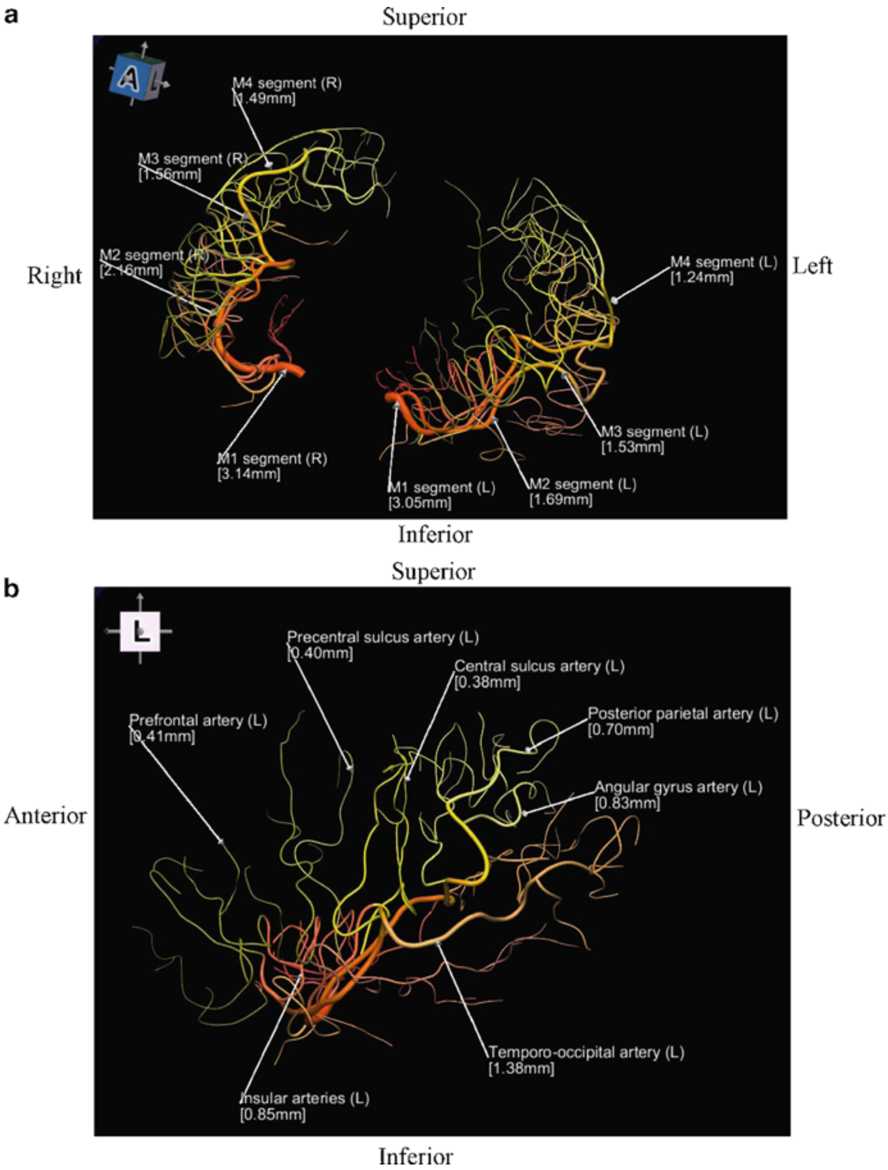



**Fig. 2.19** Middle cerebral artery: (**a**) M1, M2, M3, and M4 segments; (**b**) main branches of the left hemisphere

- ***Cerebral veins***
  - ***Superficial veins***
  - ***Deep veins***

The cerebral veins empty into the dural sinuses.

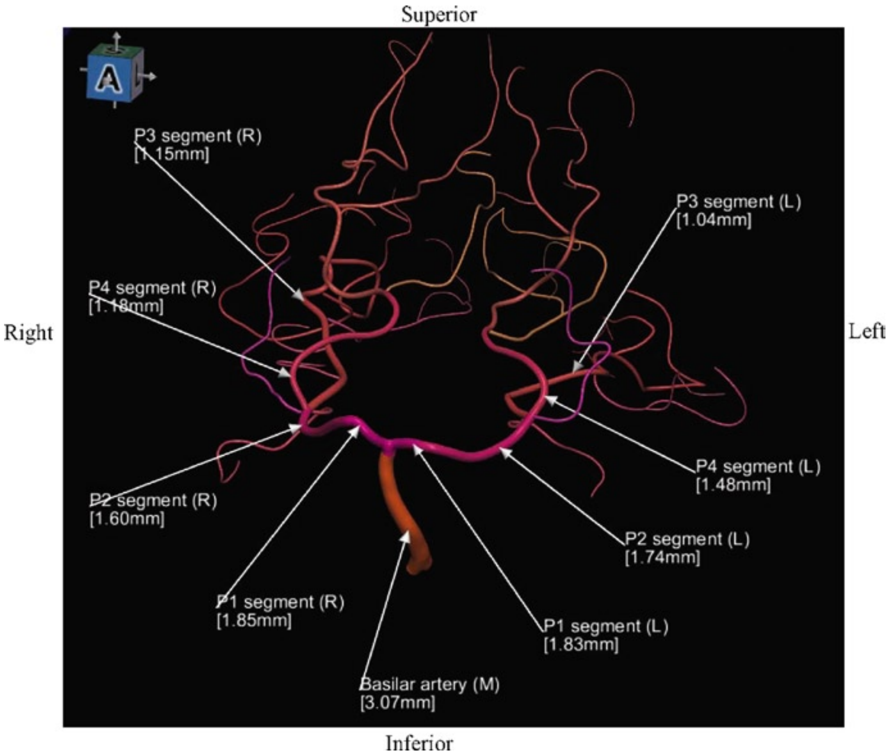



**Fig. 2.20** Posterior cerebral artery

### 2.3.2.2 Dural sinuses

The main dural sinuses are (Fig. 2.23):

- ***Superior sagittal sinus***
- ***Inferior sagittal sinus***
- ***Straight sinus***
- Left and right ***transverse sinuses***
- Left and right ***sigmoid sinuses***

### 2.3.2.3 Cerebral Veins

The main superficial cerebral veins are (Fig. 2.24):

- ***Frontopolar veins***
- ***Prefrontal veins***
- ***Frontal veins***
- ***Parietal veins***
- ***Occipital veins***

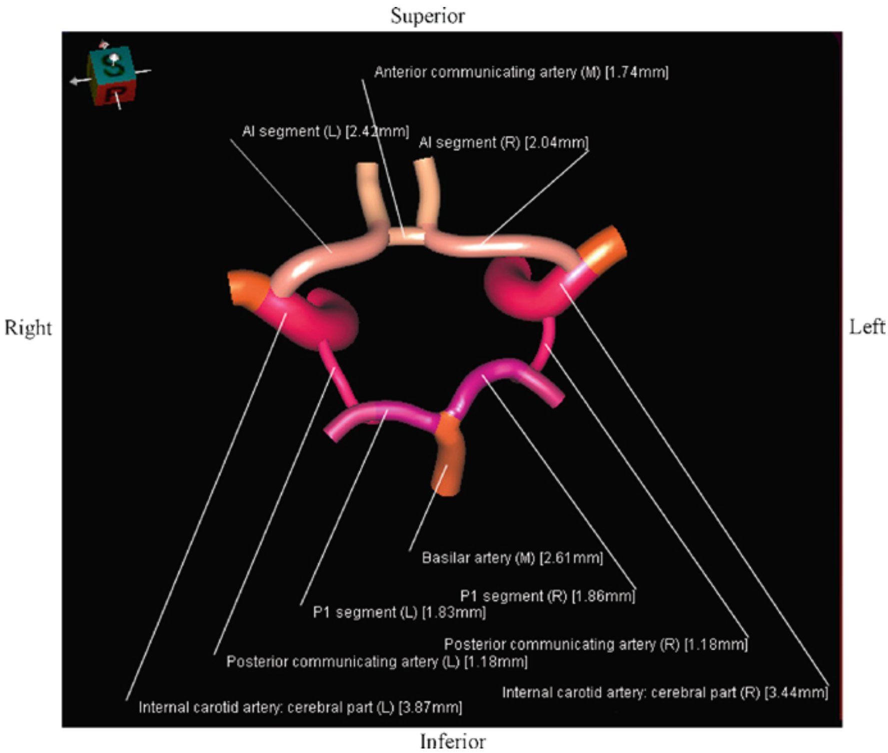



**Fig. 2.21** The circle of Willis

Other important superficial veins include ***superior*** and ***inferior anastomotic veins***, and ***superficial middle cerebral vein***.

The main deep cerebral veins are (Fig. 2.25):

- ***Great vein*** (of Galen)
- Left and right ***basal vein*** (of Rosenthal)
- Left and right ***internal cerebral veins***

### *2.3.3 Vascular Variants*

The human cerebrovasculature is highly variable and vascular variants have been extensively studied, see e.g., [6, 10, 13, 22]. Variations exist in terms of origin, location, shape, size, course, branching patterns as well as surrounding vessels and structures. The knowledge of cerebrovascular variants is central in diagnosis, treatment, and medical education.

Main variants in 3D in the circle of Willis are show in Fig. 2.26 (more 3D variants are presented in [70]).

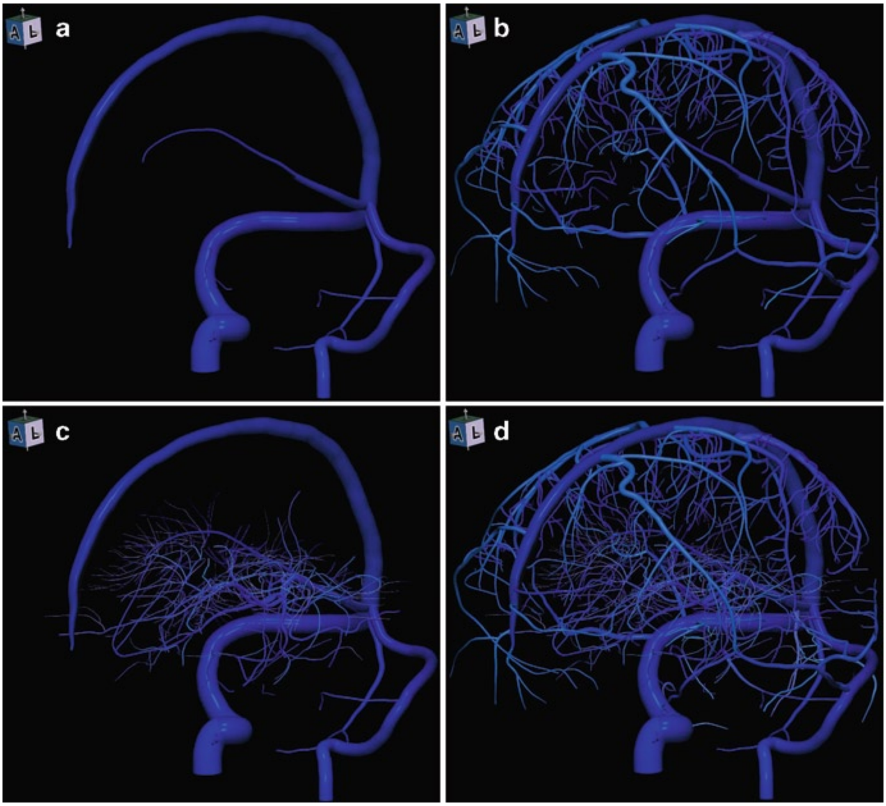



**Fig. 2.22** Parcellation of the venous system: (**a**) dural sinuses (DS); (**b**) superficial veins with the DS; (**c**) deep veins with the DS; (**d**) complete venous system

## 2.4 Connectional Neuroanatomy

Three types of white matter connections (or tracts, fibers, bundles, fiber pathways, fascicles) are distinguished in the cerebral hemispheres (Fig. 2.27):

- ***Commissural tracts***
- ***Association tracts***
- ***Projection tracts***

In addition, three cerebellar paired peduncles:

- ***Superior peduncle***
- ***Middle peduncle***
- ***Inferior peduncle***

connect the cerebellum to the midbrain, pons and medulla of the brainstem, respectively.

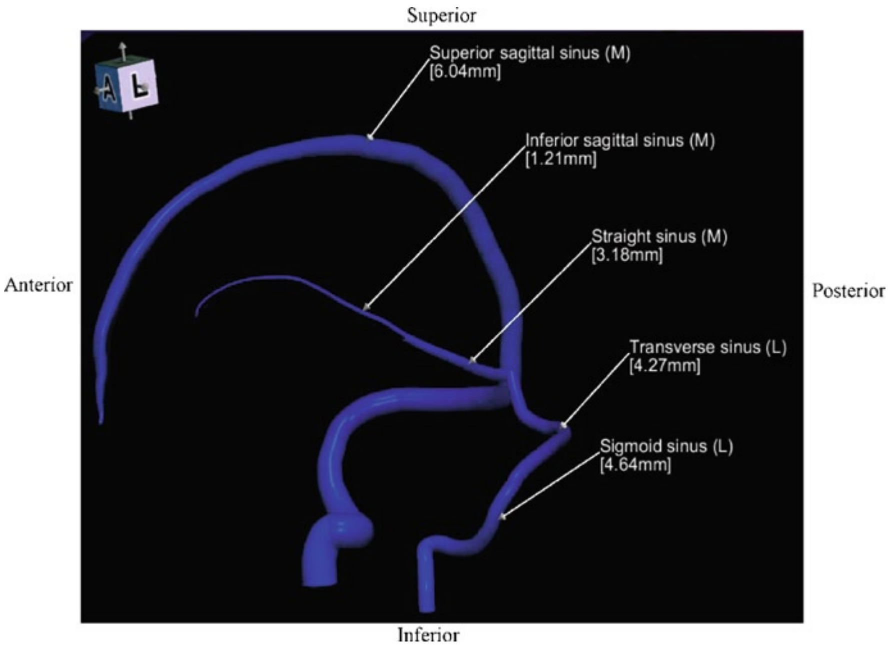



**Fig. 2.23** Dural sinuses (the left hemisphere is labeled)

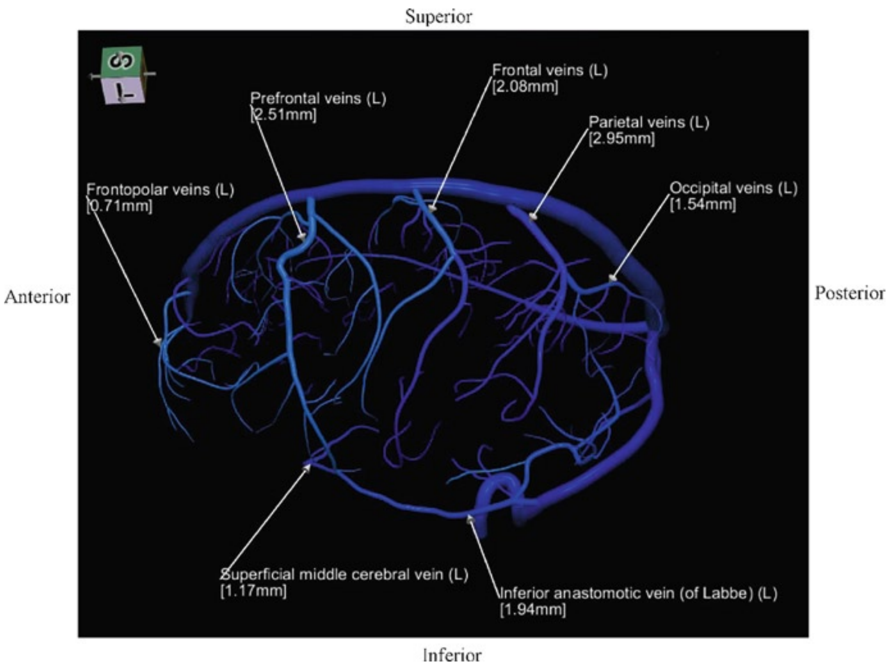



**Fig. 2.24** Superficial cerebral veins of the left hemisphere

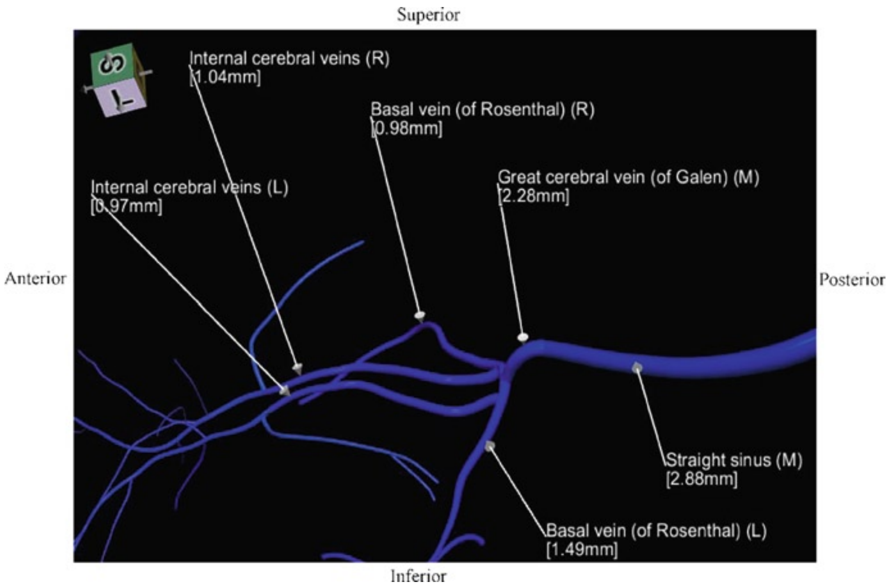



**Fig. 2.25** Deep cerebral veins


**Fig. 2.26** Vascular variants of the circle of Willis: (**a**) double anterior communicating artery; (**b**) absent left posterior communicating artery; (**c**) absent left P1 segment (the variants are in *white*)

### *2.4.1 Commissural Tracts*

The commissural tracts interconnect both hemispheres across the median plane. The main commissural tracts are, Fig. 2.28:

- ***Corpus callosum***
- ***Anterior commissure***
- ***Posterior commissure***

The corpus callosum (the great commissure) is the largest commissure. Its three main parts, ***genu*** (knee), ***body***, and ***splenium***, connect the frontal lobes, wide areas of hemispheres, and the occipital lobes, respectively.

The anterior commissure connects the temporal lobes, while the posterior commissure the midbrain, thalamus, and hypothalamus on both sides.

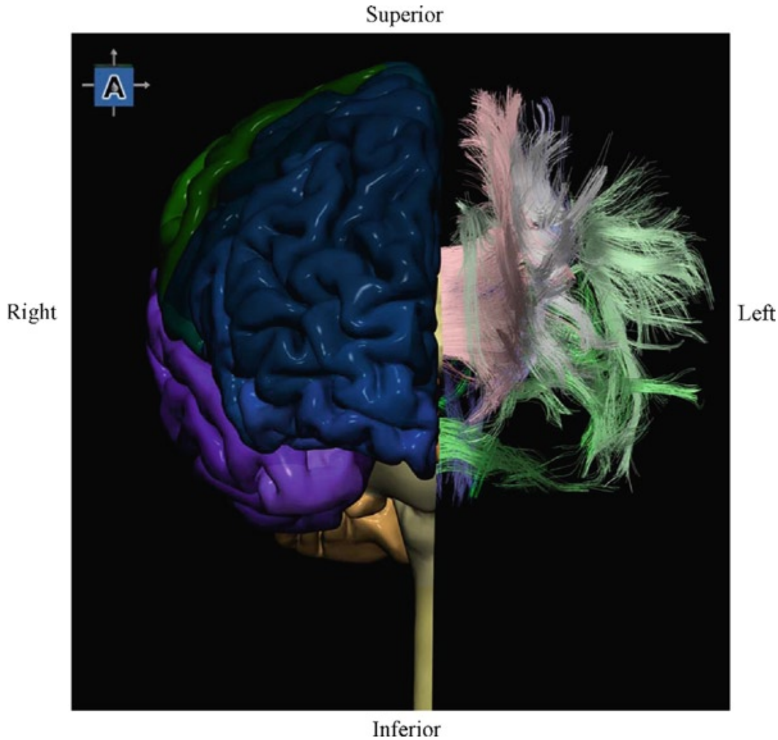



**Fig. 2.27** White matter tracts on the left and for comparison the brain on the right

## *2.4.2 Association Tracts*

The association tracts interconnect different cortical regions of the same hemisphere. There are two types of the association tracts:

- *Short arcuate* fibers that connect adjacent gyri (U fibers)
- *Long arcuate* fibers interconnecting widely separated gyri

The main association tracts are (Fig. 2.29):

- ***Superior longitudinal fasciculus***
- ***Middle longitudinal fasciculus***
- ***Inferior longitudinal fasciculus***
- ***Superior occipito-frontal fasciculus***
- ***Inferior occipito-frontal fasciculus***
- ***Cingulum***
- ***Uncinate fasciculus***

The superior longitudinal fasciculus connects the frontal lobe with the temporal, parietal, and occipital lobes. The inferior longitudinal fasciculus links the temporal lobe with the occipital lobe. The cingulum deep to the cingulated gyrus interconnects

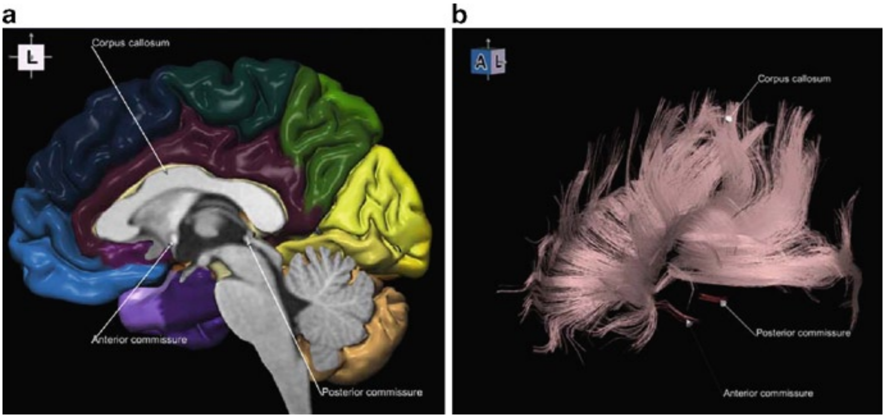



**Fig. 2.28** Commissural tracts with the corpus callosum, anterior commissure, and posterior commissure: (**a**) on the midsagittal plane; (**b**) in 3D

parts of the temporal, parietal, and occipital lobes. The uncinate fasciculus connects the frontal lobe (orbital gyri and motor speech area) with the temporal lobe.

### *2.4.3 Projection Tracts*

The projection tracts connect the cortex with the subcortical structures in the diencephalon, brainstem, and spinal cord. The main projection tracts are (Fig. 2.30):

- ***Cortico-spinal (pyramidal) tract***
- ***Cortico-thalamic tract*** including the *anterior, posterior (optic),* and *superior thalamic radiations*
- ***Cortico-bulbar tract*** (connecting to the brainstem)
- ***Cortico-pontine tract*** (projecting to the cerebellum)
- ***Auditory radiations***

The projection fibers between the striatum and thalamus form the ***internal capsule*** consisting of the ***anterior limb*** (containing the cortico-thalamic tract), ***genu*** (comprising the cortico-bulbar tract), and ***posterior limb*** (containing the cortico-spinal tract). The fibers radiating from the internal capsule to various parts of the cerebral cortex form the ***corona radiata***.

## 2.5 Summary

The brain contains the cerebrum, cerebellum, and brainstem, and it encases the ventricular system. The cerebrum comprises the paired cerebral hemispheres and deep gray matter nuclei including the caudate nucleus, putamen, lateral and medial globus

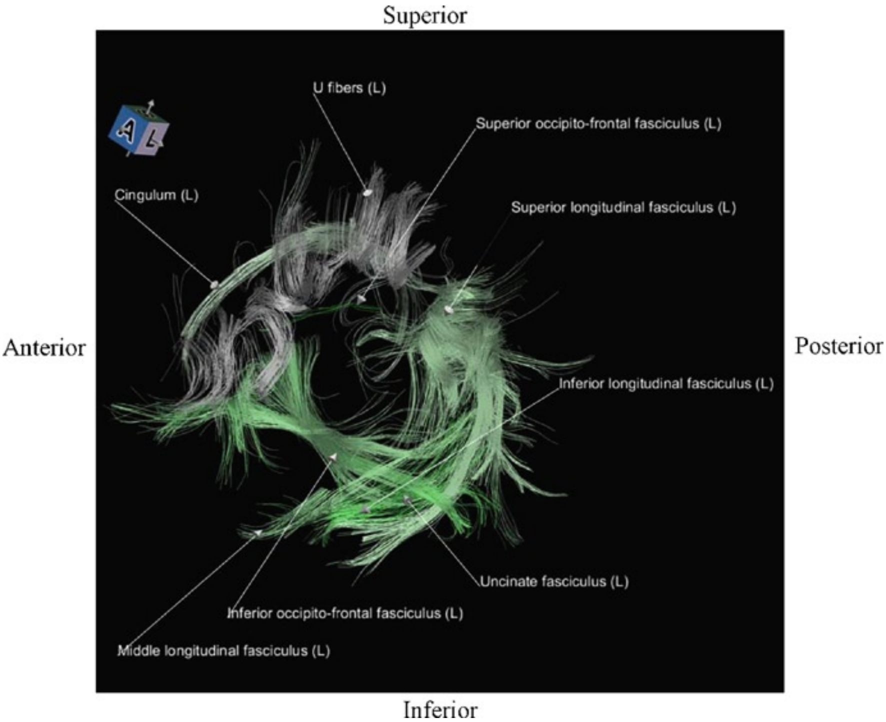



**Fig. 2.29** Association tracts of the left hemisphere

pallidus, thalamus, hypothalamus, hippocampus, and amygdala. The hemispheres are parcellated into frontal, temporal, parietal, occipital, and limbic lobes. The cerebellum contains the paired cerebellar hemispheres united by the midline vermis. The brainstem is subdivided into midbrain, pons, and medulla. The ventricular system contains the paired lateral and midline third and fourth ventricles.

The cerebral vasculature comprises the arterial and venous systems. The brain is supplied by two pairs of arteries: internal carotid artery anteriorly and vertebral artery posteriorly. The anterior and posterior circulations are connected by the circle of Willis, from which originate three paired branches: anterior cerebral, middle cerebral, and posterior cerebral arteries. The venous system contains dural sinuses, and cerebral superficial and deep veins.

The brain is connected by commissural, association, and projection tracts. The main commissural tracts (interconnecting both hemispheres) are: corpus callosum, and anterior and posterior commissures. The major association tracts (interconnecting different regions of the same hemisphere) are: superior longitudinal, middle longitudinal, inferior longitudinal, superior occipito-frontal, inferior occipito-frontal, and uncinate fascicles. The main projection tracts (connecting the cortex with subcortical structures) contain: cortico-spinal, cortico-thalamic (including optic radiation), cortico-bulbar, and cortico-pontine tracts as well as auditory radiation.

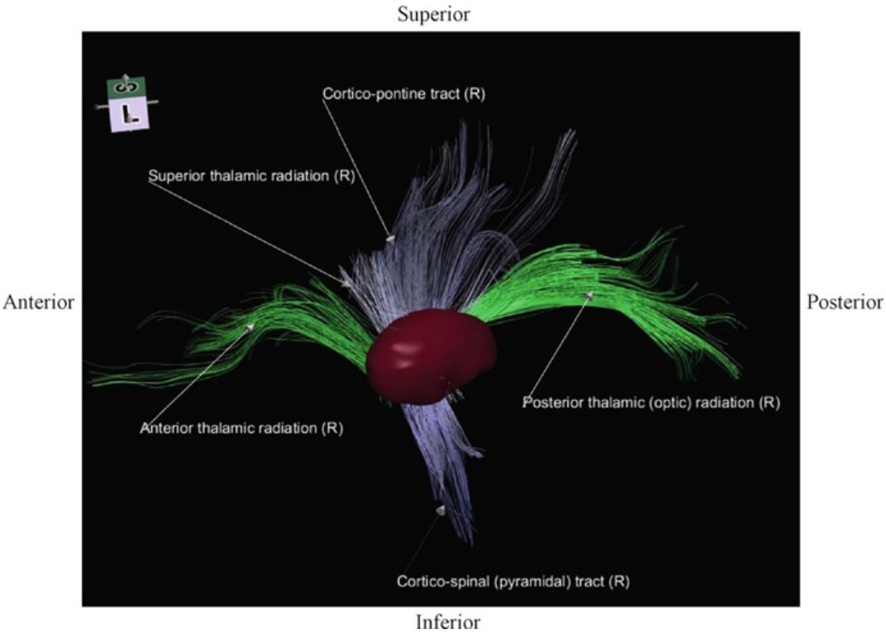



**Fig. 2.30** Projection tracts of the right hemisphere along with the thalamus

This introduction covers basic neuroanatomy. For further study, the reader is referred to the existing literature and electronic atlases.

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