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CASE REPORT/SURGICAL VIDEO

Surgical video of transsylvian resection of prechiasmatic craniopharyngioma

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The Sylvian fissure (SF), also referred to as the lateral sulcus, is one of the most prominent anatomical landmarks on the lateral surface of the cerebral hemisphere. This fissure separates the frontal and parietal lobes superiorly from the temporal lobe inferiorly and forms an important corridor in neurosurgical procedures. Within the depth of the fissure lies the Sylvian cistern, which contains critical neurovascular structures such as the middle cerebral artery (MCA) and its branches, superficial Sylvian veins, and arachnoid trabeculae. We present an operative video of a 16-year-old boy who presented with a bifrontal headache and visual impairment for 1 month. He was subjected to transsylvian resection of the suprasellar lesion, after which there was significant improvement in his symptoms. This manuscript highlights the surgical technique of SF dissection with emphasis on the principles of microneurosurgery.

Keywords: Sylvian fissure, micro neurosurgery, trans sylvian, optico carotid, middle meningeal artery

Introduction

The Sylvian fissure (SF) was first described in the 17th century by the Dutch anatomist Franciscus Sylvius (1614–1672). His work contributed significantly to the early understanding of cerebral anatomy. In cranial neurosurgery, the SF serves as a natural surgical pathway, allowing access to deep intracranial structures with minimal cortical retraction. Through careful microsurgical dissection, surgeons can reach the basal cisterns, insular cortex, anterior circulation aneurysms, and mesial temporal structures. The SF is considered the gateway for the microneurosurgical exposure of a number of pathologies arising from the sellar, suprasellar, medial temporal, and anterior base of the skull. It also provides surgical access to the lesion in the posterior fossa to a variable extent of the clivus. The safe dissection of the SF is regarded as the highest degree of the microneurosurgical skill, which can be achieved by regular practice on animal or simulator models. Prof. M.G. Yasargil (1925–2025) has repeatedly emphasized the importance of cadaver dissection and its long-lasting effect on one's neurosurgical career (1, 2).

Case summary

A 16-year-old boy presented with a bifrontal headache and visual impairment for 1 month. His clinical examination revealed impaired visual acuity (right-4/60, left-6/9; with no pinhole correction), with the rest of his examinations being within normal limits. His contrast-enhanced CT brain was suggestive of a cystic lesion measuring approximately 4.8*3.6*3.4 cm, centered within the suprasellar region with a peripheral nodular component that enhances on postcontrast study with peripheral calcifications. The above mass was abutting the third ventricle, extending more into the right SF than the left side. The tumor was infiltrating into the interpeduncular fossa with moderate mass effect, suggestive of a suprasellar pathology. The magnetic resonance imaging of the brain could not be performed because he had a non-MRI-compatible implant in his right femur. Hence, the MRI images were missing from the neuroimaging section.

Surgical intervention

The patient underwent a right frontotemporal (pterional) craniotomy, and surgical excision of the solid-cystic lesion was performed via a right transsylvian approach. The details of the operative steps are as follows:

The patient was positioned supine with head fixed in a Sugita head fixator frame, with neck rotated towards the left to 15 degrees with slight extension. All pressure points were well-padded, and the skin incision was marked using a marker pen. A right frontotemporal craniotomy was performed using a high-speed drill. During craniotomy, care was taken to avoid inadvertent injury to the cortical veins by adequately separating the dura from the undersurface of the bone. The sphenoid ridge was drilled till the frontal and the temporal base became flat to lie along a straight line. The dura mater was opened carefully and reflected anteriorly over the sphenoid ridge.

The SF was opened sharply using an arachnoid knife (we use a 24-G needle as an arachnoid knife). The distal to medial Sylvian splitting was followed by using a pair of jeweler's forceps. The deeper part of the SF was reached by following a cortical branch of MCA (M4 segment). After reaching the deeper part, the fissure was split like opening an orange. The opening of the superficial part is advanced from the lateral to the medial end of the SF. The opening of the stem of the superficial SF exposes the cisterns around the internal carotid artery (ICA) and optic apparatus. The deeper exposure of the fissure allows access to the M3 and M2 segments of the MCA. The origin of the lateral lenticulostriate branches can be noticed and preserved during exposure of the deeper part of the SF. The supraclinoid ICA was noticed with the A1 and M1 segments arising from the terminal part of the ICA.

These cisterns led to the opticocarotid cistern, and the lateral aspect of the tumor wall could be noticed through this corridor. The sharp opening of the cyst wall was performed, and straw-colored fluid came out under pressure. The sharp dissection is achieved by using micro scissors and fine nontraumatic keyhole suction. The solid part was composed primarily of the stippled calcification within the tumor, admixed with the fibrous but thickened cyst wall. The piecemeal removal of the tumor was performed using micro scissors, a fine dissector, and suction.

The lateralmost part of the tumor was accessed through the oculomotor-carotid cistern. The posterior communicating (pComm) artery was identified, and tumor around the pComm was removed completely. The tumor was mobilized by applying countertraction, and direct pulling of the tumor was absolutely avoided throughout the surgical resection.

After removing the tumor through this corridor, the tumor residing in the interoptic cistern was approached. The stalk of the pituitary gland could be seen and was preserved safely by using principles of microsurgery. The opposite optic nerve and ICA could be noticed through the operative corridor. The remaining tumor was accessed through the opticocarotid cistern and was removed in a piecemeal manner. A small segment of the posterior wall of the tumor that was out of the surgical view was left in place. The completeness of the resection was verified by inspecting the free-floating Lilliquist membrane without any tumor attached to it. The operative cavity was inspected to look for the completeness of the resection. The exposed SF, along with the surgical corridor, reveals a meticulous exposure and surgical bed without postresection blood in the operative cavity.

Postoperative course

The patient recovered well postoperatively without any new neurological deficits. The CECT brain scan on postoperative day one was suggestive of adequate excision without any operative cavity hematoma or infarction in the arteriovenous territory. He developed a couple of episodes of diabetes insipidus, which were managed by fluid replacement. He was discharged on postoperative day seven with advice for regular follow-up. Histopathology confirmed the diagnosis of adamantinomatous craniopharyngioma. On follow-up, the patient showed significant improvement in headache and visual function. The visual acuity improved from 4/60 to 6/12 in the right eye and from 6/9 to 6/6 in the left eye.

Discussion

The term "SF" was popularized in anatomical literature by Caspar Bartholin and Thomas Bartholin. The development of microsurgical neurosurgery in the 20th century, especially through the pioneering work of M. G. Yaşargil, transformed SF dissection into a fundamental surgical technique. Yaşargil's introduction of the pterional approach and microsurgical instruments revolutionized the management of cerebral aneurysms and deep-seated brain lesions. Later, Albert L. Rhoton Jr. provided detailed microsurgical anatomical descriptions of the SF and insula, which remain foundational in modern neurosurgical training.

Anatomically, the SF is bounded superiorly by the frontal and parietal opercula, and inferiorly it is bounded by the temporal operculum. The SF can be divided into the superficial SF and the deep SF. The superficial part of SF has a stem and three rami; the stem begins medially at the anterior clinoid process and extends laterally along the sphenoid ridge between the junction of the frontal and temporal lobes to the pterion. At this point, the stem divides into anterior horizontal, anterior ascending, and the posterior rami. The deep part of the SF is obscured below the surface, which is referred to as the Sylvian cistern. The deep part of the SF is more complex than the superficial part and is divided into sphenoidal and operculoinsular compartments. The deeper SF contains the branches of the middle cerebral artery (MCA) and the major draining venous channels of the lateral surface of the hemisphere. The medial wall of the SF is formed by the lateral surface of the insular cortex. This wall is noticed only when the lips of the SF are widely separated following a successful SF dissection (2, 3).

Contents of the Sylvian fissure

The folds of the SF harbor the following important structures, such as the MCA with its M1 (sphenoidal segment), M2 (insular segment), and M3 (opercular segment). The M4 segments are the cortical branches coming out of the fissure towards the frontal and temporal surfaces. The superficial middle cerebral vein (SMCV) with its draining tributaries. The vessels at the depth of the fissure are anchored by the arachnoid membranes and trabeculae. These vessels run on the lateral surface of the insular cortex.

Types of Sylvian fissure depending upon the anatomical architecture

Yasargil described four different types of intraoperatively observed anatomical SF variants:

1. Category I is a straight wide SF.
2. Category II is a straight narrow SF.
3. Category III is a herniated frontal lobe into the SF and
4. Category IV is a herniated temporal lobe into the SF.

Methods of Sylvian fissure splitting/opening

The opening of the SF depends upon the underlying pathology. There are two major methods that are commonly used for the dissection of the lateral fissure.

Distal-to-proximal dissection

This is the most commonly used technique. In this method, the dissection begins from the distal superficial part of the fissure. Classically, a cortical branch of the MCA (M4) is traced from the cerebral surface deep into the SF. This technique leads gradually towards the M2 segment and subsequently towards the bifurcation of the MCA. The release of the cerebrospinal fluid from the SF offers relaxation of the brain during the course of SF dissection. The "opening like an orange" technique for the SF, a signature approach developed by Professor M. Gazi Yasargil, refers to a meticulous microsurgical technique that splits the SF from a superficial to deeper surface, mimicking the separation of citrus segments to expose the deep structures of the brain without traversing the brain parenchyma. This approach uses natural, CSF-filled spaces (arachnoid cisterns) to access tumors, aneurysms, and vascular malformations, making it a cornerstone of modern microneurosurgery.

Proximal-to-distal dissection

This technique of SF dissection is used when the anterior sylvian point (ASyP) is used to start the opening of the SF. The ASyP, corresponding to the arachnoid enlargement of the SF inferior to the retracted pars triangularis of the inferior frontal gyrus. The ASyP represents a constant anatomical point with precise relationships with surrounding brain structures and offers the advantage to start the SF dissection. This technique offers early access to the opticocarotid cistern, which allows early release of CSF. This offers early proximal control of the ICA and anterior and middle cerebral arteries. This is mostly applicable to the aneurysm surgery, where the application of a proximal temporary clip facilitates the perianeurysmal dissection safely and smoothly (4, 5).

Surgical nuances of the Sylvian fissure dissection

After a standard pterional craniotomy, the SF can be identified by the natural anatomical course of the SMCV. The arachnoidal cleft, which is present between the frontal and temporal opercula. The opening of the arachnoid membrane covering the fissure is routinely opened using an arachnoid knife, micro scissors, and a pair of jeweler's forceps. The jeweler's forceps provide a sharp and precise access to advance the opening of the fissure. The use of bipolar diathermy must be avoided because the majority of the venous bleedings used to be controlled by gentle tamponade provided by the small- to medium-sized cottonoids. A sharp and clean dissection is always favorable rather than the blunt dissection. The wide splitting of the SF allows minimal retraction and access to all the segments of the MCA from the cortical (M4) segment up to the supraclinoid ICA. This exposure offers access to the medial end of the SF with the cisterns around the ICA and optic nerve. The standard teaching considers the lateral/SF as the natural valley between the frontal and the temporal lobes. This valley is often occupied by the arteriovenous structure floating in the CSF, which is anchored by the septations arising from the deeper layer of the arachnoid mater.

A few important key points to be followed during the dissection of the SF. They are:

1. Sharp dissection must be followed—This offers a clear surgical plane and allows better tissue handling.
2. Follow the arachnoid planes—The deeper layer of the arachnoid mater within the SF is the natural anchor for the arteriovenous structures of the fissure. Meticulous dissection along the arachnoid planes allows the opening of the deeper part of the fissure.
3. Continuously irrigate the surgical cavity—The dissection area should be thoroughly and continuously irrigated with saline to clear away the venous blood arising during dissection. This provides an additional privilege to avoid any pial breach, which could lead to loss of the surgical plane.
4. Avoid excessive brain retraction—The SF dissection offers adequate exposure, which eliminates the need for brain retraction. The retraction, if required, must be of a dynamic nature where the shaft of the nontraumatic suction provides adequate traction to further proceed with the surgical dissection.
5. Adequate microneurosurgical ergonomics—This includes an adjustable neurosurgical operating chair with bilateral arm supports. The microscope should be operated using a foot switch regulator, which necessarily keeps both the operating hands free all the time.

Utility of Sylvian fissure dissection in clinical practice

Opening the SF provides a natural corridor to deep intracranial structures, reducing the need for cortical incision. Several neurosurgical procedures demand the SF dissection. A few of these are mentioned below.

1. Anterior circulation aneurysm surgery
2. Insular tumors
3. Temporal lobe tumors
4. Arteriovenous malformations (AVMs)
5. Skull base lesions

The surgical video of Transsylvian resection of craniopharyngioma is attached with the hyperlink provided as below (**Video 1**).

VIDEO 1 | Transsylvian resection of craniopharyngioma. https://youtu.be/fGV6yR8RJnQ

Potential complications

Adhering carefully to the microsurgical technique significantly reduces the risks that may arise during the dissection of the SF. The improper dissection may result in the following unwanted outcomes (6). A few of these are as follows.

1. Venous infarction: Injury to the tributaries of the SMCV or injury to the main draining vein may lead to venous infarction.
2. Injury to the branches of the MCA: This is a potential source of arterial injury if the arachnoidal planes and the microneurosurgical principles are not followed.
3. Subarachnoid hemorrhage: This complication can potentially arise due to the arteriovenous injury during the SF dissection.
4. Brain edema: This is noticed after a period of hours of surgery to a few days. This feature appears after prolonged application of static retractors and potentially results in injury to the superficial or deep draining veins. This manifests as perisylvian hypodensity in the postoperative period.

Conclusion

Sylvian fissure (SF) dissection remains one of the most important microsurgical techniques in cranial neurosurgery. Since its early anatomical description by Franciscus Sylvius, advances in microsurgical instrumentation and operative approaches have refined the technique. Mastery of SF anatomy and dissection allows safe access to critical vascular and deep brain structures while minimizing cortical injury. During the period of neurosurgical training, a resident must learn these nuances and should be offered the splitting of the SF in cadaveric labs and animal specimens (sheep/goat brains). One must be familiar with the handling of the microsurgical instruments and the operative microscope and have a sound knowledge of neuroanatomy before embarking on a case where SF dissection is crucial.

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Conflict of interest

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