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Pterional transsylvian–transinsular approach in three cavernomas of the left anterior mesiotemporal region

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ABSTRACT

Objective: To describe the pterional transsylvian–transinsular approach for cavernomas of the left anterior mesiotemporal region in three patients.
Methods: A retrospective analysis of patients who underwent surgery for cavernous angiomas in the temporal lobe was performed via the left mesiotemporal lobe (MTL). The technique was as follows: using the pterional approach, the Sylvian fissure was widely opened, distally to proximally. The temporal branch of the middle cerebral artery was displaced medially, and once the limiting sulcus of the insula was located, an 8 mm long corticotomy was performed, just behind the limen insulae. The dissection was extended through the white matter until the anterior portion of the temporal horn was reached. Finally, lesion resection was performed.
Results: Three patients presented with cavernomas in the anterior sector of the MTL and underwent the transsylvian–transinsular approach. There were no deaths in this series. One patient sustained a permanent postoperative deficit, a right homonymous quadrantanopia.
Conclusion: The pterional transsylvian–transinsular approach allows for selective resection of lesions located in the anterior mesiotemporal region (MTR) of the dominant hemisphere, while avoiding damage to the lateral or basal cortex of the temporal lobe or to structures in the dominant hemisphere.

1. Introduction

The mesiotemporal region (MTR) is hidden in the depths of the temporal lobe and ventricular system; it is located on the margins of the basal cisterns, surrounded by important vascular and nervous structures that must be preserved during surgery [1] (Fig. 1A–B). From an anatomical and surgical point of view, the MTR is divided into 3 sectors: anterior, medial, and posterior [1]. The anterior limit of the anterior segment of the MTR is a transverse line which passes through the rhinal sulcus; the posterior limit is a line passing through the inferior choroidal point. We aimed to describe the pterional transsylvian–transinsular approach in treating cavernomas in the anterior MTR of the dominant hemisphere. This approach has the advantage of preserving the lateral and basal temporal cortex, but carries the risk of damaging optic radiations or the uncinate fasciculus. With regards the dominant hemisphere, it is important to avoid damaging the inferior fronto-occipital fasciculus (IFOF) as it passes through the temporal stem, in order to prevent postoperative speech alterations [2].

2. Methods

2.1. Data collection

We retrospectively analyzed patients who underwent surgery for left temporal cavernous angiomas by the left MTR approach, between June 2005 and December 2013. Clinical charts, radiographic studies, and follow up visit data were reviewed. Outcomes were assessed according to the modified Rankin Scale (mRS). All patients with cavernomas of the anterior mesial temporal region underwent the pterional transsylvian–transinsular approach.

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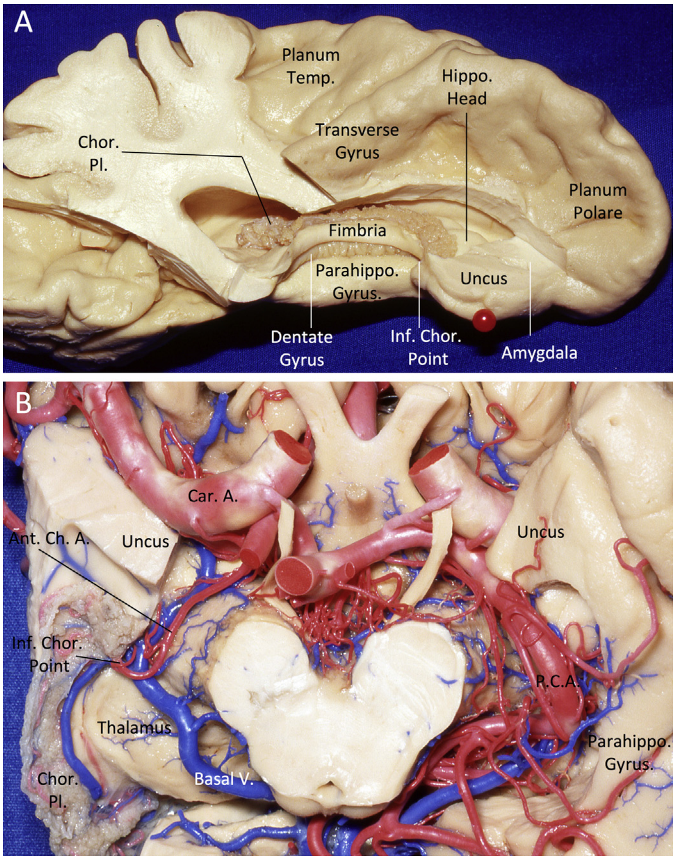

Fig. 1. (A) Superior view of the right temporal lobe. The upper surface of the temporal lobe forms the floor of the sylvian fissure and presents two distinct parts: the planum polare anteriorly and the planum temporale posteriorly. The planum polare is free of gyri, and its lateral edge is formed by the superior temporal gyrus. The planum temporale is formed by the transverse temporal gyri. The inferior choroidal point, or the lower end of the choroidal fissure, is located just behind the uncus and head of the hippocampus, the posterior limit of the anterior mesiotemporal region. The choroid plexus, as well as the fimbria, the dentate, parahippocampal gyrus, hippocampal head, and amygdala are demarcated. Ch., choroidal; Chor., choroid; Hippo., hippocampus; Inf., inferior; Parahippo., parahippocampal; Pl., plexus; Temp., temporale. (B) Inferior view of the basal surface of the brainstem and temporal lobe. The floor of the right temporal lobe, except for the anterior part of the uncus, has been removed. The anterior choroidal artery is demarcated; the preoptic part of the AChA extends from its origin at the inferomedial side of the carotid artery to the artery's genu along the carotid cistern. The postoptic part of the cisternal segment courses within the crural cistern and extends from the genu to the inferior choroidal point. This segment is hidden behind the uncal apex. The choroid plexus, the thalamus, the basal vein, and the posterior cerebral artery are also demarcated. A., artery; Ant., anterior; Car., carotid; Ch., choroidal; Chor., choroid; Inf., inferior; Parahippo., parahippocampal; P.C.A., posterior cerebral artery; Pl., plexus; V., vein.

2.2. *Surgical technique (Fig. 2A–F)*

The patient was placed in the dorsal decubitus position, with the head 15–20° rotated toward the contralateral side and extended [3]; this positioning makes the Sylvian fissure vertical, avoiding the need for retraction during opening. The incision was begun at the upper edge of the zygomatic arch near the tragus, and continued behind the hairline until the midline was reached. To protect the facial nerve (VII), subgaleal and interfascial dissection was performed until the orbital border and the temporal muscle were exposed. After dissection of the temporal muscle, a pterional craniotomy was performed, centered at the level of the Sylvian fissure. Opening of the dura mater was performed with two flaps (frontal and temporal), with the central incision along the Sylvian fissure. Next, the Sylvian fissure was widely opened, distally to proximally, beginning at the pars opercularis of the inferior frontal gyrus. The veins were displaced temporally. The dissection progressed until the frontal lobe was separated from the temporal lobe; arterial branches were mobilized frontally or temporally, exposing the middle cerebral artery (MCA) bifurcation. It is necessary to medially displace the temporal branch of the Sylvian artery to accurately visualize the anterior and inferior parts of the limiting sulcus of the insula. Additionally, small vessels entering the insula require division. Then, a small (approximately 8 mm) corticotomy was performed, at the level of the limiting sulcus of the insula, just behind the limen insulae. Thus, the incision was deepened through the white matter until the anterior portion of the temporal horn was reached. Once the ventricular anatomy was recognized (hippocampal head, choroid plexus, etc.), resection of the lesion was performed. The closure was similar to that carried performed for a pterional approach (Fig. 2).

3. Results

In a 102-month period, 14 patients with temporal lobe cavernomas underwent surgery; of these, three patients had cavernomas in the left anterior MTR and received the transsylvian–transinsular approach. There were no deaths. A permanent postoperative deficit occurred in one patient with right homonymous quadrantanopia. For all three patients, the follow-up period was 24 months, with a favorable final mRS score (0–1).

3.1. *Case 1 (Fig. 3A–D)*

A 33 year-old male presented to the emergency room with an acute headache. The patient had no comorbid conditions and no neurological deficits. A computed axial tomography (CAT) scan of the brain was performed and identified a hematoma at the uncal level of the left temporal lobe. Cerebral angiography was negative. Nuclear magnetic resonance (NMR) imaging was performed, which revealed blood at the uncal level of the left temporal lobe. The patient was taken to the operating room, where a pterional, transsylvian–transinsular approach was used; the lesion was resected and confirmed to be a cavernoma on pathologic examination. No postoperative neurological deficits were reported, except for a right homonymous quadrantanopia (Fig. 3).

3.2. *Case 2 (Fig. 4A–E)*

A 19-year-old male presented to the emergency room with an acute headache while playing soccer. He displayed no focal neurologic deficits and his headache did not respond to standard medical treatment. Brain computed tomography showed a hematoma at the uncal level of the left temporal lobe. Cerebral angiography was negative. A brain MRI again showed blood at the uncal level of the left temporal lobe. A pterional, transsylvian–transinsular approach was performed and the lesion was resected. A cavernoma was again confirmed on pathology. No postoperative neurological deficits were reported and visual field campimetry was normal after surgery (Fig. 4).

3.3. *Case 3 (Figs. 5A–F and 6A, B)*

A 61-year-old male patient with seizures refractory to medical treatment was referred from the Neurology Department. A brain MRI showed a lesion compatible with a cavernoma located at the uncal level of the left temporal lobe. A pterional approach was performed via a transsylvian–transinsular approach and the lesion was resected, again confirming a cavernoma on postoperative pathology. No postoperative neurological deficits were reported and visual field campimetry was normal after surgery (Figs. 5 and 6).

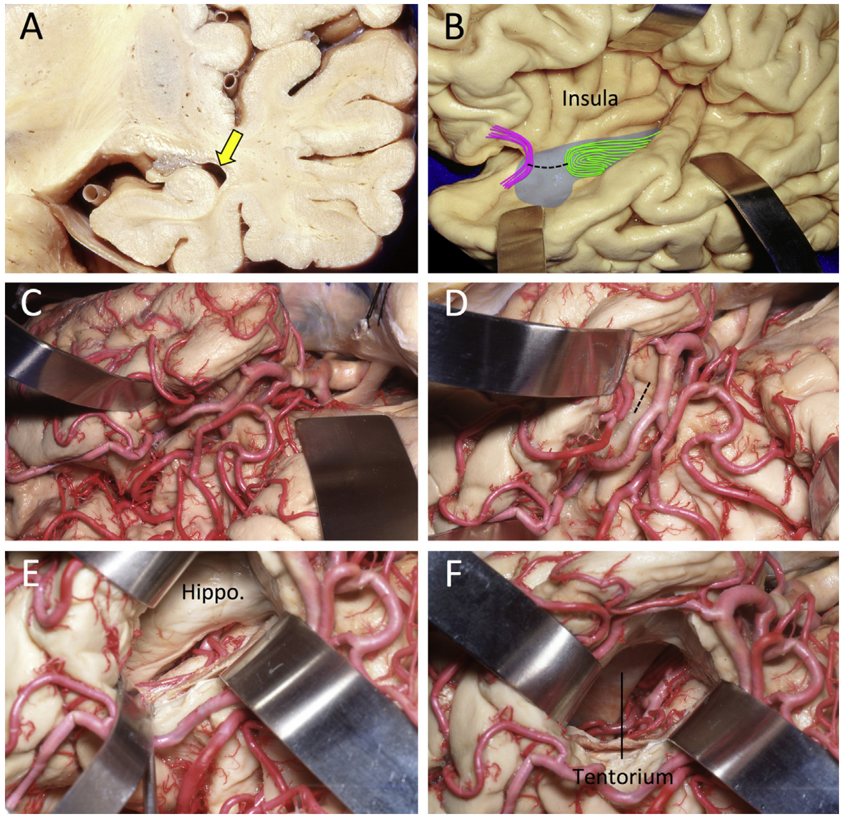

Fig. 2. Mesiotemporal region. (A) The coronal view shows the relationship between the hippocampus, insula lobe, and the temporal horn. The yellow arrow points out the direction of the approach, through the temporal horn. (B) The sylvian fissure is opened widely and the limiting sulcus of the insula is exposed. The dashed line shows the corticotomy site, of no more than 8 mm. The uncinate fasciculus (pink), optic radiations (green), and the projection of the temporal horn (gray) are demarcated. (C and D) The sylvian fissure and the branches of the middle cerebral artery are exposed. The dashed line shows the corticotomy site. (E) The anterior part of the temporal horn with the hippocampal head was exposed. Also, the choroid was opened. (F) The hippocampal head was resected. (For interpretation of the references to color in figure legend, the reader is referred to the web version of the article.)

4. Discussion

The selective approach to the MTR (i.e. without resecting the surrounding temporal lobe) began with epilepsy surgery. In 1958, Niemeyer was the first to describe selective amygdalohippocampectomy via the medial temporal gyrus [4]. In 1985, Yasargil introduced selective amygdalohippocampectomy via the limiting sulcus of the insula [5].

In 1998, Vajkoczy et al. [6], and more recently Figueiredo et al. [7] described a selective amygdalohippocampectomy technique via the Sylvian fissure, performing the corticotomy in front of the limen insulae, or via the uncus. The main advantage of this approach is that it avoids damage to the optic radiations [8,9]; the main disadvantage is its poor access and view of the MTR behind the uncal apex [1] (Fig. 2B).

The anterior choroideal artery (AChA) courses within the perimesencephalic cisterns [10]. The cisternal segment extends from its origin to the choroidal fissure; the plexal segment passes through the inferior choroidal point to enter the temporal horn. Tanriover et al. described an interesting division in the cisternal segment: the pre and postoptic parts [11]. The postoptic part of the artery is hidden behind the apex of the uncus and has several perforating arteries that supply critical deep structures. Special care should be taken when resections are performed around or in the uncus while using the transsylvian–transinsular approach, so as not to injure or cause spasm in these arteries (Fig. 1B).

Another possible risk in this approach when it is performed in the dominant hemisphere is the possibility of compromising speech due to an IFOF lesion, produced when it passes through the temporal stem [2,12,13]. According to anatomical studies, the IFOF occupies the posterior two thirds of the temporal lobe stem. Therefore, an incision within the posterior 8 mm of the limen insulae is less likely to damage the FOF [2]. The uncinate fasciculus traverses the anterior region, which might be injured by this approach. Focusing on the left uncinate fasciculus, intraoperative stimulation is not associated with general language impairment [14]. It has been shown that the left uncinate fasciculus has redundant functions with other fiber pathways for some aspects of lexical retrieval and verbal memory, with the exception of proper naming [14,15] (Fig. 2B).

Another way to approach the middle temporal region is via the supracerebellar transtentorial well, as described by Türe et al. It is a posterior approach that in our view is more useful for resecting the posterior and middle portions of the medial temporal region [16]. Another feasible approach is the pretemporal craniotomy, described by de Oliveira et al. This approach could be useful and is well described for extra-axial lesions in the interpeduncular cistern and petroclival region; however, we have never used it for cavernomas [17].

In the three cases presented in this study, access was achieved via the limiting sulcus of the insula. In Case 1, the patient developed a postoperative quadrantanopia, while in Cases 2 and 3, the patients had normal postoperative visual fields. We think that this may be due to the fact that in the latter two cases, the incision was directly behind the limen insulae (Fig. 6A, B). Speech impairment secondary to an IFOF or uncinate fasciculus lesion was not reported in any of the three cases.

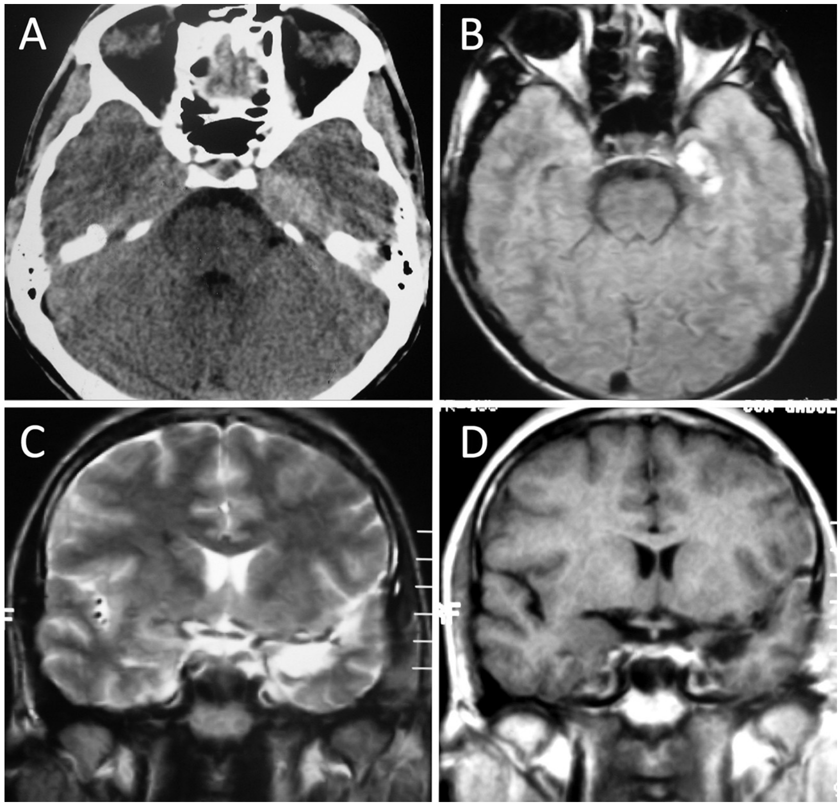

Fig. 3. A 33-year-old man was evaluated at an outside emergency department complaining of a severe, acute headache. (A and B) Computed tomography scan and axial T2-weighted magnetic resonance imaging demonstrating a hyperdense and hyperintense lesion at the temporal mesial region. (C and D) Postoperative axial T2 and T1 weighted MRI, without the lesion.

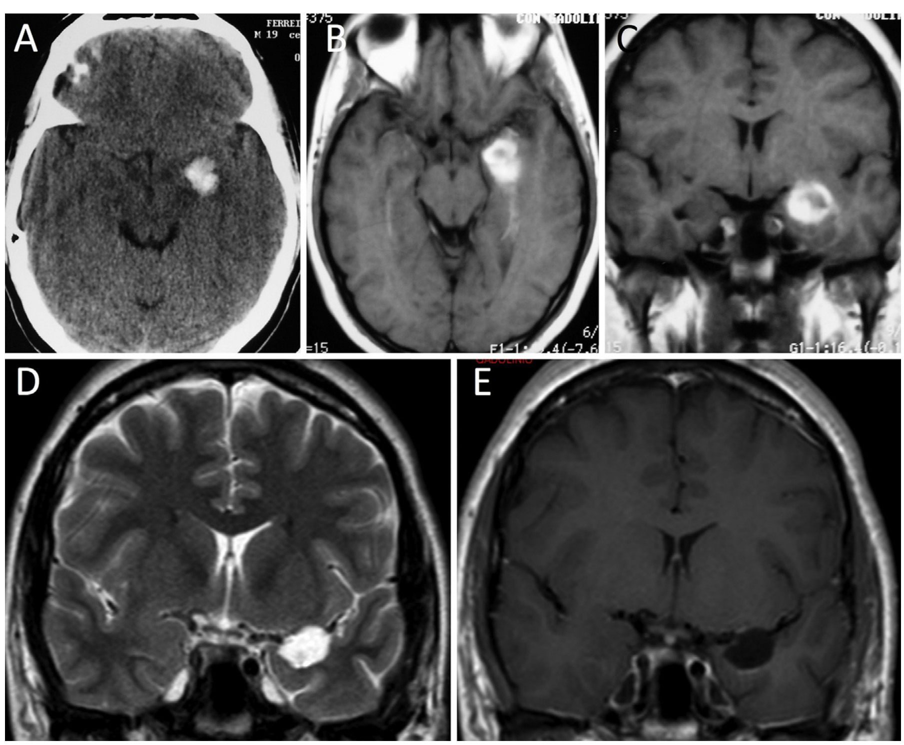

Fig. 4. A 19-year-old male was evaluated by the emergency service for an acute headache. Computed tomography demonstrated a hematoma at the uncal level of left temporal lobe. (B and C) Axial and coronal T1-weighted magnetic resonance imaging revealed a subtle area of increased density at the uncal level. (D and C) Postoperative axial T2 and T1 weighted magnetic resonance imaging after resection of the lesion.

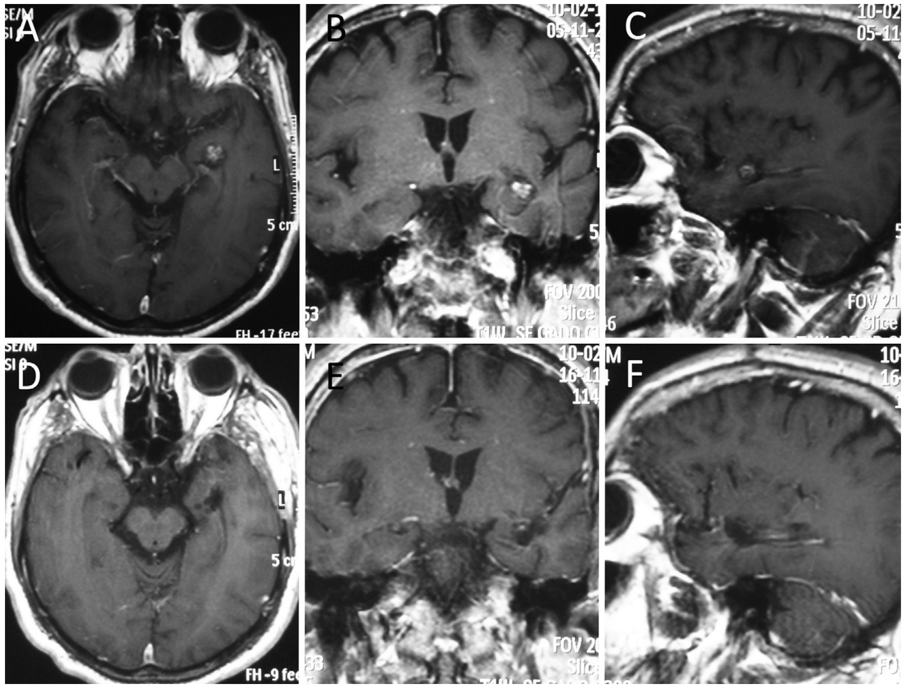

Fig. 5. A 61-year-old male was referred from the neurological service due to seizures that were refractory to medical treatment. (A–C) Axial, coronal, and sagittal T1 weighted magnetic resonance imaging demonstrated a left uncal cavernoma. (C–E) Postoperative MRI after resection of the lesion.

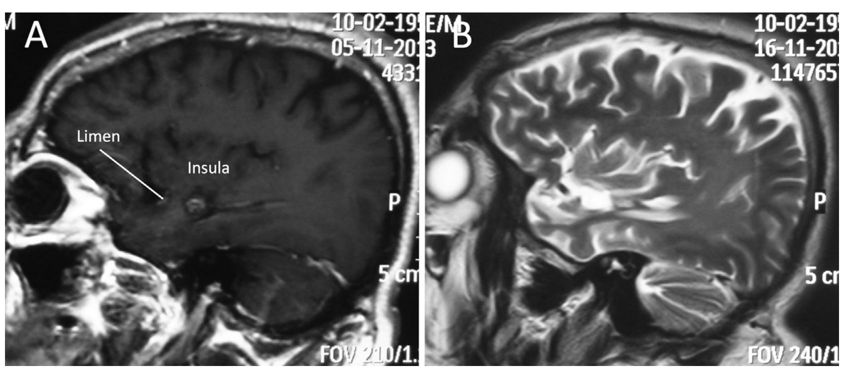

Fig. 6. (A) Preoperative sagittal T1 weighted magnetic resonance imaging shows a hyperintense lesion at the uncal process. (B) Postoperative sagittal T2 weighted image control.

The indication for surgery in Cases 1 and 2 was based on: (a) age; (b) risk of future bleeding; and (c) symptomatic hemorrhage [18]. In Case 3, the indication was refractory epilepsy.

Most publications on transsylvian selective amygdalohippocampectomy refer to epilepsy surgery (hippocampal sclerosis) [5–7,12,19–21]. However, recent studies have confirmed its usefulness and applicability, especially for vascular lesions [22–24] located in the anterior segment of the MTR. Therefore, beyond the remaining unresolved discussions regarding the best way to approach the anterior segment of the MTR, it is important to point out that the approaches described for epilepsy surgery are useful for other pathologies in the region (cavernomas, AVMs, tumors, etc.). Additionally, these approaches can be performed in the dominant hemisphere with a low risk of damaging the dominant structures, as well as the basal and lateral cortex.

Knowledge of microsurgical anatomy is still essential for this approach, but not always sufficient to avoid injury. Tractography with neuronavigation could be useful.

5. Conclusion

The transsylvian–transinsular approach allows for selective resection of cavernomas located in the anterior left MTR, while avoiding damage to the lateral or basal cortex of the temporal lobe, and without the risk of damaging the IFOF and other structures of the dominant hemisphere.

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