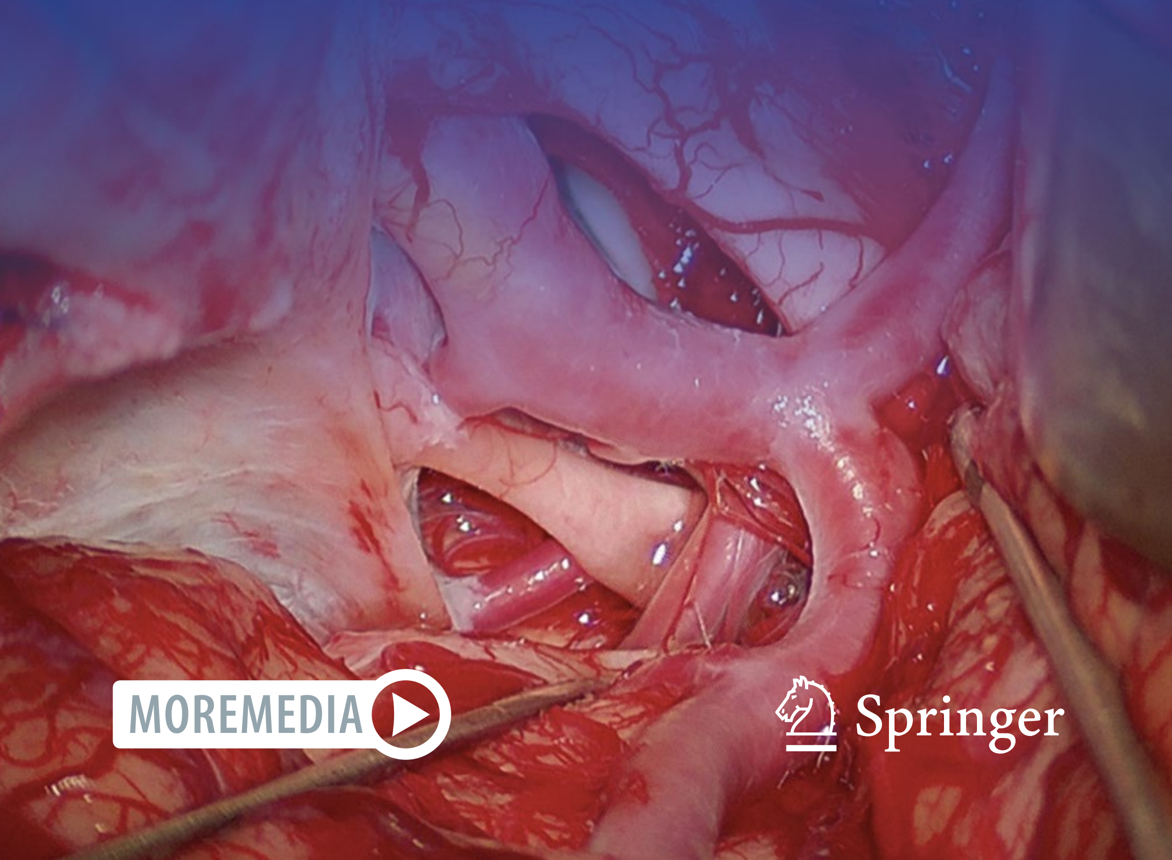
Feres Chaddad-Neto
Marcos Devanir Silva da Costa

Microneuroanatomy and Surgery

A Practical Anatomical Guide



Springer

Microneuroanatomy and Surgery

Feres Chaddad-Neto
Marcos Devanir Silva da Costa

Microneuroanatomy and Surgery

A Practical Anatomical Guide

Springer

Feres Chaddad-Neto
Neurosurgery Division, Department of Neurology and Neurosurgery
Universidade Federal de São Paulo
São Paulo, SP, Brazil

Laboratory of Microneurosurgery Anatomy
Universidade Federal de São Paulo
São Paulo, Brazil

Department of Neurology and Neurosurgery
Hospital Beneficência Portuguesa de São Paulo
São Paulo, Brazil

Marcos Devanir Silva da Costa
Neurosurgery Division, Department of Neurology and Neurosurgery
Universidade Federal de São Paulo
São Paulo, SP, Brazil

Pediatric Neurosurgeon at Instituto de Oncologia Pediátrica - GRAACC - UNIFESP
São Paulo, Brazil

Laboratory of Microneurosurgery Anatomy
Universidade Federal de São Paulo
São Paulo, Brazil

ISBN 978-3-030-82746-5 ISBN 978-3-030-82747-2 (eBook)
https://doi.org/10.1007/978-3-030-82747-2

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

For my wife, Patricia, the love and meaning of my life, who has always encouraged me to fly towards my dreams.
For my daughter, Marina, who has been a gift from the beginning and teaches me, every day, the meaning of happiness.
For my parents, Arlindo Chaddad (in memoriam) and Neide Gomes Chaddad, for raising me, with unconditional love, to believe that anything was possible. My sister Andrea who encouraged me during my journey.
For Prof. Emerson Cocco Lanaro (in memoriam) for inspiring and introducing me to the world of neuroanatomy.
For Dr Evandro de Oliveira (in memoriam), with whom I worked for the past 16 years and owe him all my neurosurgical training and microsurgical techniques.
For Dr. Guilherme Carvalhal Ribas, I truly appreciate his unconditional support throughout the course of my career.
For all the colleagues, students, and fellows, who have taught me the extraordinary path of neuroscience, enhancing my life purpose.
I hope this book will serve you well and bring light to your practice as much as other books have meant in my journey.

Feres Chaddad-Neto, MD, PhD

This book is dedicated to
My wife Vanessa my light, my love, my life.
My children Augusto, Julia, and Vitor – my reasons for living.
My mom Eponina and my father Devanir (in memoriam) my examples.
My beloved family which always supported me.
My Professors that generously transferred their precious knowledge, especially my mentors Prof. Sergio Cavalheiro and Prof. Feres Chaddad-Neto.
My readers, a new generation of neurosurgeons.

Marcos Devanir Silva da Costa, MD, PhD

Foreword

Over the 8 years that Dr. Feres Eduardo Chaddad-Neto has been the associate professor of neurosurgery at the Paulista School of Medicine, he has delivered magnificent work. His methodological rigor in anatomical dissections, bold surgical procedures, and organization are strong qualities.

This book updates the reader regarding the state-of-the-art combination of anatomical and surgical approaches, particularly for vascular diseases.

The chapters are well structured, and the author has an excellent command over English, which makes these chapters easy to read and remember. The illustrations and radiological images are of excellent quality and provide the reader with spatial understanding of several anatomical structures.

As a surgeon, I was impressed by the anatomical description of the different areas of the brain and technical details of surgical procedures.

The 18 chapters present a harmonious balance between anatomical knowledge and surgery, making the book an indispensable tool for practitioners of neurosurgery and neuroscience students. Benefits to the patient are unequivocal.

Only a genius, curious, meticulous, inventive, and tireless worker like him could make this project a success.

The author's eminence is apparent not only in the book but also in his conference talks worldwide and at the university, with his students at different undergraduate and graduate levels, and in hospital wards, operating rooms, and the neuroanatomy laboratory.

Our university is proud to present this book of international scope and to have Dr. Feres Chaddad-Neto as a professor.

We are deeply thankful to Dr. Feres Chaddad-Neto for the work presented here as well as for his pedagogical excellence in neuroanatomy and neurosurgery.

Sergio Cavalheiro
Neurosurgery Department, Federal University of São Paulo
São Paulo, SP, Brazil

Foreword

Anatomy is the foundation of surgery. Our neurosurgical procedures are performed on brains concealed within a forbidding cranium, but once breached, we enter an otherworldly splendor. Neuroanatomy has this alluring beauty that even decades of familiarity cannot diminish. I still marvel at its complexity and never tire of my workplace. When one adds an operating microscope to magnify and illuminate neuroanatomy, this realm becomes even more exquisite. Textbooks rarely do justice to microneuranatomy because there is nothing like the real thing. Textbooks of neuroanatomy are commonplace and quite useful for medical students studying the brain for the first time. But textbooks of microneurosurgical anatomy are rare, especially good ones that relate to the procedures neurosurgeons perform and make neurosurgeons perform better.

In this textbook, *Microneuroanatomy and Surgery*, Feres Chaddad-Neto has compiled a definitive review of the microneurosurgical anatomy related to the procedures neurosurgeons perform and needed to perform microsurgery better. The book focuses on microsurgical anatomy, not just anatomy for anatomy's sake. It begins at the gyri and sulci, then moves to the lobes of the cerebrum, the central core, ventricles, brainstem, and cerebellum. It also includes excellent descriptions of the cisterns and parasellar and pineal regions. The textbook is a beautiful blend of cadaveric dissections, radiographic images, case examples, and operative photographs. A thorough read of this material cannot help but make the reader an enlightened and more knowledgeable neurosurgeon.

I congratulate Dr. Chaddad-Neto on this important contribution to the neurosurgical literature. This textbook is destined to become an invaluable resource in every cranial neurosurgeon's library. It clearly reflects Dr. Chaddad-Neto's passion for microneuroanatomy, the disciplined application of his knowledge in the operating room, meticulous surgical technique, and a genuine dedication to teaching neurosurgeons. I continue to be impressed by his work, both in the operating room and on the page, and the leadership role he has assumed as a neurosurgeon founded in anatomy.

Michael T. Lawton
The Robert F. Spetzler Chairman of Neurosurgery
President and CEO
Barrow Neurological Institute
Phoenix, AZ, USA

Foreword

One of the most gratifying aspects of a long career in medicine is enjoying the success of one's colleagues, particularly those involved in charting the future of the discipline. Feres Chaddad-Neto has time and again proven the same, and so it wasn't a surprise when he asked me to write a foreword for his upcoming book on neuroanatomy. Certainly, this book will serve as a gap between the scissors and mind to reach a lesion safely.

Yoko Kato
Fujita Health University
Toyoake, Japan

Preface

Microneuroanatomy is the essential concept required to approach the brain. Most of the time, neuroanatomy knowledge is passed on as a difficult task to accomplish or as a problematic concept to reach. However, often the problem is related to those who convey this knowledge in classes and lectures or by writing books.

In reality, neuroanatomy is simple and needs to be understood as a tool to approach the different areas of the brain, and not as an obstacle because it is difficult; the only way to overcome this problem is to apply the anatomy and correlate it with different diseases (arteriovenous malformations, aneurysms, tumors, cavernomas, hydrocephalus, etc.)

This book will provide a novel approach to the relation between microneuroanatomy and brain diseases. Every single chapter is based on a specific neuroanatomical region, and correlates all the neuroanatomical key points with diseases that affect each neuroanatomical region. This anatomical correlation provides details and tips to perform a brain surgery regarding that anatomical region safely.

Feres Chaddad-Neto
São Paulo, São Paulo, Brazil

Marcos Devanir Silva da Costa
São Paulo, São Paulo, Brazil

Acknowledgments

This book would never be possible without the commendable work of our valuable collaborators who have helped by writing, dissecting specimens, producing and editing pictures/figures, and editing videos. We are grateful for their collaboration, enthusiasm, and commitment. Their names and institutions are listed below:

Beatriz Souza Renor, MD – Universidade Federal de São Paulo, São Paulo, Brazil

Bruno Augusto Lourenço Costa, MD – Centro Hospitalar Tondela-Viseu EPE, Portugal

Bruno Loof de Amorim, MD – Universidade Federal de São Paulo, São Paulo, Brazil

Daniela de Souza Coelho, Psy, MSc – Universidade Federal de São Paulo, São Paulo, Brazil

Gabriela Miroslava Bustamante Vargas, MD – Hospital Manuel Ascencio Villarroel, Cochabamba-Bolivia

Hugo Leonardo Doria- Netto, MD – Hospital Beneficencia Portuguesa de São Paulo, São Paulo, Brazil

José Maria de Campos Filho, MD – Hospital Beneficencia Portuguesa de São Paulo, São Paulo, Brazil

Joao Vitor Fernandes Lima, MD – Universidade Federal de São Paulo, São Paulo, Brazil

Juan Leonardo Serrato-Avila, MD – Universidade Federal de São Paulo, São Paulo, Brazil

Juan Alberto Paz Archila, MD – Universidade Federal de São Paulo, São Paulo, Brazil

Kaan Yağmurlu, MD – University of Virginia, Health System, Charlottesville, VA, USA

Pedro Góes, MD, MSc – Instituto Estadual do Cérebro Paulo Niemeyer, Rio de Janeiro-RJ, Brazil

Richard Gonzalo Párraga Choque, MD – Neurosurgery Institute of Bolivia (INEB), Cochabamba-Bolivia

Ricardo Chmelnitsky Wainberg, MD – Neurosurgery Division, Hospital São Lucas da PUC-RS - Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil

Sebastian Anibal Alejandro, MD – Universidade Federal de São Paulo, São Paulo, Brazil

Silvio Sarmento Lessa, MD – Universidade Federal de São Paulo, São Paulo, Brazil

Talita Helena Martins Sarti, MD – Universidade Federal de São Paulo, São Paulo, Brazil

Thomas More Frigeri, MD, PhD – Neurosurgery Division, Hospital São Lucas da PUC-RS – Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil

Contents

Chapter 1
Surgical Anatomy of the Sulci and Gyri of the Brain

1.1 Definitions

The sulcus is a depression that is delimited by the two neighboring gyri, where the gyri are the folds of the cortical brain. Historically, fissures were defined as a deeper sulcus; however, since 1955, the only recognized fissure is the interhemispheric fissure. The sulci and gyri compose the cortical surface of the brain.

The brain is composed of the telencephalon and diencephalon. The telencephalon is composed of two hemispheres connected by three commissures, which includes corpus callosum, anterior commissure, and hippocampal (fornix) commissure. The diencephalon is formed by the thalamus, hypothalamus, epithalamus, subthalamus, and metathalamus. From our surgical understanding, we considered the thalamus as the center of the encephalon because surrounding the encephalon we have the hemispheres, lateral and basal nuclei (which are also part of the hemispheres), and internal capsule, and to the inferior of the thalamus lies the brain stem.

The brain has three surfaces: superolateral, medial, and inferior; each of which has a group of sulci and gyri. The first important concept is to identify the sulci that are 100% constant in each of them because they will be the landmarks for the surface anatomy recognition.

All the time, as neurosurgeons, we face the challenge of transposing the radiological topographic diagnoses of a certain brain disease through a small opening on the patients' head called as craniotomy, so this chapter and the next chapters were designed for assisting the readers on this hard task.

1.2 Superolateral Surface

The sulci from the superolateral and basal surfaces point in the direction of the ventricles; for this reason, some pathology such as arteriovenous malformation presents a conical shape. There are several strategies for identifying/recognizing the sulci

F. Chaddad-Neto, M. D. Silva da Costa, *Microneuroanatomy and Surgery*,
https://doi.org/10.1007/978-3-030-82747-2_1

and gyri pattern in the lateral surface; however, there is one strategy that can be applied either to anatomical specimens, radiological images, or during the surgery. An end-to-side connection needs to be found between two sulci, one vertical, and another horizontal (Figs. 1.1 and 1.2). Therefore, there are only two options for the vertical sulcus or the sulcus that is connected by the side to be: precentral sulcus or postcentral sulcus (Fig. 1.3).

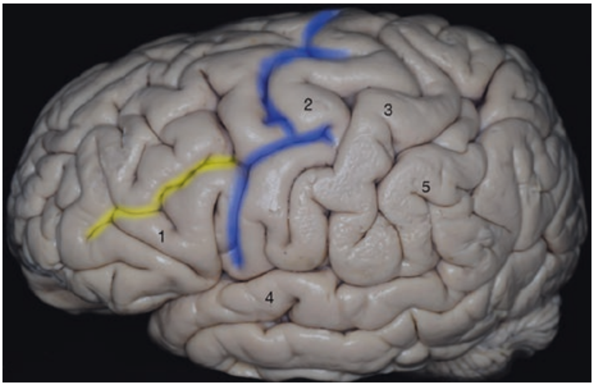


Fig. 1.1 Lateral and superior view showing the end-to-side connection between a vertical sulcus (yellow) and a horizontal sulcus (blue), which is the precentral sulcus. This identification and understanding of this relation allow us to clearly identify the numbered gyri: precentral gyrus (2), postcentral gyrus (3), supramarginal gyrus (5), superior temporal gyrus (4), and inferior frontal gyrus (1)

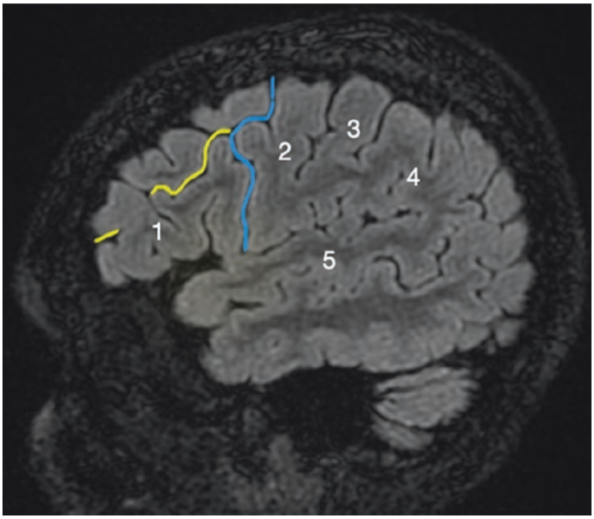


Fig. 1.2 A real brain magnetic resonance imaging scan in the Cube-FLAIR sequence and its sagittal view. The yellow line (inferior frontal sulcus) is the vertical sulcus that connects with the lateral side of the precentral sulcus (blue). Now it becomes easy for identifying the numbered gyri: precentral gyrus (2), postcentral gyrus (3), supramarginal gyrus (4), inferior frontal gyrus (1), and superior temporal gyrus (5)

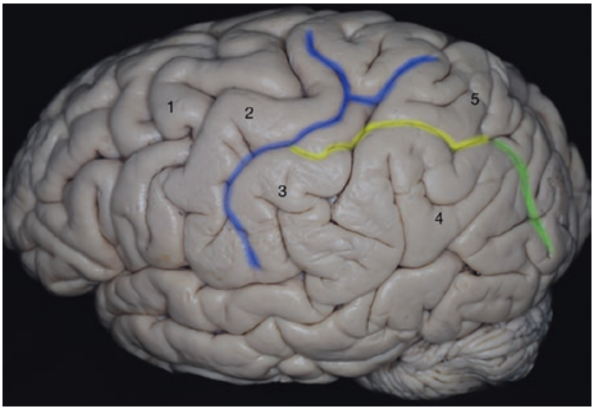


Fig. 1.3 The posterolateral view shows the horizontal sulcus, which is the intraparietal sulcus (yellow) that connects to the lateral side of the vertical sulcus (blue), which must be the postcentral sulcus because the vertical sulcus (yellow) runs from the posterior to the anterior. Here, it becomes simple to identify the numbered structures: precentral gyrus (1), postcentral gyrus (2), supramarginal gyrus (3), angular gyrus (4), and superior parietal lobule (5). The green sulcus is the intra-occipital that is continuous with the intraparietal sulcus (yellow)

1.3 So How to Differentiate the Precentral from the Postcentral Sulcus?

Both the precentral and postcentral sulcus can be identified by the recognition of the relation between one horizontal sulcus connecting to a vertical sulcus (end-to-side connection); the precentral sulcus is always anterior, and the postcentral sulcus is always located posteriorly (Fig.1.3).

It is possible to identify the precentral sulcus, precentral gyrus, central sulcus, postcentral gyrus, and the postcentral sulcus just by identifying one anatomical relation, that is, an end-to-side connection between a horizontal sulcus with a vertical sulcus. If this relation happens posteriorly, the vertical sulcus is the postcentral, and if this happens anteriorly, the vertical sulcus is the precentral.

The central sulcus has an oblique S shape format and rarely connects to a horizontal sulcus. It runs from the posterior to the anterior and from the medial to the lateral; its superior end can be identified 5 cm posteriorly to the bregma, and the inferior end can be identified 7 cm above the preauricular pit.

1.4 Frontal Lobe

The frontal lobe, in the superolateral surface, is formed by three sulci: two are horizontal that delineates three gyri and one vertical, which is the precentral sulcus (Fig. 1.4). The two horizontal sulci, inferior and superior frontal sulcus, delineate from superior-medial to inferior-lateral, superior, middle, and inferior frontal gyrus.

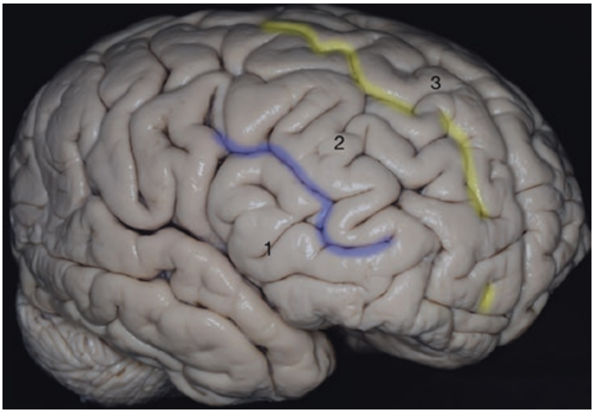


Fig. 1.4 The antero-lateral view of the lateral surface of the frontal lobe, two sulci, delineates three gyri: the inferior frontal gyrus (1), inferior frontal sulcus (blue), middle frontal gyrus (2), superior frontal sulcus (yellow), and superior frontal gyrus (3)

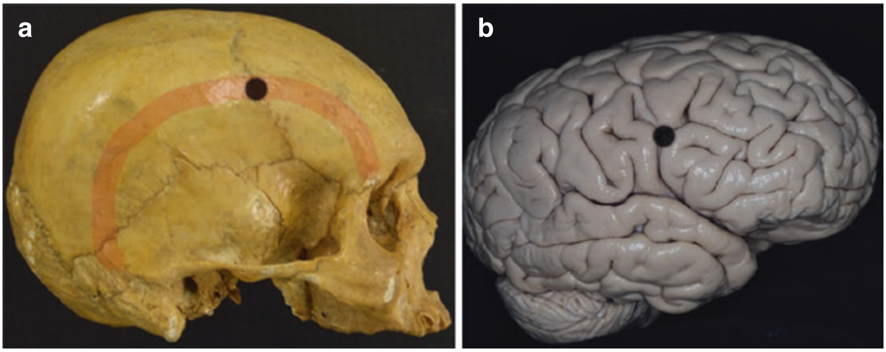


Fig. 1.5 The black dot represents the Stephanium cranial point in (**a**) and the end-to-side connection of the inferior frontal sulcus and precentral sulcus in (**b**). The red line (**a**) is the superior temporal line that meets the coronal suture in the black dot defining the Stephanium cranial point, and representing the end-to-side connection between the precentral sulcus and the inferior frontal sulcus

In 12–16% of the cases, there is an intermediate frontal sulcus, which runs inside the middle frontal gyrus. The central sulcus is the posterior limit of the frontal lobe, while the interhemispheric fissure is the superior-medial limit, and the lateral sulcus (Sylvian fissure) is the inferior-lateral limit.

1.5 Is There a Cranial Landmark for the Inferior Frontal Gyrus?

There is a very important cranial point called Stephanium, characterized by the union between the coronal suture and the superior temporal line; this point is in the same projection of the union between the precentral sulcus and the inferior frontal sulcus (Fig. 1.5). Therefore, below the superior temporal line, we have the projection of the inferior frontal gyrus. Below the inferior frontal gyrus, we have the most important landmark in the lateral surface, the Sylvian fissure.

The lateral sulcus (Sylvian fissure) is the key landmark of the lateral surface, which is divided into a superior-lateral (related to frontal and parietal lobes) and an inferior-lateral (related to temporal lobe) part by the lateral sulcus. It is possible to recognize three rami: anterior horizontal, anterior ascending, and posterior. At the inferior frontal gyrus, the anterior horizontal and anterior ascending ramus, in a V-shaped fashion, delineate the triangular part, with the orbital part located anteriorly and the opercular part posteriorly. The orbital part is located superiorly to the orbital roof and continues as the lateral orbital gyrus in the basal surface, while the opercular part with the triangular part covers the anterior part of the insula as a curtain (Figs. 1.6 and 1.7).

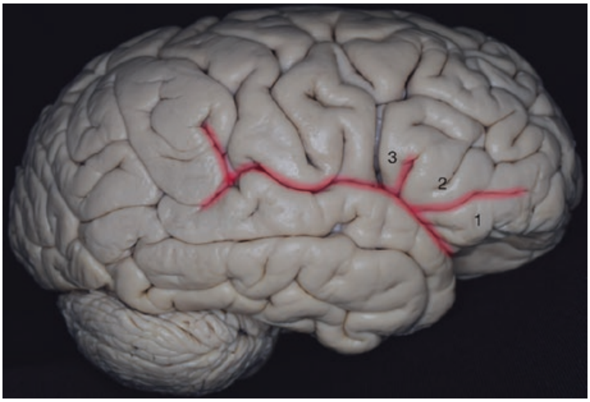


Fig. 1.6 This lateral view of the brain illustrates the Sylvian fissure or lateral sulcus of the brain (red). The sulcus has different rami that separate the inferior frontal gyrus into three parts: orbital part (1), triangular part (2), and opercular part (3)

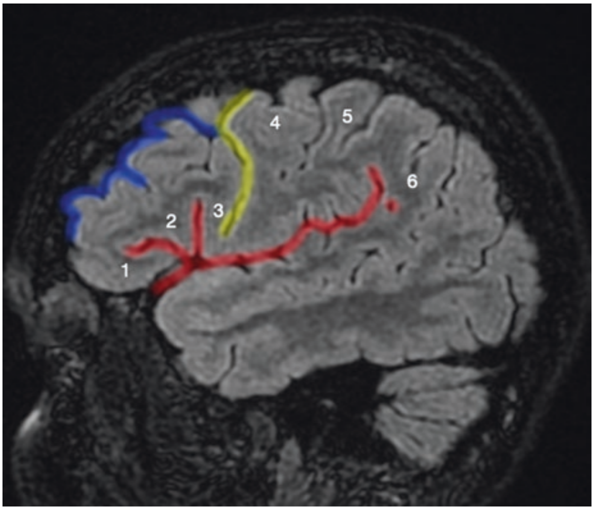


Fig. 1.7 The Cube-FLAIR sequence of a brain magnetic resonance imaging scans reveals some of the anatomic structures studied in the cadaver specimen. The Sylvian fissure (red) and its rami that delineate the orbital part (1), triangular part (2), and opercular part (3). In addition, the meeting of the end of the inferior frontal sulcus (blue) with the side of the precentral sulcus (yellow), precentral gyrus (4), postcentral gyrus (5), and marginal gyrus (6) surrounding the posterior end of the Sylvian fissure is being continuous to the superior temporal gyrus

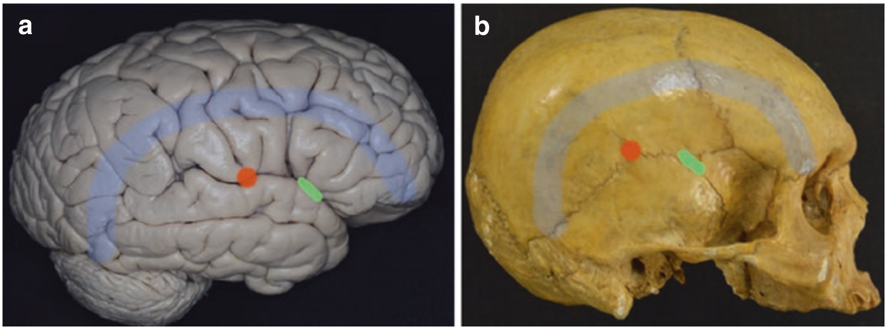


Fig. 1.8 The superior temporal line is represented in B by the blue line, which is also a projection of the inferior frontal sulcus in A, and the projection of the corpus callosum in the brain and cranial surface. The red dot represents the higher point of the squamous suture in B and the point where the central sulcus reaches the Sylvian fissure in A. The green dash represents the Asterion in B and the Anterior Sylvian Point in A

The triangular apex part points out toward the Sylvian fissure. The point of union of these three rami is called as anterior Sylvian point, a cisternal point. The triangular part of the inferior frontal gyrus points out to the anterior Sylvian point and deeply into the lumen of the insula, where the middle cerebral artery changes its axis from M1 to M2 because at this point the middle cerebral artery changes its axes from the medial toward the lateral direction to anterior toward posterior direction.

The lateral sulcus (Sylvian fissure) projects obliquely from the inferior to the superior and from the medial to the lateral, being parallel to the lesser sphenoid wing. This sulcus contains the middle cerebral artery and Sylvian veins.

The Sylvian fissure is represented in the cranial surface by the squamous suture; the highest point of the squamous suture represents the point where the central sulcus reaches the Sylvian fissure. The pterion, which is the region of union of the frontal-sphenoidal suture, sphenotemporal suture, sphenoparietal suture, squamous suture, and coronal suture, also is a reference for the anterior Sylvian point (Fig. 1.8).

1.6 Temporal Lobe

The temporal lobe is located below the lateral sulcus (Sylvian fissure), and it has two horizontal sulci, superior and inferior temporal sulci in the lateral surface, that delineate three horizontal gyri, namely, the superior, middle, and inferior temporal gyri (Fig. 1.9).

The superior temporal gyrus continues posteriorly as the supramarginal gyrus, also known as "temporoparietal operculum." This correlation is of great relevance during the surgery because even with arachnoid membranes and vessels, it is easy to identify the lateral sulcus of the brain. Therefore, the main surgical tip is to identify the Sylvian fissure and infer that inferiorly we can find the superior temporal gyrus that continues by folding posteriorly as the supramarginal gyrus, once the last is the posterior limit of the lateral sulcus (Sylvian fissure).

The superior temporal sulcus divides, as a horizontal "Y," into two rami where one is the posterior limit of the supramarginal gyrus and the other is the occipital ramus that is the inferior limit of the angular gyrus (Fig. 1.10).

The middle temporal gyrus continues posteriorly as the angular gyrus, and deeply it corresponds to the sagittal stratum and to the temporal horn of the lateral ventricle. The inferior temporal gyrus communicates the lateral and the basal surface of the brain and deeply corresponds to the inferior longitudinal fasciculus.

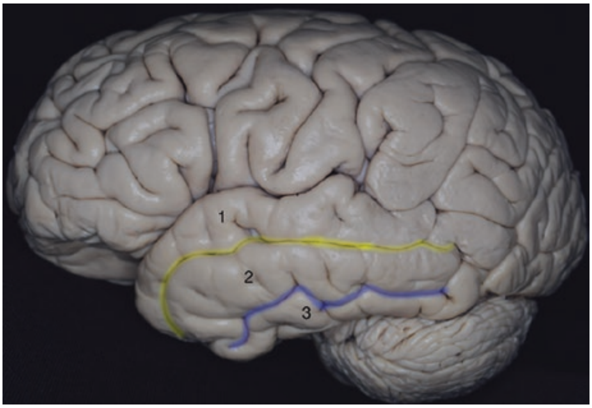


Fig. 1.9 Lateral view of the temporal lobe showing the two sulci separating the lateral surface into three gyri: superior temporal gyrus (1), superior temporal sulcus (yellow), middle temporal gyrus (2), inferior temporal sulcus (blue), and inferior temporal gyrus (3)

Fig. 1.10 Illustrates the relation between the two neighboring gyri; the superior temporal gyrus (purple) continues to be supramarginal gyrus (blue) by involving the end of the Sylvian fissure. In the same way, the middle temporal gyrus (yellow) continues as the angular gyrus (green)

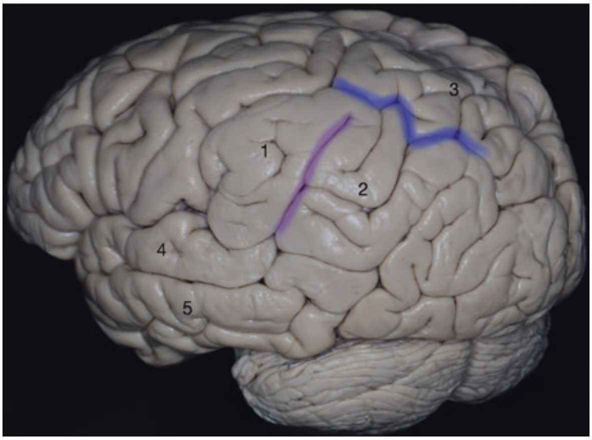


Fig. 1.11 This posterolateral view of the brain emphasizes the parietal lobe; the intraparietal sulcus (blue) is the main sulcus to the lateral surface of the parietal lobe; it divides the superior parietal lobule (3) from the inferior parietal lobule (1 and 2), which is separated by the intermediate sulcus (Jensen – purple) that can come from the superior temporal sulcus or from the intraparietal sulcus. The two gyri numbered 4 and 5 illustrates that the superior temporal gyrus (4) continues as supramarginal gyrus (1) and the middle temporal gyrus (5) continues as the angular gyrus (2). This relation is relevant for observing during the surgical approaches to parenchymal lesions

1.7 Parietal Lobe

The parietal lobe is composed of three principal areas, the post-central gyrus, superior, and inferior parietal lobule, which are separated from each other by the intraparietal sulcus. The inferior parietal lobe has the supramarginal and angular gyrus, which are separated from each other by the intraparietal sulcus (Jensen's sulcus). The connection between intraparietal sulcus with postcentral sulcus is also an example of an end-to-side connection where the horizontal sulcus corresponds to the postcentral and the vertical sulcus to the intraparietal sulcus (Fig. 1.11). The intraparietal sulcus in its depth has an external relation with the atrium of the lateral ventricle. There is a cranial point named intraparietal point that is located 5 cm anterior to the lambda and 4 cm lateral do the sagittal suture. The intraparietal point indicates the point in the intraparietal sulcus that can be used as a pathway for entering the atrium of the lateral ventricle.

1.8 Occipital Lobe

The occipital lobe has no evident separation from the temporal and parietal lobe; thus, it is important to emphasize that the boundaries of the lobe are arbitrary. The anterior limit at the lateral surface is an imaginary line between the pretemporo-occipital notch and the impression of the parieto-occipital sulcus. The superomedial

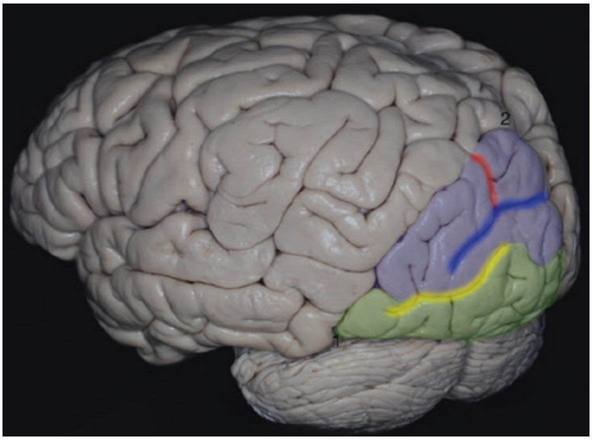


Fig. 1.12 This figure illustrates the posterior view of the lateral surface. The occipital lobe has many possible variations. Here, we show one type of presentation where the lateral occipital sulcus (yellow) separates the occipital lobe in two gyri, the superior occipital gyrus (purple) and inferior occipital gyrus (green). Inside the superior occipital gyrus, we can see the transverse occipital sulcus (blue) establishing a connection with the intra-occipital sulcus (red) that is the direct continuation of the intraparietal sulcus. Number 1 represents the temporo-occipital notch that is the impression of the vein of Labbè at the point where the vein drains to the transverse-sigmoid sinus junction. Number 2 represents the impression of the parieto-occipital sulcus in the lateral surface. By connecting these two numbers as an imaginary line, we delineate the anterior limit of the occipital lobe once there are no clear separations between the occipital lobe and both the temporal and parietal lobe

limit is the interhemispheric fissure, and inferior-lateral limit is the border that is parallel to the transverse sinus. It is important to note that the impression of the parieto-occipital sulcus in the lateral surface is marked in the cranial surface by the union of the lambdoid suture to the sagittal suture; this junction occurs 6–7 cm ahead of the inion, the external occipital protuberance. The intrinsic anatomy exhibits different patterns compared to the previously described lobes. To date, there are at least seven different classifications. Therefore, we will consider the two most prevalent forms, one that considers three gyri and two sulci—the superior, middle, and inferior occipital gyri separated by the interoccipital and lateral occipital sulci—and the other that considers two gyri separated by one sulcus, superior and inferior occipital gyri, and lateral occipital sulcus. However, in this case, the superior occipital gyrus can harbor the interoccipital sulci and transverse occipital gyri (Fig. 1.12).

1.9 Insular Lobe

The insular lobe has three characteristics: it is covered by the frontoparietal and temporal opercula; it lies in the depth of the hemispheric part of the lateral sulcus of the brain (Sylvian fissure). In addition, it is the lateral limit of the central core.

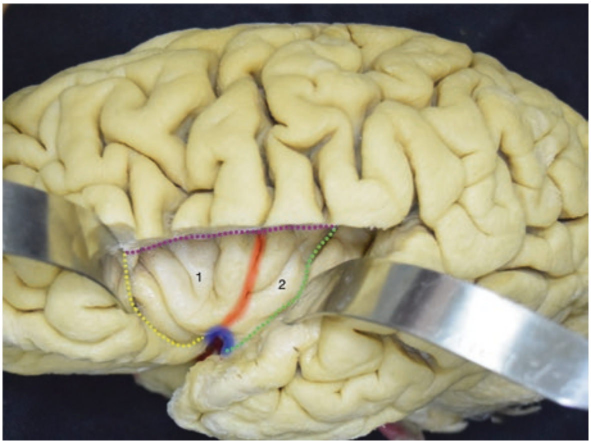


Fig. 1.13 The insular lobe is surrounded by the peri-insular sulcus that is composed of three main parts, the inferior limiting sulcus (green dotted line), superior limiting sulcus (purple dotted line), and anterior limiting sulcus (yellow dotted line). The inferior limiting sulcus (green dotted line) meets the anterior limiting sulcus (yellow dotted line) in the most inferior portion of the insula that is named as the lumen of the insula (blue). The lateral aspect of the insular lobe is separated into two parts by the central sulcus of the insula (red): anteriorly to this sulcus, we found the short gyri of the insula (1), and posteriorly we found the long gyri of the insula (2)

The sulci that encircle the insular lobe are superior, anterior, and inferior limiting sulci that resembles a pyramid with a triangular base. The insular lobe also has two surfaces: one anterior that harbors the anterior transverse gyri and one lateral that has the short and long gyri separated by the central sulcus of the insula, which is in the same projection of the central sulcus of the brain. It is possible to find three to five short insular gyri and one to two long insular gyri (Fig. 1.13).

The limen of the insula is the point where the middle cerebral artery changes its direction and becomes M2 segment (insular); therefore, from a surgical point of view, everything that is medial to the M2 segment is the insular lobe; the triangular part of the inferior frontal gyrus also points to the lumen of the insula that corresponds to the anterior Sylvian point in the lateral sulcus of the brain (Sylvian fissure), which is usually the start point for initiating the Sylvian fissure dissection. The uncinate fibers that connect the fronto-orbital region to the temporal pole are superficially represented by the lumen of the insula.

1.10 Medial Surface

The main landmark of the medial surface is the corpus callosum, which is a telencephalic commissure located on the medial surface of the brain composed of six parts: rostrum, knee, body, splenium, major forceps, and minor forceps (Fig. 1.14). The corpus callosum is encircled by a 100% constant sulcus, the sulcus of the callosum, which contains the pericallosal artery. The corpus callosum is easily

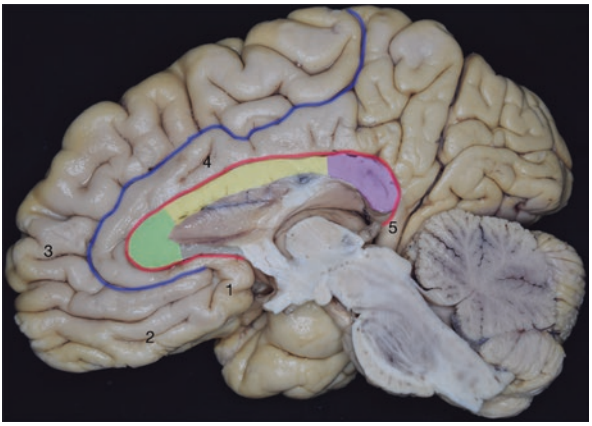


Fig. 1.14 This is a medial view of the brain. The key landmark of this surface is the corpus callosum, which can be separated into four segments at the sagittal view: rostrum (gray), genu (green), body (yellow), and splenium (purple). The corpus callosum is encircled with 100% constant sulcus that is the sulcus of the corpus callosum (red), which separates the corpus callosum from the cingulate gyrus (4) and which is delineated by the sulcus of the cingulate gyrus (blue). We can also identify the subcallosal area (1), rectus gyrus (2), medial frontal gyrus (3), and isthmus of the cingulate gyrus (5)

recognized during the interhemispheric approaches; it has a white surface that is the main tip for differentiating from the cingulate gyrus.

The cingulate gyrus, which is part of the limbic lobe, is delimited by the sulcus of the corpus callosum and cingulate sulcus, and it forms a “belt” around the corpus callosum. When passing below the splenius of the corpus callosum, it has a narrow part, which is called the isthmus of the cingulate gyrus. At this exact point, the isthmus of the cingulate gyrus is a cortical projection of the medial wall of the atrium of the lateral ventricle (Fig. 1.14). Therefore, the isthmus of the cingulate gyrus can be a cortical window for approaching the atrium of the lateral ventricle from the medial surface.

The identification of the corpus callosum sulcus and cingulate gyrus and sulcus is important to differentiate the other structures that belong to the lobes described in the medial surface, for example, the frontal lobe that has the rectus gyrus and the medial frontal gyrus in the medial surface. The precentral and postcentral gyrus are represented in the medial surface as paracentral lobule, which is delineated anteriorly by the paracentral sulcus, posteriorly by the marginal branch of the cingulate sulcus, inferiorly by the cingulate sulcus, and medially by the interhemispheric fissure. The parietal lobe is also represented in the medial surface by the quadrangular lobule or precuneus. The precuneus is also quadrangular, delineated anteriorly by the marginal branch of the cingulate sulcus, posteriorly by the parieto-occipital sulcus, and inferiorly by the subparietal sulcus (Fig. 1.14).

The occipital lobe has its best definition in the medial surface because it is separated from the quadrangular lobule by the parieto-occipital sulcus or fissure that is very deep with 100% constant sulcus. The occipital lobe in the medial surface is