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ILLUSTRATIVE SURGICAL VIDEO

# Endoscopic hemispherotomy: an illustrative video

**Jitin Bajaj[1*], Nishtha Yadav[2], Namrata Khandelwal[3], Jayant Patidar[1], Vijay S. Parihar[1], M. N. Swamy[1] and Y. R. Yadav[4]**

[1]Department of Neurosurgery, Superspeciality Hospital, NSCB Medical College, Jabalpur, India
[2]Department of Neuroradiology, Superspeciality Hospital, NSCB Medical College, Jabalpur, India
[3]Department of Neurology, Superspeciality Hospital, NSCB Medical College, Jabalpur, India
[4]Apex Hospital and Research Center, Jabalpur, India

*Correspondence:
Jitin Bajaj,
bajaj.jitin@gmail.com

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Endoscopic surgery has brought about a paradigm shift in the field of neurosurgery. It provides a panoramic view, heightened illumination, magnification, and the unique ability to navigate corners, all of which significantly enhance surgical precision. Endoscopic hemispherotomy is a procedure that allows functional disconnection of the abnormal hemisphere from the ipsilateral basal ganglia, thalamus, and contralateral brain. This video article gives an overview of endoscopic hemispherotomy for a case of drug-refractory epilepsy due to an old middle cerebral artery infarct. It also showcases the value of functional magnetic resonance imaging in deciding the surgery.

**Keywords:** epilepsy, functional hemispherectomy, Neuroendoscopy, stroke

## Introduction

The integration of endoscopy has garnered widespread acceptance in various neurosurgical procedures (1–4). Endoscopic hemispherotomy, introduced by Chandra et al. enables the disconnection of the involved hemisphere from the ipsilateral basal ganglia, thalamus, and contralateral brain (1, 5, 6). It allows surgery in the pediatric population that requires minimal blood loss and earlier recovery, and in whom early surgery prevents the decline of cognitive functions (7). Historically, hemispherotomy in adults was eschewed, primarily out of concerns about plasticity limitations. However, recent evidence has demonstrated its safety across all age groups (8).

This video article elucidates the intricacies of the endoscopic hemispherotomy technique, delving into key aspects such as patient selection, preoperative investigations, technical nuances, and strategies for avoiding complications.

Case: The patient, a 27-year-old woman, presented with a 25-year history of epilepsy. She experienced a left middle cerebral artery stroke at the age of 2 years, after which she continued to have intermittent focal to bilateral tonic-clonic seizures. The seizures initially manifested in her right arm and progressed to involve her face, lower limb, and eventually her entire body. At the time of presentation, the frequency was 1–2 seizures per week. Despite the administration of six antiseizure medications in appropriate dosages and combinations, she remained resistant.

Upon examination, the patient was conscious, oriented to time, place, and person. She exhibited left-sided weakness with a power of 0/5 in the left wrist and hand, and graded weakness ranging from 3 to 4/5 in the rest of the left upper and lower limbs. Her speech was intact, and her intelligence quotient was measured at 80. Both interictal and ictal electroencephalograms (EEG) indicated localization at F7, T3, T5, suggestive of left frontotemporal discharges. Magnetic resonance imaging (MRI) revealed gliosis predominantly in the fronto-insulo-parietal region of the affected hemisphere (**Figure 1**).

The alignment of the patient's clinical presentation, EEG, and MRI exhibited a strong correlation. Consequently, the consideration of undergoing a left-sided hemispherotomy was contemplated. However, this option posed a risk of potential loss of power in her left lower limb and speech. To address this dilemma, a functional MRI was conducted, revealing a noteworthy shift of her speech, and motor

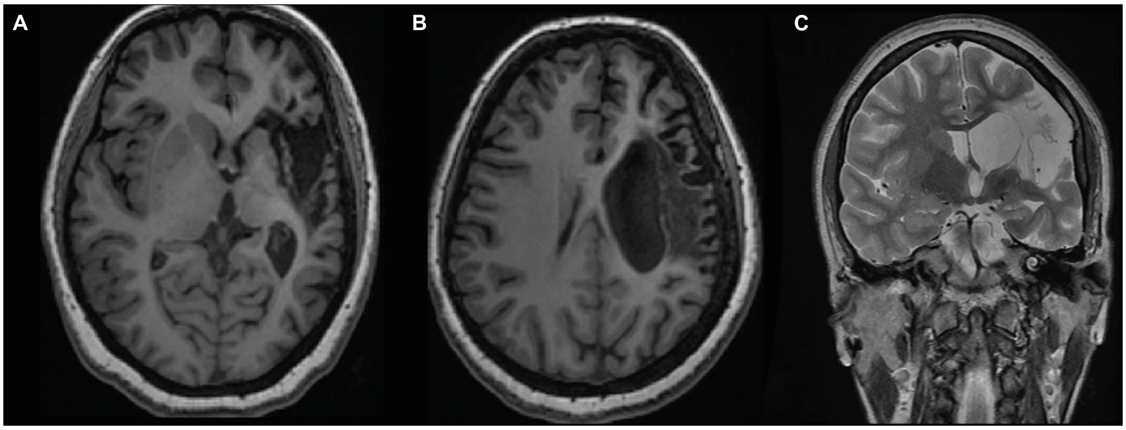


**FIGURE 1 | (A, B)** T1 axial images with evidence of left frontoinsuloparietal gliosis. **(C)** T2 coronal image with a similar finding.

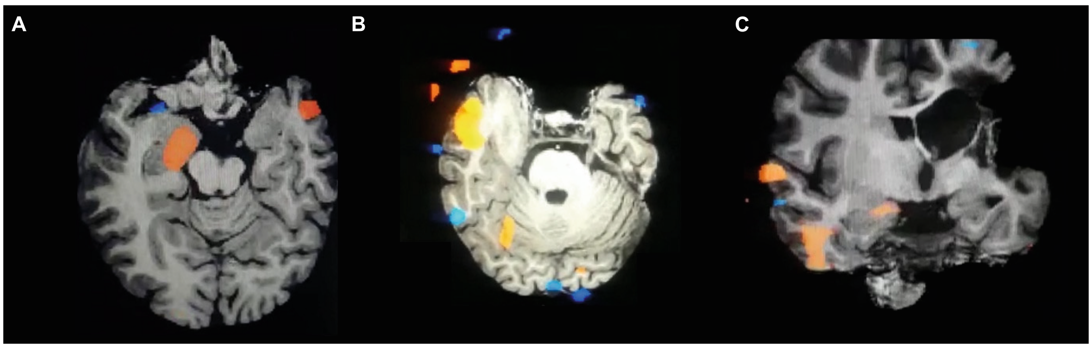


**FIGURE 2 |** Functional MRI with panel **(A)** showing the blood-oxygen-level-dependent (BOLD) signal activity of the right lower limb movement from the right mesial temporal lobe. **(B,C)** The BOLD signal activity of speech predominantly from the right temporal lobe.

functions of the right leg to the right hemisphere, as depicted in Figure 2. Armed with this valuable insight, we were able to counsel the patient effectively and make an informed decision to proceed with a left-sided endoscopic hemispherotomy.

Procedure: The step-by-step procedure is shown in Video 1. The patient was placed in a supine position with the head slightly flexed. A transverse incision was marked about 1 cm ahead of the coronal suture of a size of 5 cm crossing the midline. A minicraniotomy of a size of 4×3 was lifted to the midline. The dura was opened and reflected with the base toward the sagittal sinus. A zero-degree 30 cm long endoscope was used for visualization. It was held on an endoscopic holder. Using the interhemispheric approach, the corpus callosum was exposed completely. The surgery was done in four steps: (a) Complete corpus callosotomy (over the ipsilateral ventricle), (b) anterior disconnection (disconnecting frontal lobe), (c) middle disconnection (disconnecting temporal lobe, temporal stem, insula, and parietal lobe), and (d) posterior disconnection (disconnecting occipital lobes). This disconnects one cerebral hemisphere from the ipsilateral basal ganglia, thalamus, and contralateral brain.

(A) Corpus callosotomy: the corpus callosum was incised over the ipsilateral ventricle, which was different from the normal callosotomy where the disconnection is exactly in the midline. The callosotomy was done completely from the splenium to the rostrum.

(B) Anterior disconnection: it starts anterior to the genu and progresses laterally. The gyrus rectus was incised up to the anterior skull base, from midline up to the lesser wing of the sphenoid.

(C) Middle disconnection: The disconnection starts from the lesser wing of the sphenoid bone and extends until the atrium. This was done just lateral to the thalamus and goes up to the middle cranial fossa base in depth. The temporal stem was also disconnected. We prefer this disconnection in the reverse order, i.e., from the atrium to the lesser wing of the sphenoid.

(D) Posterior disconnection: It involved incising the white matter between the choroid plexus and splenium.

**VIDEO 1** | Video showing the step-by-step description of a case of endoscopic hemispherotomy.
https://youtu.be/gsJahr8RlgM

The surgery was completed after achieving hemostasis and putting an external ventricular drain for 3–4 days. The dura was closed, the bone reposited and fixed, and the wound was closed in the standard manner.

Audio transcript in the video:

0:00 This video demonstrates a left-sided endoscopic hemispherotomy for a case of drug-refractory epilepsy due to an old middle cerebral artery stroke.

0:07 A 27-year-old woman came to us with a 25-year history of epilepsy. Her seizures began at the age of 2 after a stroke in the left middle cerebral artery. The seizures were focal to bilateral tonic-clonic from her right arm, to her face, lower limb, and eventually her whole body. She was having 1–2 seizures per week at the time of the visit, despite being treated with six different anti-seizure medications in proper doses and combinations.

0:32 On examination, she was conscious, alert, and oriented to time, place, and person. She had power of 0/5 in the left wrist, and graded weakness ranging from 3 to 4/5 in the rest of the left upper and lower limbs. She had intact speech, and her intelligence quotient was 80.

0:49 Her interictal and ictal EEG showed left frontotemporal discharges. Her MRI revealed gliosis mainly in the fronto-insulo-parietal region of the left hemisphere.

1:00 The patient had a good clinic-electro-radiological correlation pointing toward the left-sided hemispherotomy. However, considering her intact speech and nearly-intact right lower limb power, there was a dilemma whether the surgery would be safe. To address this concern, a functional MRI was conducted to assess speech and right lower limb functions. The results indicated a notable shift of both speech and right lower limb functions to the right hemisphere. This crucial information enabled us to confidently consider and make the decision to proceed with a left-sided endoscopic hemispherotomy.

1:36 The patient was positioned in a supine posture with a slightly flexed head. A transverse incision, measuring approximately 5 cm and located 1 cm ahead of the coronal suture, was marked, crossing the midline. A minicraniotomy, sized 4×3 cm, was then created and lifted to the midline. The dura was opened and reflected with the base oriented toward the sagittal sinus.

1:59 The surgical procedure unfolds in four distinct steps: complete corpus callosotomy (over the ipsilateral ventricle), anterior disconnection (disconnecting the frontal lobe), middle disconnection (disconnecting the temporal lobe, temporal stem, insula, and parietal lobe), and posterior disconnection (disconnecting the occipital lobes).

2:18 For visualization, a 30 cm long zero-degree 4 mm wide endoscope was utilized, securely held in place by an endoscopic holder. Employing the interhemispheric approach, complete exposure from Genu to the splenium of the corpus callosum was achieved. The callosotomy was started from splenium over the ipsilateral ventricle. This was different from the conventional callosotomy, which is done strictly over the midline. Here we can see the left-sided choroid plexus and foramen of Monro.

3:16 The anterior disconnection starts anterior to the genu and progresses laterally. The gyrus rectus was incised up to the anterior skull base, also disconnecting the rostrum. It was performed from midline up to the lesser wing of the sphenoid laterally.

3:45 The middle disconnection extends from the lesser wing of the sphenoid bone to the atrium lateral to the thalamus and the middle cranial fossa base in depth, also disconnecting the temporal stem. We performed this disconnection in the reverse order, i.e., from the atrium to the lesser wing of the sphenoid. Here we are seeing the atrium. The disconnection was made lateral to the left thalamus. The temporal horn was also opened and the choroidal point was reached. Thereafter, the temporal stem and ventral amygdala were also sucked. The disconnection was met with the anterior disconnection point.

4:47 The posterior disconnection involved incising the white matter between the choroid plexus and splenium. The galenic venous system can be seen underneath the arachnoid.

5:02 After achieving hemostasis, the wound was closed after putting an external ventricular drain.

5:04 On postoperative CT scan, one can appreciate the “C” shaped disconnection line of the left cerebral hemisphere.

5:11 Postoperatively, the patient had Engel class 1 outcome, i.e., no seizures since surgery at a follow-up of 2-year duration. She has intact speech and no deterioration in the power. Her Clobazam was reduced immediately, and other drugs are being slowly reduced.

5:26 One can refer to these articles for further reading.

## Discussion

Hemispherotomy, when conducted under appropriate indications, demonstrates excellent outcomes. Good indications for hemispherotomy include post-MCA stroke epilepsy, Rasmussen’s encephalitis, Sturge–Weber syndrome, Hemimegalencephaly, etc. Class I success rates documented in various studies range from 54 to 94%

(6, 9–12). Complications associated with hemispherotomy include aseptic meningitis (attributed to blood products), infrequent instances of hydrocephalus, and infections. It is important to note that a potential exacerbation of weakness in the limbs opposite to the operated hemisphere may occur, though this is considered an expected outcome rather than a complication. As previously mentioned, this weakness typically shows improvement within a few months, except for the pincer grip that persists.

## Conclusion

This video demonstrates the procedure of Endoscopic hemispherotomy, which is a safe and effective procedure for unihemispheric-onset drug-resistant epilepsy.

## References

1. Chandra P, Kurwale N, Garg A, Dwivedi R, Malviya S, Tripathi M. Endoscopy-assisted interhemispheric transcallosal hemispherotomy: Preliminary description of a novel technique. *Neurosurgery.* (2015) 76:485–494; discussion494–495.
2. Yadav Y, Parihar V, Kher Y, Bhatele P. Endoscopic inter laminar management of lumbar disease. *Asian J Neurosurg.* (2016) 11:1–7.
3. Parihar V, Yadav N, Yadav Y, Ratre S, Bajaj J, Kher Y. Endoscopic management of spinal intradural extramedullary tumors. *J Neurol Surg A Cent Eur Neurosurg.* (2017) 78:219–26.
4. Bajaj J, Chandra P. Recent developments in endoscopic endonasal approach for pituitary adenomas. *Neurol India.* (2020) 68:S79–84.
5. Chandra S, Tripathi M. Endoscopic epilepsy surgery: Emergence of a new procedure. *Neurol India.* (2015) 63:571–82.
6. Chandra P, Subianto H, Bajaj J, Girishan S, Doddamani R, Ramanujam B, et al. Endoscope-assisted (with robotic guidance and using a hybrid technique) interhemispheric transcallosal hemispherotomy: A comparative study with open hemispherotomy to evaluate efficacy, complications, and outcome. *J Neurosurg Pediatr.* (2018) 23:187–97.
7. Dwivedi R, Ramanujam B, Chandra P, Sapra S, Gulati S, Kalaivani M, et al. Surgery for drug-resistant epilepsy in children. *N Engl J Med.* (2017) 377:1639–47.
8. Bajaj J, Chandra S, Ramanujam B, Subianto H, Girishan S, Doddamani R, et al. Comparative analysis of hemispherotomy in adults versus children– a prospective observational series. *Neurol India.* (2024) 72:69–73.
9. Bajaj J, Chandra S, Ramanujam B, Girishan S, Doddamani R, Tripathi M. Need of immediate drug reduction after epilepsy surgery – a prospective observational study. *Neurol India.* (2019) 67:1050–3.
10. Girishan S, Chaudhary K, Samala R, Agarwal M, Kumaran S, Doddamani R, et al. Long-term functional outcome following left hemispherotomy in adults and pediatric participants with FMRI analysis. *Neurol India.* (2022) 70: 1593–600.
11. Pilioneta M, Chen H, Losito E, Bourgeois M, Chémaly N, Eiserman M, et al. Interhemispheric vertical hemispherotomy: Technique, outcome, and pitfalls-a bicentric retrospective case series of 39 cases. *Oper Neurosurg (Hagerstown).* (2023) 26:413–22.
12. Thomé U, Batista L, Rocha R, Terra V, Hamad A, Sakamoto A, et al. The important role of hemispherotomy for Rasmussen encephalitis: Clinical and functional outcomes. *Pediatr Neurol.* (2024) 150:82–90.