www.surgicalneurologyint.com

ScientificScholar® Knowledge is power
Publisher of Scientific Journals

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Professor of Clinical Neurosurgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Neurovascular

Editor
Kazuhiro Hongo, MD
Shinshu University, Matsumoto, Japan

SNI Open Access

Original Article

Anatomical aspects, technical nuances, and a case series of the resection of the inferior temporal gyrus as a strategy to access the basal surface of the temporal lobe and the lateral incisural space

Erica Antunes Effgen[1], Mariano Teyssandier[1], Sebastian Juan Mária Giovannini[1], Luis Ángel Canache Jiménez[1], Érico Samuel Gomes Galvão da Trindade[1], Alejandro Benjamin Romero Leguina[1], Dionisio Figueiredo Lopes[1], Feres Chaddad-Neto[1,2]

[1]Department of Neurology and Neurosurgery, Univerisdade Federal de São Paulo, [2]Department of Neurosurgery, Hospital Beneficência Portuguesa de São Paulo, São Paulo , Brazil.

E-mail: Erica Antunes Effgen - erica.effgen@gmail.com; Mariano Teyssandier - dr.teyssandier.ncx@gmail.com; Sebastian Juan Mária Giovannini - sjmgiova@gmail.com; Luis Ángel Canache Jiménez - canachevzla@gmail.com; Érico Samuel Gomes Galvão da Trindade - samuelggt@hotmail.com; Alejandro Benjamin Romero Leguina - benjaminleguina@gmail.com; Dionisio Figueiredo Lopes - dioflopes@gmail.com; *Feres Chaddad-Neto - feres.chaddad@unifesp.br

***Corresponding author:**
Feres Chaddad-Neto,
Department of Neurology and Neurosurgery, Universidade Federal de São paulo, São Paulo, Brazil.

feres.chaddad@unifesp.br

Received: 27 November 2024
Accepted: 15 January 2025
Published: 21 February 2025

DOI
10.25259/SNI_1016_2024

Quick Response Code:

ABSTRACT

Background: Pathologies of the basal surface of the temporal lobe (TL) and the lateral incisural space (IS) commonly present microsurgical challenges. Since the inferior temporal gyrus (ITG) is part of both the lateral and the basal surfaces, it has a close relationship with the basal surface of the TL and lacks major white matter tracts, reducing the risk of eloquence. This study aims to describe the technique of ITG resection, its applications in four surgical cases, and the relevant anatomical aspects.

Methods: An anatomical review of the TL and the IS was performed. Anatomical pieces fixed using Klingler's technique and alcohol-fixed, silicone-injected cadaver heads were used to demonstrate landmarks and relationships. The step-by-step surgical technique is described, with four case reports exemplifying its application.

Results: The patients reported no visual field impairments, memory complaints, or neurological complications. The resection of the ITG increases the working space and wider the surgical corridor, allowing access to medial temporal basal structures and the tentorial notch.

Conclusion: The resection of the ITG represents a useful technique to reach the basal surface of the TL and the lateral IS since it avoids excessive retraction of the TL which may cause vessel injury, mainly to the vein of Labbé. Furthermore, it provides relaxation of the vein of Labbé when venous congestion is present. However, more studies are necessary to demonstrate short and long-term outcomes of the resection of the ITG.

Keywords: Basal, incisural space, Inferior temporal gyrus, Medial temporal lobe, Resection

INTRODUCTION

The basal surface of the temporal lobe (TL) and the lateral incisural space (IS) are regions of the brain that are difficult to reach, which causes pathologies of those regions to be challenging for microsurgical treatment. The inferior temporal gyrus (ITG) is part of both the lateral and basal surface of the brain [3], so it holds a close relationship with the basal surface of the TL. Few studies have proposed a corticectomy or the resection of part of the ITG to aid in the treatment of pathologies of the lateral IS and the basal surface of the TL.[9,19,28] Furthermore, it is necessary to detail and provide an additional description of the step-by-step technique of removing the ITG and the specific anatomical landmarks involved. The use of anatomical pieces and sequences of dissections aids in the study of structures and landmarks, which can promote better planning of the microsurgical treatment.[15] The purpose of this study is to describe the technique of resection of the ITG and the anatomical landmarks and relationships that should be considered, besides reporting four surgical cases in which this technique was applied.

MATERIALS AND METHODS

An anatomical review regarding the TL and the IS was performed using the keywords "temporal," "medial," and "basal" to research on the database of Medline (PubMed). For the study of anatomical landmarks and their relationships, we used five anatomical pieces fixed according to Klingler's technique,[12] five alcohol-fixed and colored silicone-injected cadaver heads, and one skull. Furthermore, the step-by-step surgical technique is described. For exemplification, two case reports of arteriovenous malformations (AVMs) of the fusiform gyrus, a dural arteriovenous fistula of the tentorium, and a tumor involving the petrous ridge and the tentorium are described, as well. The data of the patients were collected from the medical records and the surgeries were performed by the same senior neurosurgeon. The ethics committee of our institution approved this study. Appropriate consent was obtained for the publication of the cadaveric images.

RESULTS

Bibliography search

While reviewing the available articles and original works regarding the anatomy of the TL and IS, considering the inclusion criteria mentioned above, we included 10 articles in English, besides two neuroanatomy books and one neurovascular surgery book that discuss the anatomical and technical aspects. We also discussed certain applications of ITG and its importance in neurosurgical approaches.

Anatomical aspects

The ITG is part of both the lateral and basal surface of the brain, with its limits defined by the inferior temporal sulcus (ITS) on the lateral surface and the occipitotemporal sulcus (OTS) on the basal surface.[3] Posteriorly, an imaginary line between the preoccipital notch and the superior portion of the parieto-occipital sulcus delimits the ending of the TL and the beginning of the occipital lobe on the lateral surface.[3]

The main sulci of the basal surface of the TL are the collateral, the occipitotemporal, and the rhinal sulci as depicted in Figure 1a; the last one being the anterior segment of the collateral sulcus (CS), with a variable percent of continuity between those sulci.[6,8] The parahippocampal gyrus, anteriorly, and the lingual gyrus, posteriorly, form the medial occipitotemporal gyrus; the lingual gyrus begins at the level of the cingulate isthmus.[6,8] The lateral occipitotemporal gyrus is delimited by the CS medially and the OTS laterally; nevertheless, in the cases in which the OTS connects to the CS, the lateral occipitotemporal gyrus is called the fusiform gyrus,[3] as demonstrated in Figure 1b.

The anterior part of the mediobasal TL includes the semilunar and the ambient gyri – located superiorly and related to the Sylvian fissure and the carotid cistern; and the uncus, anteromedial part of the parahippocampal gyrus – located inferiorly.[8] Thus, the anterior part of the mediobasal TL is related to the anterior two-thirds of the cerebral peduncle and, hence, to the crural cistern.[8] The middle part of the mediobasal TL, which is related to the posterior one-third of the cerebral peduncle, the tegmentum of the midbrain, and the ambient cistern, includes the CS, inferiorly, and the subiculum of the parahippocampal gyrus, the dentate gyrus, and the fimbria of the fornix, located medially.[8] The posterior part of the mediobasal TL comprises the isthmus of the cingulate gyrus (located anterior and medially), the splenium of the corpus callosum, the inferior portion of the precuneus, the posterior part of the dentate gyrus, the fasciolar gyrus (which is continuous to the dentate gyrus), and lingual gyrus (which is located inferiorly).[8] Finally, the posterior portion of the mediobasal TL is associated with the tectum of the midbrain, the pulvinar of the thalamus, the posterior portion of the ambient cistern, and the quadrigeminal cistern.[8]

The temporal horn of the lateral ventricle is at the level of the middle temporal gyrus (MTG).[3,4] The lateral limit of the temporal horn consists of white matter fibers of the sagittal stratum,[4] including the optic radiation, the anterior commissure, and the inferior fronto-occipital fasciculus. The medial limit of the temporal horn includes the hippocampus, the fornix, the choroidal fissure, and the choroidal plexus.[4] Its anterior limit is the amygdala, and the thalamus and the tail of the caudate nucleus represent its superior limit.[4] Finally, the floor of the temporal horn includes the impression made by the CS, which is named collateral eminence. [7] Therefore, the CS is a reference when it is necessary to enter the temporal horn from its basal aspect.[9,28] Figure 1c illustrates the anatomy of the lateral ventricle.

Cadaveric white fiber dissection is useful for studying and planning microsurgical treatment.[4,7] Among the white

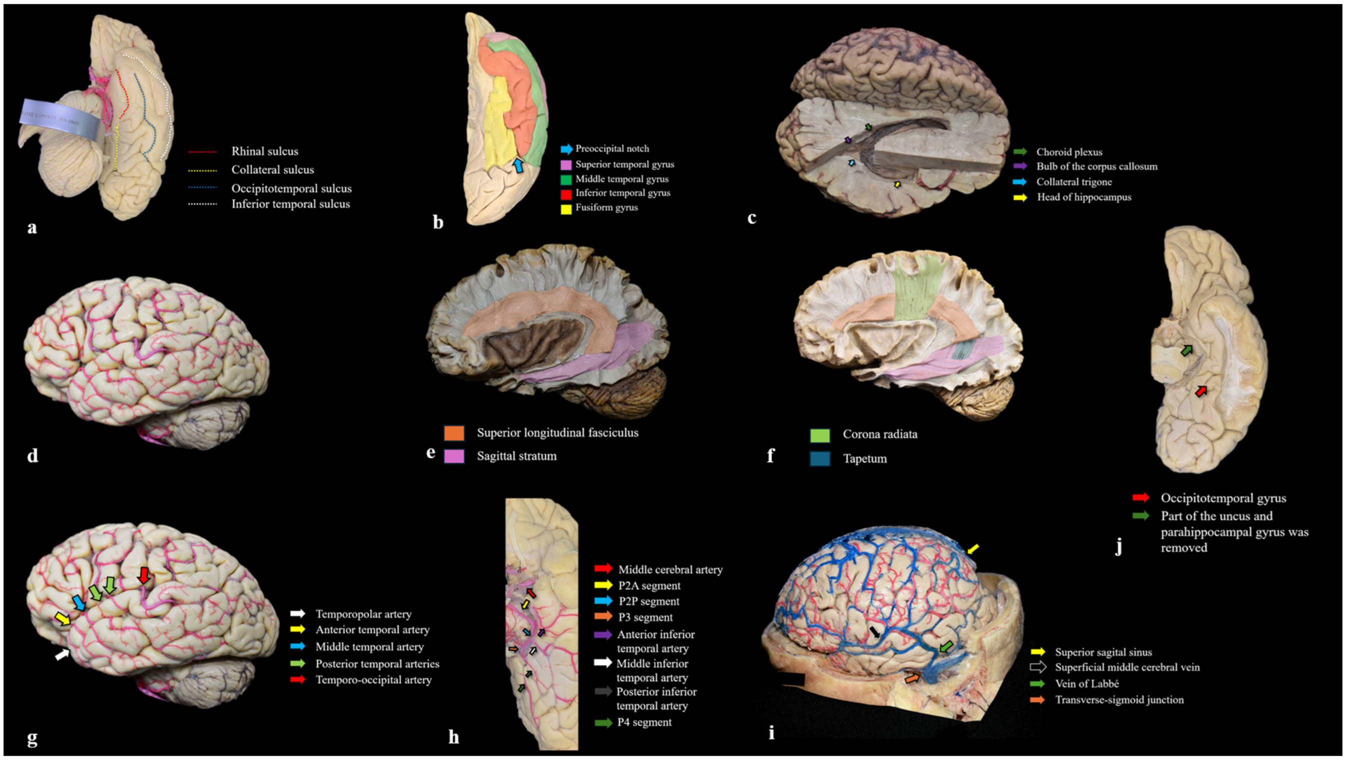

Figure 1: (a) Anatomical piece in which the main sulci of the basal surface of the temporal lobe is highlighted. (b) An anatomical piece depicting the basal surface of the temporal lobe, demonstrating the fusiform gyrus. (c) Anatomical piece with dissection of the lateral ventricle. (d-f) Anatomical pieces demonstrating a sequence of dissection of the white matter tracts. (d) Brain hemisphere before dissection starts. (e) The superior longitudinal fasciculus and the sagittal stratum are possible to be identified. (f) Part of the superior longitudinal fasciculus was removed to demonstrate the corona radiata and the tapetum, which contains fibers from the splenium and trunk of the corpus callosum. (g and h) Anatomical piece demonstrating the vascularization of the lateral surface (g) and the basal surface (h) of the temporal lobe. (i) Lateral view of a cadaveric head dissected demonstrating the vein of Labbé providing an anastomosis between the superficial middle cerebral vein and the transverse-sigmoid junction. (j) Basal view of an anatomical piece after the inferior temporal gyrus resection, demonstrating the increase of working space in the basal region of the temporal lobe.

matter association fibers present in the TL, optic radiation and the inferior fronto-occipital fasciculus are part of the sagittal stratum.[3,25] Meyer's loop, which is the anterior bundle of the optic radiation, presents proximity to the temporal horn at the level of the MTG.[3,25] Thus, quadrantanopia consists of one of the main risks of transcortical approaches to access pathologies of the mediobasal TL,[19,25] mainly in cases with corticectomies involving the superior and middle temporal gyri.[25] Nevertheless, ITG lacks the main white matter tracts. Figures 1d-f depicts some of the main white matter tracts in a sequence of dissection.

The vascularization of the lateral surface of the TL is provided mainly by branches of the middle cerebral artery, as summarized by Figure 1g; however, the ITG may receive irrigation from inferior temporal branches of the posterior cerebral artery.[3]

The basal temporal region is irrigated, as depicted in Figure 1h, by the anterior, middle, and posterior inferior temporal arteries, usually branches from the P2A or P2P segments of the posterior cerebral artery,[3,20] but they may also emerge as a common temporal artery.[3,4,20]

Concerning the medial aspect of the basal TL, the blood supply for its anterior part is provided by early branches of the middle cerebral artery, by the uncal artery – a branch from the anterior choroidal artery, by the hippocampal arteries – branches from the posterior cerebral artery, and by branches of the anterior choroidal artery.[8,20] The middle portion of the mediobasal TL is irrigated by the anterior choroidal artery and by the anterior inferior, middle inferior, and posterior inferior temporal arteries – which are branches from the posterior cerebral artery depicted in Figure 1h.[8,20] The terminal branches of the posterior cerebral artery, the parieto-occipital, and the calcarine arteries are responsible for the blood supply of the posterior portion of the medial aspect of the basal temporal surface.[8,20]

The temporobasal veins perform the venous drainage of the basal surface of the TL – anterior, middle, and posterior – which join the lateral tentorial sinuses at the preoccipital notch.[3,16] The anterior portion of the medial aspect of the basal TL is drained by the uncal vein (a tributary of the deep middle cerebral vein or the initial portion of the basal vein of Rosenthal) and by the anterior hippocampal vein (a tributary of the inferior ventricular vein or the second segment of the basal vein of Rosenthal).[8] The middle portion of the medial temporal basal region is drained by the anterior longitudinal hippocampal vein – a tributary of the inferior ventricular vein, of the anterior hippocampal vein, or the basal vein of Rosenthal, and by the medial temporal vein – a tributary of the basal vein of Rosenthal.[8] Finally, the posterior longitudinal hippocampal vein – which is a tributary of the third segment of the basal vein of Rosenthal, internal cerebral vein, lateral atrial vein, or medial atrial vein – and the occipitotemporal vein, which is a tributary of the third segment of the basal vein of Rosenthal – are responsible for the drainage of the posterior portion of the medial basal temporal region.[8]

Regarding the lateral surface of the TL, the temporosylvian veins, which drain to the superficial Sylvian vein, perform its venous drainage.[3] The vein of Labbé, also named the inferior anastomotic vein demonstrated in Figure 1i, is responsible for communicating the veins of the Sylvian fissure with the transverse sinus, in which it usually ends at the preoccipital notch area.[20]

Craniometric parameters

The middle cranial fossa contains most of the basal surface of the TL, except its posterior part, located over the cerebellar tentorium.[28] To surgically access this region, it is essential to understand craniometric parameters. The limits of the TL may be identified by the squamous suture superiorly, which corresponds to the Sylvian fissure until the superior squamous point, and the asterion posteriorly, which usually corresponds to the preoccipital notch[3] [Figure 2a]. In addition, the superior margin of the zygomatic arch is related to the inferior margin of the ITG.[3]

Surgical positioning

The patient is positioned in dorsal decubitus, although the lateral decubitus could be used as well, with an anatomical cushion under the ipsilateral shoulder and the head rotated to the contralateral side approximately 90º, parallel to the floor and slightly tilted downward, similarly to the subtemporal approach,[11] so that the zygoma is placed as the most superior anatomic feature. The head is fixed with a 3-point skull clamp system with pins, as shown in Figure 2b, with the lone pin placed at the forehead, above the hairline, if possible, but not in the midline, so that lesions of the superior sagittal sinus are avoided and with a previous study of the anatomy of the frontal sinus. The other pins are placed just above the superior nuchal line, avoiding lesions of the muscles below it.

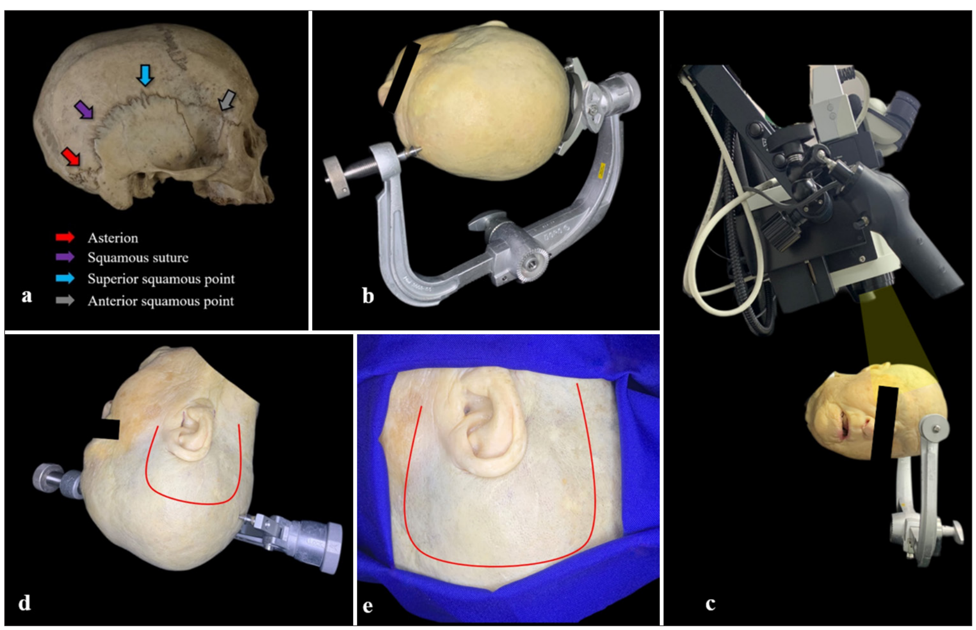

Figure 2: (a) Demonstration of the most important craniometric parameters involved in the approach proposed. The red, purple, blue and gray arrows correspond respectively to the asterion, squamous suture, superior squamous point and anterior squamous point. (b) A human cadaveric head is used to demonstrate surgical positioning. (c) A human cadaveric head is used to demonstrate the angle of view after the forward inclination of the microscope, which is necessary in this approach. (d) The skin incision is marked in red in the human cadaveric head. (e) Human cadaver head in a simulation of the surgical field; the skin incision is marked in red.

Furthermore, it is necessary to prepare the surgical table so that the supports and holders will not prevent the microscope from reaching the forward inclination necessary for the angle of view in the subtemporal approach, as illustrated by Figure 2c.

Step-by-step technique

The skin incision should be made to expose the craniometric parameters previously mentioned – the asterion, the squamous suture, and the superior margin of the zygomatic arch. An upside-down U-shaped incision should be started about 1 cm anteriorly to the tragus, with upward and then posterior direction, surrounding the ear,[11] as demonstrated in Figures 2d and e. The incision extends superiorly, approximately 6–8 cm.

Regarding the temporal craniotomy, it should have a size of at least 4 to 5 cm, its inferior border should be as low as feasible, and the temporal bone should be drilled and flattened to be leveled with the floor of the middle cranial fossa.[11] For the purpose of maximizing the craniotomy, it should be centered at the root of the zygoma.[28]

Drilling the posterior aspect of the temporal bone may expose the mastoid cells, which need to be sealed with bone wax before closure; otherwise, postoperative cerebrospinal fluid leak or ear fullness may occur. Preoperative computed tomography is useful for verifying the presence and distribution of the air cells in the temporal bone. A C-shaped dural opening may be used, with its base facing the middle fossa floor.

After the dural opening, anatomical landmarks should be inspected, such as the vein of Labbé, usually related to the preoccipital notch and the ITS. The procedure initiates with sharp arachnoid dissection of the ITS, with careful attention not to injure the MTG, since it contains the optic radiation. The dissection proceeds posteriorly with caution to avoid injuring the vein of Labbé. After reaching the bottom of the ITS and performing pial coagulation and a corticectomy, the aspiration of the ITG is initiated. The aspiration and resection of the ITG proceed until reaching the OTS. Figure 1j illustrates an anatomical piece after the resection of the ITG. The extension of removal of the gyrus depends on each pathology. If necessary, the vein of Labbé may be dissected to extend the resection of the ITG posteriorly through aspiration – arachnoid dissection of the veins is more difficult than that of the arteries due to their proximity to the pia mater. The temporal pole might be resected through this approach, as well, if required. After the resection of the ITG, the working space increases significantly, enabling the visualization of the free edge of the tentorium cerebelli until its posterior aspect at the tentorium notch. It is also possible to access the content of the crural and ambient cisterns through this technique. Care should be taken when dealing with the free edge of the tentorium so that possible injuries to the third and fourth cranial nerves and injuries to the vessels of the cisternas will not result in neurological deficits.

Neurosurgical applications

Case report 1

The first case is a 29-year-old female with no comorbidities who presented at the emergency service complaining of a sudden severe headache. Her neurological examination had no abnormalities. Brain magnetic resonance imaging (MRI) and digital subtraction angiography (DSA) were performed for investigation and demonstrated an AVM of the fusiform gyrus at the left hemisphere [Figure 3a-l]. She was submitted to microsurgical treatment with resection of the ITG, which enabled the visualization of the AVM [Figures 3m-o]. Intraoperative indocyanine green (ICG) angiography was used to aid the procedure. The AVM was completely removed [Figure 3p-t], and the patient evolved without deficits. Confrontation visual field testing was unaltered. She was submitted to neuropsychological evaluation through the Neupsilin test, which revealed an improvement in memory, praxis, and executive function (working memory, problem solving, and verbal fluency) [Table 1]. However, the perception declined postoperatively.

Case report 2

The second case is a 48-year-old female presenting with progressive tetraparesis for 6 months, besides vomiting and urinary retention. MRI and DSA demonstrated the presence of a left dural arteriovenous fistula at the tentorium, causing medulla oblongata and spinal edema [Figures 4a-d]. Endovascular treatment was tried without success. She was then submitted to microsurgical treatment, depicted in Figures 4e-i, using the resection of the inferior gyrus to create a wider surgical corridor for the tentorium and to promote relaxation of the vein of Labbé since there was venous congestion and parenchymal edema. Intraoperative ICG aids in the confirmation of the dural fistula removal. The patient evolved with jugular thrombosis postoperatively, which required anticoagulation. There was a gradual resolution of the edema in the postoperative complementary examinations [Figure 4j-m] and progressive improvement of the neurological symptoms with rehabilitation. The patient presented no visual field deficits or memory complaints.

Case report 3

The third case is a 21-year-old female patient with a clinical history of headache and left hemifacial numbness. Brain MRI evidenced an expansive lesion located in the petrous ridge

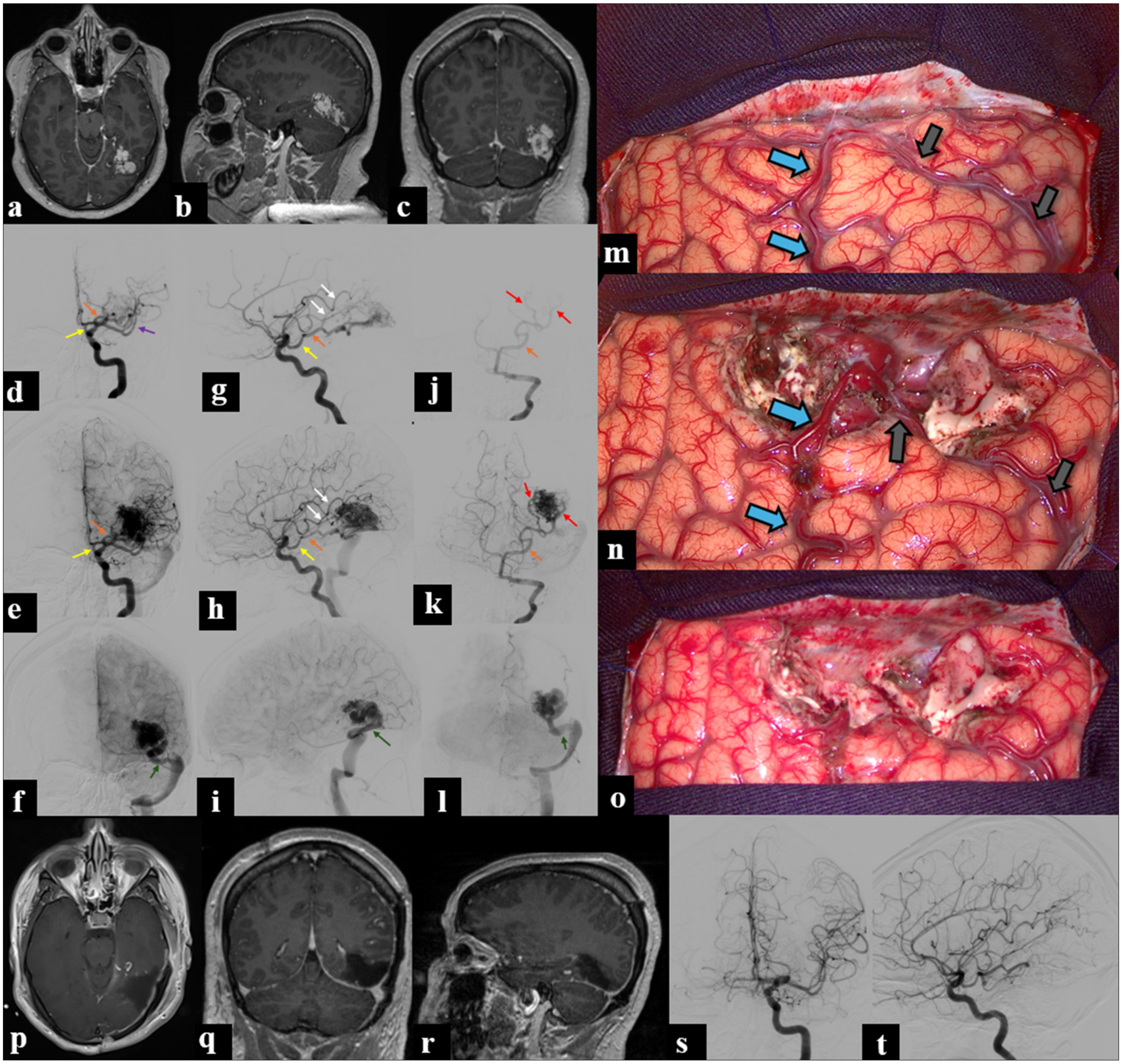

Figure 3: (a) Axial view of the post-contrast T1-weighted sequence of MRI revealing an AVM at the fusiform gyrus. (b and c) Sagittal view (in b) and coronal view (in c) demonstrating that the AVM presents a relationship with the tentorium. (d) Anteroposterior view of the early arterial phase of the angiogram of the left internal carotid artery revealing that the main feeding arteries were branches of the middle cerebral artery (pointed by the purple arrow) and the posterior cerebral artery (pointed by the orange arrow). The yellow arrow points to the posterior communicating artery. (e) Late arterial phase of the anteroposterior view demonstrating the nidus. The yellow and orange arrows point to the posterior communicating artery and to the posterior cerebral artery, respectively. (f) Venous phase demonstrating the main draining vein (pointed by the green arrow), with signs of venous hypertension such as a reduction of its caliber before draining into the transverse-sigmoid junction. (g and h) Lateral view of the arterial phase of the angiogram of the left internal carotid artery revealing that the feeders were the temporal branches of the middle cerebral artery (pointed by white arrows) and branches of the posterior cerebral artery, which was pointed by the orange arrow. The posterior communicating artery is pointed, as well, by the yellow arrow. (i) Venous phase of the lateral view showing the main draining vein, pointed by the green arrow, draining to the sigmoid-transverse junction. (j and k) Arterial phase of the anteroposterior view of the vertebrobasilar angiogram demonstrating the lateral posterior choroidal arteries (pointed by the red arrows), the main feeders from the posterior cerebral artery (pointed by the orange arrow). (l) Venous phase of the anteroposterior view of the vertebrobasilar angiogram demonstrating the main draining vein (pointed by the green arrow). (m) Initial aspect before the resection of the inferior temporal gyrus. The vein of Labbé (blue arrow), which in this case is part of the venous drainage of the AVM, and another superficial draining vein (gray arrow), tributary to the superficial middle cerebral vein, are demonstrated. (n) Aspect after the resection of the inferior temporal gyrus, enabling the visualization of the AVM nidus. The vein of Labbé (blue arrow) and the other superficial draining vein (gray arrow) are demonstrated, as well. (o) Final aspect, after the excision of the AVM. (p-r) Axial (p), coronal (q), and sagittal views (r) of the postoperative MRI post-contrast T1-weighted sequence showing the surgical cavity with the removal of the entire lesion. (s and t) Anteroposterior view (s) and lateral view (t) of the postoperative angiogram revealing the absence of the early draining vein and the nidus.

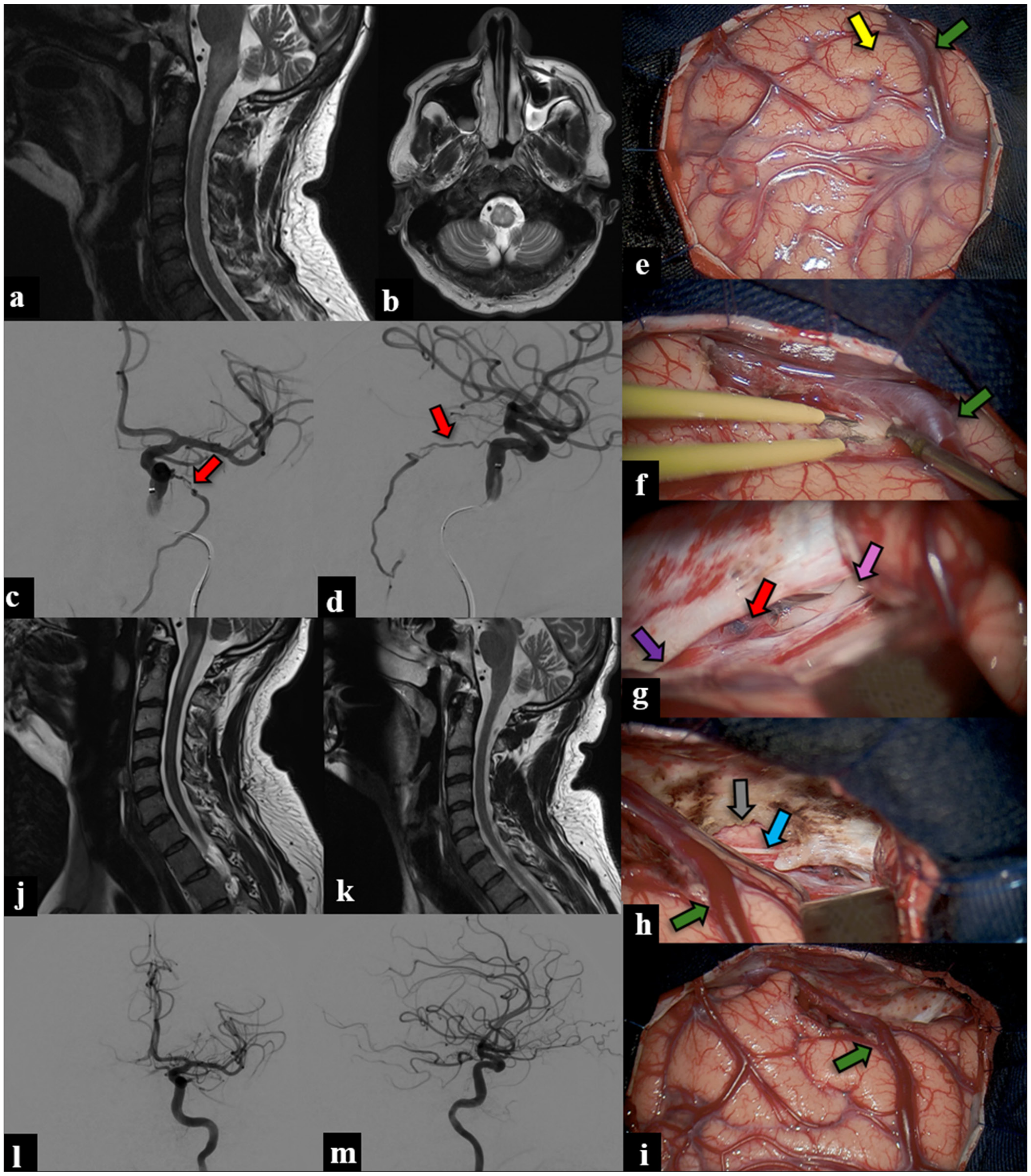

Figure 4: (a) Sagittal view of the T2-weighted magnetic resonance imaging (MRI) sequence of the cervical spine (a) showing the presence of edema in the medulla oblongata and the high cervical spine. (b) Axial view of the T2-weighted sequence of the brain MRI revealing the medulla oblongata edema. (c and d) Anteroposterior view (c) and lateral view (d) of the left internal carotid artery angiogram demonstrating the presence of an arteriovenous fistula, arising from the medial tentorial artery (of Bernasconi and Cassinari), pointed by the red arrow, to tentorial veins. (e) The initial aspect during the surgical treatment demonstrated the inferior temporal gyrus (pointed by the yellow arrow) and the vein of Labbé (pointed by the green arrow), which appeared turgid initially. (f) Aspiration and resection of the inferior temporal gyrus, including its part below the vein of Labbé (pointed by the green arrow), proceeded. (g) After the resection of the inferior temporal gyrus, there was an increase in the working space, allowing access to the free edge of the tentorium (pointed by the purple arrow) and to the ambient cistern, along with the third cranial nerve (pointed by the pink arrow) and the posterior cerebral artery (pointed by the red arrow). (h) After identifying the fourth cranial nerve (pointed by the blue arrow), the resection of the dural arteriovenous fistula located in the tentorium proceeded (gray arrow) with the aid of intraoperative intraoperative indocyanine green. Remarkably, there was a relaxation of the vein of Labbé (pointed by the green arrow) after the resection of the inferior temporal gyrus. (i) The final aspect of the brain exhibiting the resection of the inferior temporal gyrus. The green arrow marks the vein of Labbé. (j and k) Postoperative sagittal views of the T2-weighted sequence of the MRI, performed 10 months after the surgery (j) and 1 year and 2 months after the surgery (k), revealing a progressive improvement in the edema of the medullar oblongata and high cervical spine. (l and m) Postoperative angiogram of the left internal carotid artery in the anteroposterior view (l) and the lateral view (m) exhibiting the resolution of the arteriovenous fistula.

and in the tentorium at the left side, involving both middle and posterior fossae, as shown by Figures 5a-c. She underwent surgical treatment, including the resection of the ITG, and presented a solitary fibrous tumor as the anatomopathological result. However, control imaging examinations revealed a recurrence of the lesion, so the patient was submitted to an additional surgical treatment using the same previous approach 1 year and 4 months later [Figures 5d-f]. The patient evolved without neurological symptoms, including visual field or memory disorders; in addition, the postoperative examinations did not demonstrate another recurrence [Figures 5g-i].

Case report 4

The fourth case is a 20-year-old female patient with a complaint of chronic headaches for the last few months. Her previous background was positive for episodes of anxiety, and her neurological exam was normal. MRI and DSA revealed an AVM situated in the left fusiform gyrus [Figures 6a-i]. She underwent microsurgical treatment of the AVM with the resection of the ITG [Figures 6j-o] after preoperative embolization. Postoperative neuroimaging examinations showed effective removal of the AVM [Figures 6p-u], and the patient evolved without neurological complications.

DISCUSSION

Critical structures surround mesial basal TL pathologies, and several approaches are described for accessing this region; however, each one has advantages and disadvantages.[3,25]

The Transylvanian approach was initially proposed by Yasargil *et al.*[31] carries a risk of vasospasm and lesions to

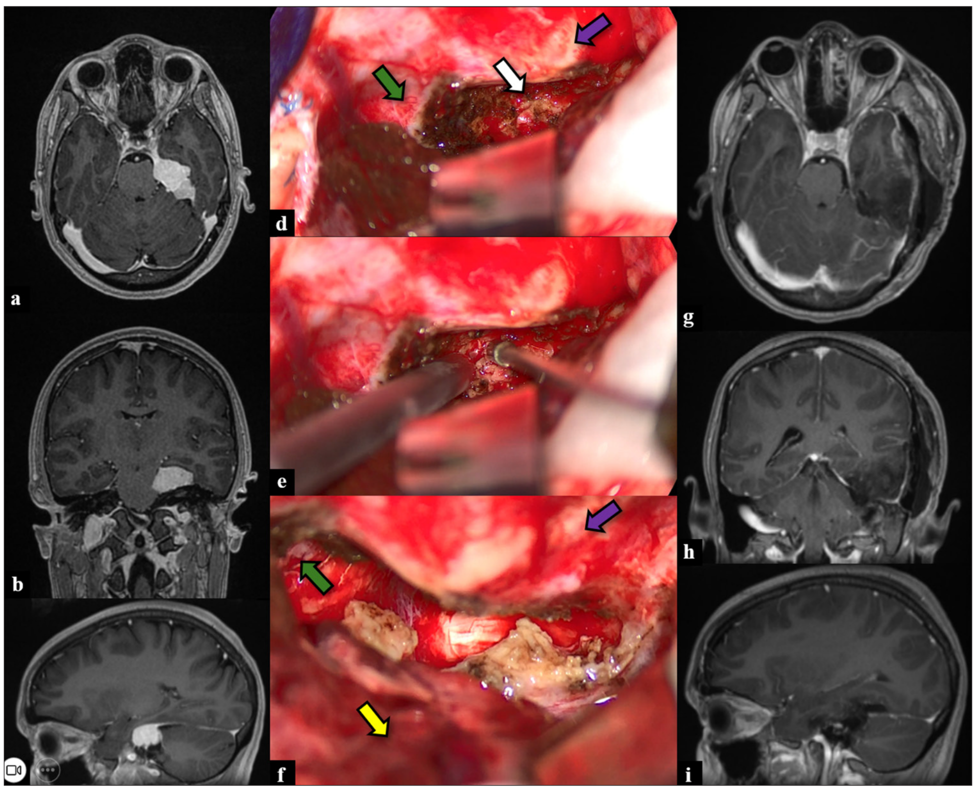

Figure 5: (a-c) Axial (a), coronal (b), and sagittal (c) views of the postcontrast T1-weighted sequence of the initial brain magnetic resonance imaging (MRI), revealing an extra-axial lesion located in the petrous ridge and tentorium cerebelli ate the left side. (d-f) Images retrieved from the second surgical treatment. (d) The recurrent tumor (pointed by the white arrow) was located from the petrous ridge to the tentorial notch (pointed by the green arrow). The purple arrow points to the petrous part of the temporal bone. (e) The resection of the recurrent tumor was performed using the same previous approach, which included the resection of the inferior temporal gyrus. (f) The final aspect is after the tumor resection and the dural coagulation. The tentorial notch (pointed by the green arrow), the petrous part of the temporal bone (pointed by the purple arrow), and the left temporal lobe (pointed by the yellow arrow) are demonstrated. (g-i) Axial (g), coronal (h), and sagittal (i) views of the postcontrast T1-weighted sequence of brain MRI performed after the second surgical treatment evidenced no other tumoral recurrence.

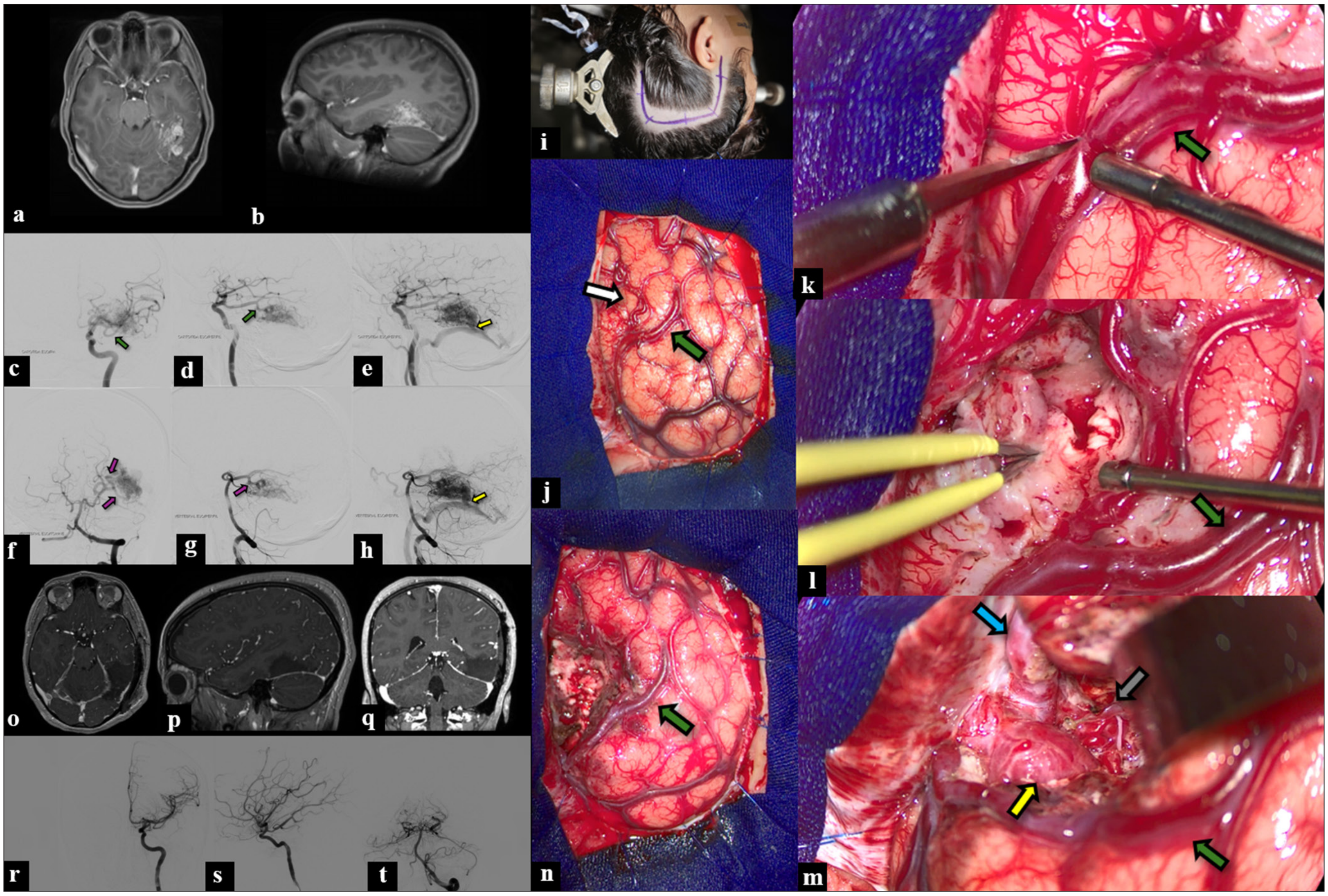

Figure 6: (a) Axial view of the post-contrast T1-weighted sequence of MRI revealing an AVM at the fusiform gyrus. (b) Sagittal view demonstrating that the nidus of the AVM presents a relationship with the tentorium. (c) Anteroposterior view of the early arterial phase of the angiogram of the left internal carotid artery revealing feeding arteries, branches of the middle cerebral artery (pointed by the green arrow). (d) Lateral view of the early arterial phase of the angiogram of the left internal carotid artery revealing feeding arteries, branches of the middle cerebral artery (pointed by the green arrow). (e) Late arterial phase of the lateral view showing the main draining vein, pointed by the yellow arrow, draining to the transverse sinus. (f) Early arterial phase of the anteroposterior view of the vertebrobasilar angiogram demonstrating the lateral posterior choroidal arteries (pointed by the purple arrows), the main feeders from the posterior cerebral artery. (g and h) Lateral view of the vertebrobasilar angiogram in the early (g) and late (h) arterial phases, depicting the lateral posterior choroidal artery (purple arrow) and the main draining vein (yellow arrow), respectively. (i) The patient was positioned on dorsal decubitus with the head rotated 90º, parallel to the floor. (j) Initial aspect of the brain; the vein of Labbé (green arrow) and the inferior temporal gyrus (white arrow) are evidenced. (k) The vein of Labbé (green arrow) is dissected before the resection of the inferior temporal gyrus. (l) The resection of the inferior temporal gyrus through aspiration, coagulation and cutting is proceeded. The vein of Labbé is demonstrated (green arrow). (m) After the resection of the inferior temporal gyrus, it is possible to visualize the nidus of the AVM (gray arrow), the main draining vein (blue arrow), and a venous aneurysm (yellow arrow). The vein of Labbé is also demonstrated (green arrow). (n) Final aspect after the AVM resection. The vein of Labbé was preserved (green arrow). (o-q) Axial (o), sagittal (p), and coronal (q) views of the postoperative MRI post-contrast T1-weighted sequence exhibiting the surgical cavity. It is possible to note in the coronal view (q) that a characteristic of the inferior temporal gyrus is to belong to two cerebral surfaces – lateral and basal. (r-t) Postoperative angiogram of the left internal carotid artery in the arterial phase, in the anteroposterior (r) and lateral (s) views, showing the absence of the nidus and the early draining vein, suggesting a radiological cure. (t) Postoperative angiogram of the vertebrobasilar system showing the absence of the AVM, as well.

the vessels of the Sylvian fissure, including its branches and perforating arteries.[21,30] Transcortical approaches through the MTG or the superior temporal sulcus carry the risk of injuring the temporal neocortex, responsible for verbal memory through language and semantic memory networks [24] and the sagittal stratum.

The subtemporal approach promotes a great retraction of the brain, with a risk for temporal contusion and for injuring the veins, mainly the vein of Labbé, or basal temporal bridging veins, and promoting venous congestion and the risk of venous infarction, besides providing a restricted surgical field.[11] In addition, the conformation of the tentorium limits the access to medial regions since it takes a superior direction from lateral to medial, as depicted in Figure 7.

The supracerebelar transtentorial approach is also an option for lesions in the medial basal temporal region;[2,5,8,14] however, lesions with an anterior extension, mainly anteriorly to the lateral mesencephalic sulcus plane, are more difficult to reach,[2] in an approach that already requires very long surgical instruments. The petrous ridge avoids a good visualization of the inferior surface of the anterior parahippocampal gyrus.[27] Furthermore, the superior part of the posterior region of the medial temporal region is also a limitation for the supracerebellar transtentorial approach due to the galenic venous system.[27]

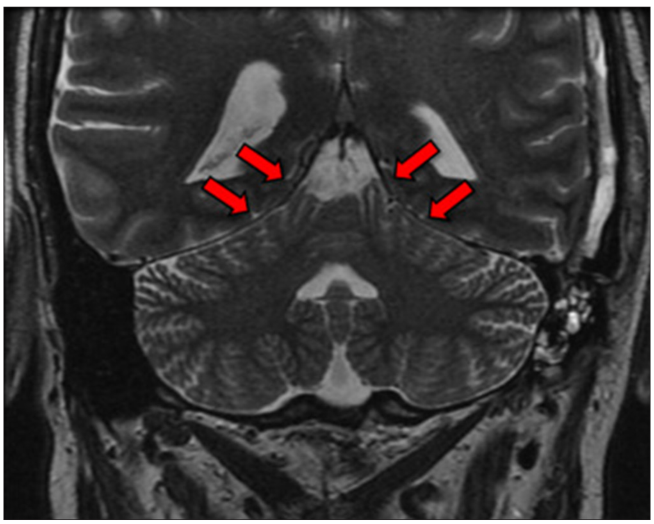

Figure 7: Coronal view of the T2-weighted sequence of the postoperative brain MRI of the patient from case number 2 is used to demonstrate that from lateral to medial, the tentorium acquires an increasingly superior course, so that it is difficult to reach medial structures through the subtemporal approach. The red arrows indicate the tentorium bilaterally.

Few studies have described a small corticectomy of ITG to reach pathologies of the medial basal temporal region.

A minimally invasive approach for microsurgical treatment of tumors of the mesial basal area and epilepsy was described by Duckworth and Vale and Uribe and Vale, respectively, to reach the mesial TL using a 2 × 3 cm craniotomy along with the middle fossa floor followed by the resection of part of the ITG.[9,28] The corticectomy started at the level of the zygomatic root and continued forwardly, with caution not to violate the MTG.[9,28] The temporal horn was opened through its floor, avoiding lesions of the optic radiation, after using the OTS and the OTS as references while creating the surgical corridor and the CS to identify the floor of the temporal horn.[9,28] Visual field or speech disturbances were not observed in any of the patients in the study of Duckworth and Vale,[9] although one case reported by Uribe and Vale with a large lesion (4 × 4,5 cm) evolved with blurred vision postoperatively and exhibited a minimal loss of superior homonymous peripheral defect after undergoing perimetry.[28]

Quinones-Hinojosa *et al*. compared patients with high-grade astrocytomas located in the mediobasal TL submitted to microsurgical treatment through MTG (9 patients) versus ITG (14 patients).[19] In their study, the postoperative visual field complications were observed only in patients submitted to tumor resection using an MTG corticectomy and entering the temporal horn of the lateral ventricle.[19] However, statistical analysis did not demonstrate significant differences regarding all the postoperative complications presented: stroke, new visual deficits, new speech deficit, and seizure control.[19]

Schramm and Aliashkevich performed a study with 235 patients with intra-axial temporal mediobasal tumors

Table 1: Neuropsychological outcomes through the Neupsilin test observed in the patient of the case 1.

Neuropsychological function	Preoperative (SD)	Postoperative (SD)
Attention	−0.5	−0.3
Perception	−0.2	−1.5
Memory	−1	−0.5
Arithmetic skill	−1.7	−1.7
Language	0.8	0.8
Praxis	0.2	0.9
Executive function - working memory	−0.9	−0.5
Executive function - problem solving	−2.2	0.3
Executive function - verbal fluency	−1.4	0.4

SD: Standard deviation

submitted to microsurgical treatment through several approaches and described that temporal pole resections and subtemporal approaches present a lower risk for hemiparesis when compared to the Transylvanian approach and the classic anterior two-thirds lobe resection.[23] However, regarding speech disorders, the Transylvanian approach, the two-thirds anterior TL resection, and the subtemporal approach present a similar risk.[23] Finally, Schramm and Aliashkevich reported that a new quadrantanopia was exhibited by 28% of the patients submitted to a subtemporal approach.[23]

In their case series of patients with lesions involving the ambient cistern who underwent a trans choroidal fissure approach using a cortical incision of the ITG (3 cm posterior to the temporal pole), Ikeda *et al*. described that the patients evolved without visual fields, memory, or emotional disturbances postoperatively.[10] In their case series of meningiomas located in the atrium of the lateral ventricle, Nayar *et al*. reported resection of the tumor using an incision in the ITG to create a surgical corridor.[17] Both patients exhibited normal perimetry; furthermore, early access to the tumor's blood supply from the choroidal vessels was achieved using a corticectomy in the inferior frontal gyrus.[17]

Hemiparesis as a complication is most likely due to a lesion of perforating branches of the brainstem or a lesion of the choroidal artery, which is why maintaining the subpial dissection when dealing with temporal mesial pathologies such as tumors or epilepsy is a relevant strategy.[19] Another cause of hemiparesis is an injury to the vessels of the Sylvian fissure, for instance, when the Transylvanian approach is used.[21,30] Upper homonymous quadrantanopia as a complication may occur when violating the lateral wall or the anterior tip of the temporal horn, compromising the optic radiation.[10,28]

It is remarkable to cite that studying preoperatively the white matter fibers through tractography is a helpful method for analyzing if any displacements or violations of them by, respectively, vascular or tumoral pathologies are present.[18] Thus, whenever available, tractography aids in the planning and execution of the microsurgical treatment [18], along with intensive studying of neuroanatomy and dissection techniques of white fibers.[1,18]

In the present study, the patients evolved without visual field impairments, memory complaints, or neurological complications. We propose a technique that increases the working space in the medial basal temporal region, providing access from its very anterior mesial structures to the posterior portion of the free edge of the tentorium cerebelli and the tentorium notch. Furthermore, the resection of the ITG avoids excessive retraction of the parenchyma and the veins, lessens the risk of lesion of the vein of Labbé, and even enables its relaxation when venous congestion is present. Finally, this approach avoids the white fibers of the optic radiation, preventing the visual field deficits postoperatively.

Analyzing the results of this study and comparing them to previous studies, we infer that the ITS consists of an important landmark for the resection of the ITG since avoiding the MTG is essential for preserving the optic radiation fibers. The free edge of the tentorium is another important landmark since the fourth cranial nerve has to be identified in the treatment of pathologies of this region to avoid its lesion. Likewise, the identification of the third cranial nerve and the posterior cerebral artery and its branches in the ambient cistern is important to avoid neurological complications. Finally, the vein of Labbé represents another important landmark since aspirating the parenchyma below it allows its relaxation and reaching the posterior IS without excessive retraction.

Limitations of the present study are the small number of cases reported and the evaluation of neuropsychological outcomes performed in only one case. Several aspects may affect the neuropsychological outcomes in patients with mesial TL pathologies, including different approaches used, the extension of the resection of mesial temporal structures, the extension of the temporal cortex resected, and the use of different tests to evaluate the neuropsychological outcomes.[13,22,26,29] As observed, the few studies concerning the ITG approach use different sizes of corticectomy (usually a small corticectomy is reported); furthermore, the approach was used for different types of pathologies with different extensions of involvement of the medial basal temporal surface or IS. Therefore, a definitive conclusion concerning the neuropsychological implications and the long-term outcomes after the resection of the ITG is still unestablished, and more studies are necessary regarding this topic.

CONCLUSION

The resection of the ITG represents a useful technique to reach the basal surface of the TL and the lateral IS since it avoids excessive retraction of the TL which may cause vessel injury, mainly the vein of Labbé. Besides, it enables a wider surgical corridor for pathologies of the lateral and posterior IS and provides relaxation of the vein of Labbé when venous congestion is present. However, more studies are necessary to demonstrate short and long-term outcomes of the resection of the ITG.

Ethical approval: The research/study was approved by the Institutional Review Board at the Ethics and Research Committee of the Federal University of São Paulo, number #56337322.4.0000.5505, dated April 29, 2024.
Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.
Financial support and sponsorship: Nil.
Conflict of interest: There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Ahumada-Vizcaino JC, Wuo-Silva R, Hernández MM, Chaddad-Neto F. The art of combining neuroanatomy and microsurgical skills in modern neurosurgery. Front Neurol 2023;13:1076778.
2. Caramanti RL, Effgen EA, Aprígio RM, de Moraes DF, Rocha CE, Laurenti MR, *et al*. Transtentorial approach for resection of parahippocampal gyrus glioma: 2-dimensional operative video. Oper Neurosurg (Hagerstown) 2024;26:604.
3. Chaddad-Neto F, da Costa MD. Surgical anatomy of the temporal lobe. in: microneuroanatomy and surgery: A practical anatomical guide. Switzerland: Springer Nature; 2022. p. 55-103.
4. Chaddad-Neto F, da Costa MDS. Surgical Anatomy of the Lateral Ventricles. In: Microneuroanatomy and Surgery: A Practical Anatomical Guide. Springer Nature Switzerland AG, 2022; 121-139.
5. Chaddad-Neto F, da Costa MD, Caramanti RL, Costa BL, Silveira CF, Echeverria KG, *et al*. Transtentorial approach for parahippocampal gyrus arteriovenous malformation resection: 3-dimensional operative video. Oper Neurosurg (Hagerstown) 2019;16:E83-4.
6. Chau AM, Stewart F, Gragnaniello C. Sulcal and gyral anatomy of the basal occipital-temporal lobe. Surg Radiol Anat 2014;36:959-65.
7. Costa M, Braga VL, Yağmurlu K, Centeno RS, Cavalheiro S, Chaddad-Neto F. A Technical guide for fiber tract dissection of the internal capsule. Turk Neurosurg 2018;28:934-9.
8. de Oliveira JG, Párraga RG, Chaddad-Neto F, Ribas GC, de Oliveira EP. Supracerebellar transtentorial approach-resection of the tentorium instead of an opening-to provide broad exposure of the mediobasal temporal lobe: Anatomical aspects and surgical applications: clinical article. J Neurosurg 2012;116:764-72.
9. Duckworth EA, Vale FL. Trephine epilepsy surgery: The inferior temporal gyrus approach. Neurosurgery 2008;63:ONS156-60.
10. Ikeda K, Shoin K, Mohri M, Kijima T, Someya S, Yamashita J. Surgical indications and microsurgical anatomy of the transchoroidal fissure approach for lesions in and around the ambient cistern. Neurosurgery 2002;50:1114-9.
11. Kim YB, Lee KS. Subtemporal approach. In: Neurovascular surgery: Surgical approaches for neurovascular diseases. Berlin: Springer Nature Singapore; 2019. p. 35-41.
12. Klingler J. Facilitation of macroscopic brain dissection through the freezing process. Schweiz Arch Neurol Psychiatr 1935;36:247-56.
13. Lee EJ, Park ES, Cho YH, Hong SH, Kim JH, Kim CJ. Transzygomatic approach with anteriorly limited inferior temporal gyrectomy for large medial tentorial meningiomas. Acta Neurochir (Wien) 2015;157:1747-55.
14. Lourenço Caramanti R, Effgen EA, Moreira Aprígio R, Freitas de Moraes D, Eduardo Rocha C, Goes MJ, *et al*. Transtentorial approach for a tentorial meningioma with superior extension: 3-Dimensional operative video. Oper Neurosurg (Hagerstown) 2022;22:e131.
15. Mattos JP, Santos MJ, Zullo JF, Joaquim AF, Chaddad-Neto F, Oliveira E. Dissection technique for the study of the cerebral sulci, gyri and ventricles. Arq Neuropsiquiatr 2008;66: 282-7.
16. Miabi Z, Midia R, Rohrer SE, Hoeffner EG, Vandorpe R, Berk CM, *et al*. Delineation of lateral tentorial sinus with contrast-enhanced MR imaging and its surgical implications. AJNR Am J Neuroradiol 2004;25:1181-8.
17. Nayar VV, Foroozan R, Weinberg JS, Yoshor D. Preservation of visual fields with the inferior temporal gyrus approach to the atrium. J Neurosurg 2009;110:740-3.
18. Pereira FS, Jiménez LÁ, Aguaisa ED, Apaza-Tintaya RA, Biondi-Soares LG, Paitán AF, *et al.* Superior frontal sulcus: A non-eloquent corridor for cavernomas of the internal capsule. Front Neurol 2024;15:1355338.
19. Quinones-Hinojosa A, Raza SM, Ahmed I, Rincon-Torroella J, Chaichana K, Olivi A. Middle temporal gyrus versus inferior temporal gyrus transcortical approaches to high-grade astrocytomas in the mediobasal temporal lobe: A comparison of outcomes, functional restoration, and surgical considerations. Acta Neurochir Suppl 2017;124: 159-64.
20. Rhoton AL. The supratentorial arteries. Neurosurgery 2002;51:S53-120.
21. Schaller C, Jung A, Clusmann H, Schramm J, Meyer B. Rate of vasospasm following the transsylvian versus transcortical approach for selective amygdalohippocampectomy. Neurol Res 2004;26:666-70.
22. Schoenberg MR, Clifton WE, Sever RW, Vale FL. Neuropsychology outcomes following trephine epilepsy surgery: The inferior temporal gyrus approach for amygdalohippocampectomy in medically refractory mesial temporal lobe epilepsy. Neurosurgery 2018;82:833-41.
23. Schramm J, Aliashkevich AF. Surgery for temporal mediobasal tumors: Experience based on a series of 235 patients. Neurosurgery 2007;60:285-94.
24. Sherman EM, Wiebe S, Fay-McClymont TB, Tellez-Zenteno J, Metcalfe A, Hernandez-Ronquillo L, *et al*. Neuropsychological outcomes after epilepsy surgery: Systematic review and pooled estimates. Epilepsia 2011;52:857-69.
25. Sincoff EH, Tan Y, Abdulrauf SI. White matter fiber dissection of the optic radiations of the temporal lobe and implications for surgical approaches to the temporal horn. J Neurosurg 2004;101:739-46.
26. Sone D, Ahmad M, Thompson PJ, Baxendale S, Vos SB, Xiao F, *et al*. Optimal surgical extent for memory and seizure outcome in temporal lobe epilepsy. Ann Neurol 2022;91:131-44.
27. Türe U, Harput MV, Kaya AH, Baimedi P, Firat Z, Türe H, *et al*. The paramedian supracerebellar-transtentorial approach to the entire length of the mediobasal temporal region: An anatomical and clinical study. Laboratory investigation. J Neurosurg 2012;116:773-91.
28. Uribe JS, Vale FL. Limited access inferior temporal gyrus approach to mesial basal temporal lobe tumors. J Neurosurg

2009;110:137-46.
29. Vivas AC, Reintjes S, Shimony N, Vale FL. Surgery of the amygdala and uncus: A case series of glioneuronal tumors. Acta Neurochir (Wien) 2020;162:795-801.
30. Wurm G, Wies W, Schnizer M, Trenkler J, Holl K. Advanced surgical approach for selective amygdalohippocampectomy through neuronavigation. Neurosurgery 2000;46:1377-82.
31. Yaşargil MG, Teddy PJ, Roth P. Selective amygdalo-hippocampectomy. Operative anatomy and surgical technique. Adv Tech Stand Neurosurg 1985;12:93-123.

How to cite this article: Effgen EA, Teyssandier M, Giovannini SJ, Jiménez LC, Da Trindade EG, Leguina AR, *et al*. Anatomical aspects, technical nuances, and a case series of the resection of the inferior temporal gyrus as a strategy to access the basal surface of the temporal lobe and the lateral incisural space. Surg Neurol Int. 2025;16:59. doi: 10.25259/SNI_1016_2024