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Surgical Approaches to Brain & Spine Tumours: Understanding Recent Advances

38th AROI-ICRO SUN PG Teaching Course WEBINAR Series Part 1: July 7, 2021

Brain Tumours

- Approaches: Convexity, Pterional, Trans callosal, TSS, P-Fossa
- Positions: Supine, Prone, Park Bench, Lateral, Sitting

- Large Craniotomy
- MIS: Eye brow incision
- HD Microscope: Y-560 dye
- HD Endoscope
- CUSA
- INOM
- Intra op USG, CT & MRI
- Stereotaxy or Navigation

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Introduction: Brain Tumours

- Surgery on Brain tumours are major part of Neurosurgical Practice
- Gliomas are very common tumors that we encounter during neurosurgical practice.
- Gross total resection of these tumors have been proven beyond doubt to increase the overall survival and progression free survival.

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Comprehensive Treatment

Modern comprehensive treatment of gliomas consists of

- Surgical resection
- Chemotherapy
- Radiotherapy

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GTR

- Increasing GTR remains a serious challenge to neurosurgeons as it is difficult to distinguish the tumor boundary from normal brain parenchyma due to the infiltrating nature of gliomas.

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Tools available to increase resection

- Intraoperative CT and MRI scan
- Intraoperative USG
- Navigation systems
- Cortical stimulation
- Fluorescence-guided resection

Among these methods, fluorescence-guided resection has shown great promise because it allows intraoperative visualization of tumor boundaries.

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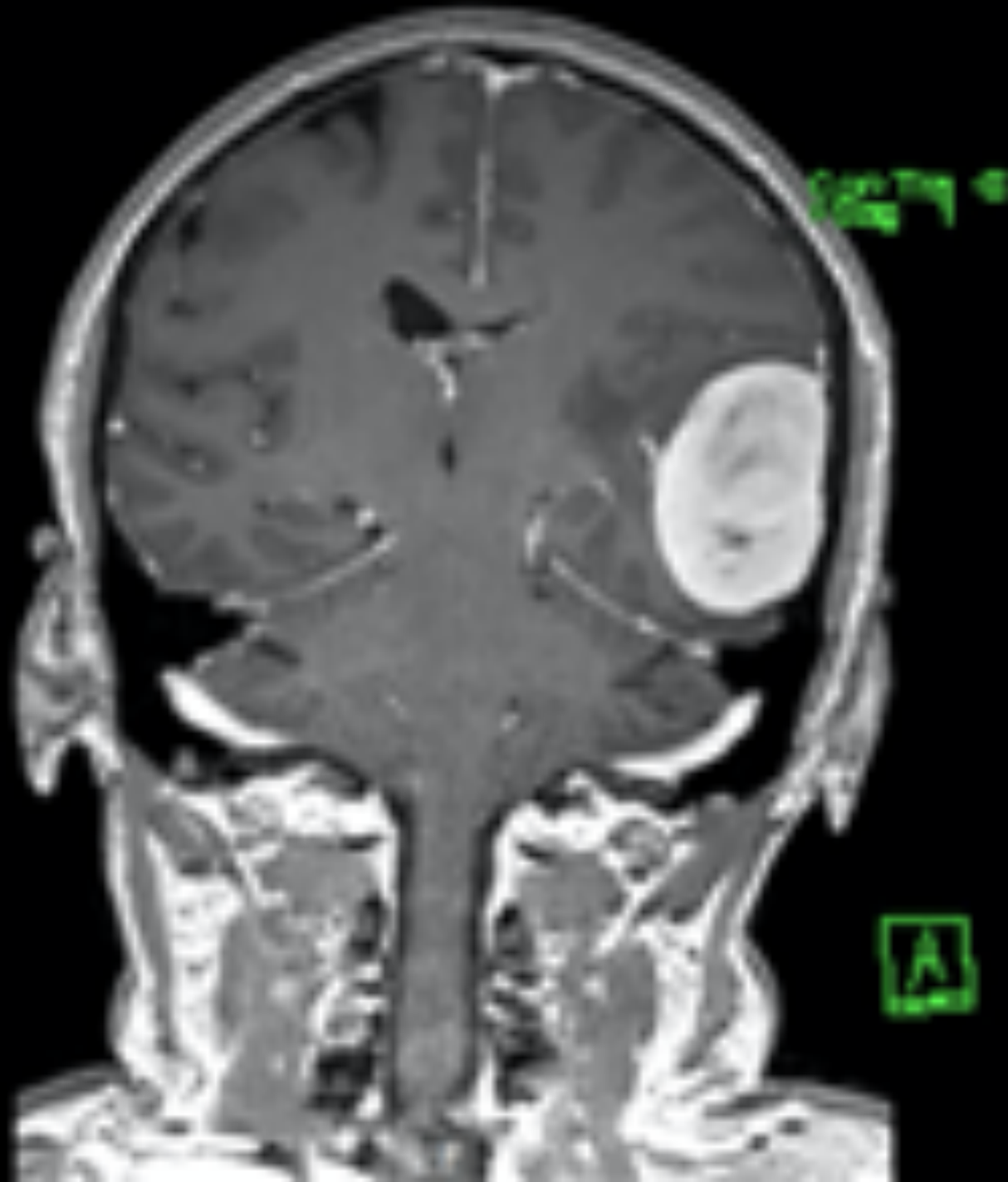
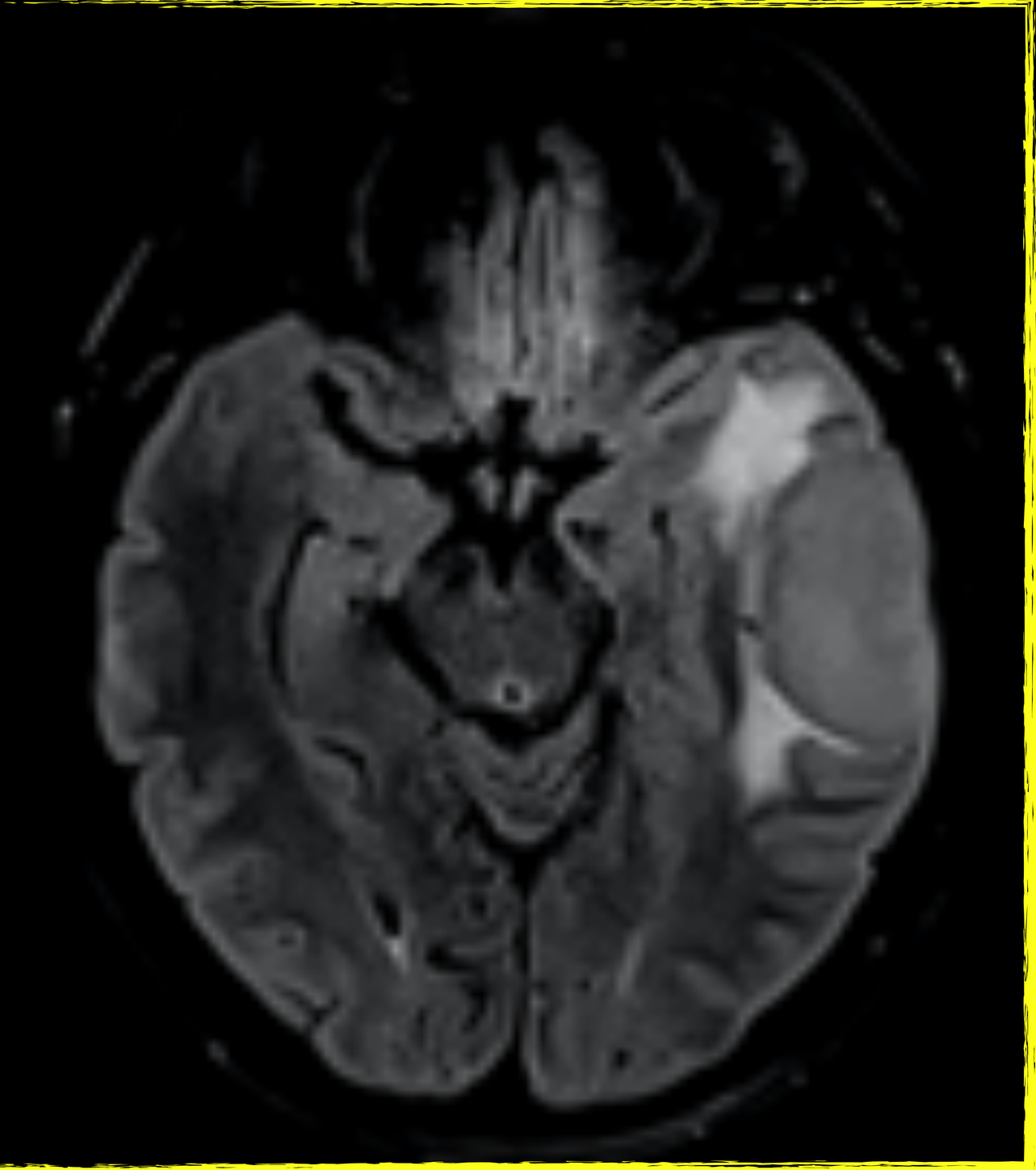
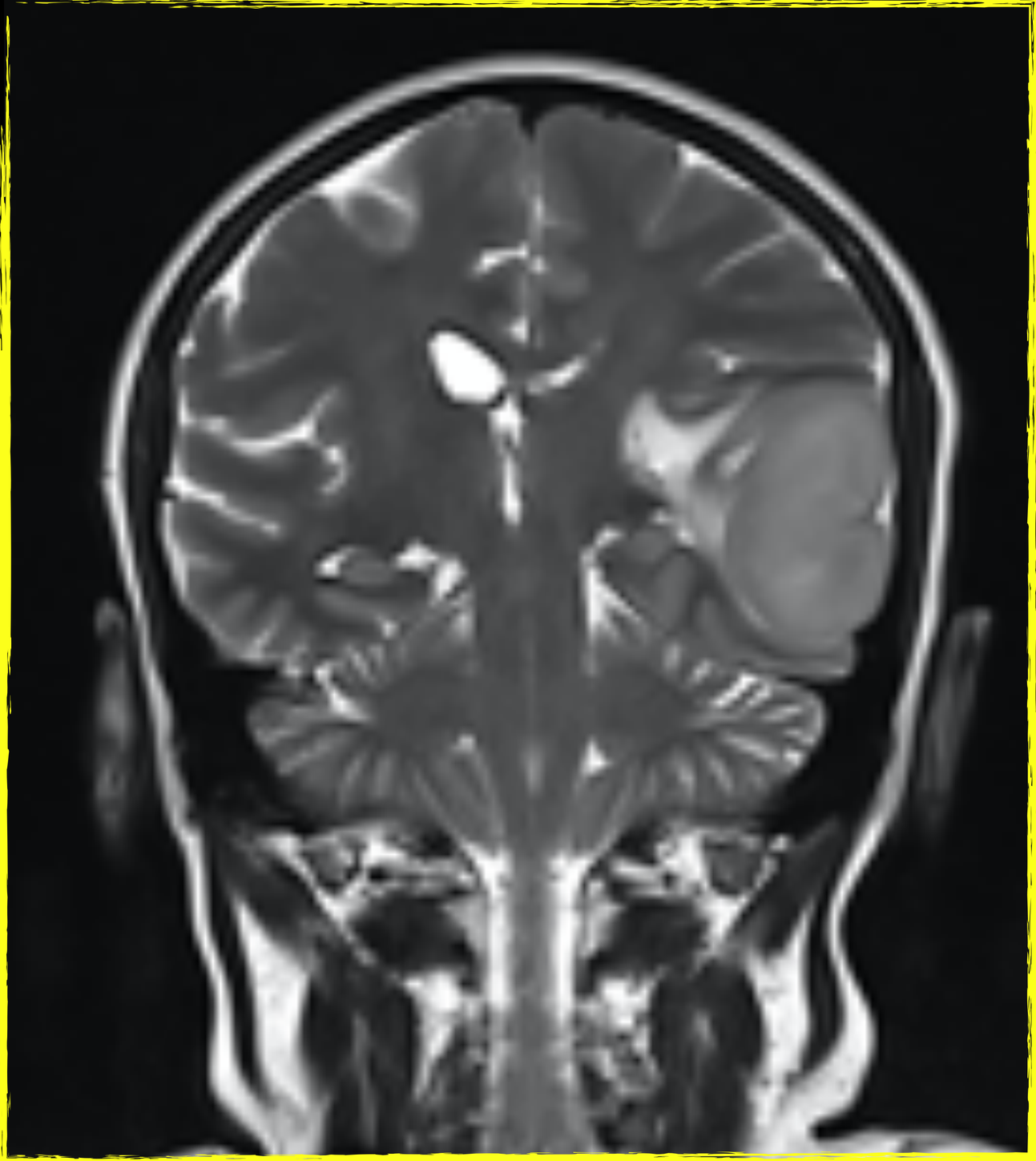
CLINICAL DETAILS

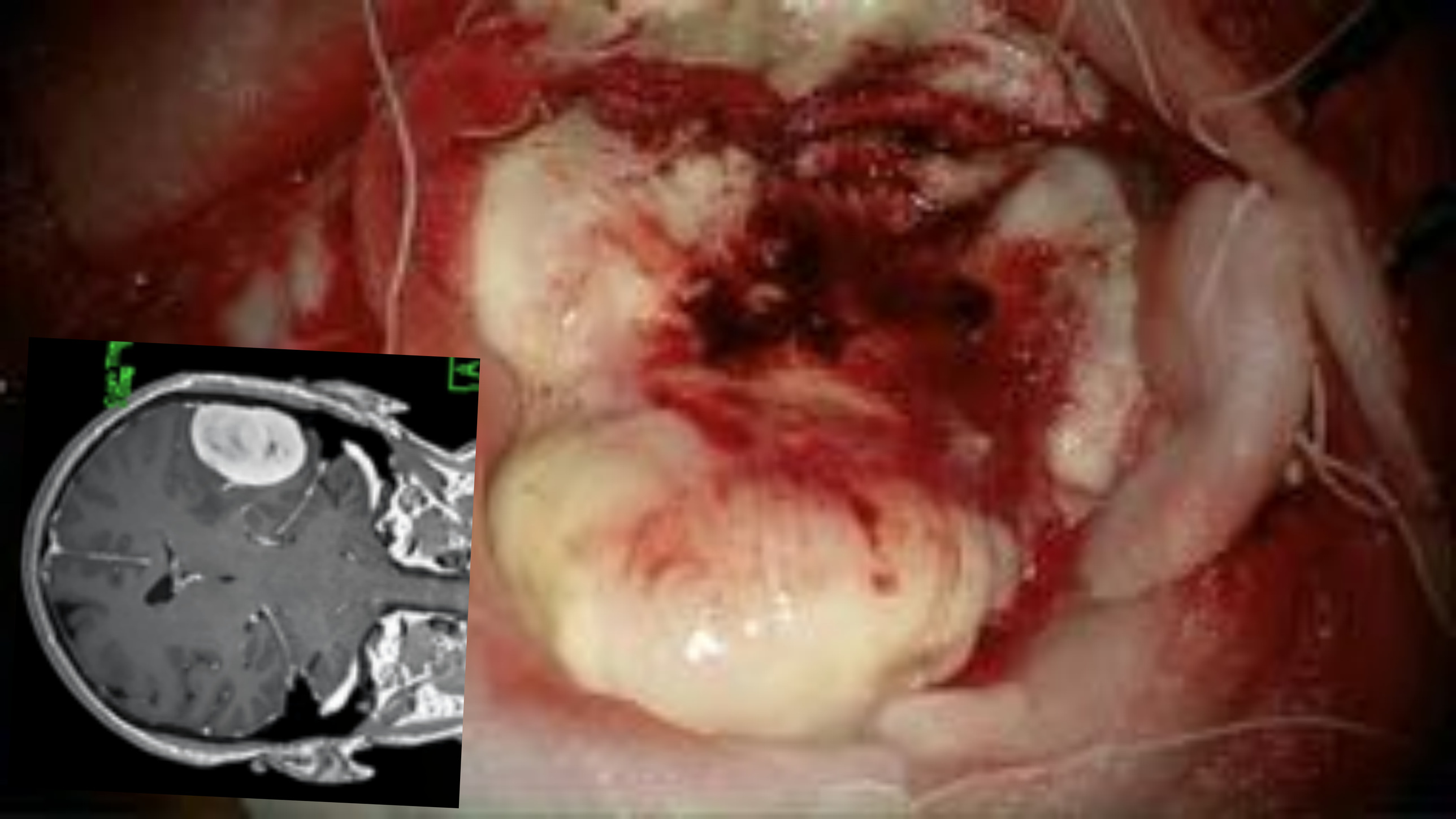
- 45 yrs Lady
- ICP features
- Rt Hemiparesis
- Seizures





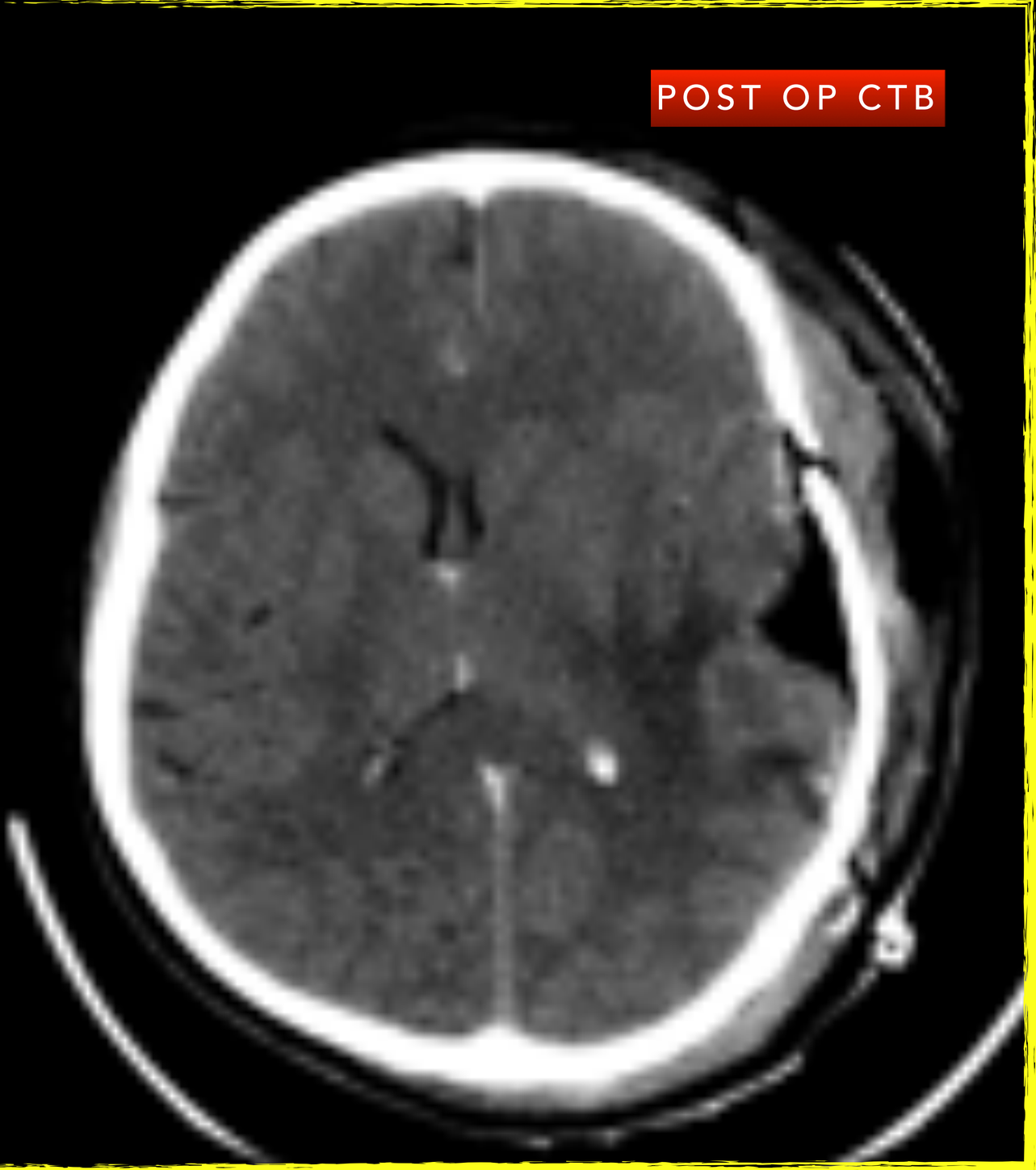


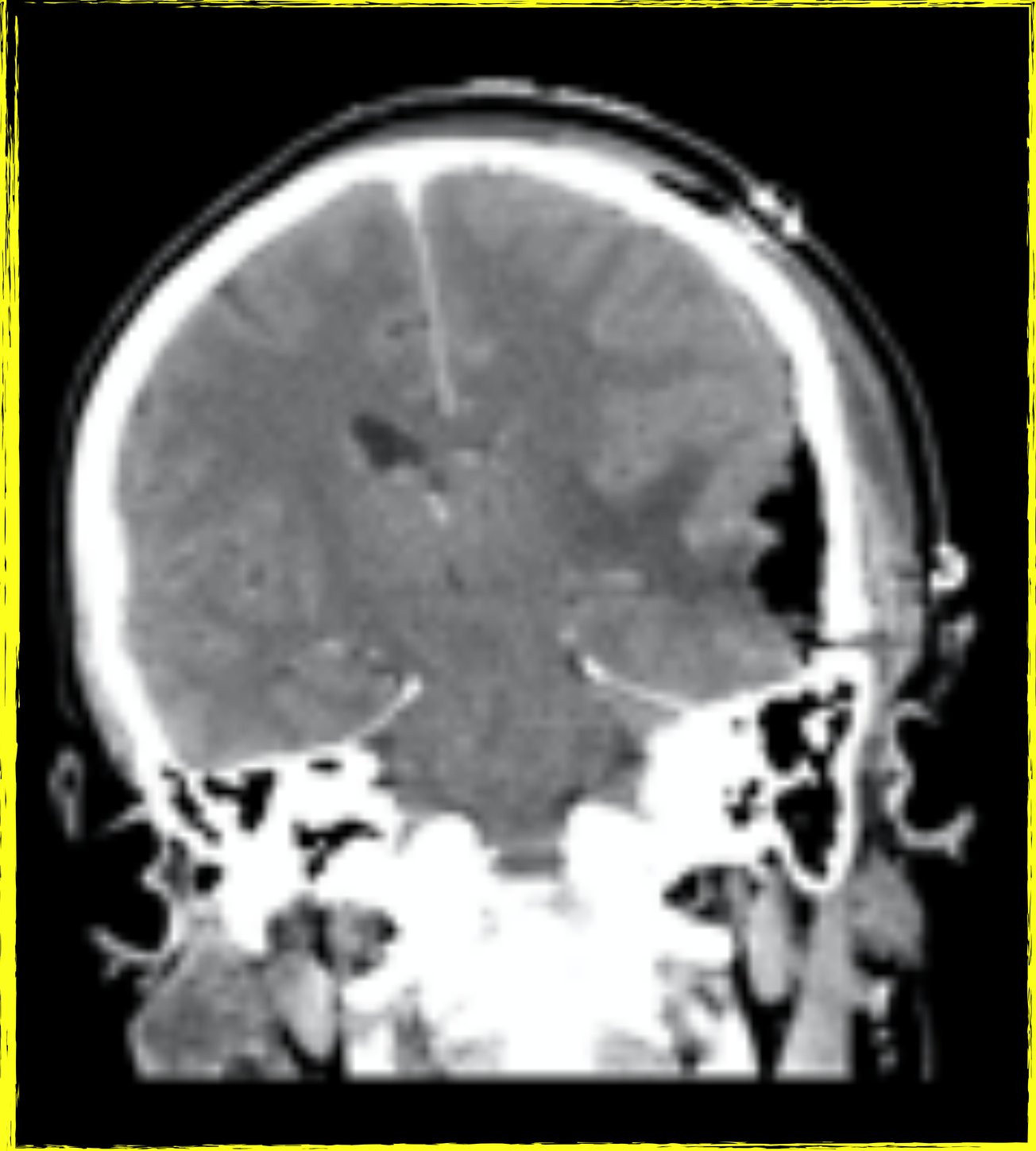
Large Craniotomy




TUMOUR: MENINGIOMA

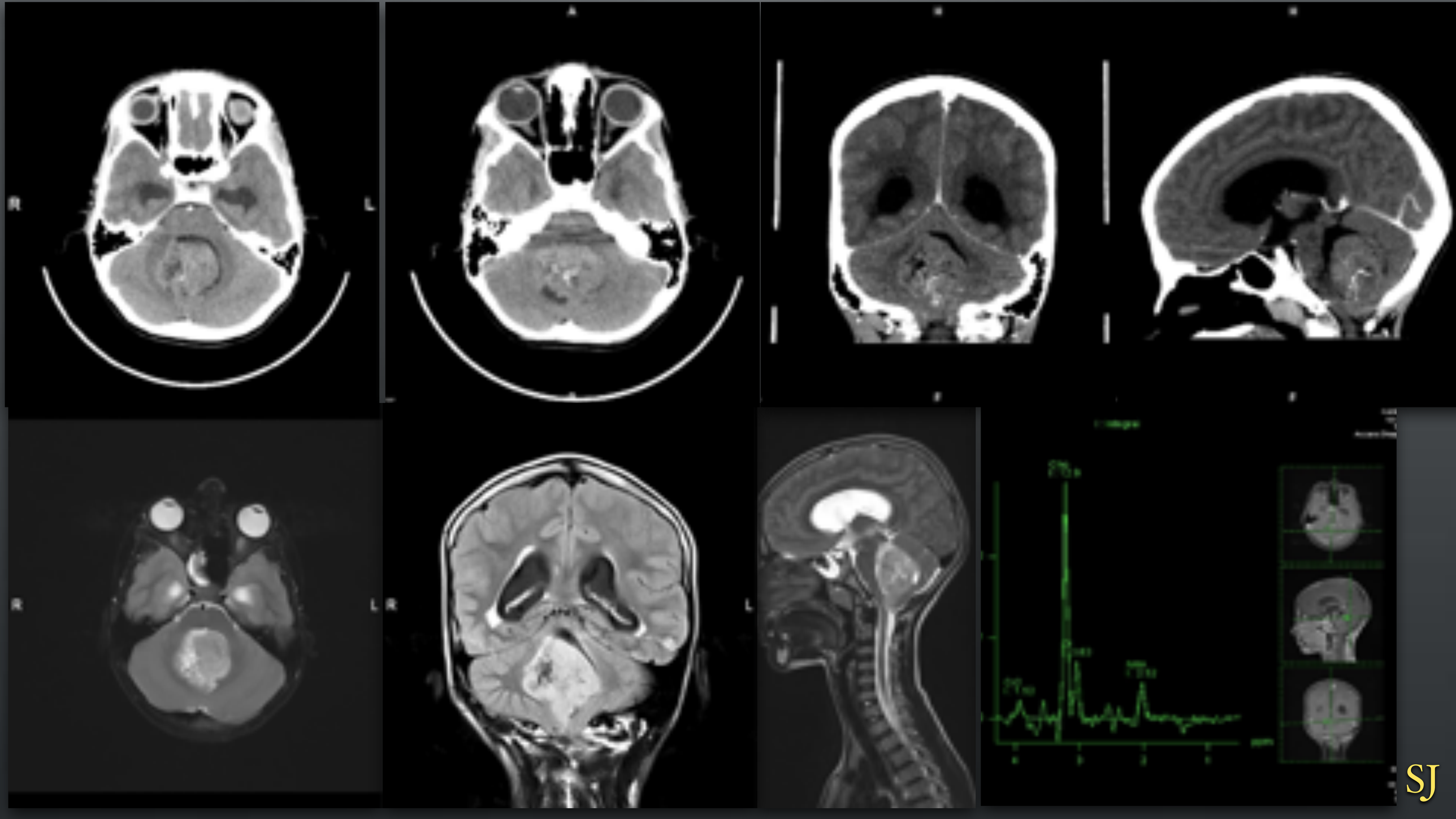

INVOLVED DURA


POST OP CTB



Case Presentation

- 12 years old Boy
- Headache for 3 months
- Vomiting, Nausea & Diplopia
- Cerebellar Signs
- CT Brain & MRI Brain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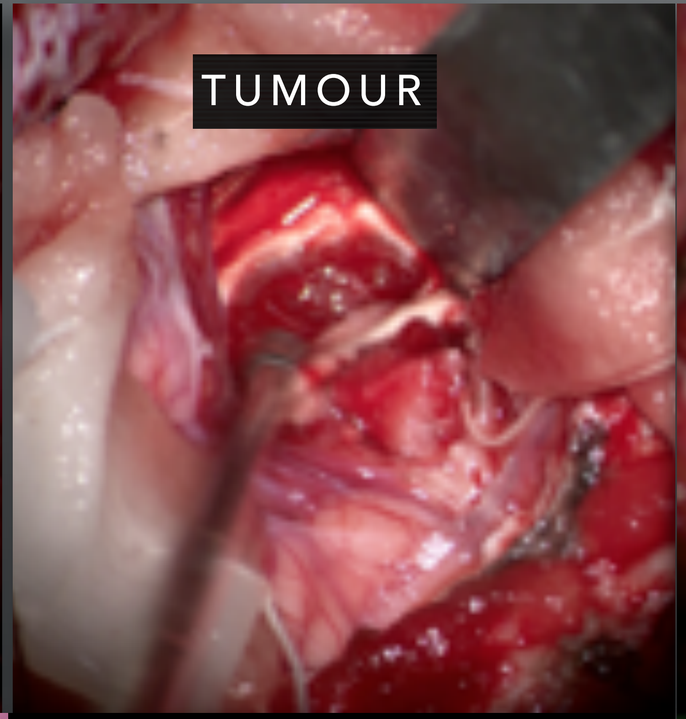
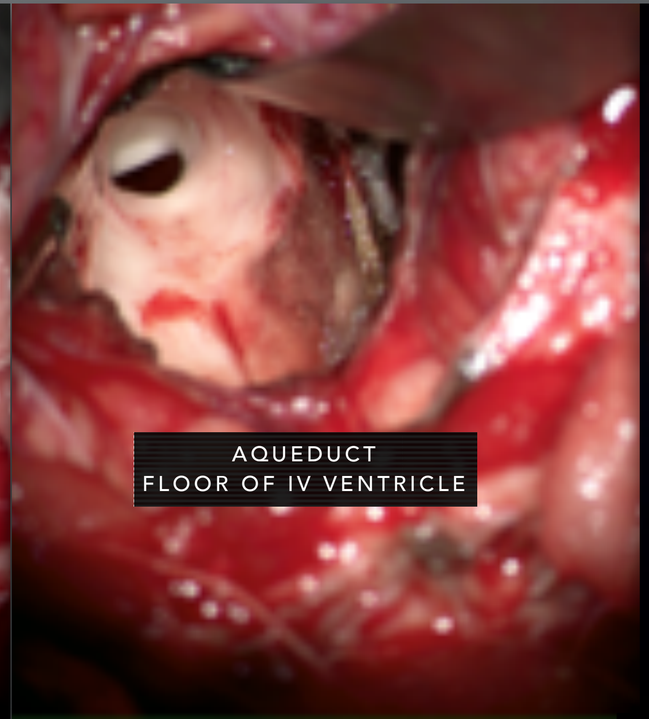
Plan

- Surgical Excision
- CSF Diversion
- Adjuvant Therapy


VERMIS SPLIT


TUMOUR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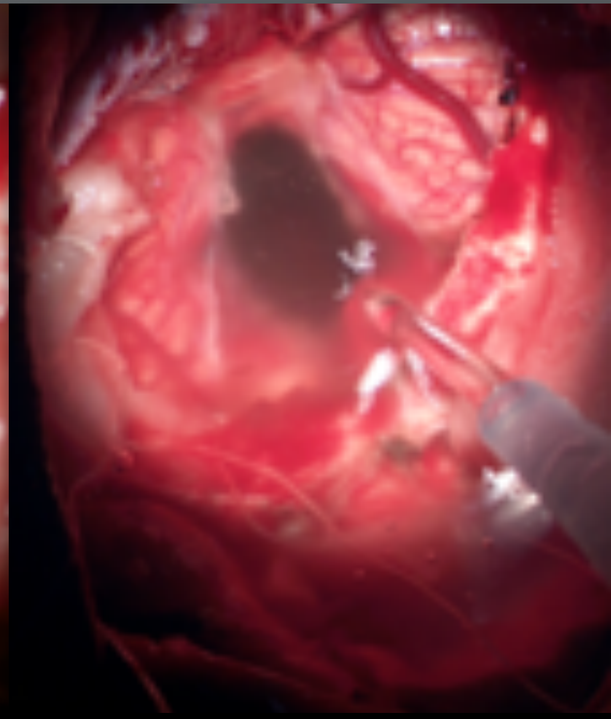
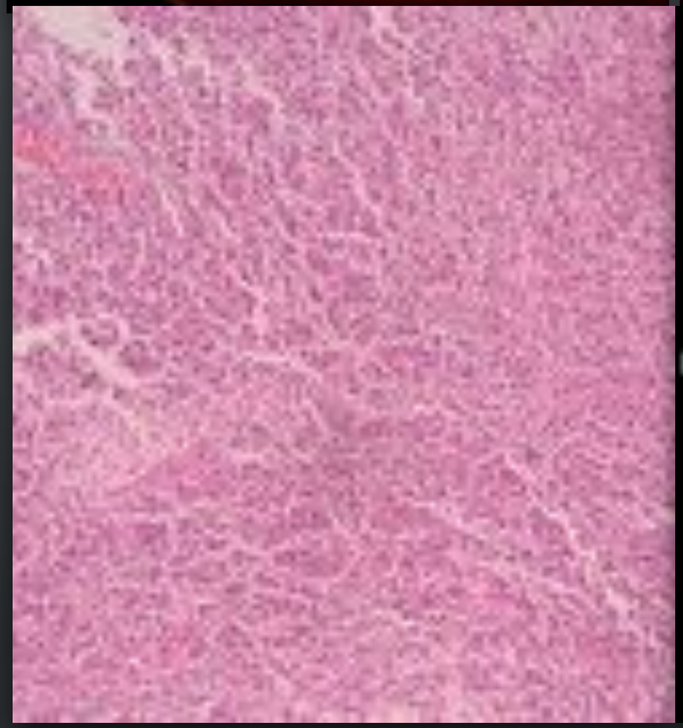
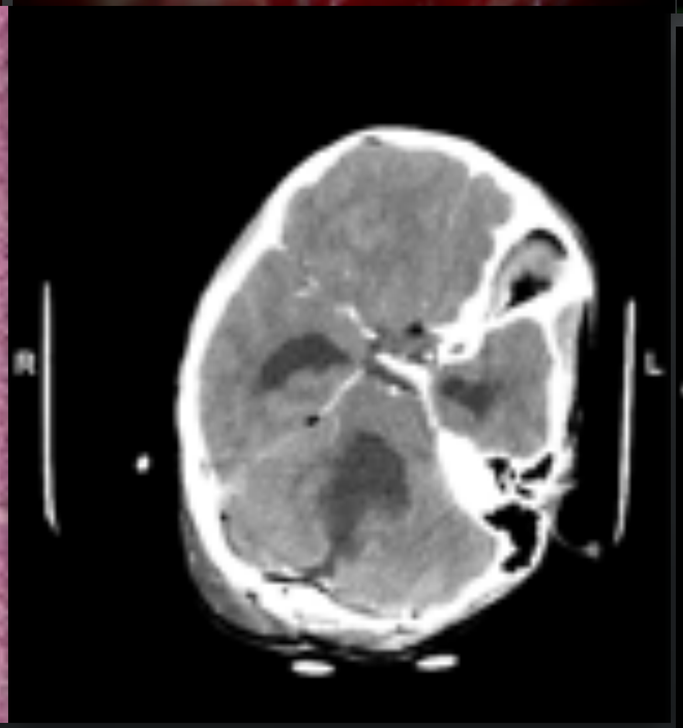
FLOOR OF IV VENTRICLE



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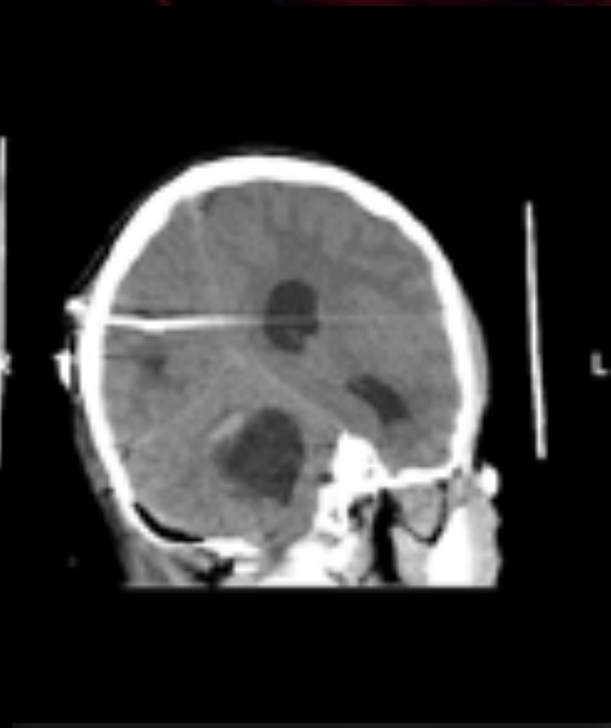
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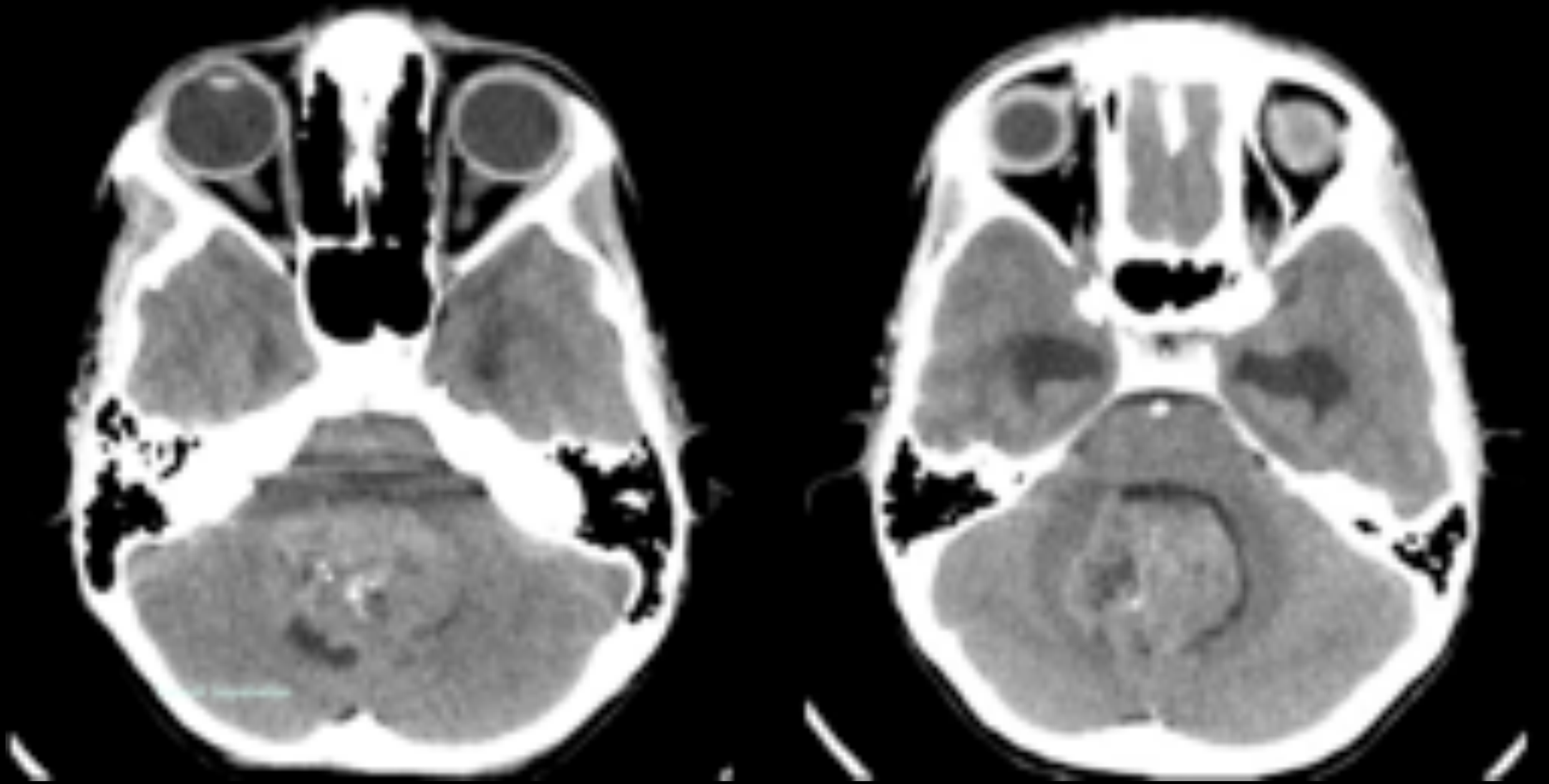
VIDEO



Clinical Presentation

- 44 yrs old Lady
- Left Focal Seizures since 2013 - infrequent only
- On Anti epileptics
- No FND

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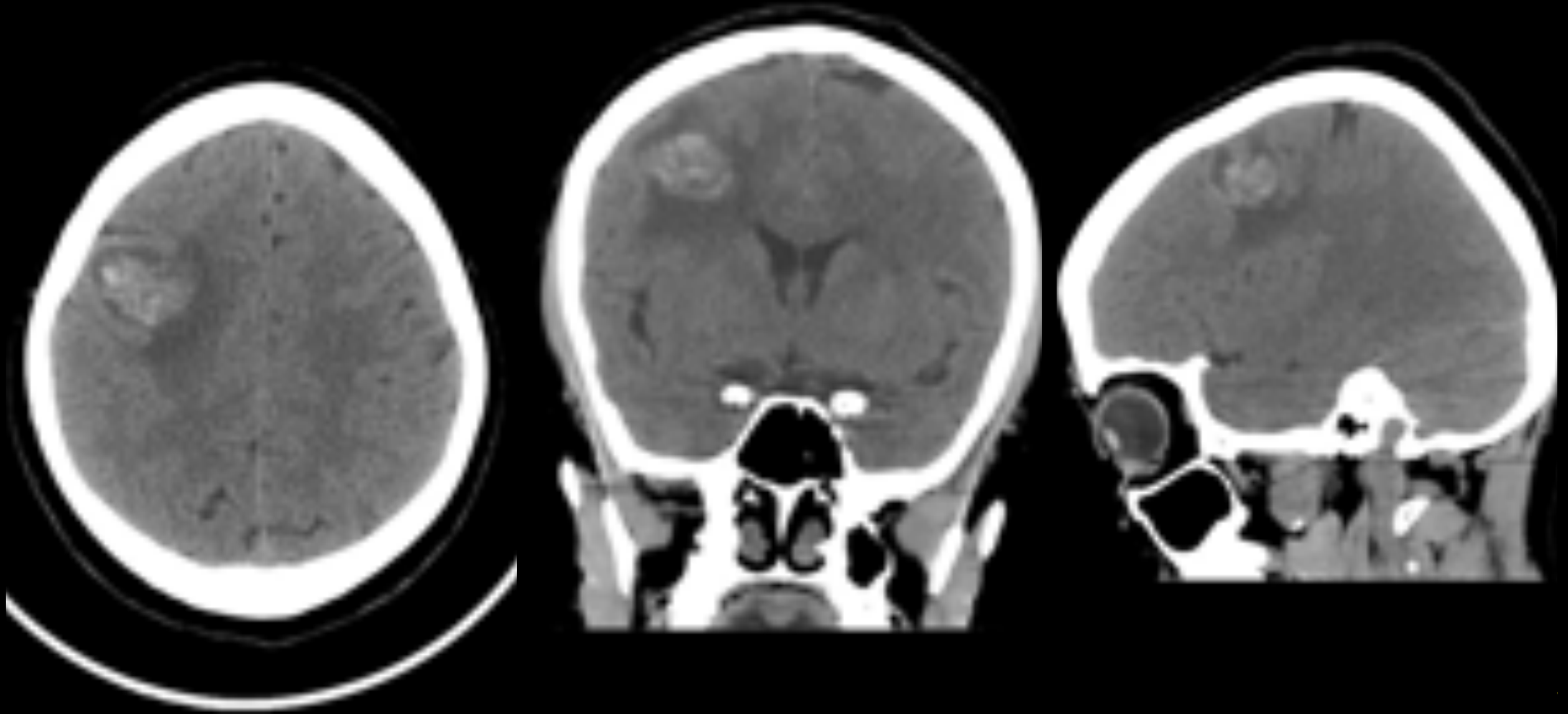

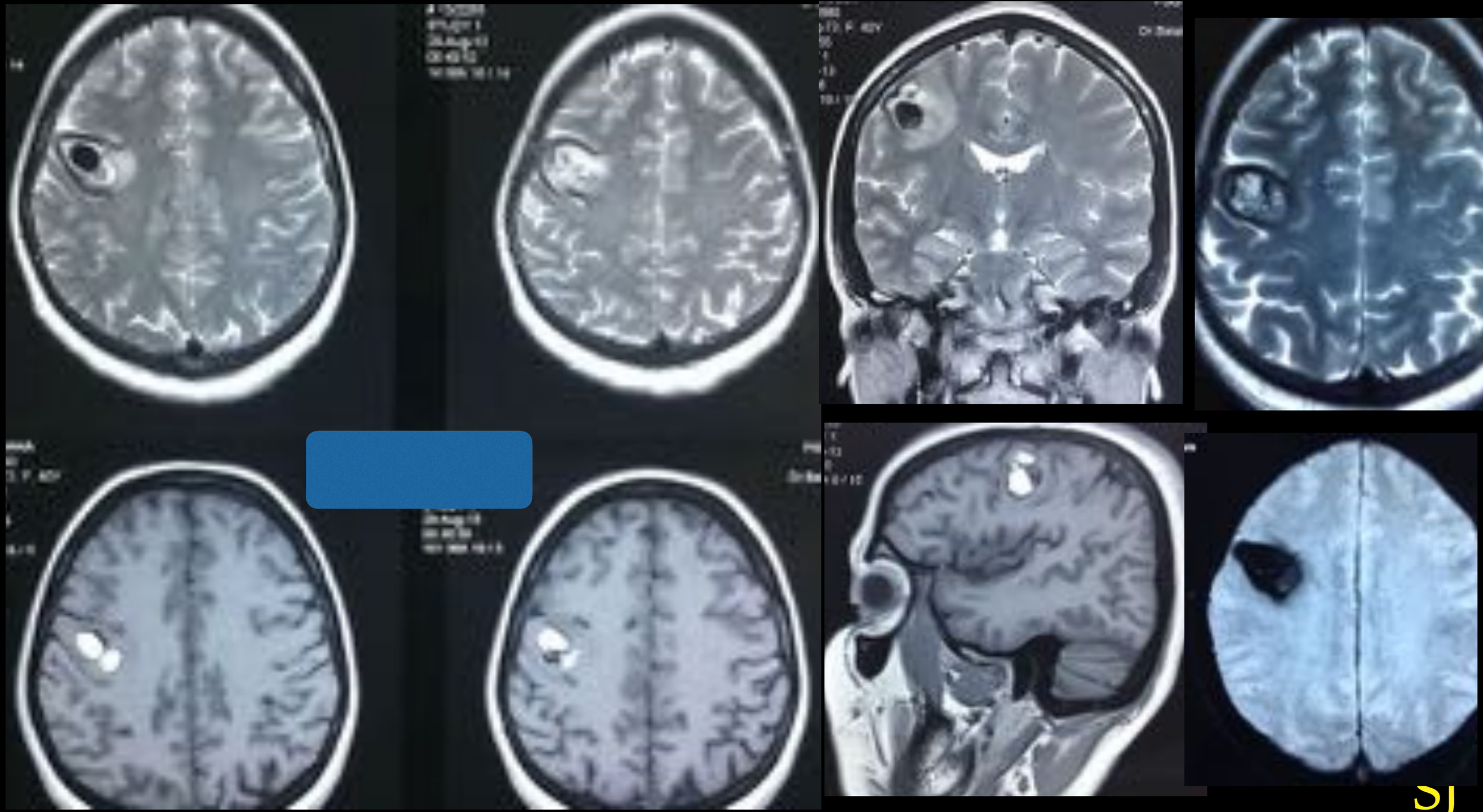

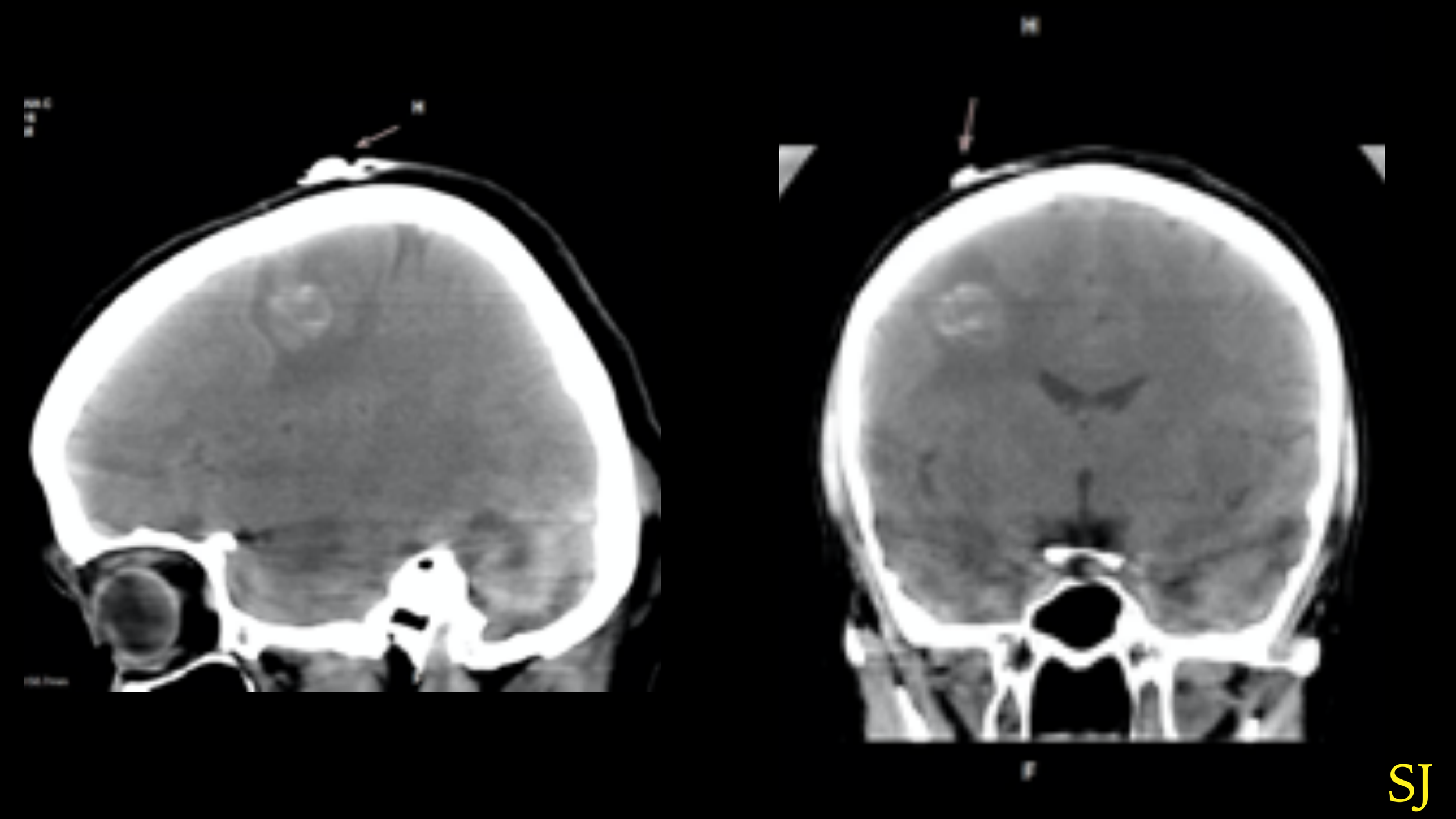

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Stereotactic guided craniotomy

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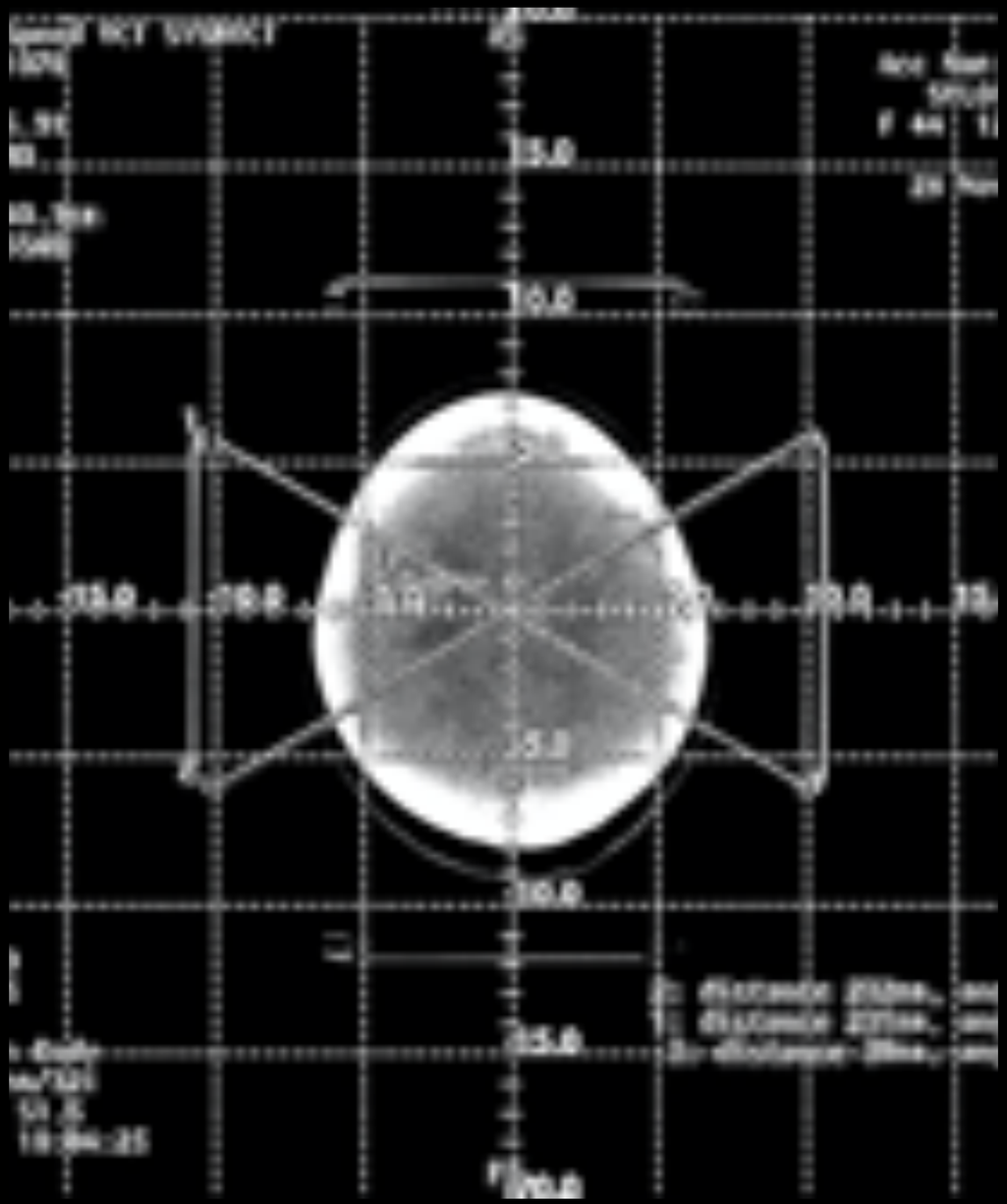

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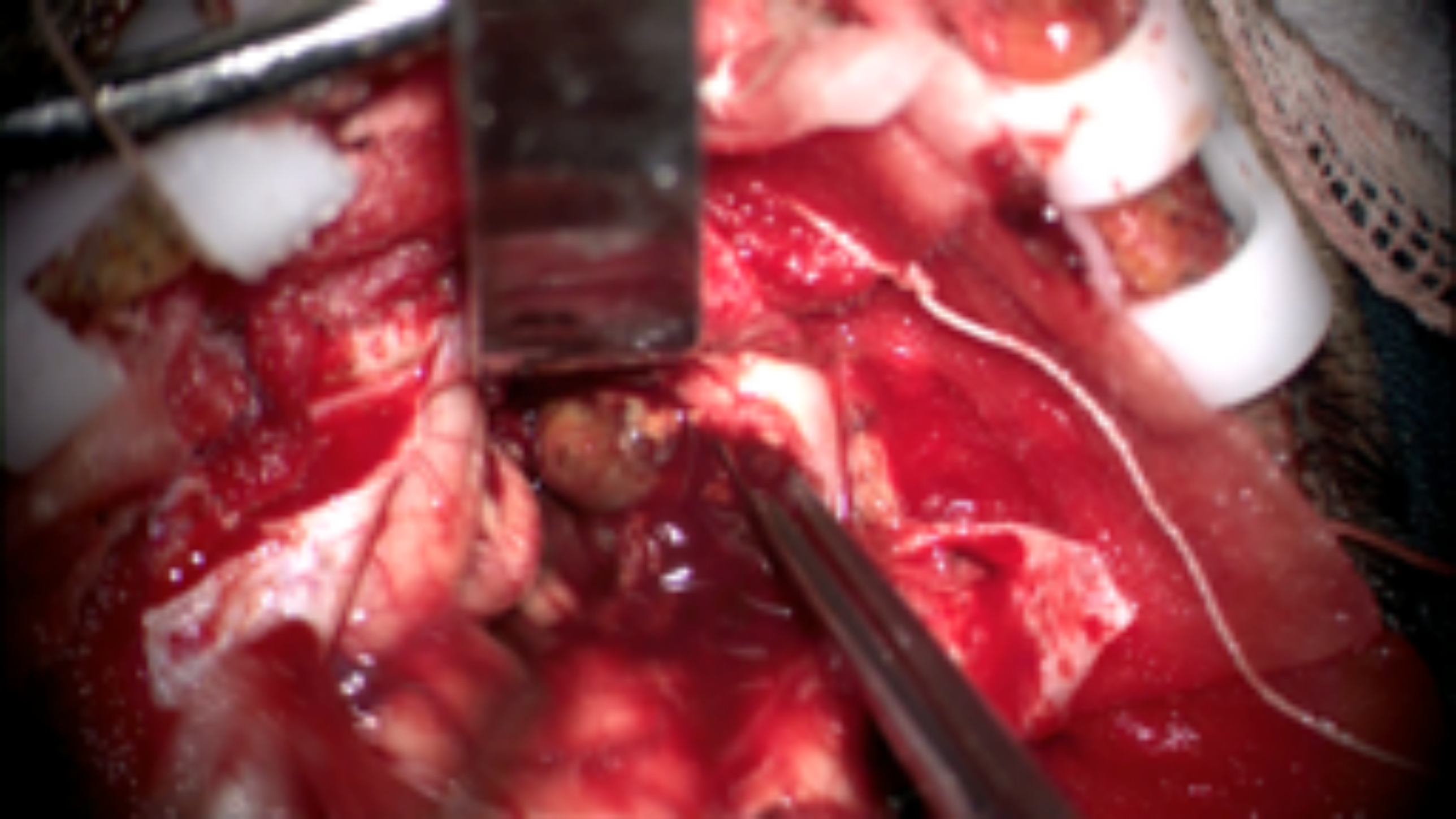

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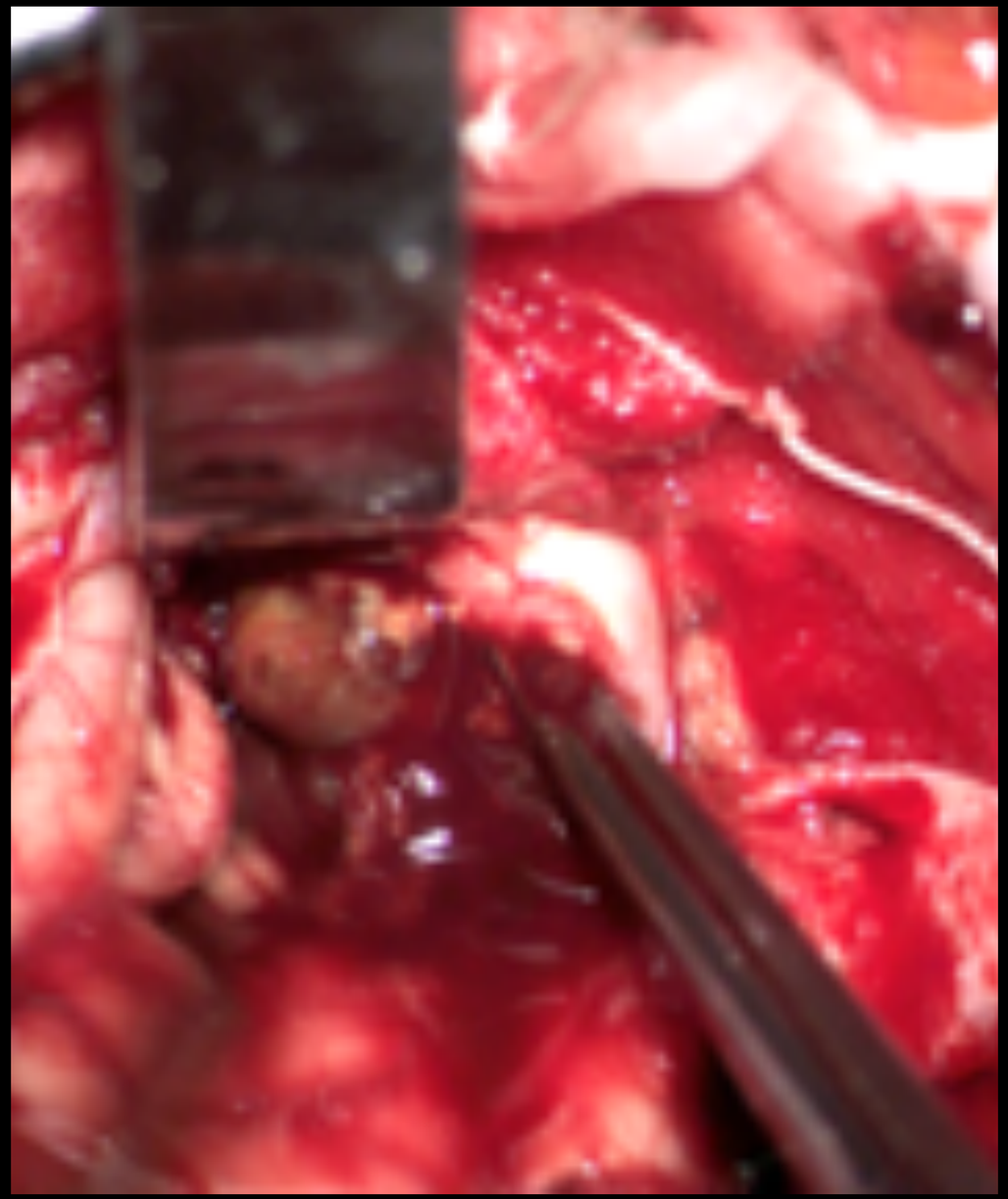

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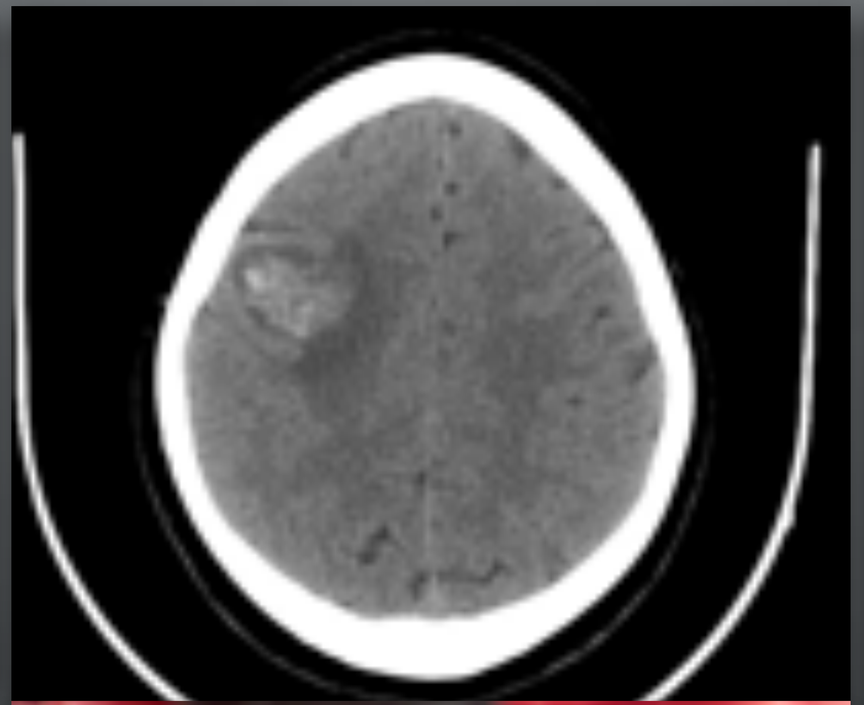
Pre op

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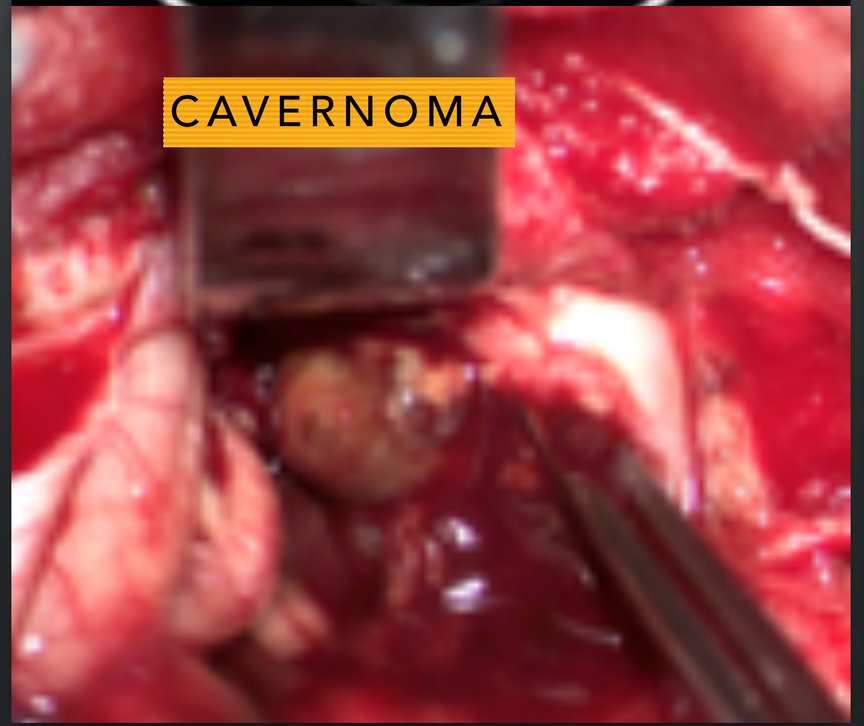
CAVERNOMA

Case Presentation

- 54 years old Lady
- Weakness of left Lower limb - ? Numbness or Dragging sensation for 1-2 weeks duration
- Known HT and Diabetic
- GCS 15, Left LL grade 4/5 power
- Extensively investigated: Spine

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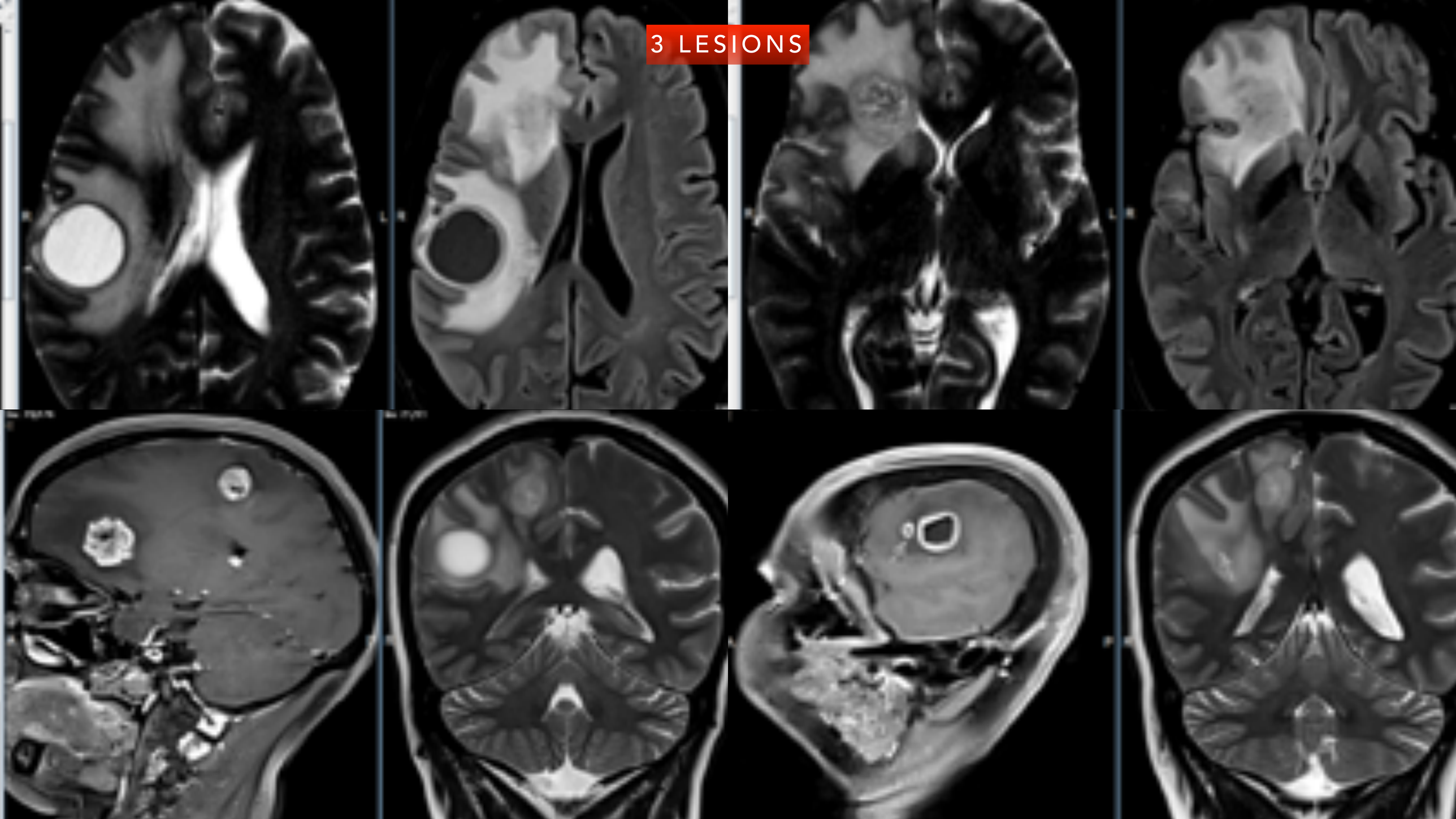
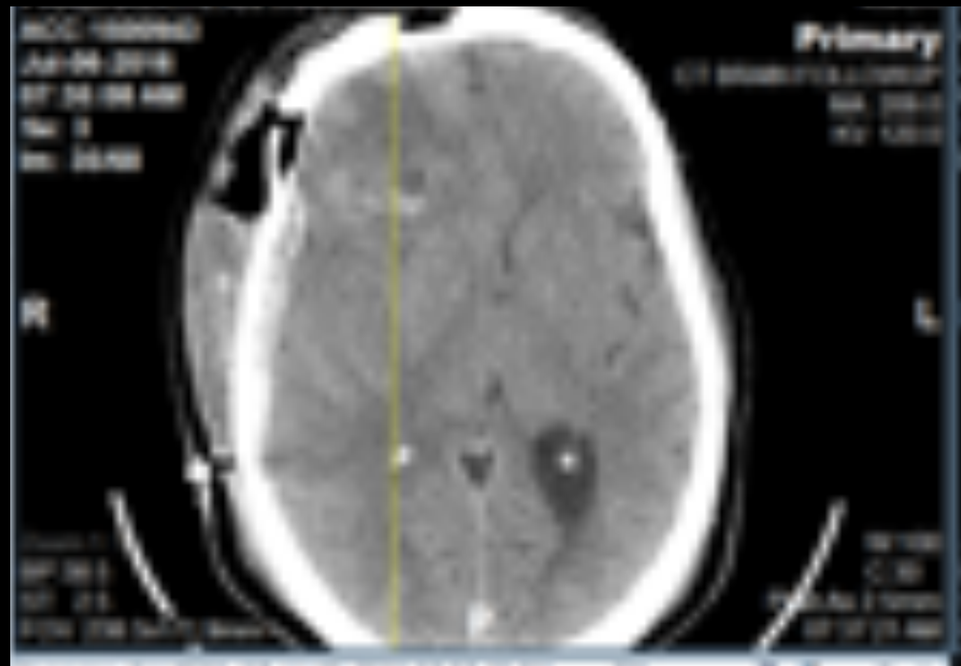

3 LESIONS


USG GUDED TUMOUR REMOVAL



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Histopathology

- Glioblastoma IDH 1 mutant
- WHO Grade 4 with intact ATRX gene

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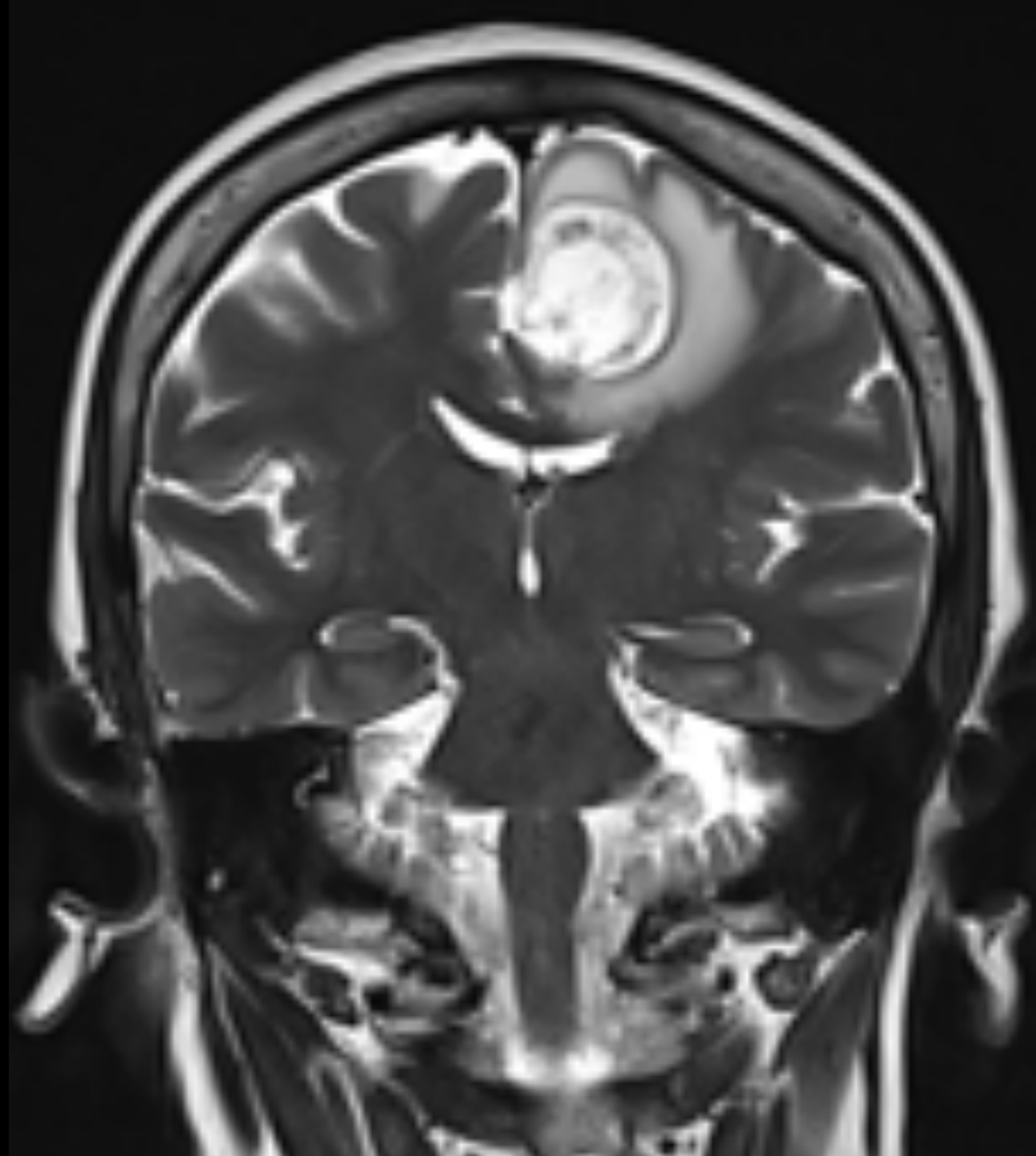
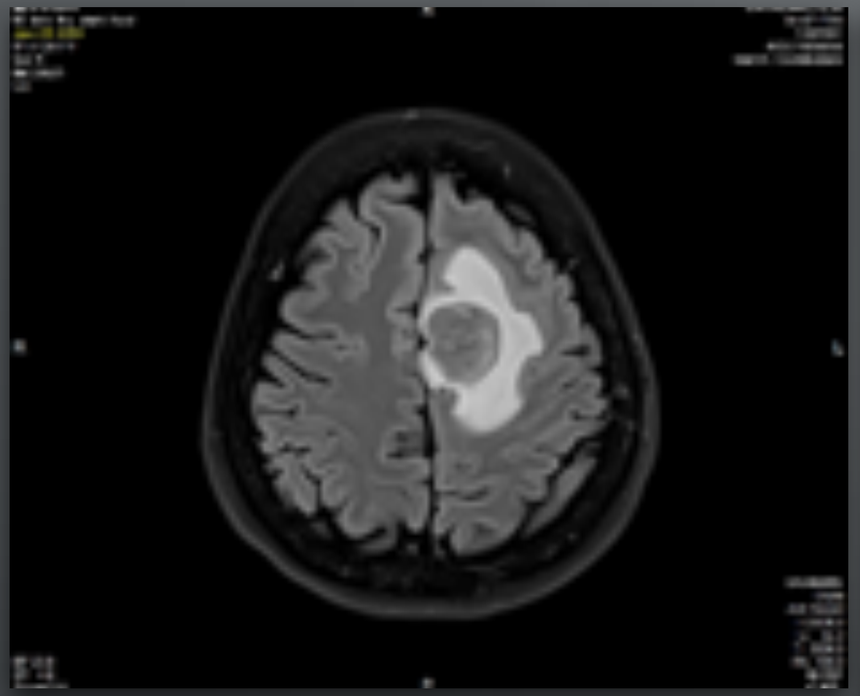
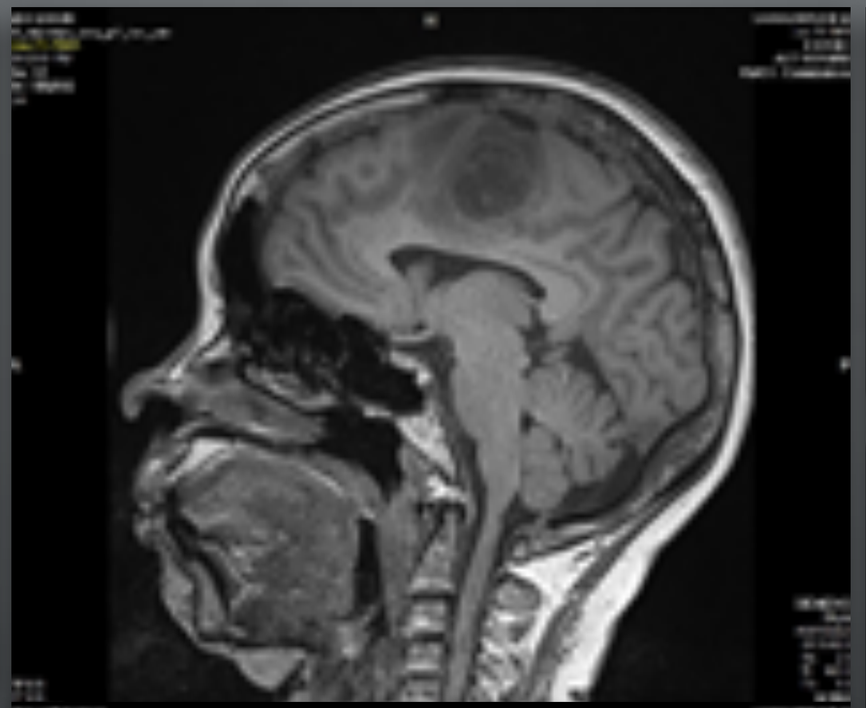
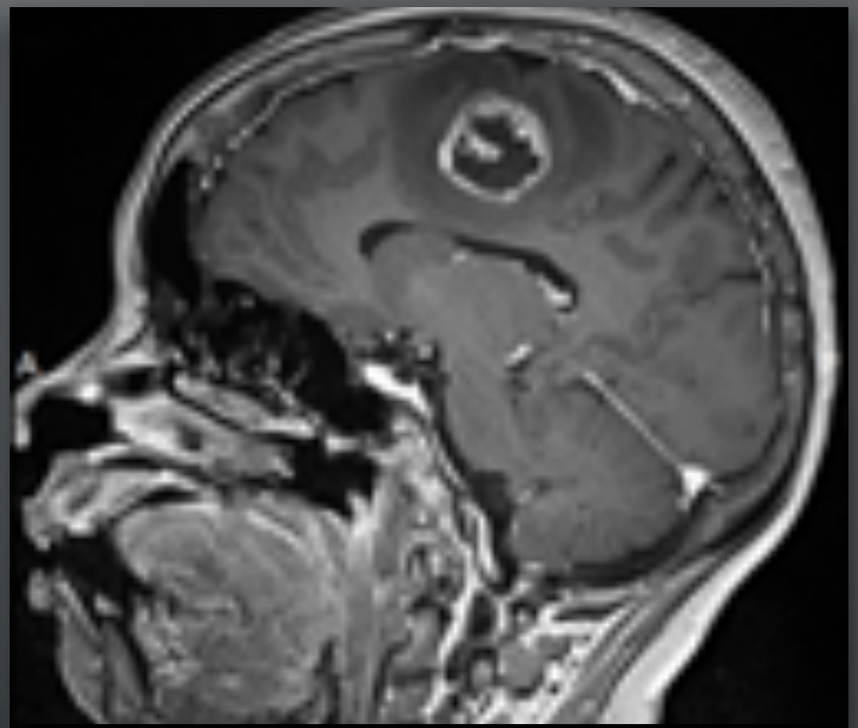
CLINICAL DETAILS

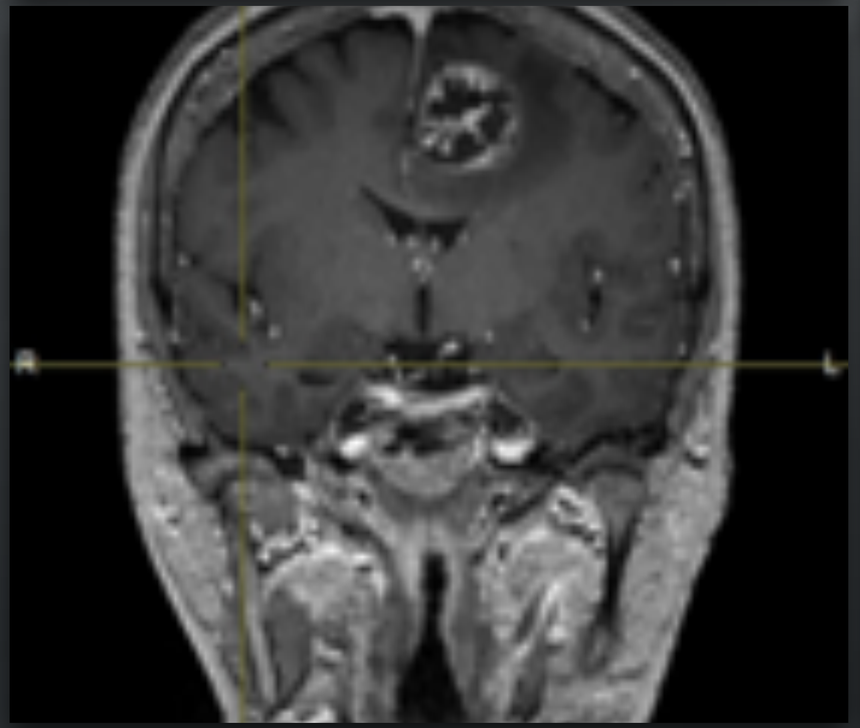
- 63 yrs Lady
- ICP features
- CT / MR Brain
- CXR & USG Abd : NAD

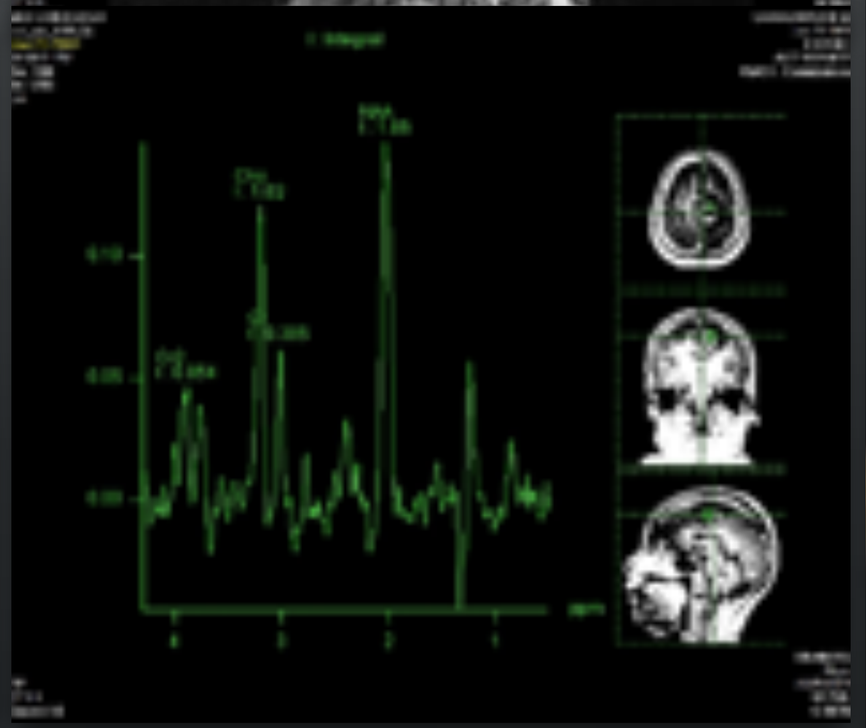


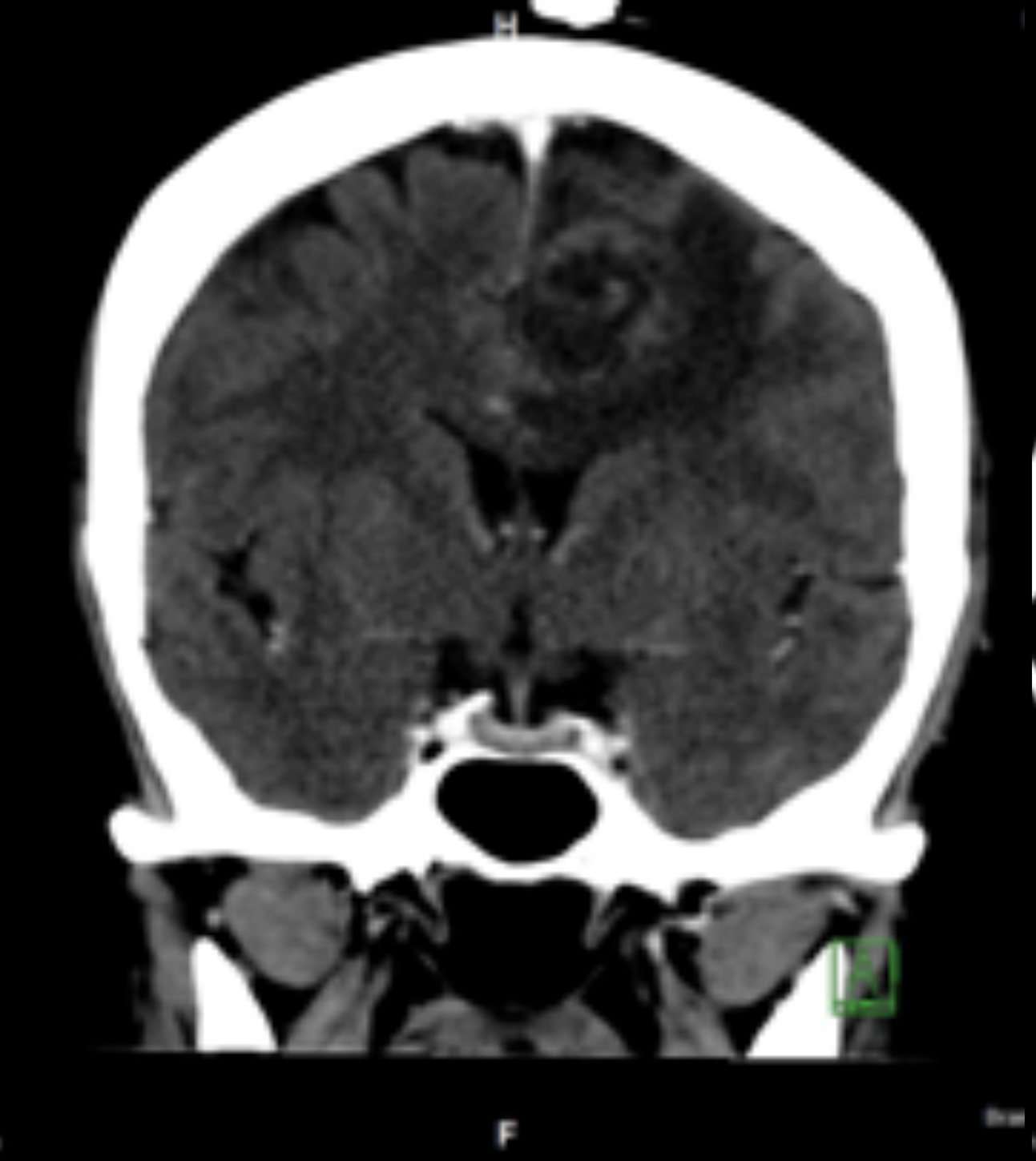








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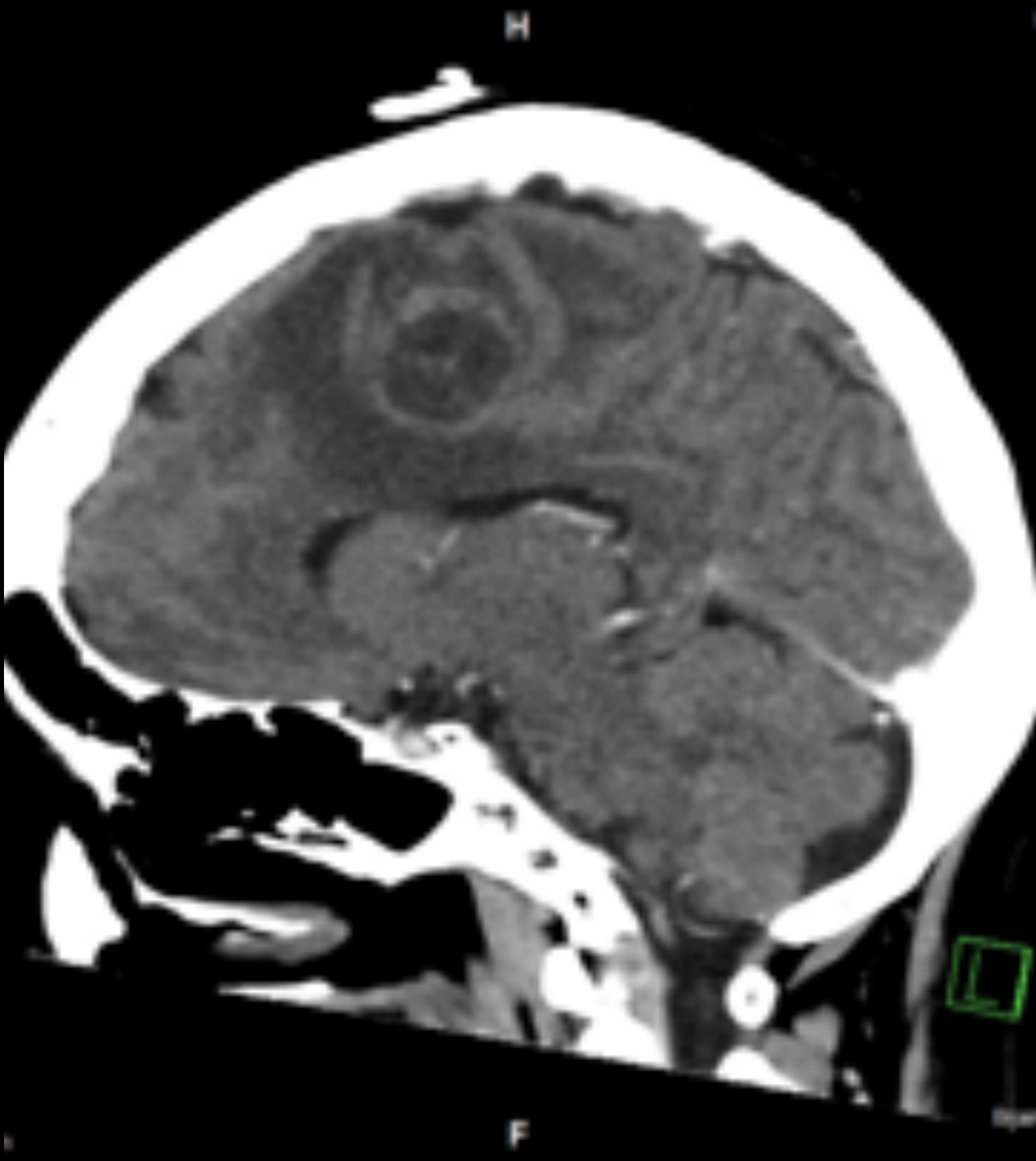
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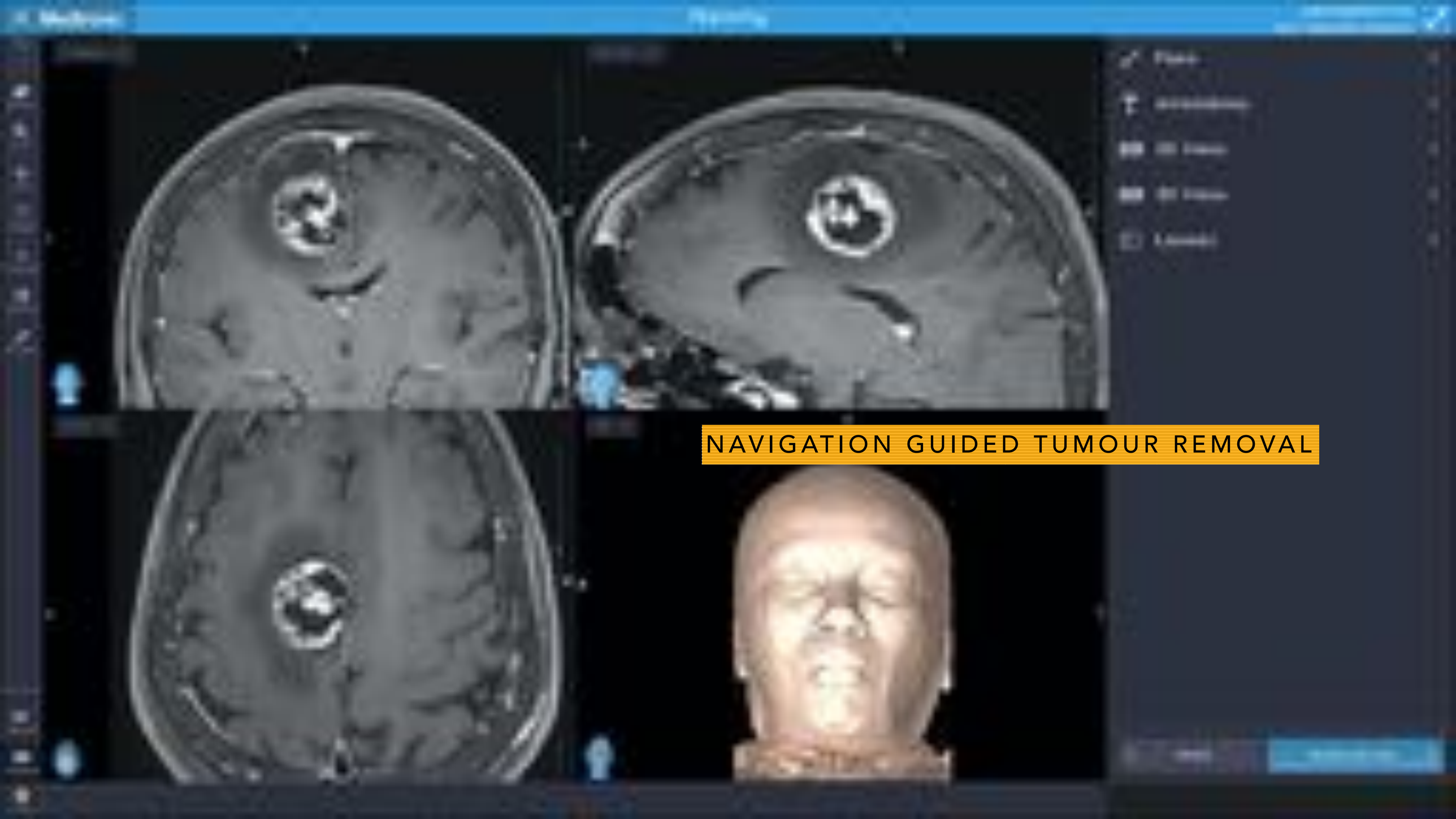
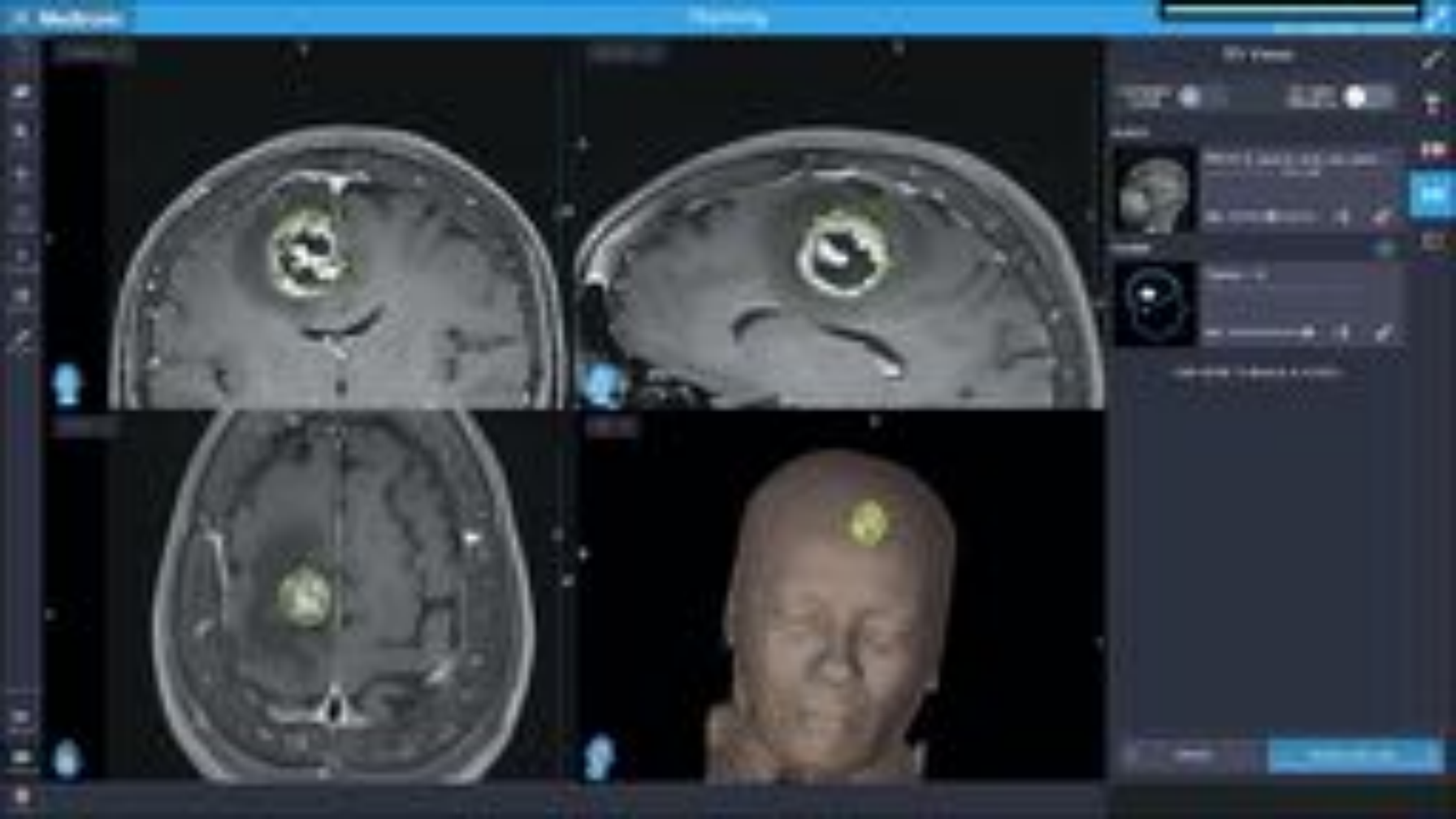
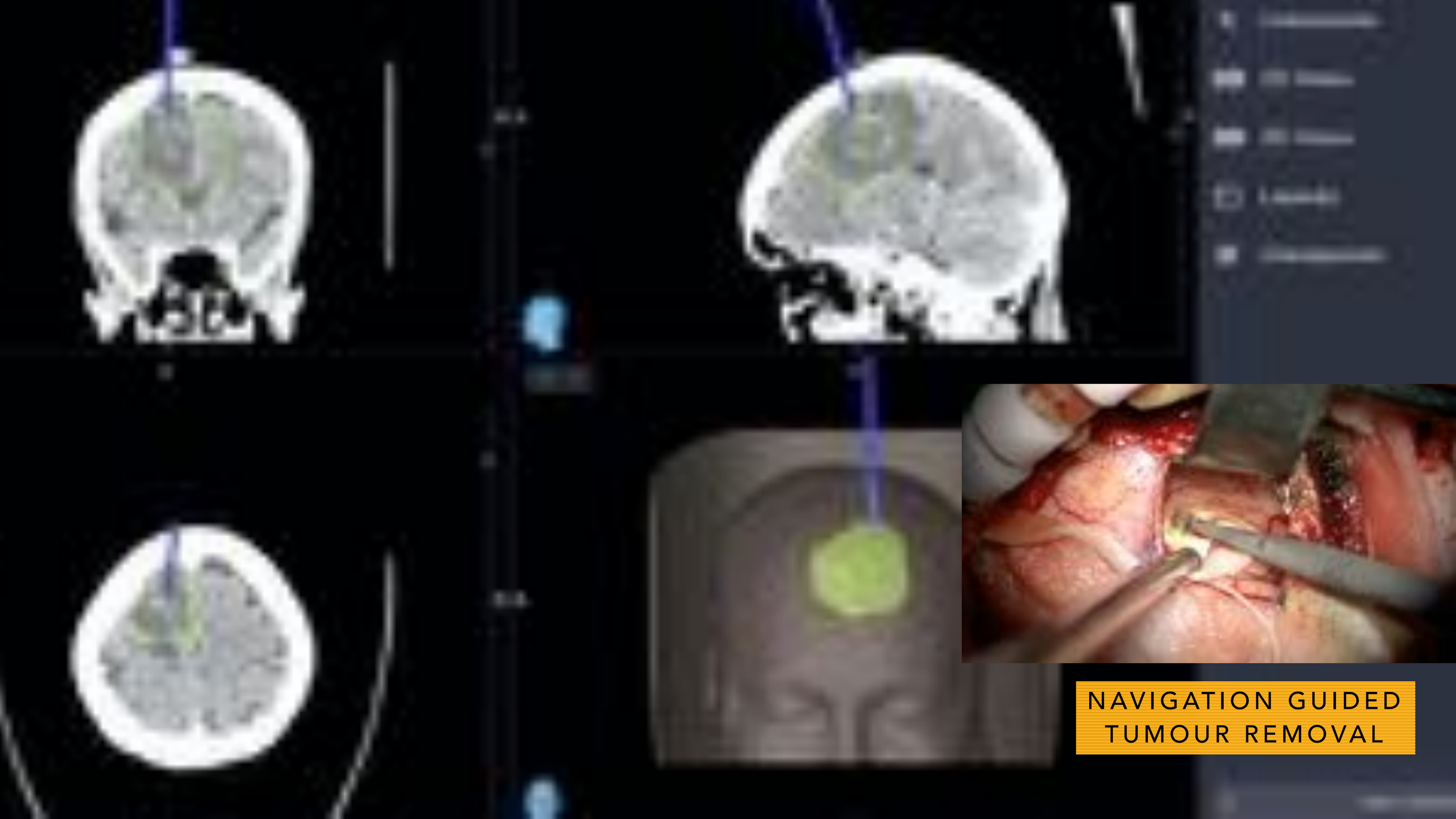

NAVIGATION GUIDED TUMOUR REMOVAL





NAVIGATION GUIDED
TUMOUR REMOVAL

Tools available to increase resection

- Intraoperative CT and MRI scan
- Intraoperative USG
- Navigation systems
- Cortical stimulation
- Fluorescence-guided resection

  Among these methods, fluorescence-guided resection has shown great promise because it allows intraoperative visualization of tumor boundaries.

DYES USED IN NEUROSURGERY

- 5 – ALA
- Indocyanine green
- Sodium fluorescein

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FL

- Sodium salt of fluorescein.
- Synthetic organic compound available as a dark orange,red powder slightly soluble in water and alcohol.
- Its molecular weight is 376.27.
- It was discovered by Adolf von Baeyer in 1871
- FL has been widely used as a fluorescent tracer in technical chemistry, microscopy, serology,and forensics.

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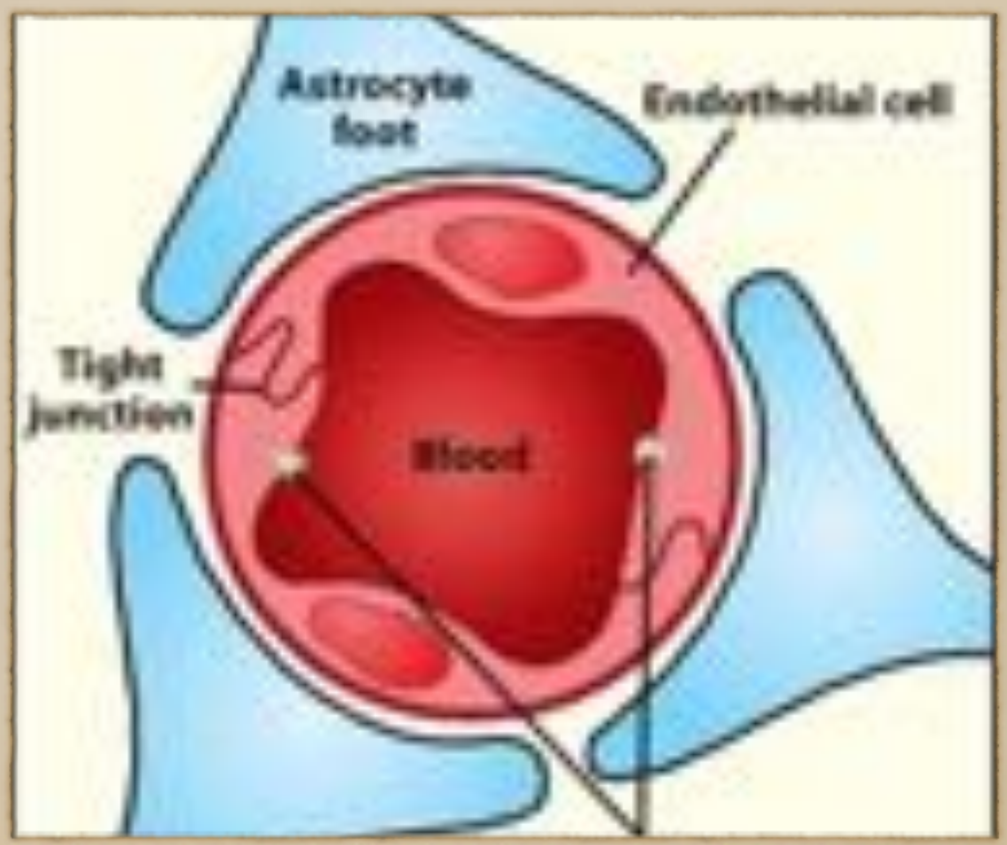
Blood-Brain Barrier (BBB) and Cerebral Lesions

- The blood-brain barrier is characterized by tight interendothelial cell junctions and adjacent astrocyte end feet separated by

  basal lamina surrounding the endothelium.



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BBB

- An intact BBB defends the central nervous system (CNS) from intrusion of foreign substances and maintains CNS homeostasis, including ionic and fluid balances.

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- Balance of this microenvironment is disrupted by cerebral lesions such as gliomas

- The disturbance of the integrity leads

  to <u>increased vascular permeability and leakage of fluid</u> into the brain parenchyma which results in high pressure and brain edema.

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Table 4A: High Dose and White Light

Authors	Year	No. of patients	Dose of FL	Tumor entity	GTR or complete resection
Shinoda et al.	2003	105	20 mg/kg	HGG (WHO IV)	84.4%
Koc et al.	2008	80	20 mg/kg	HGG (WHO IV)	83.0%
Okuda et al.	2010	36	20 mg/kg	CM	96.1%
da Silva et al.	2010	4	1000 mg	skull base tumors	100%
Chen et al.	2012	22	15-20 mg/kg	LGG, HGG (WHO II-IV)	80.0%
Liu et al.	2013	80	n/a	LGG, HGG (WHO I-IV)	80.4%
da Silva et al.	2014	5	1000 mg	Meningiomas	100%

HGG: High grade glioma, LGG: Low grade glioma, CM: Cerebral metastases, GTR: Gross total resection, FL: Fluorescein sodium

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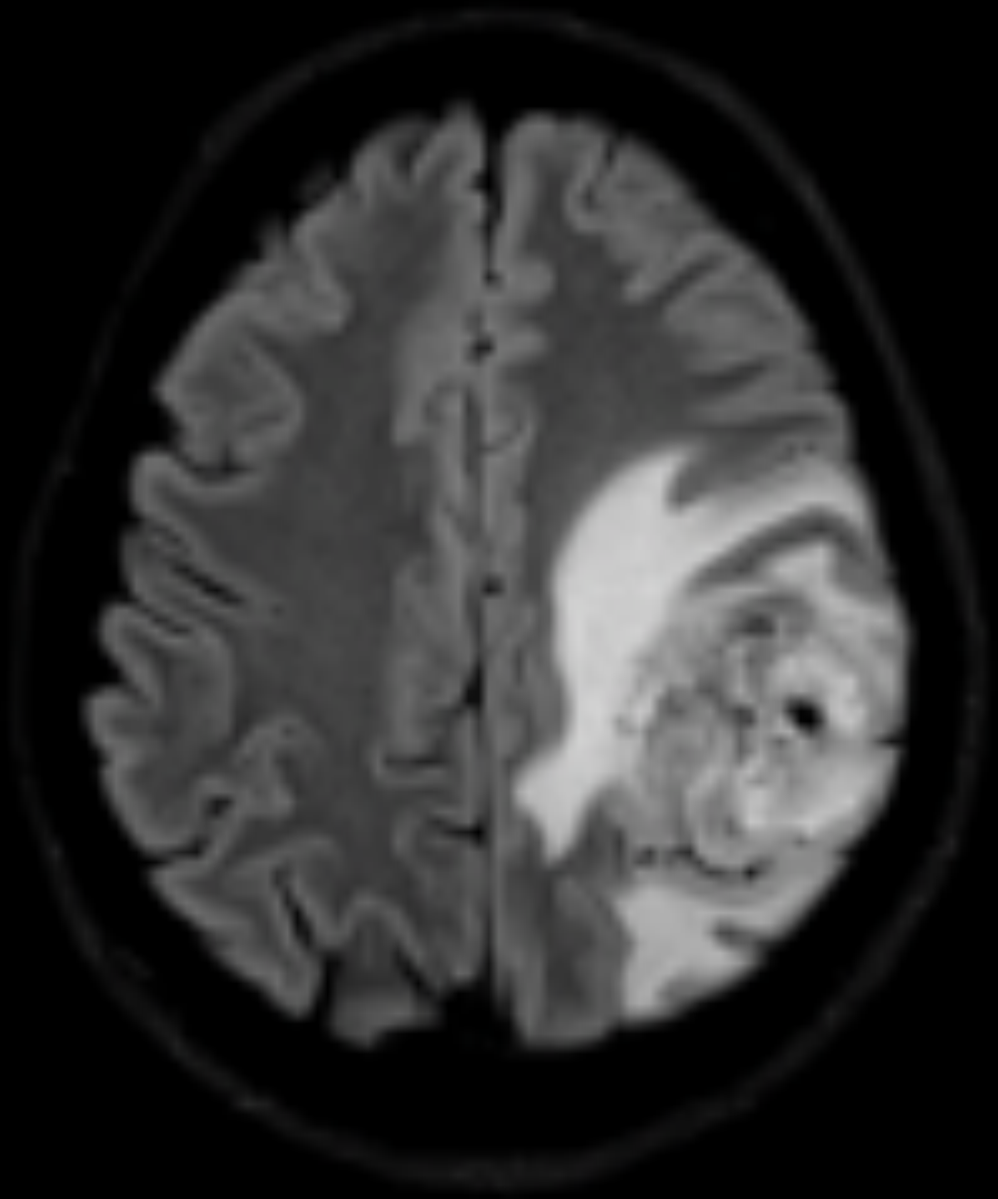
Case Presentation

43 yrs old Lady - 1 month history

Headache and Vomiting

ICP features

Focal Seizures [Right UL]



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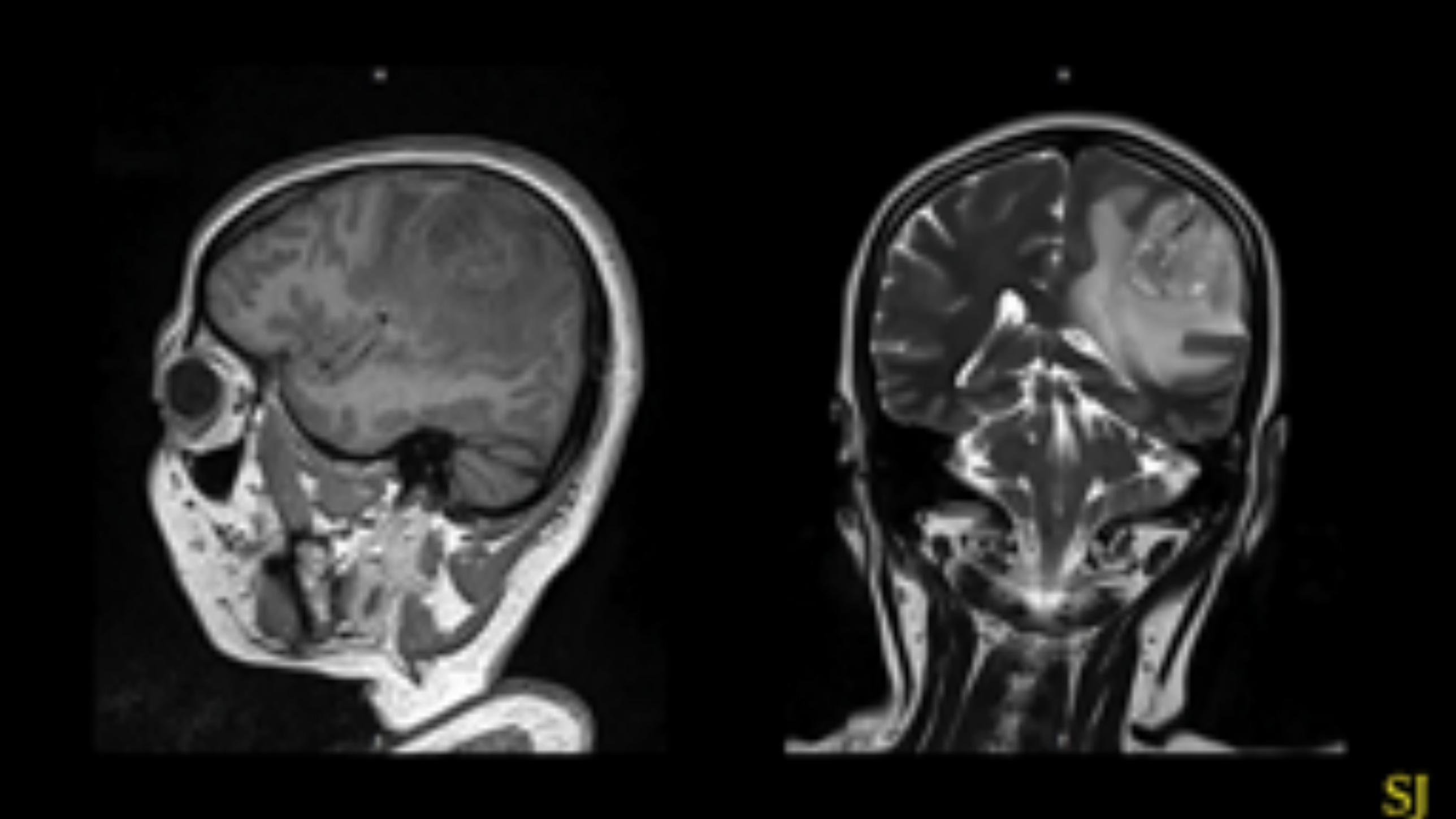

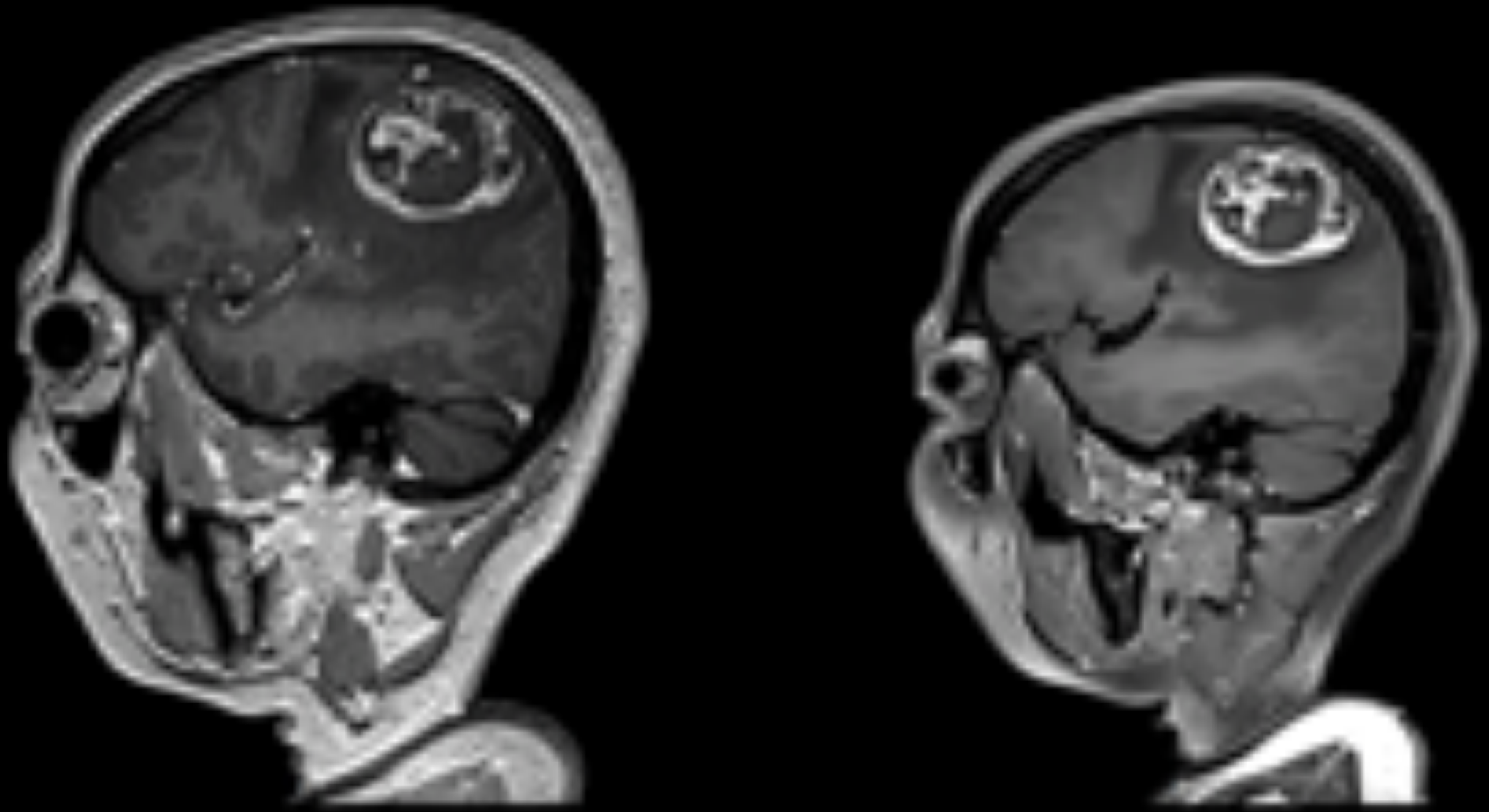


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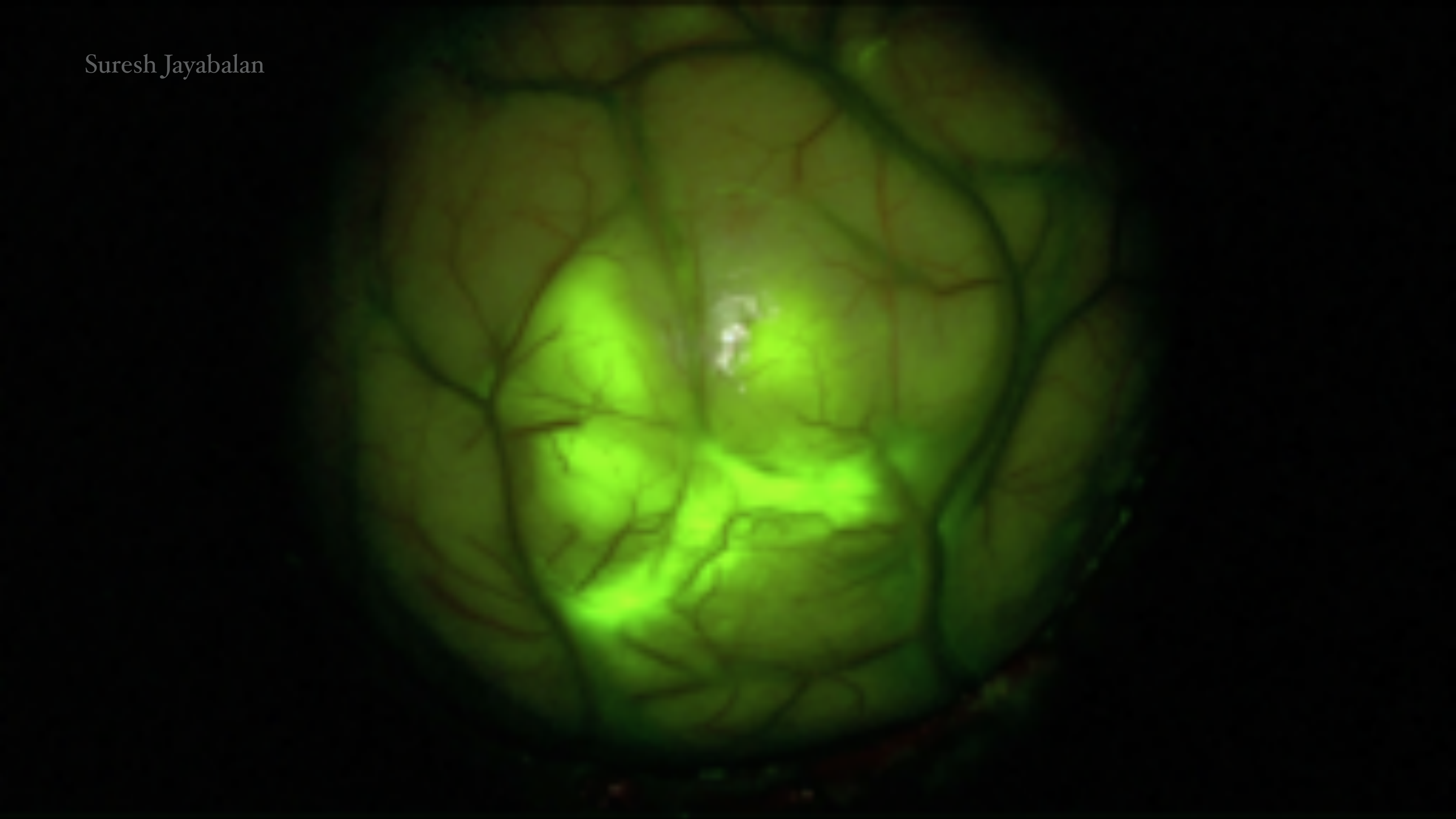
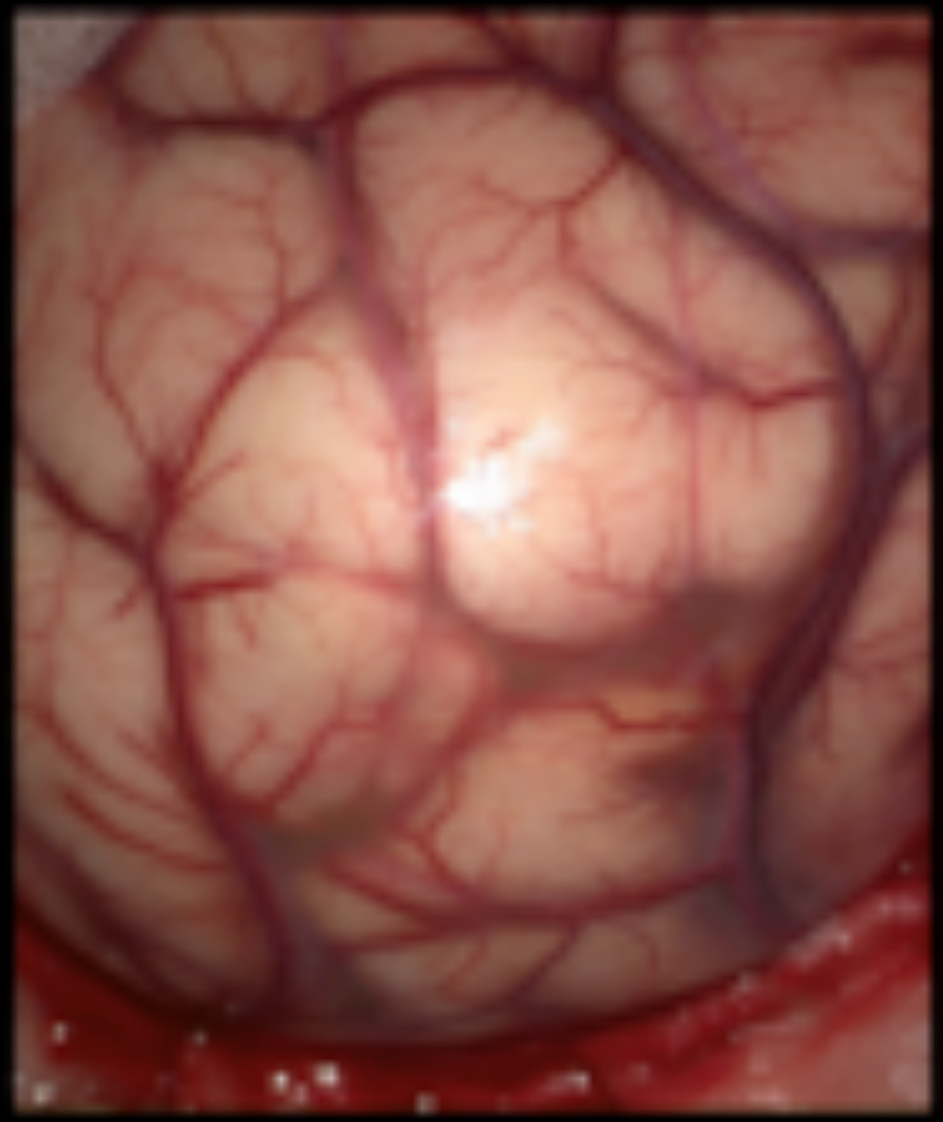
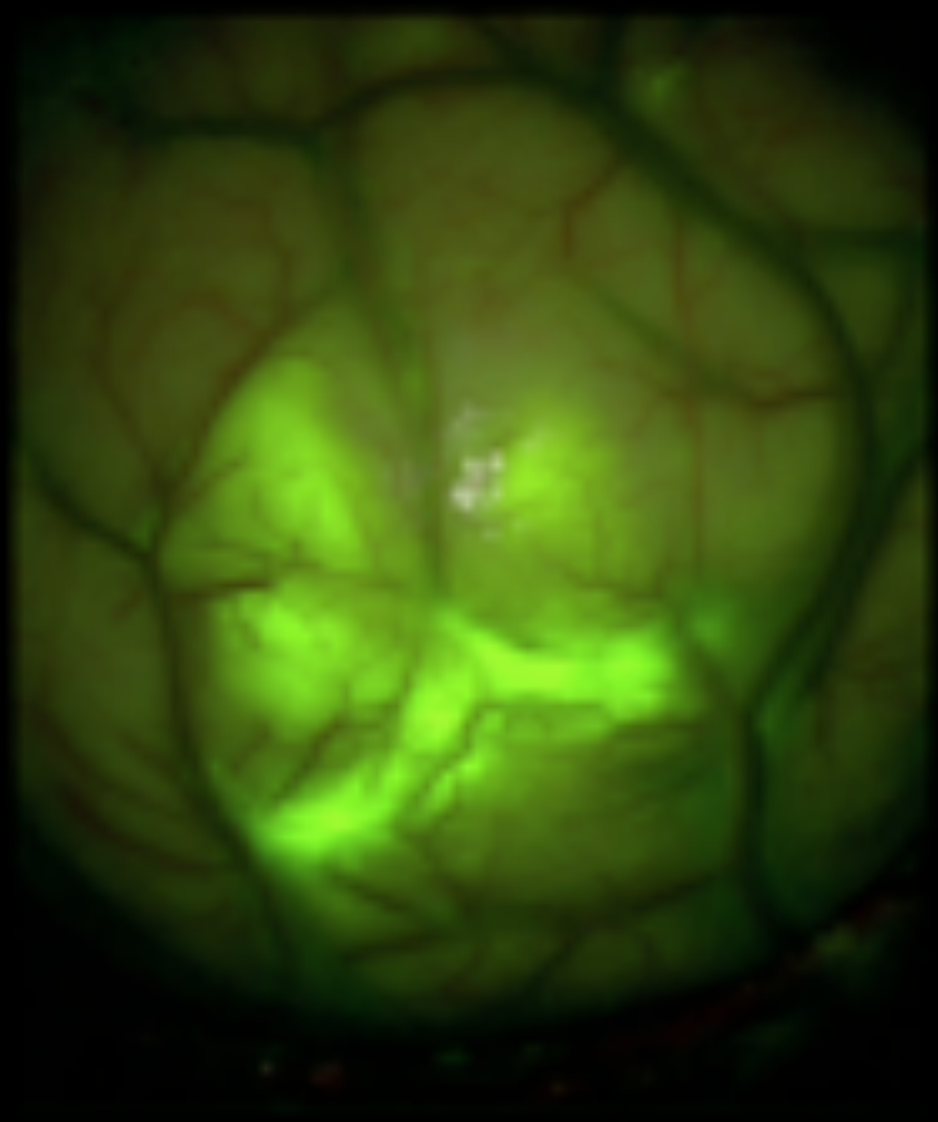
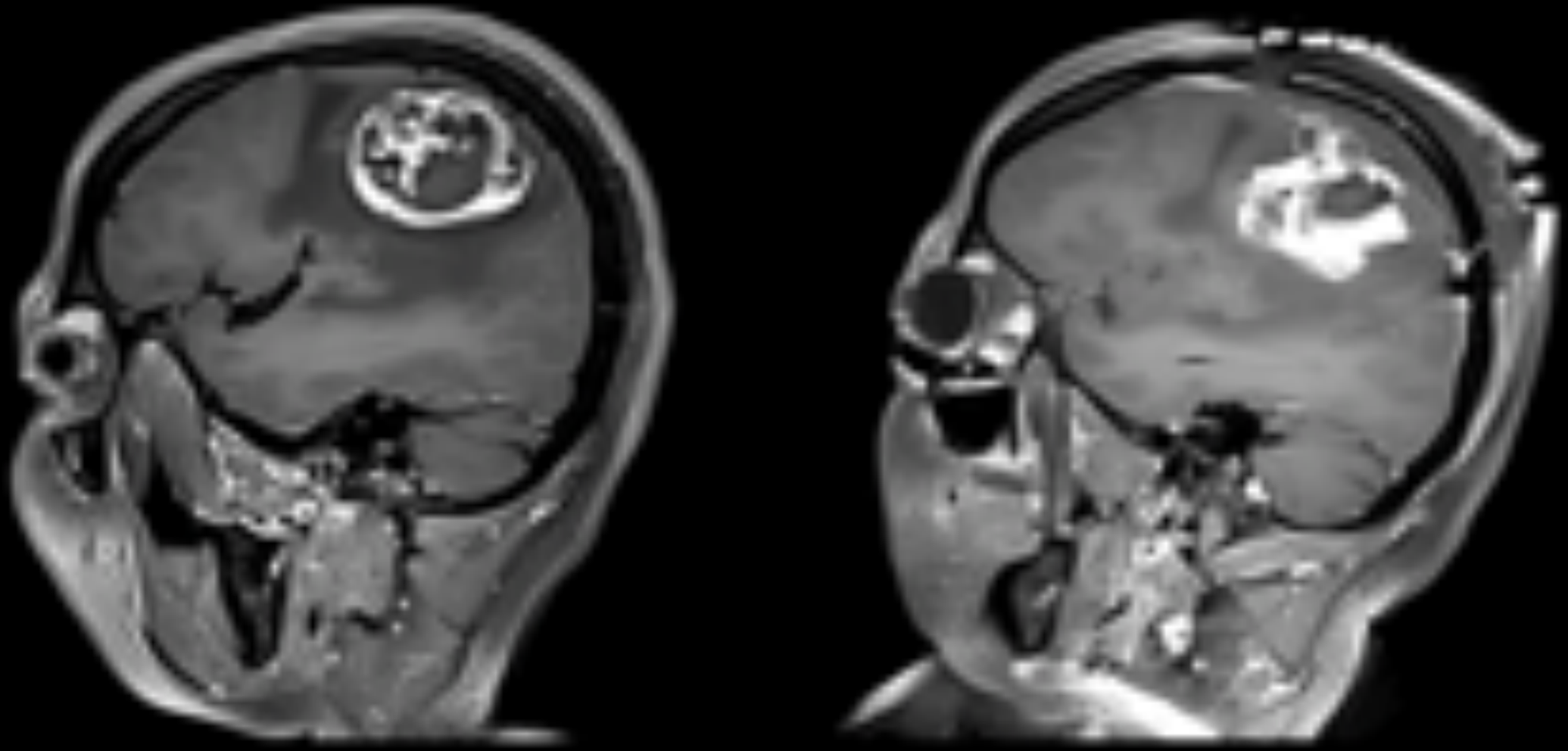


VIDEO





Pre Op & Post Op



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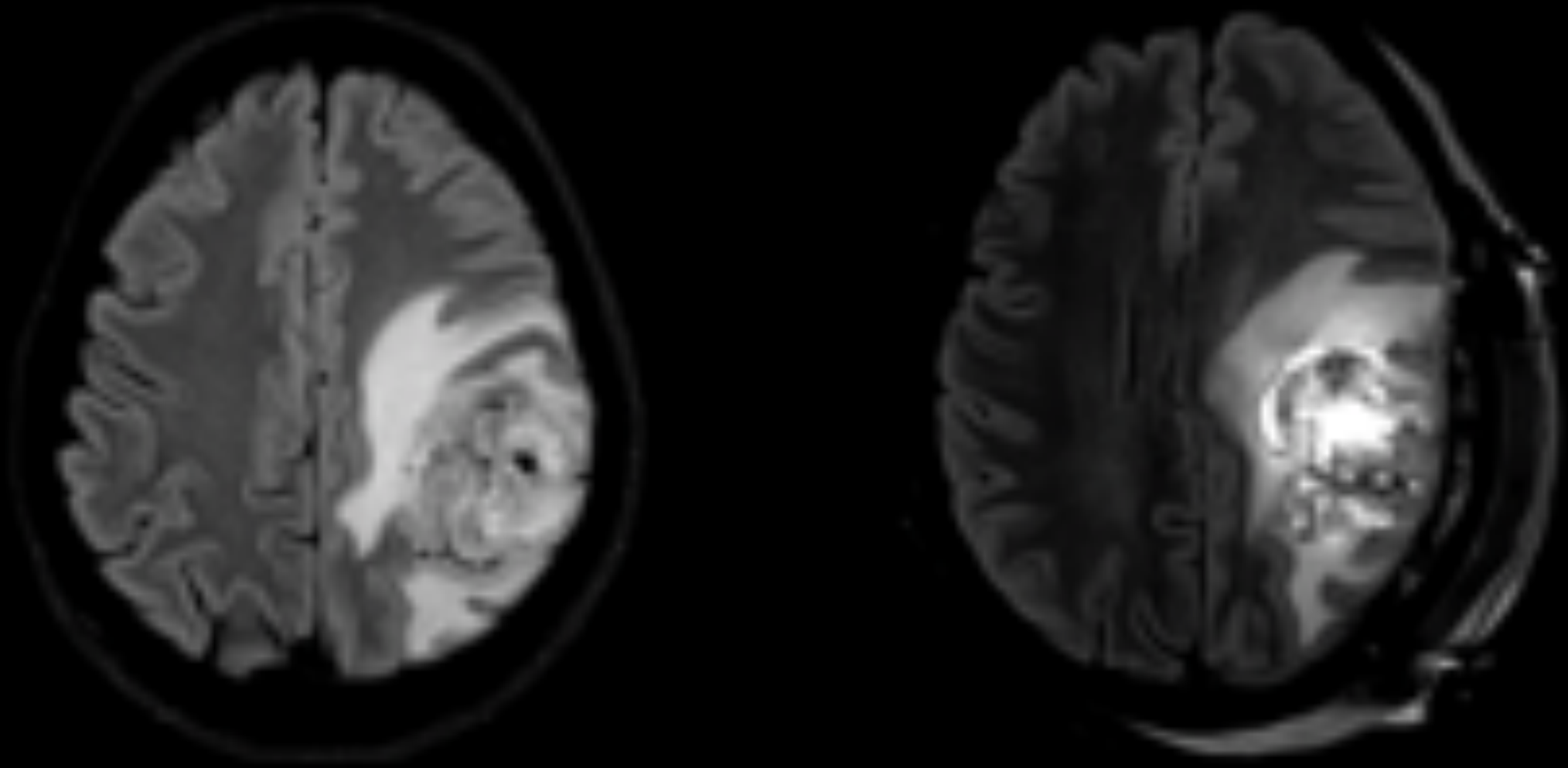
T2 trim



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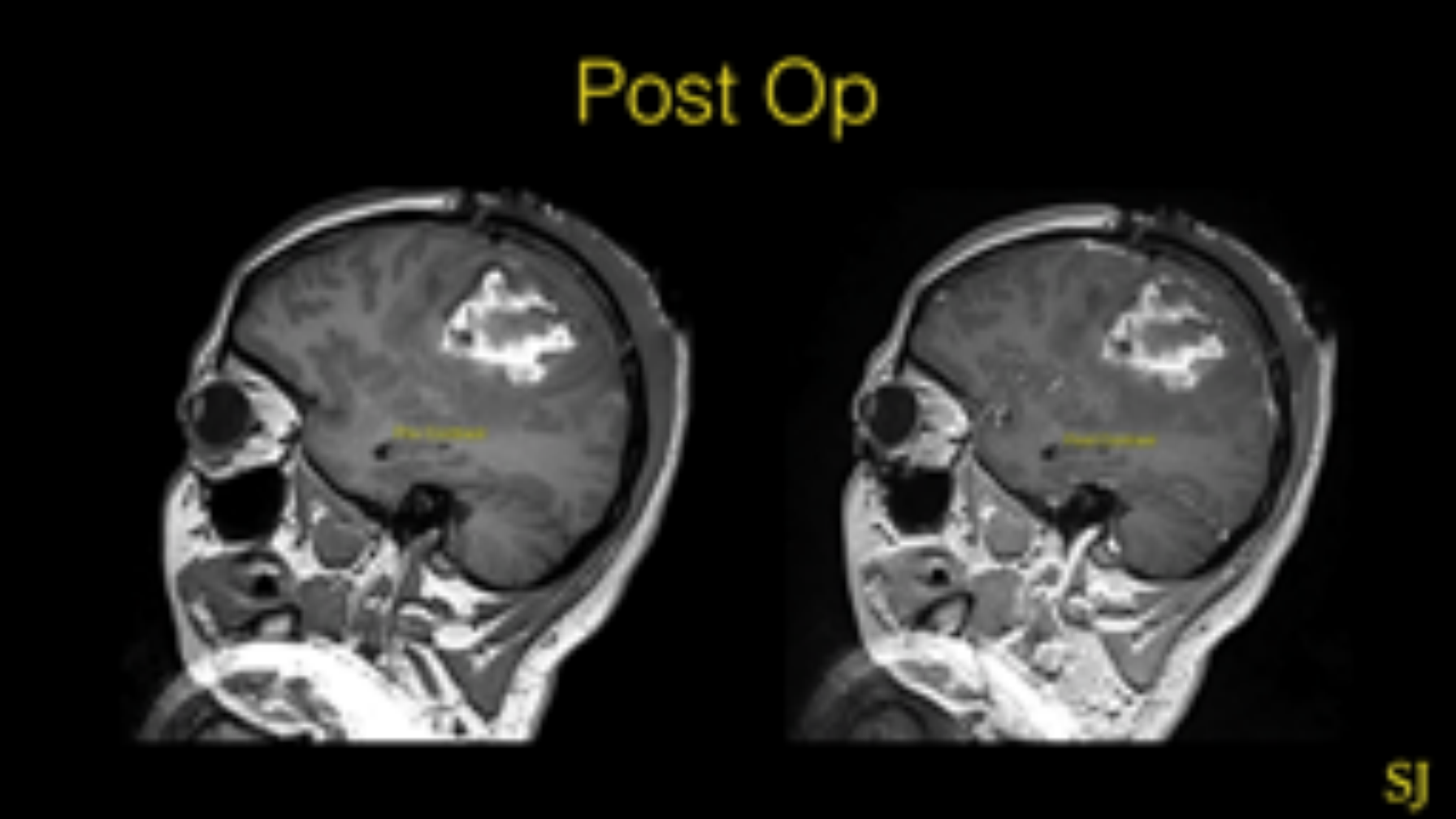
Post Op



Case Presentation

- 53 yrs old Lady
- left Hemiparesis & Altered sensorium
- Diagnosed as Lymphoma Brain with imaging and treated accordingly elsewhere

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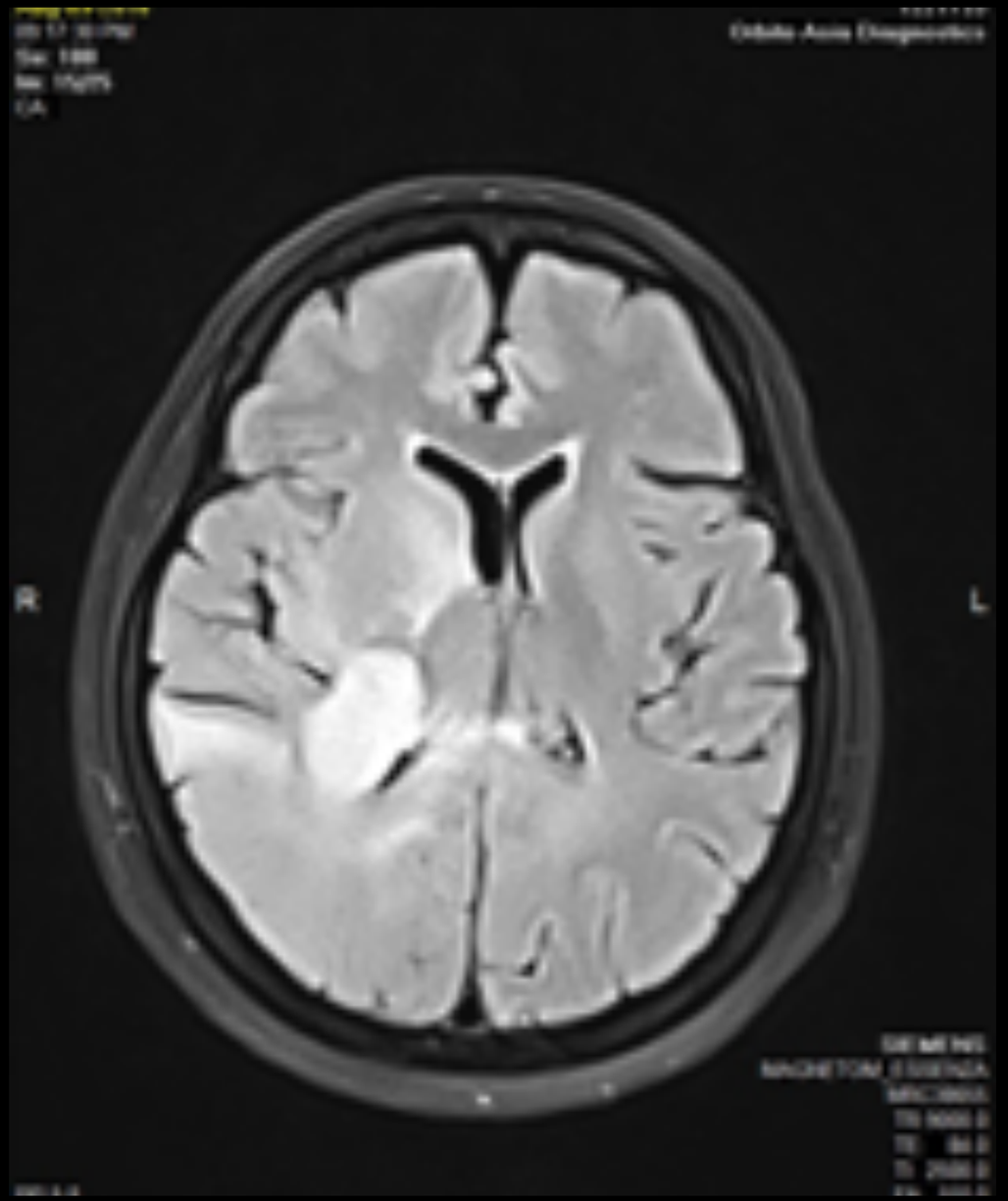

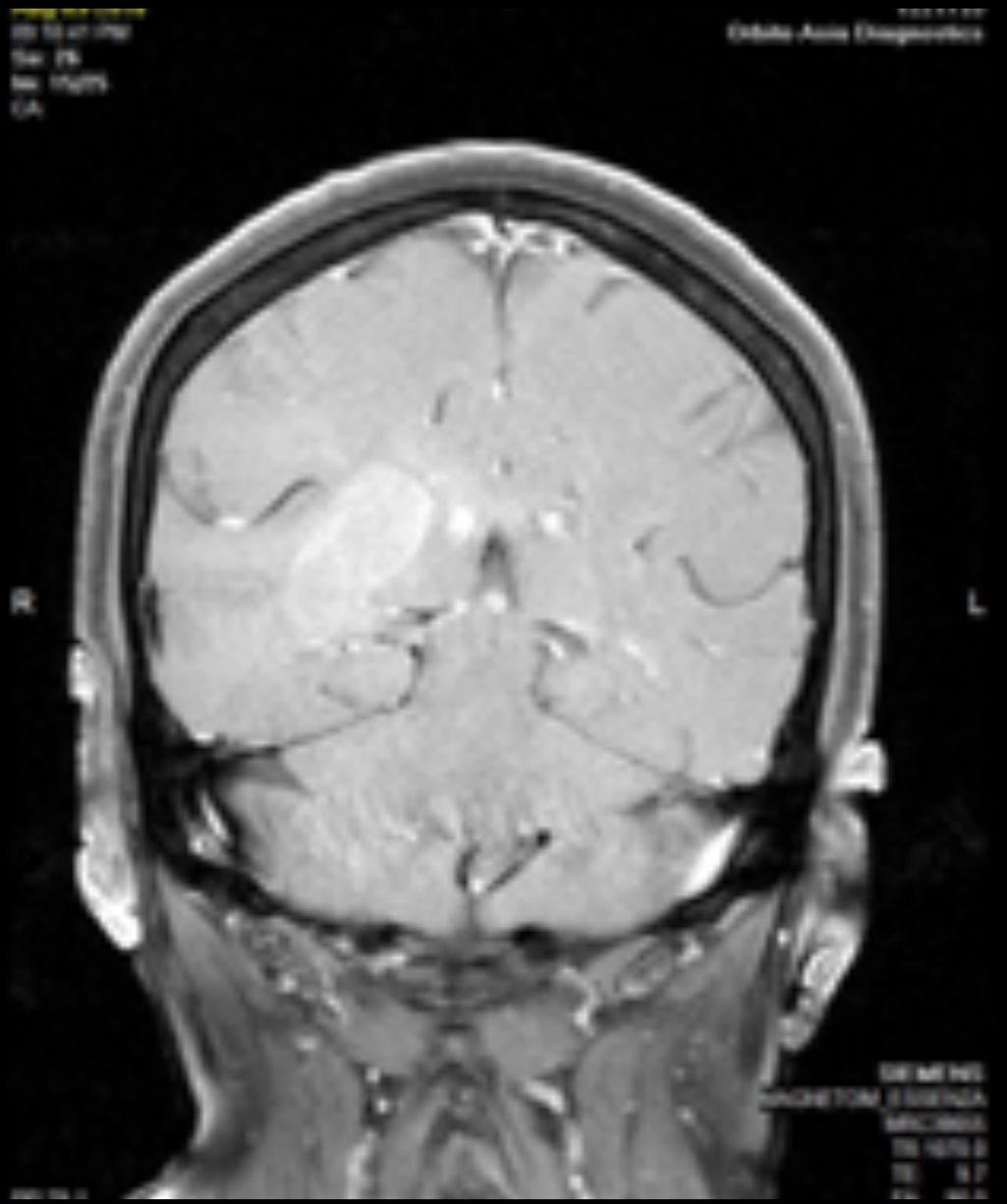

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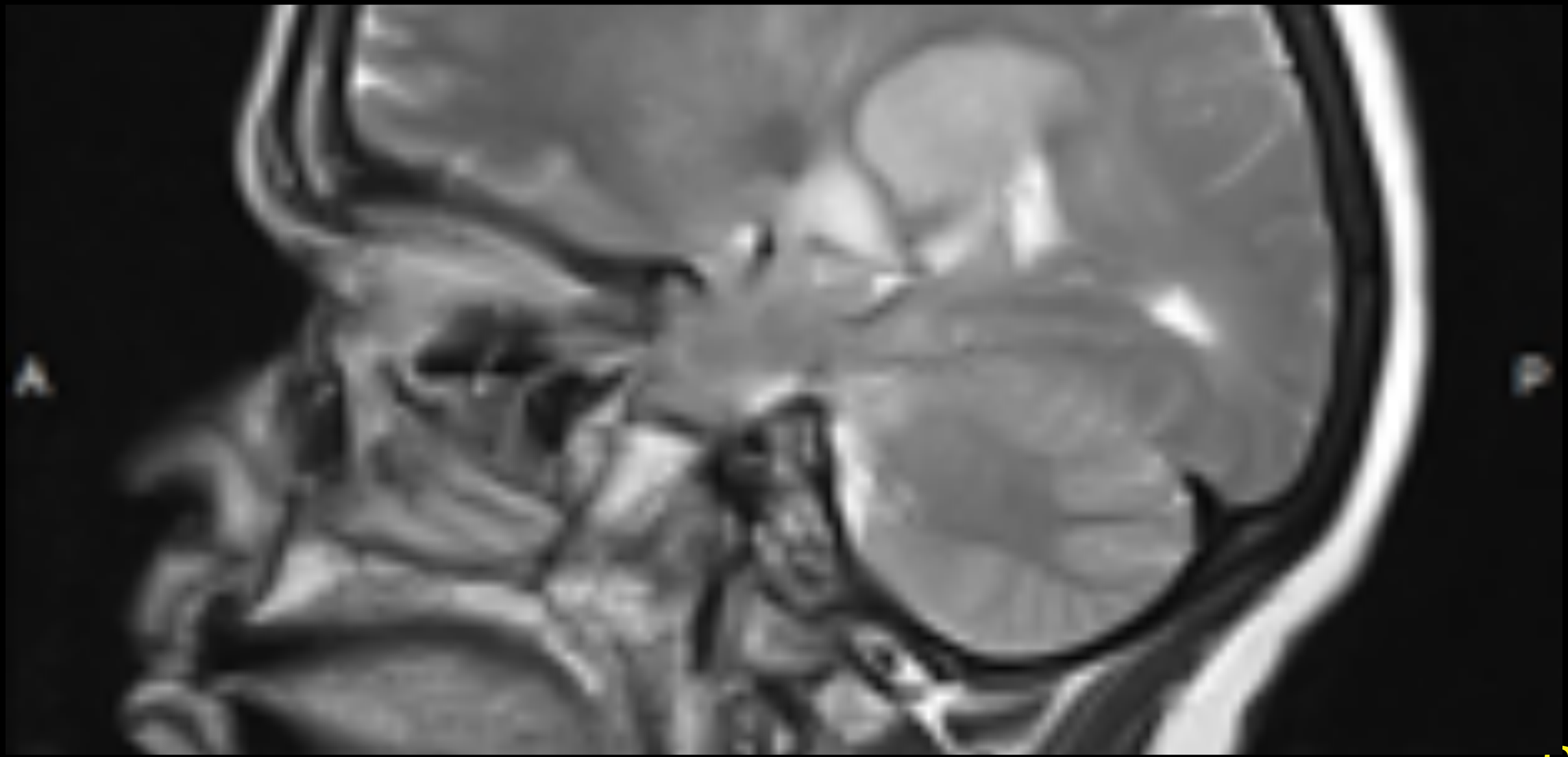
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Diagnosis ???

Biopsy

**Stereotactic Guided

**Navigation

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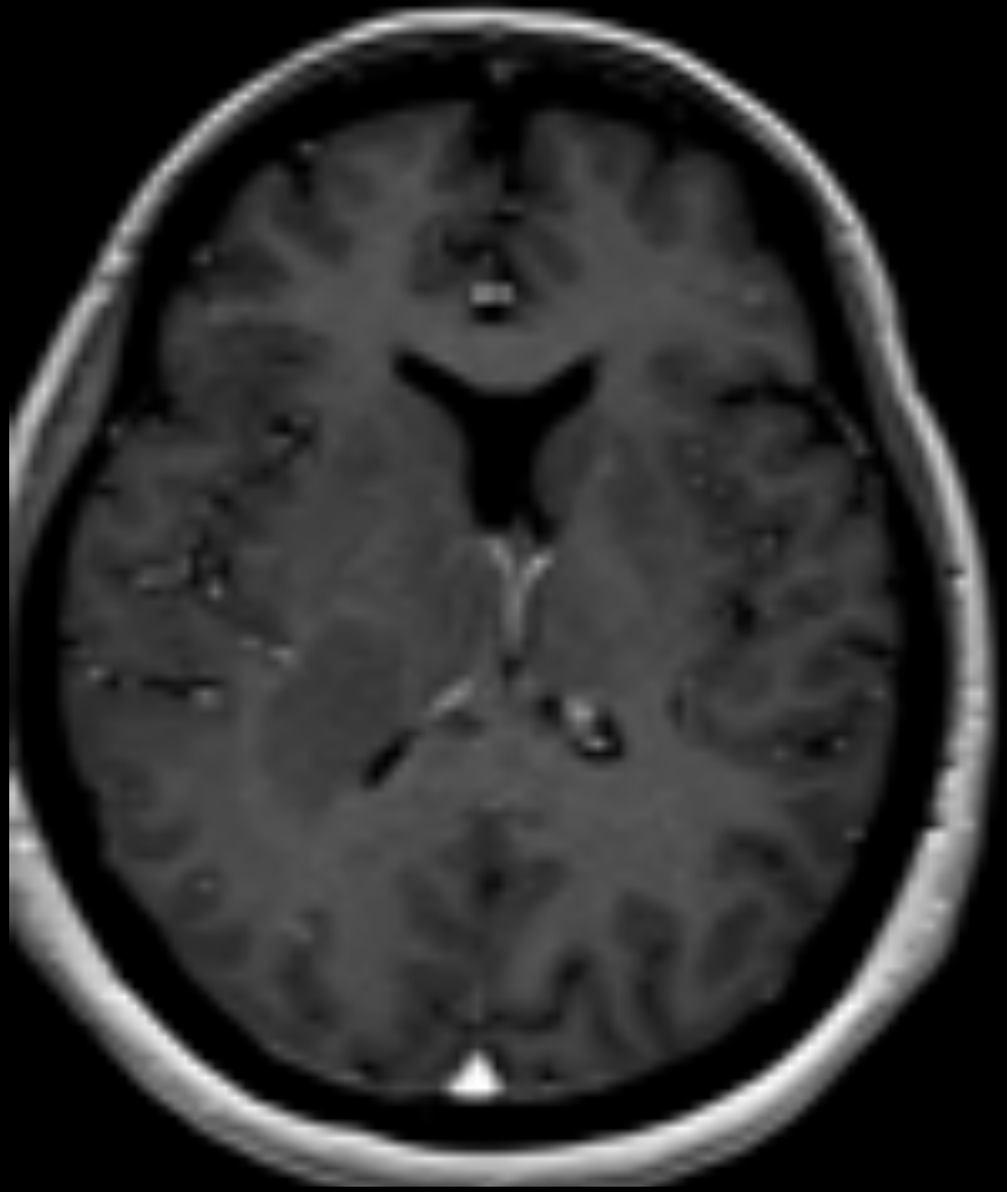

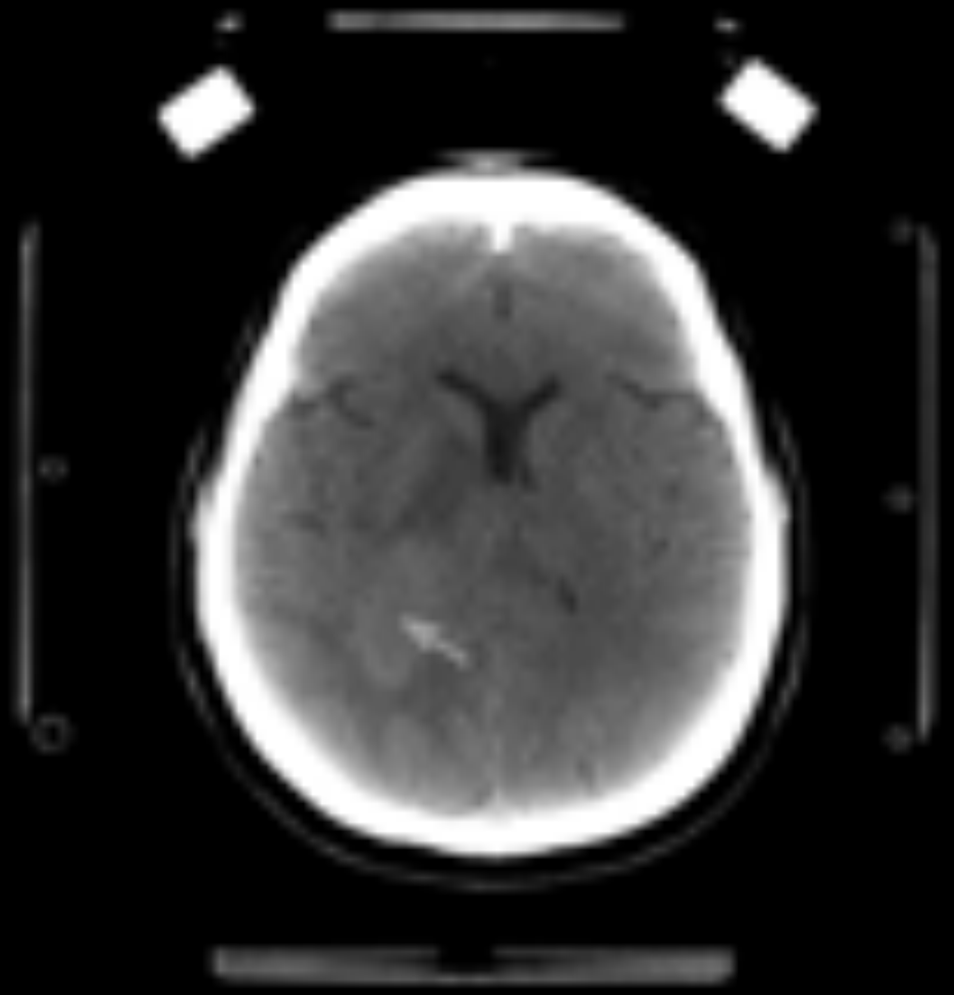

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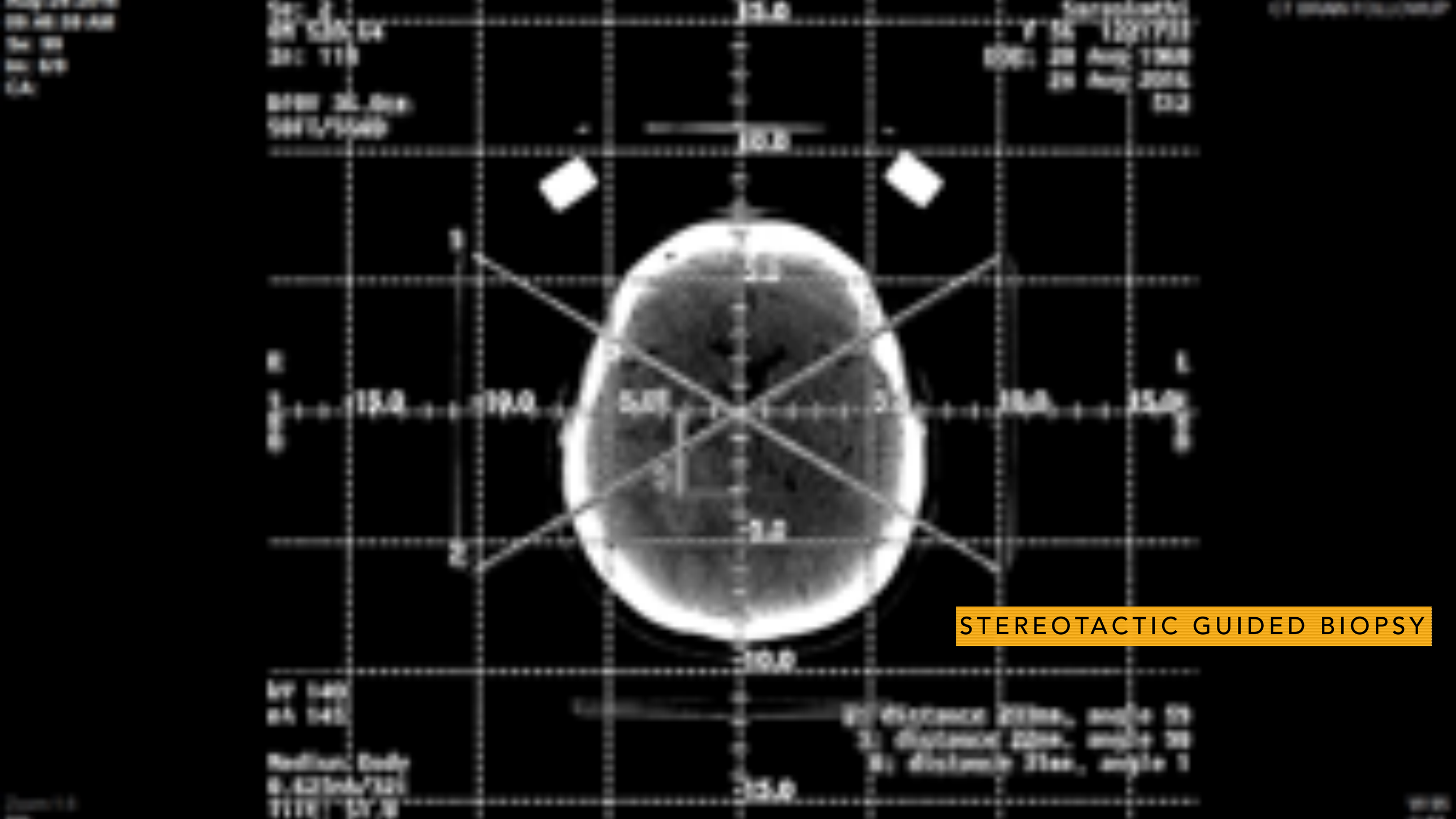
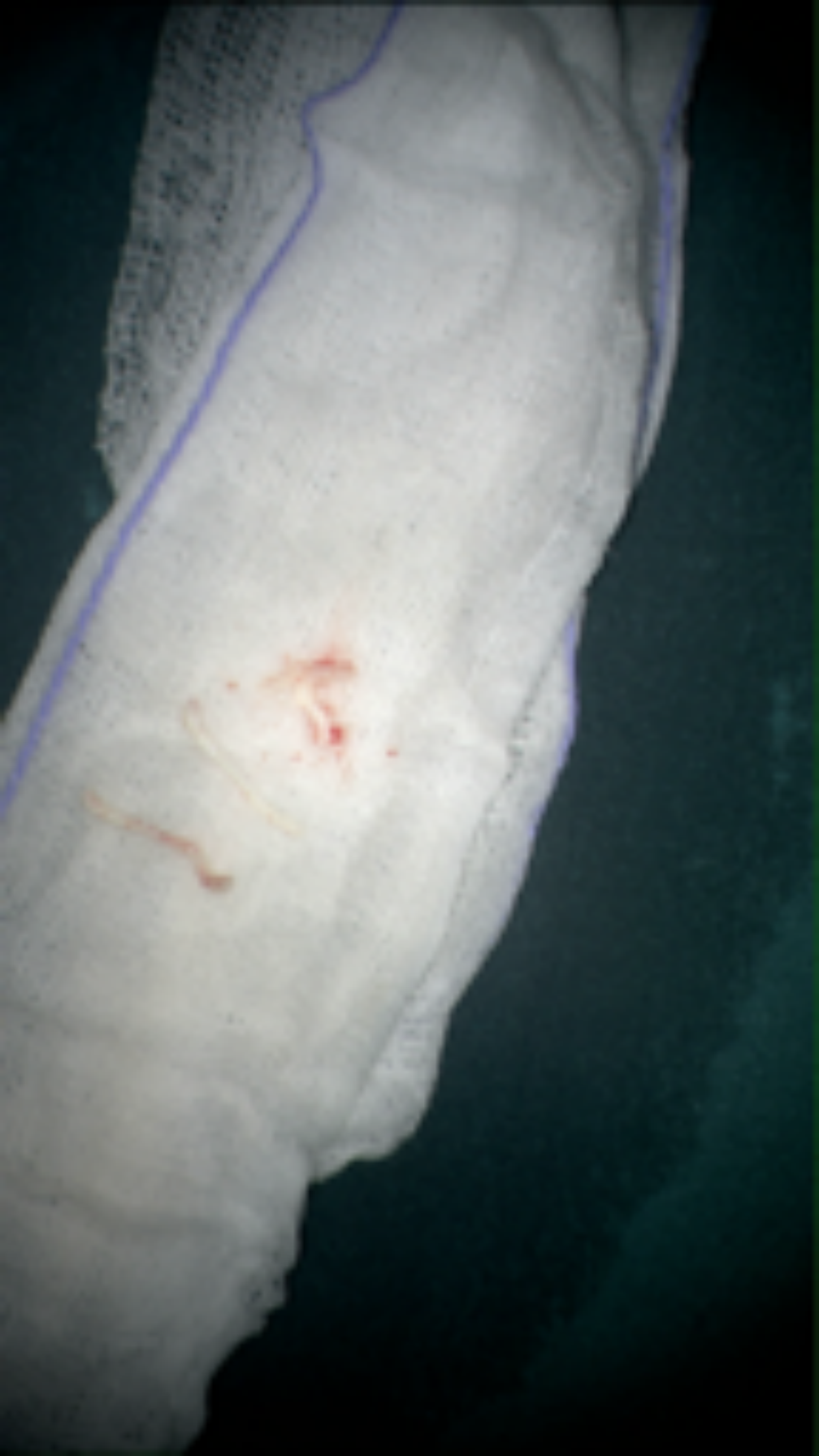
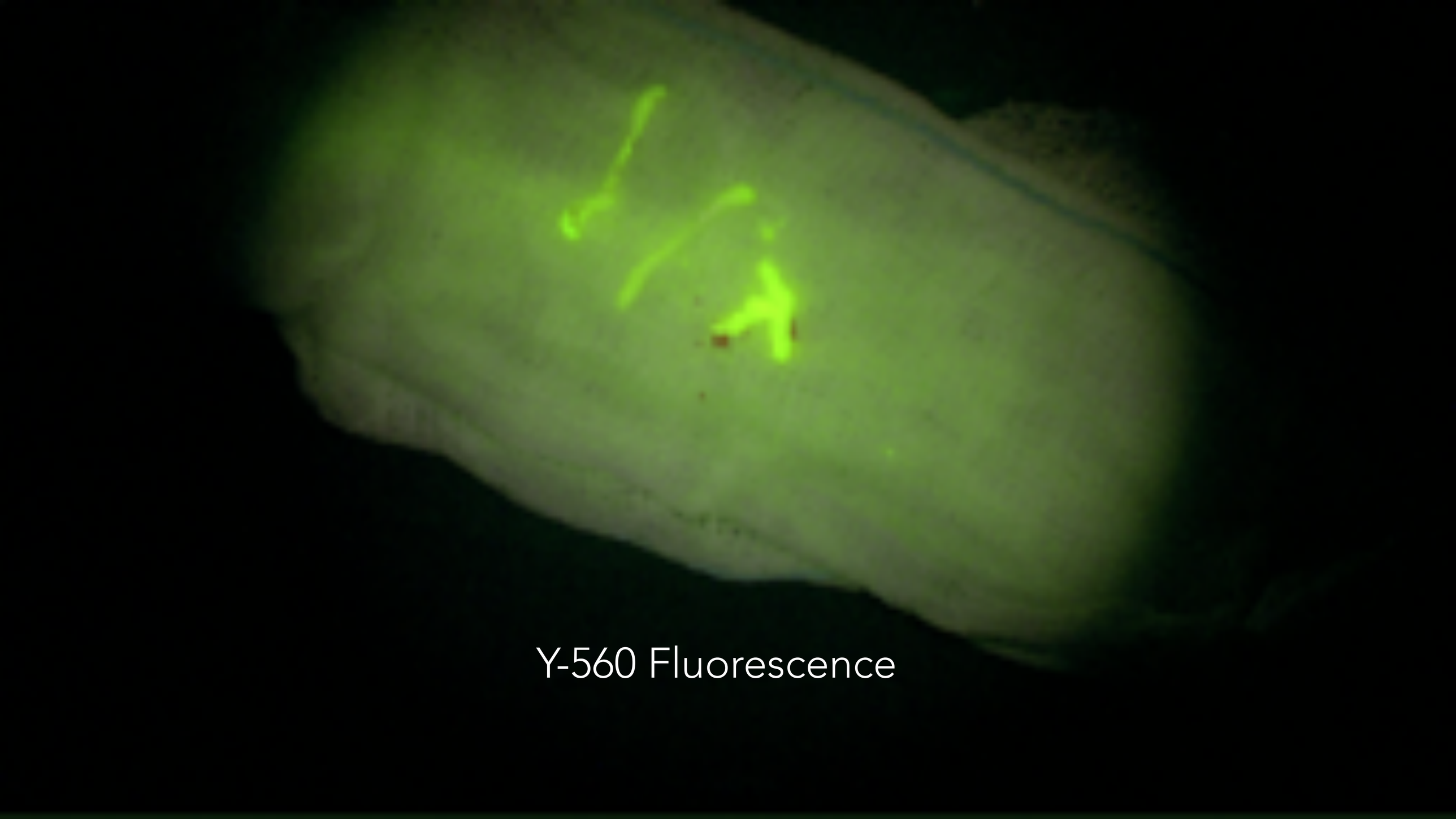
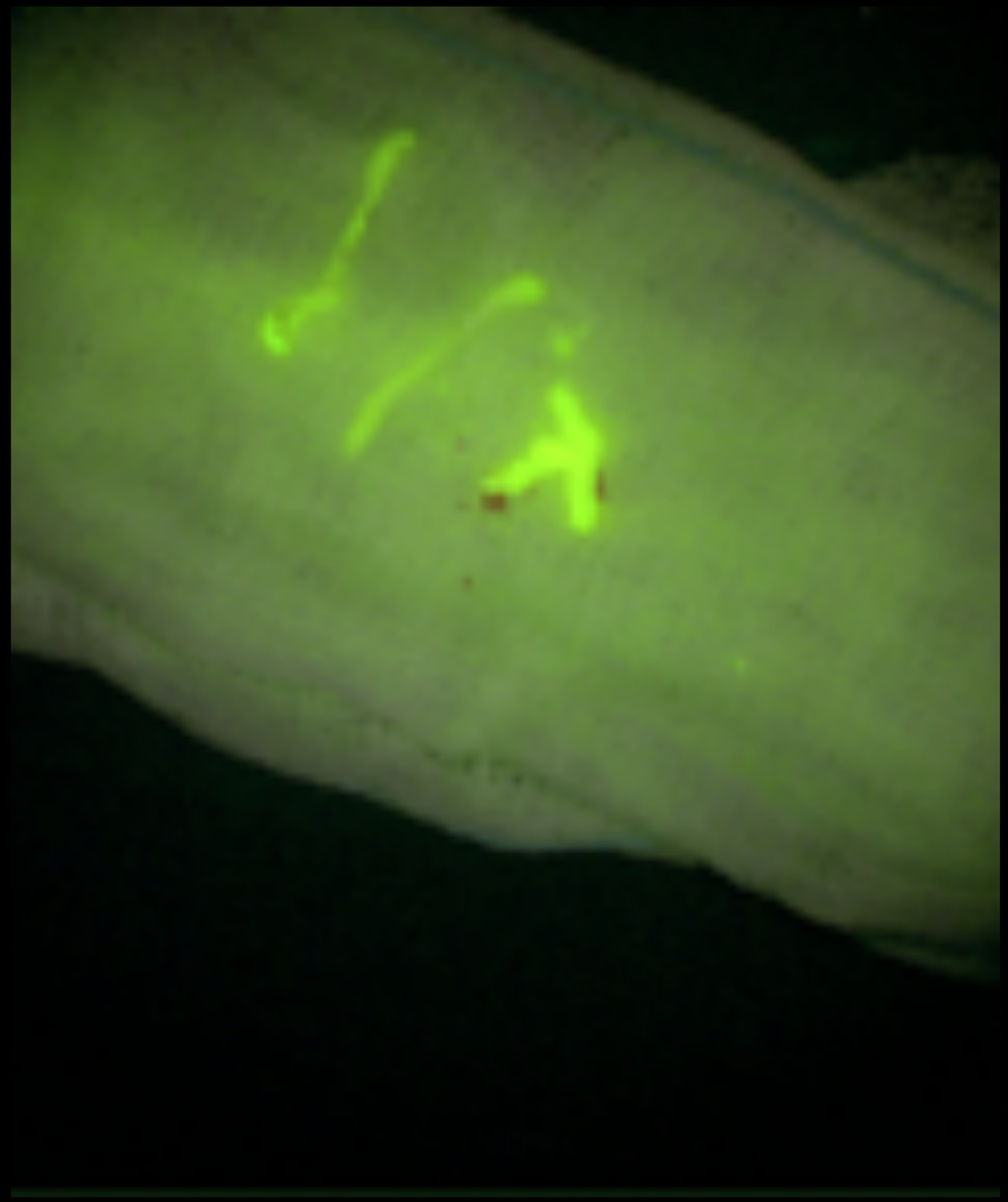

STEREOTACTIC GUIDED BIOPSY





Y-560 Fluorescence



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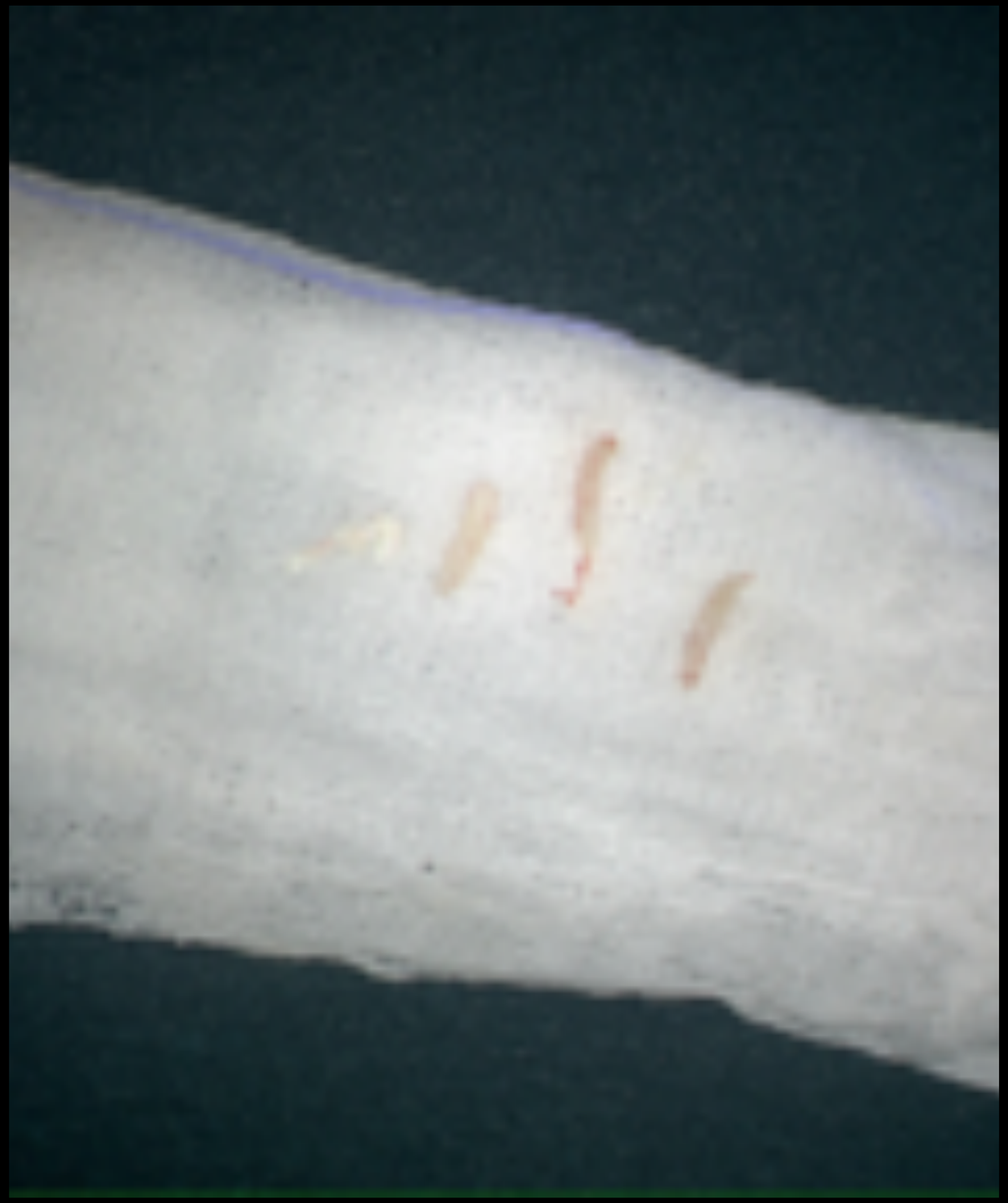

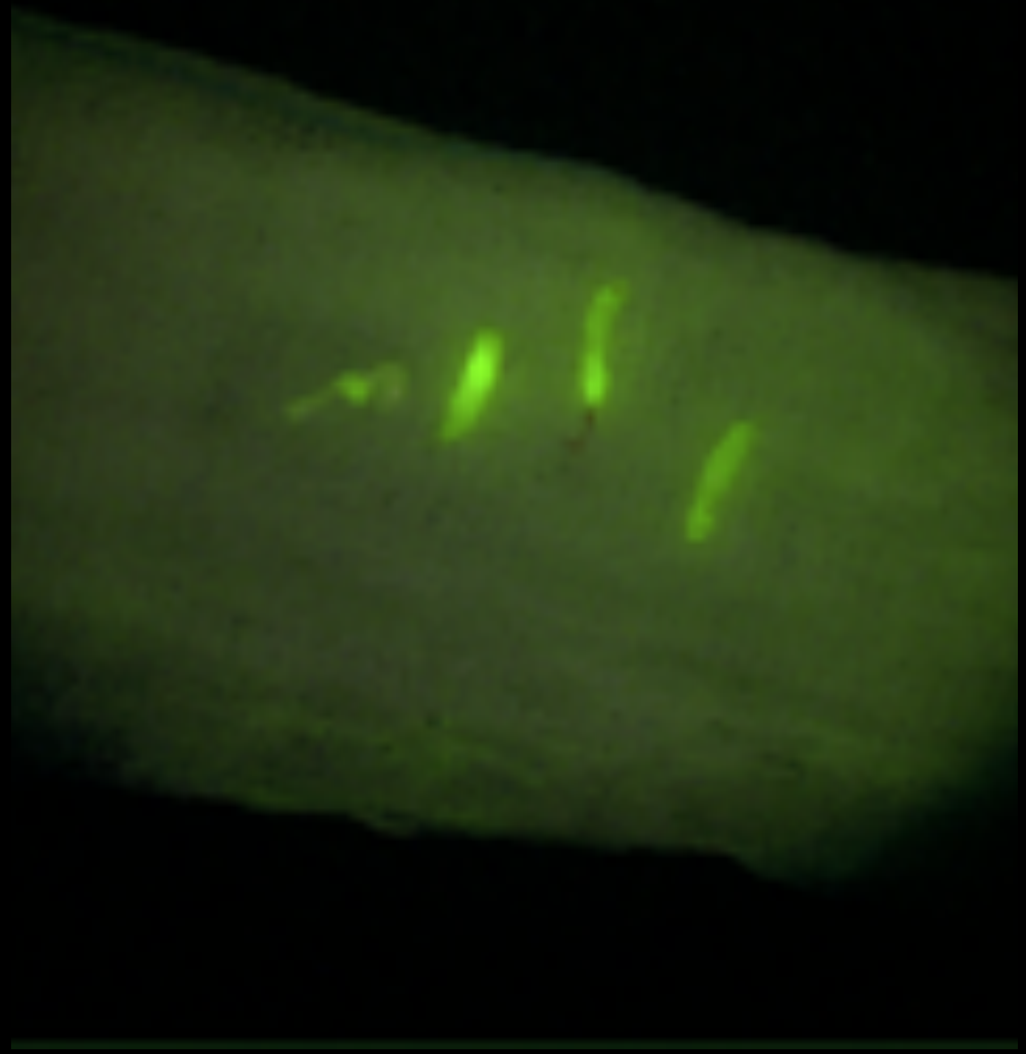

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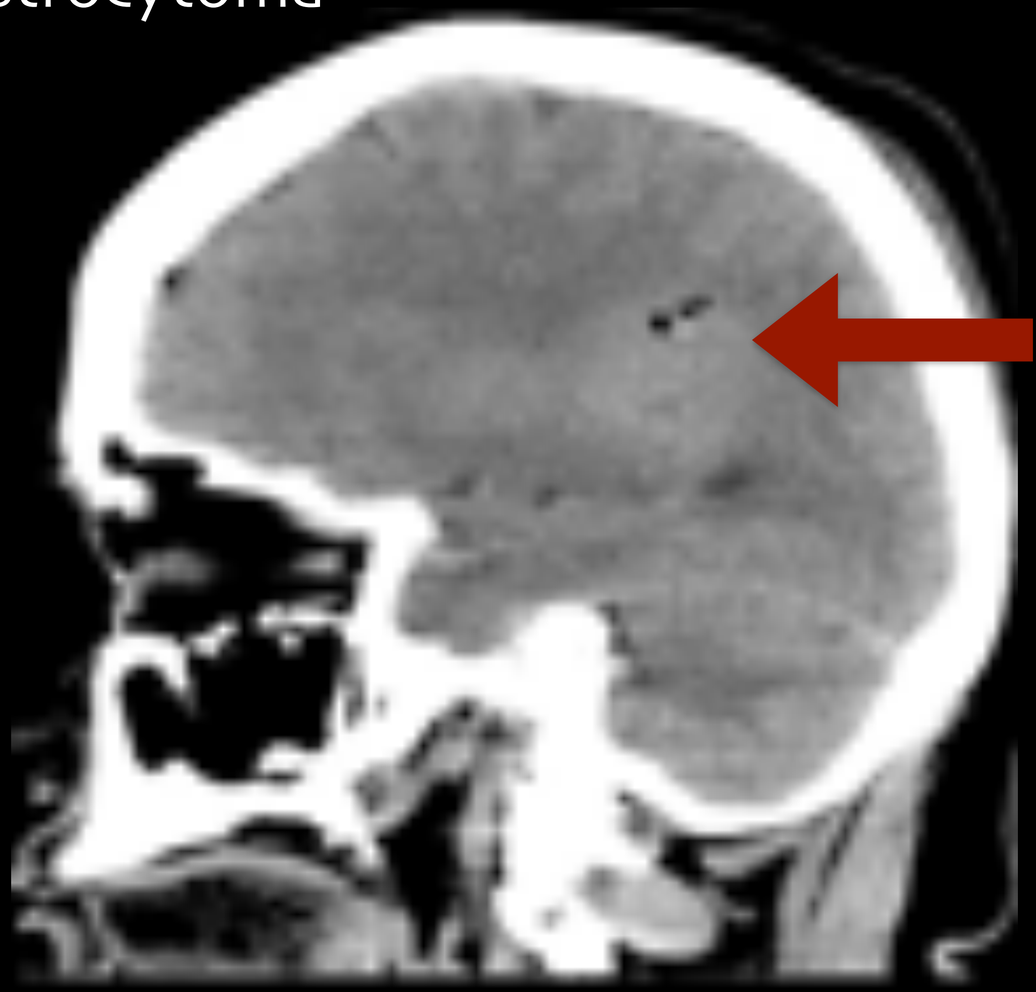
Post Op

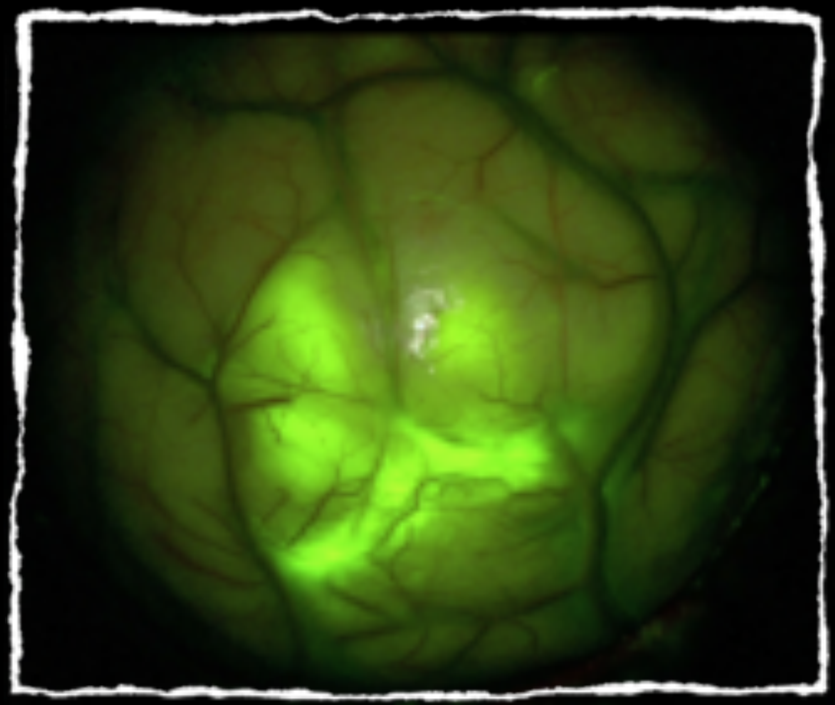
Gr 3 Anaplastic astrocytoma



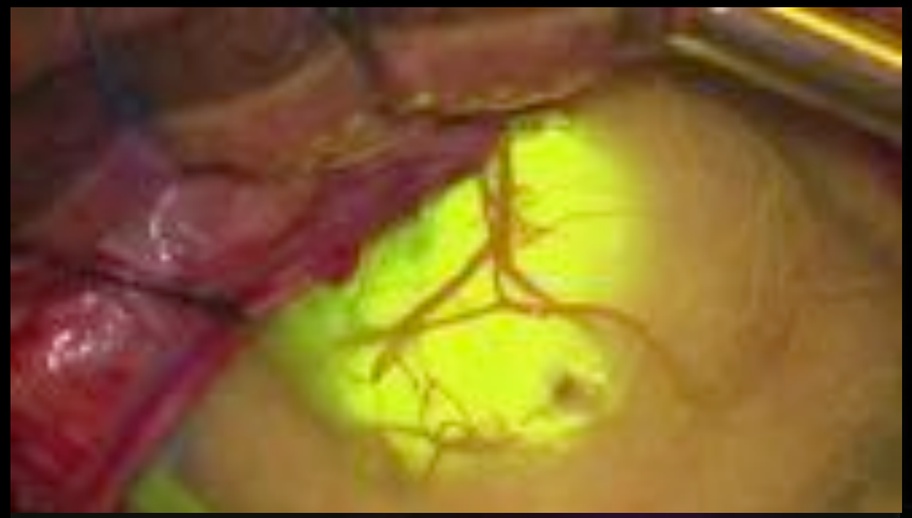
SJ

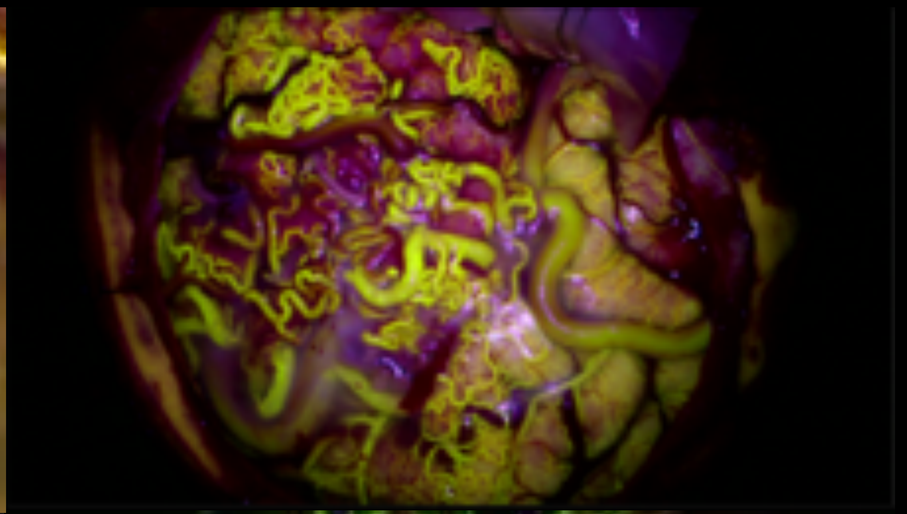
Clinical Uses

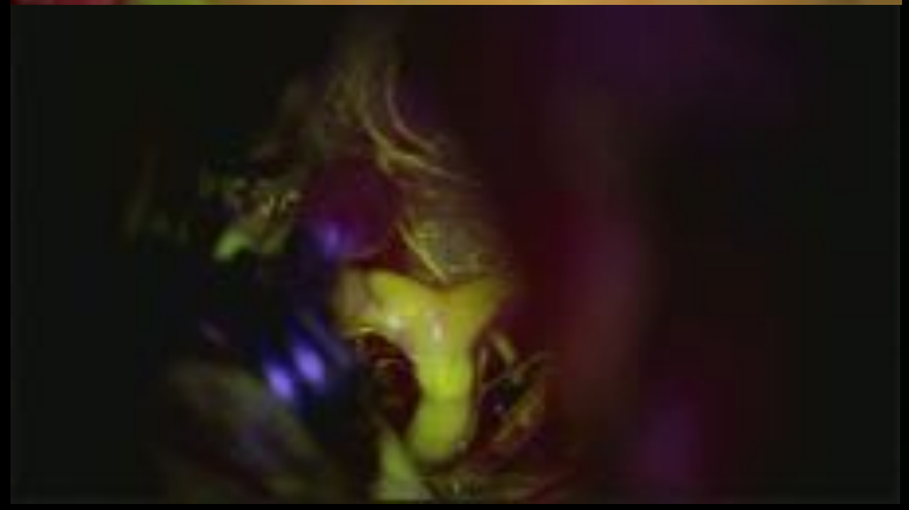
- High Grade Glioma
- Metastasis
- Meningioma
- Infection: Tuberculoma



Fluorescence
YELLOW 560 Tumours / Aneurysm / AVM Surgery







CP ANGLE TUMOURS

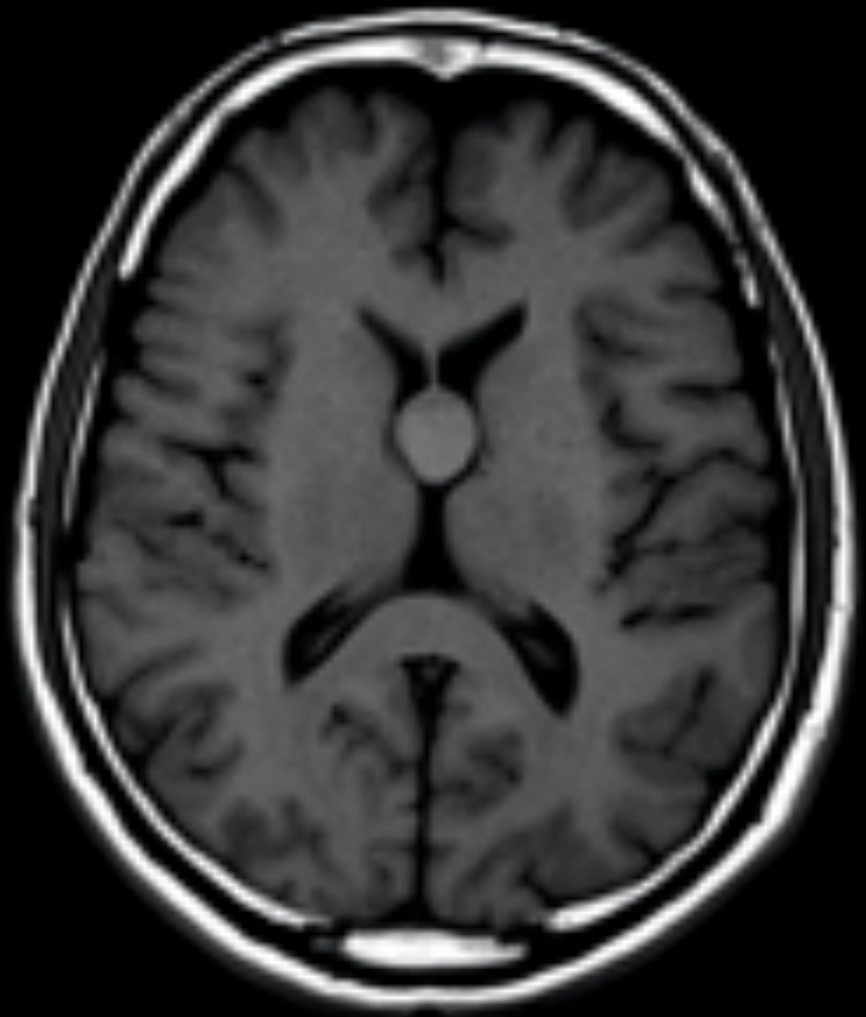
CRANIAL NERVES MONITORING

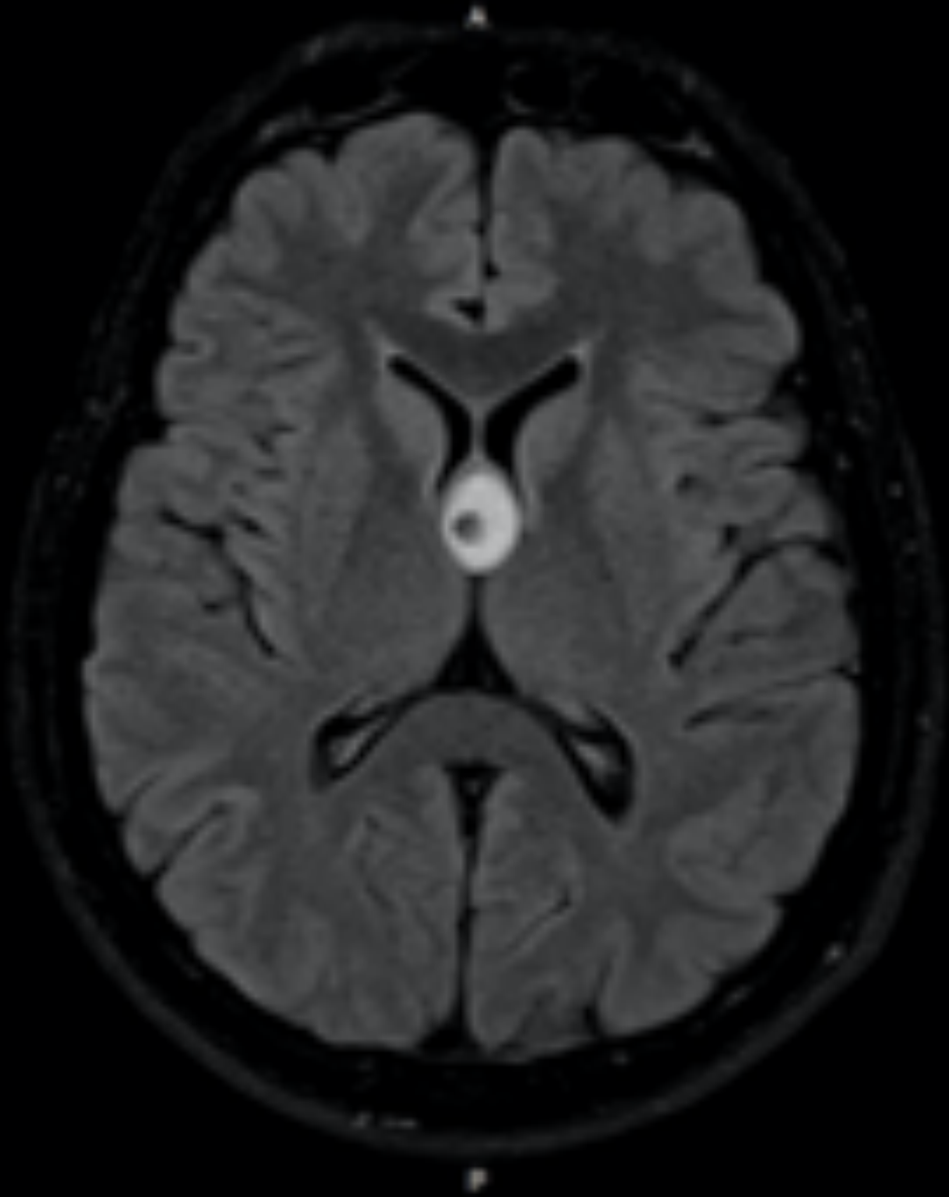
LATERAL POSITION

- Neck Flexed in Neutral Position
- Arm rests on Mayfield

Trans Callosal Approach to Colloid Cyst

Suresh Jayabalan





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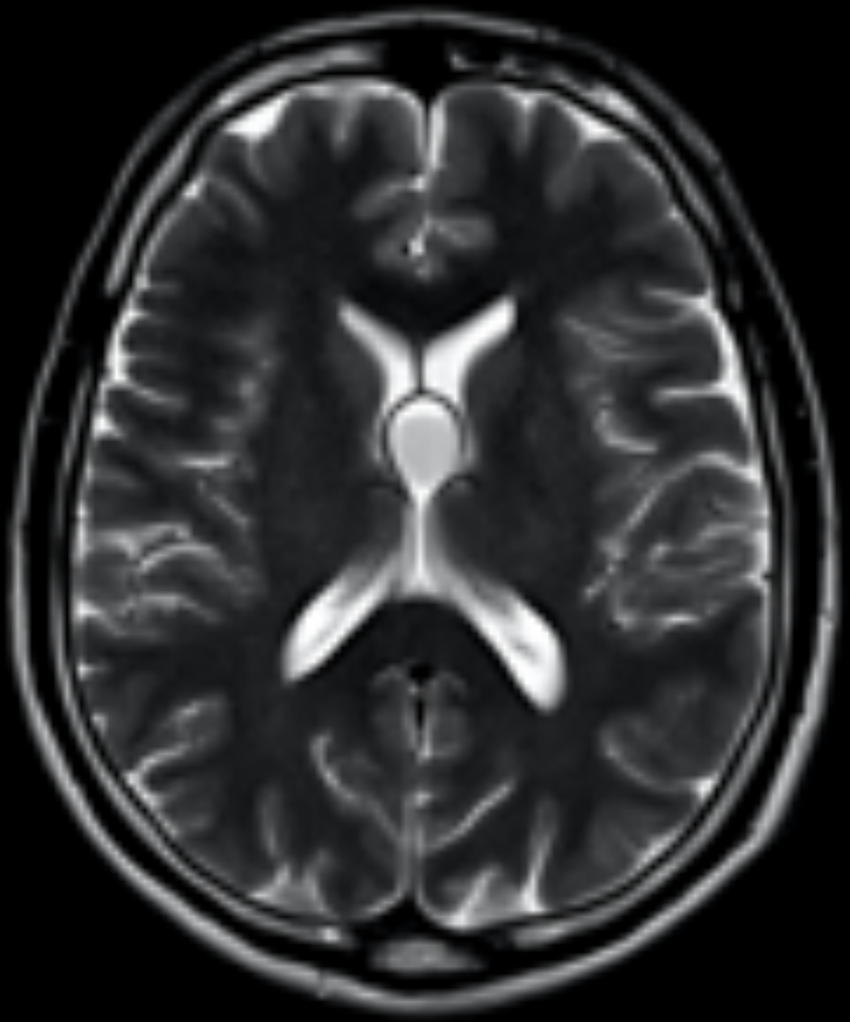

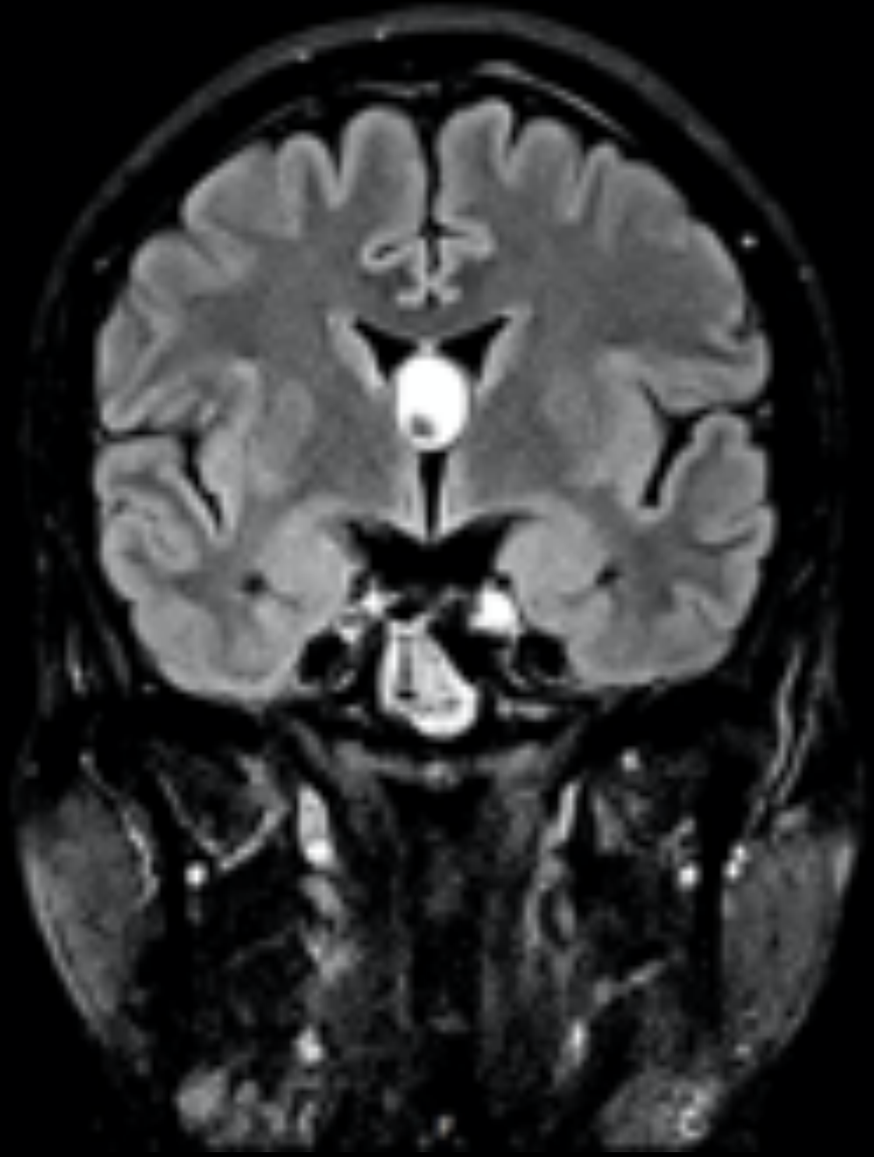

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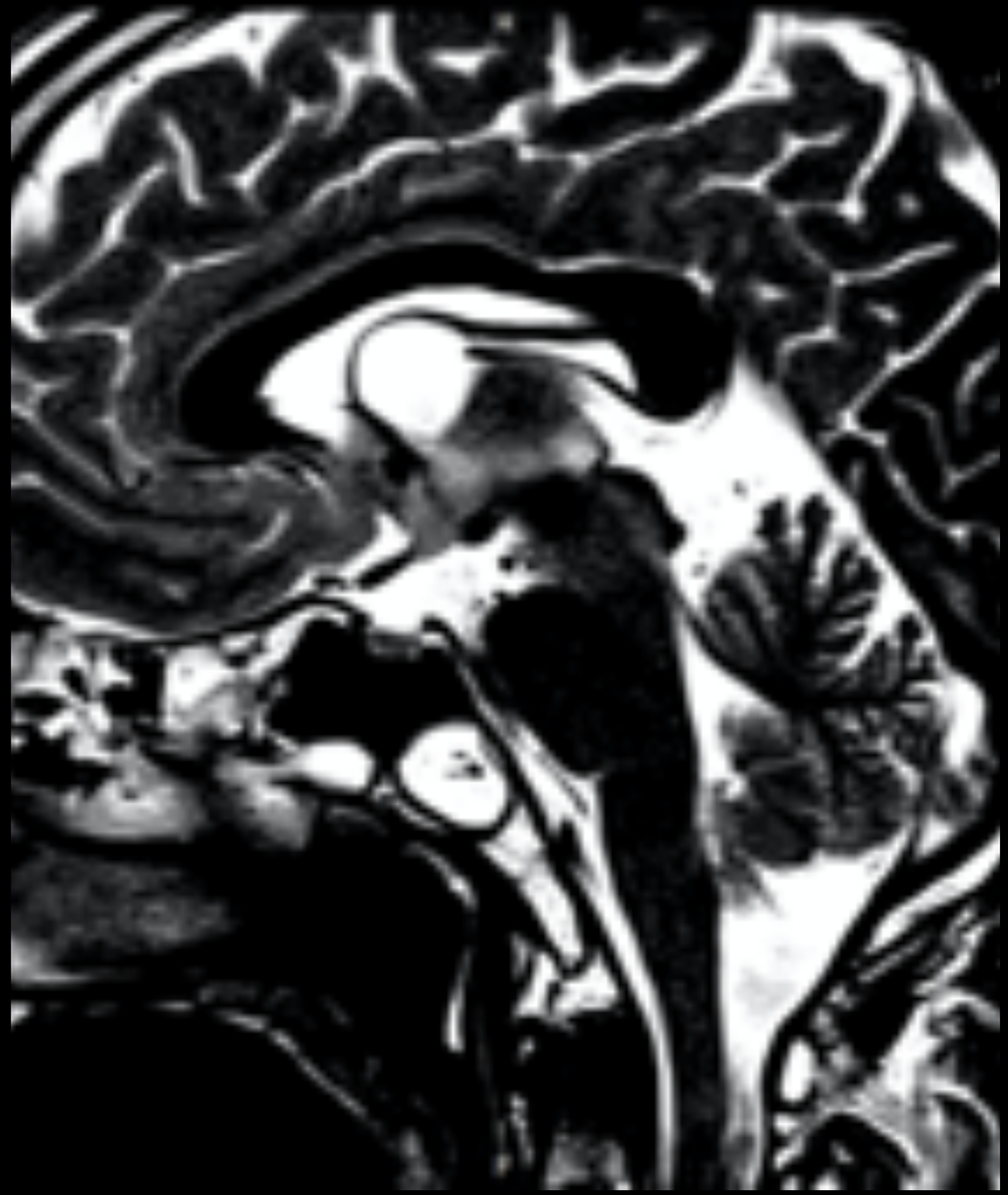
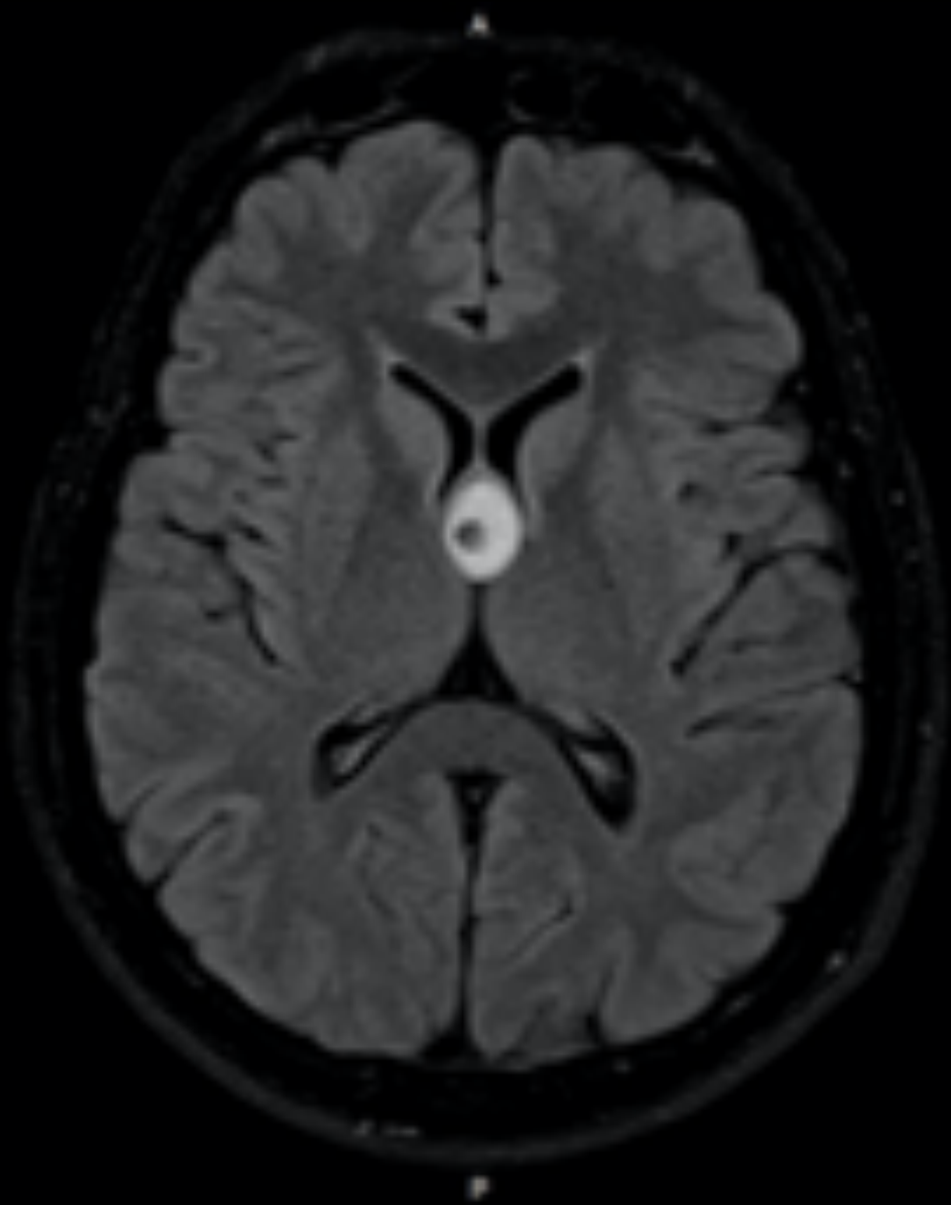


SJ

? Approach

No Hydrocephalus

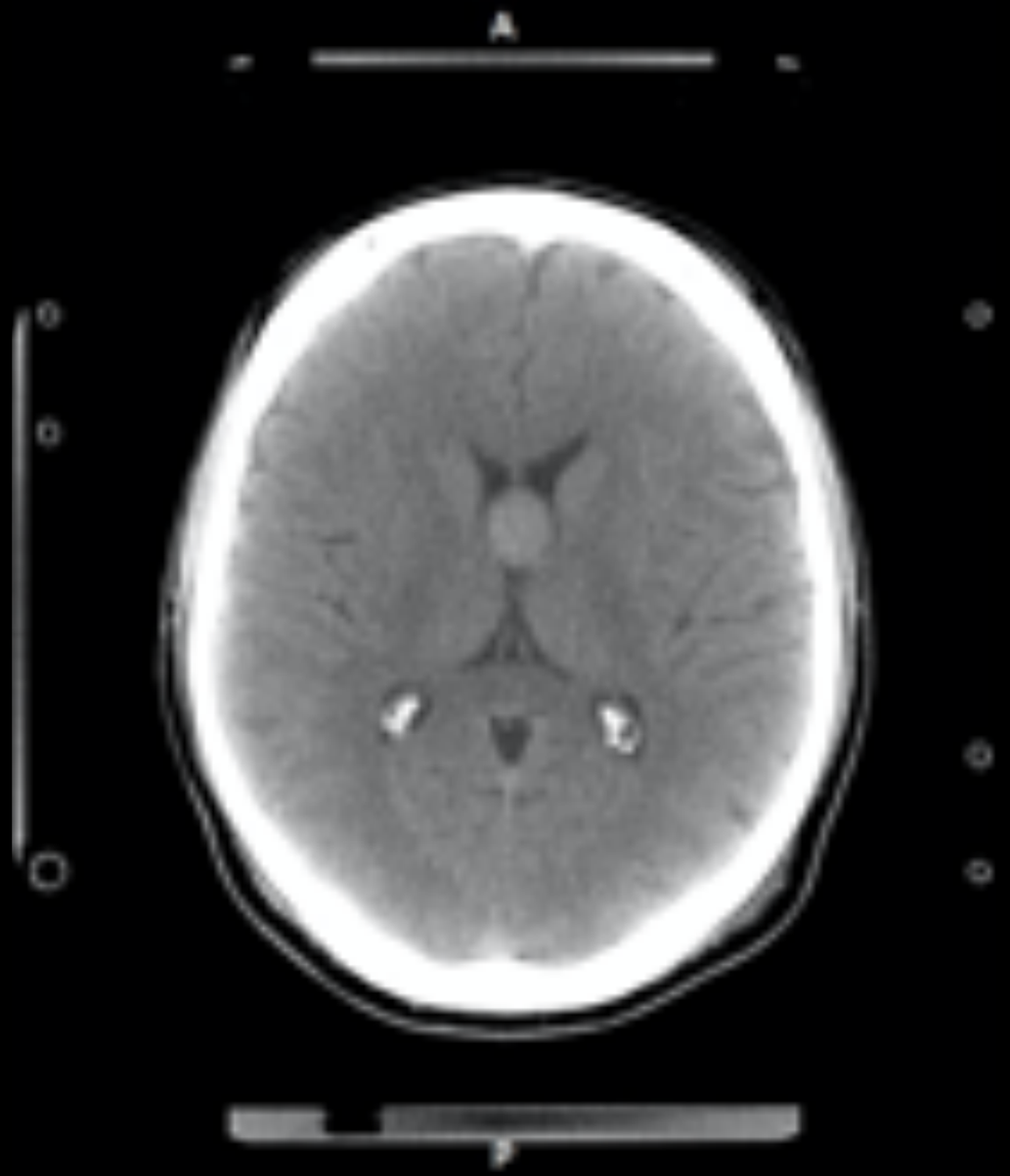


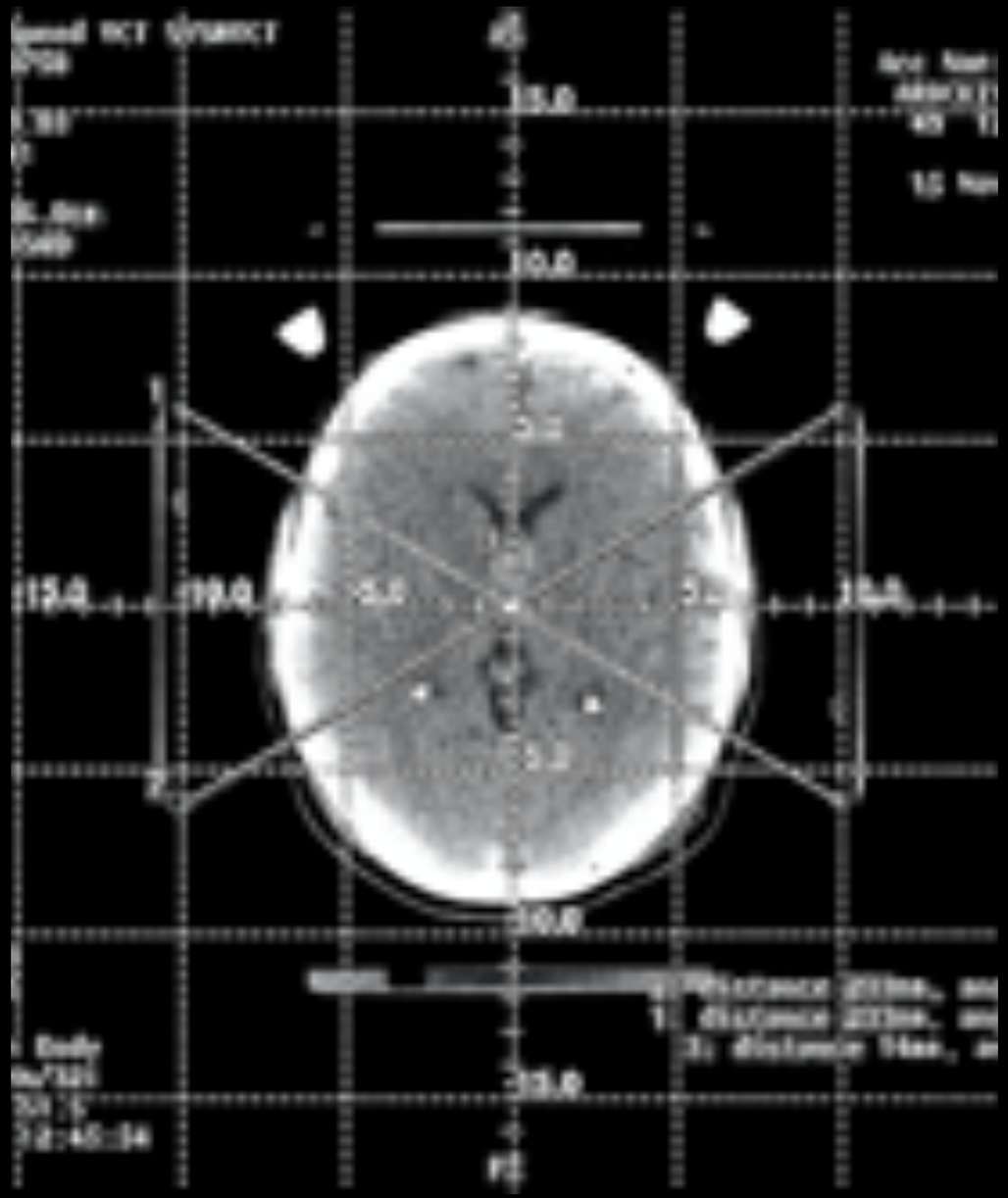
SJ

Interhemishpheric Transcallosal

- Pre op Venous anatomy
- Side: Right side preferred
- Navigation Useful
- Pre Op Localiser / Stereotactic Localisation
- Craniotomy: Postion - Supine, neck neutral with minimal flexion, Elevated Thorax, Craniotomy 2/3 infront & 1/3 behind coronal suture, Expose medial edge of SSS, Dural reflection on SSS

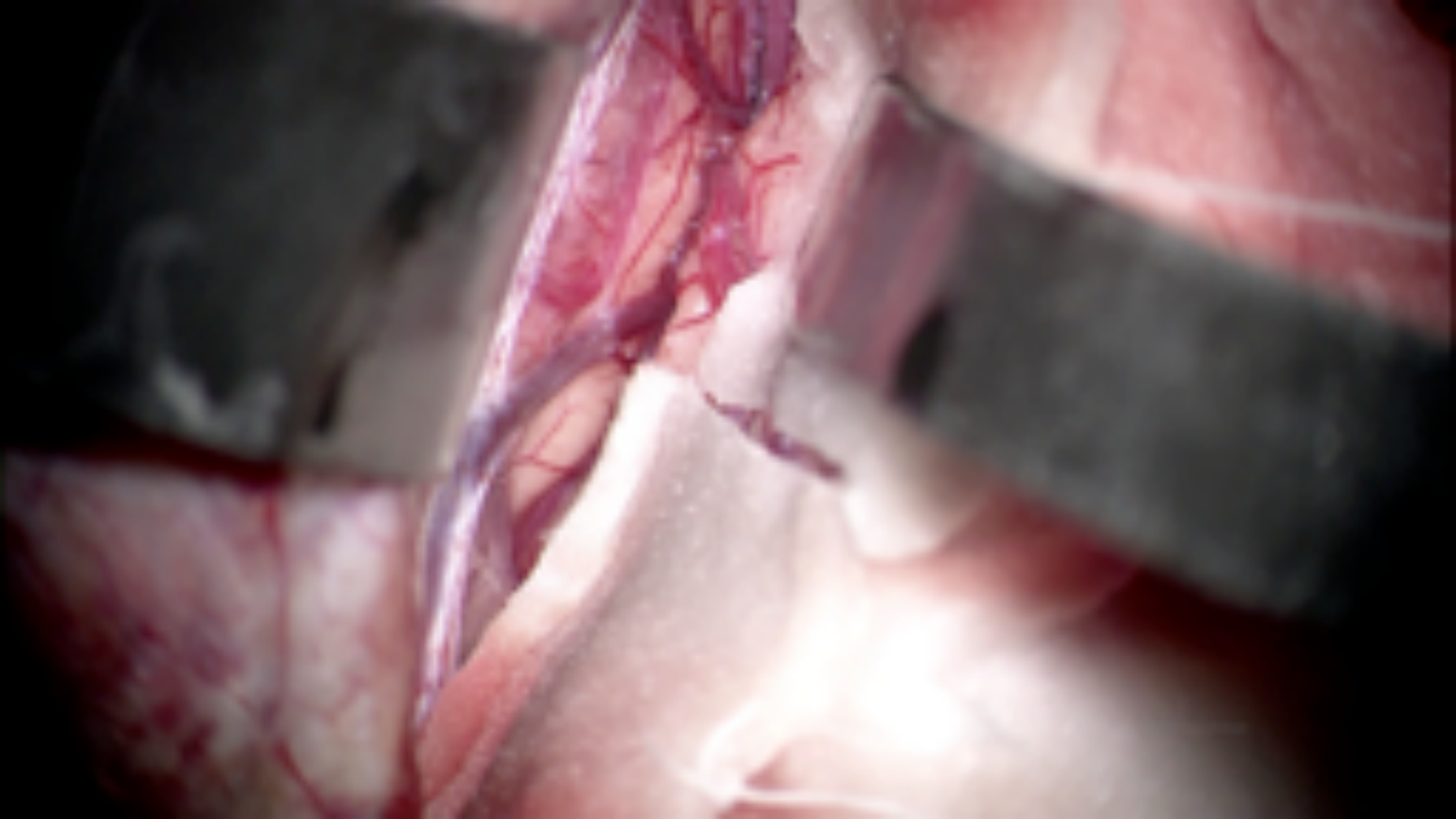
SJ

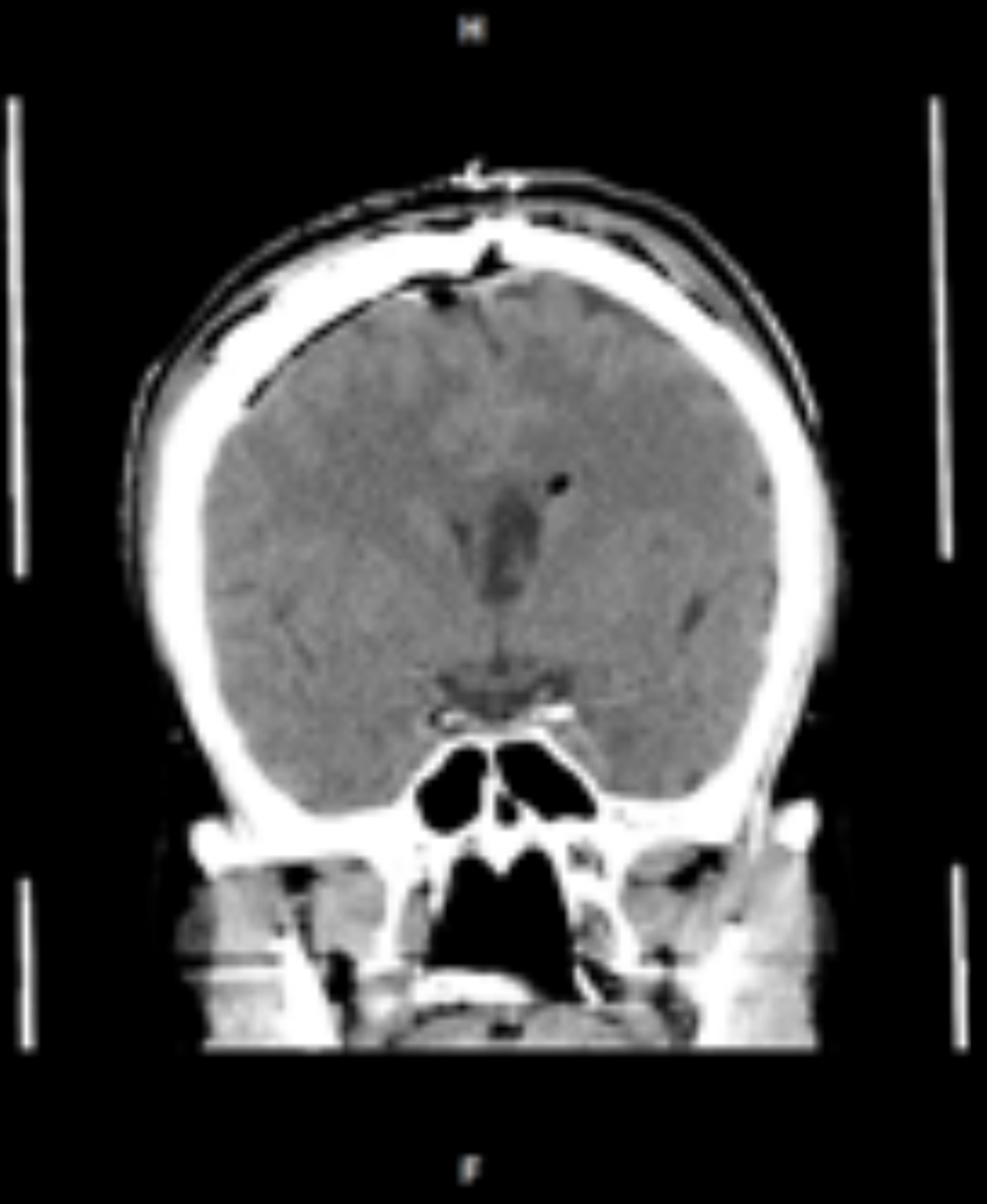




SJ


Localising Marker





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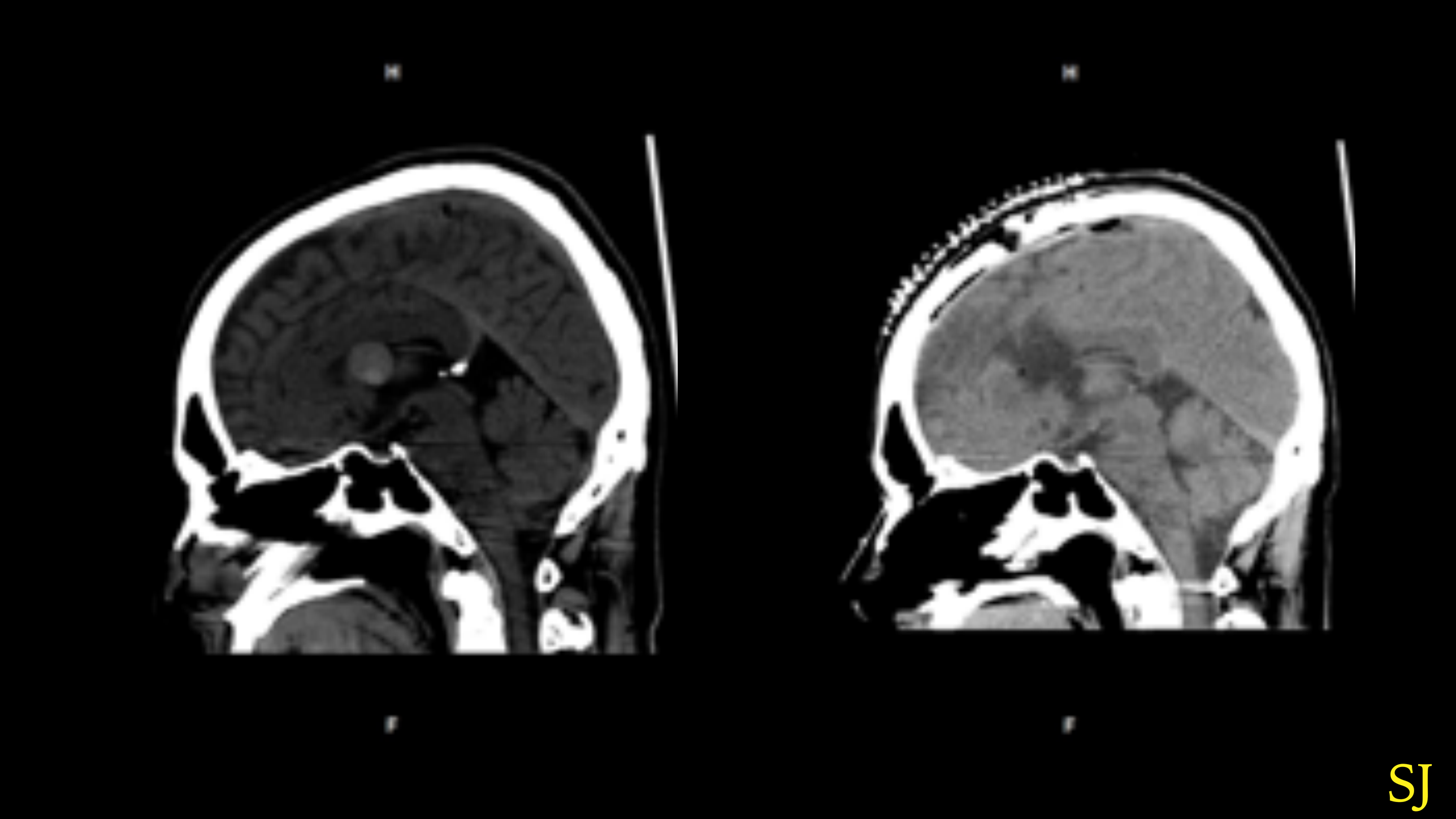
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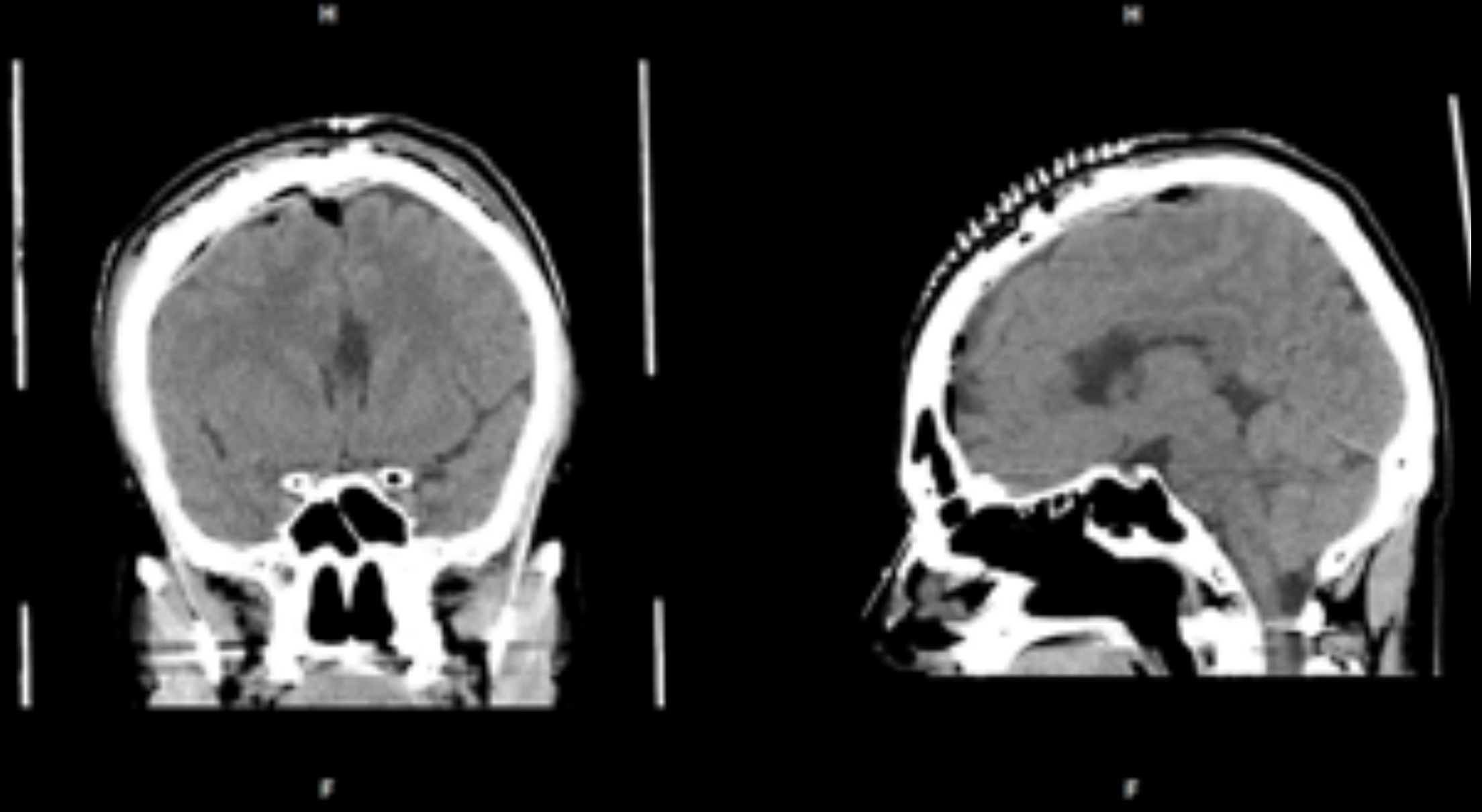
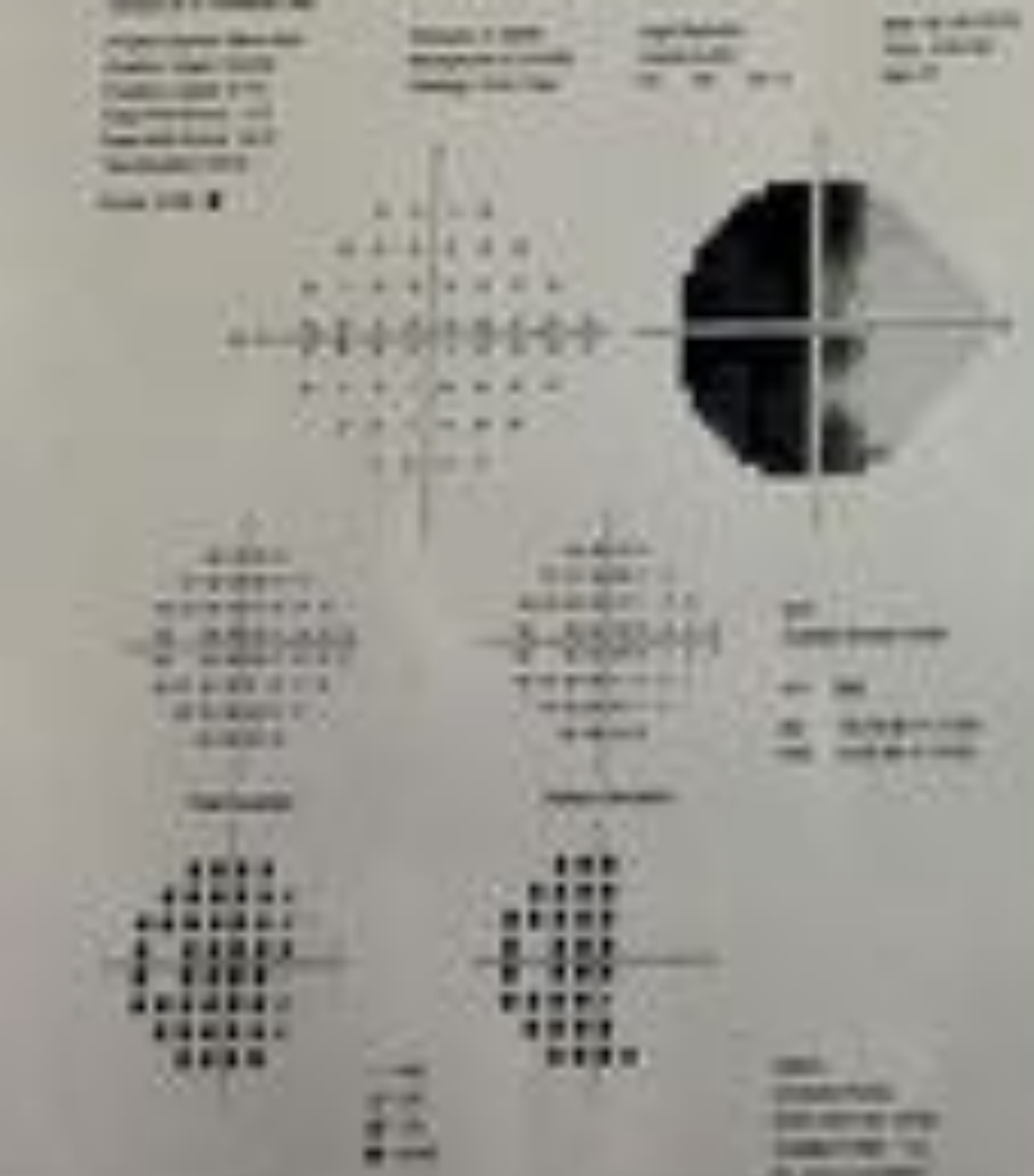
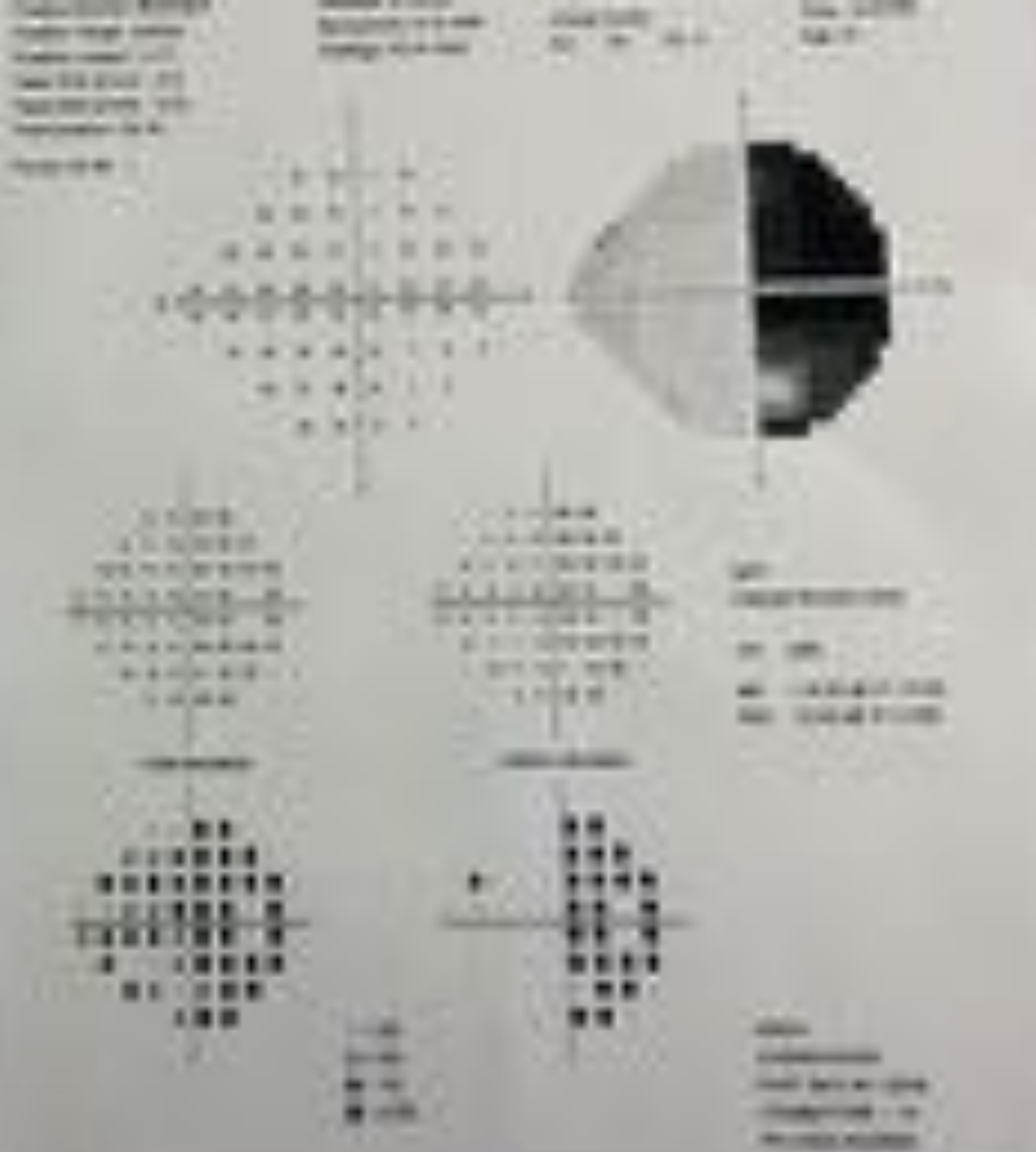
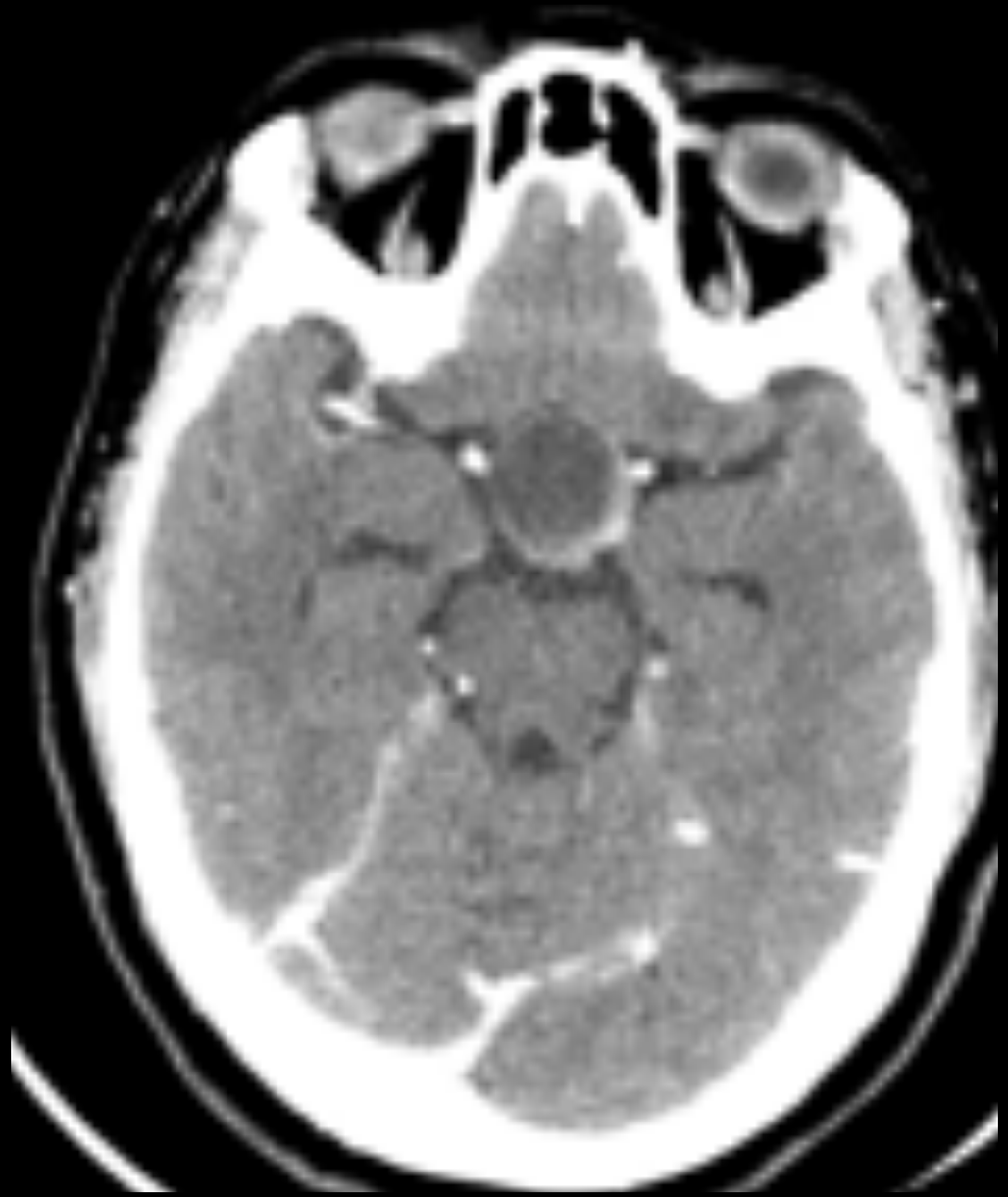


Trans Sphenoidal Sellar Tumour Excision

Suresh Jayabalan







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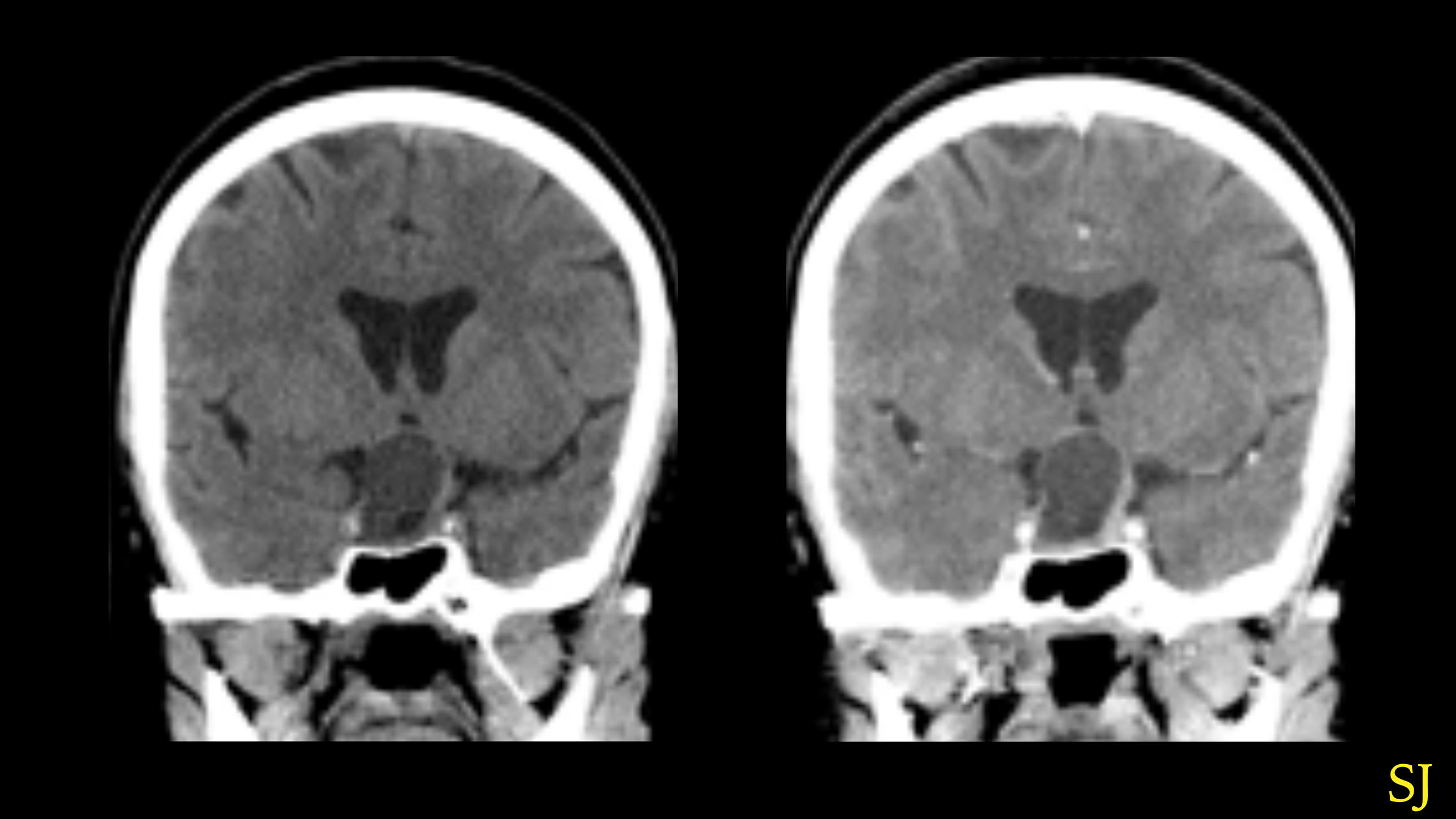
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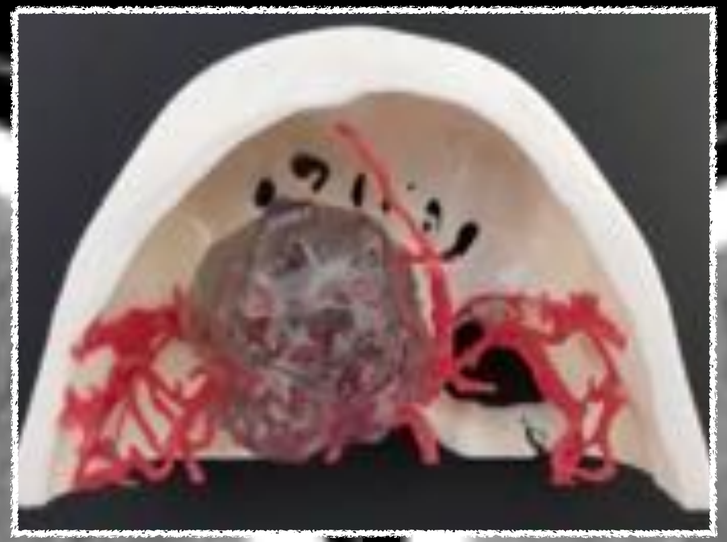

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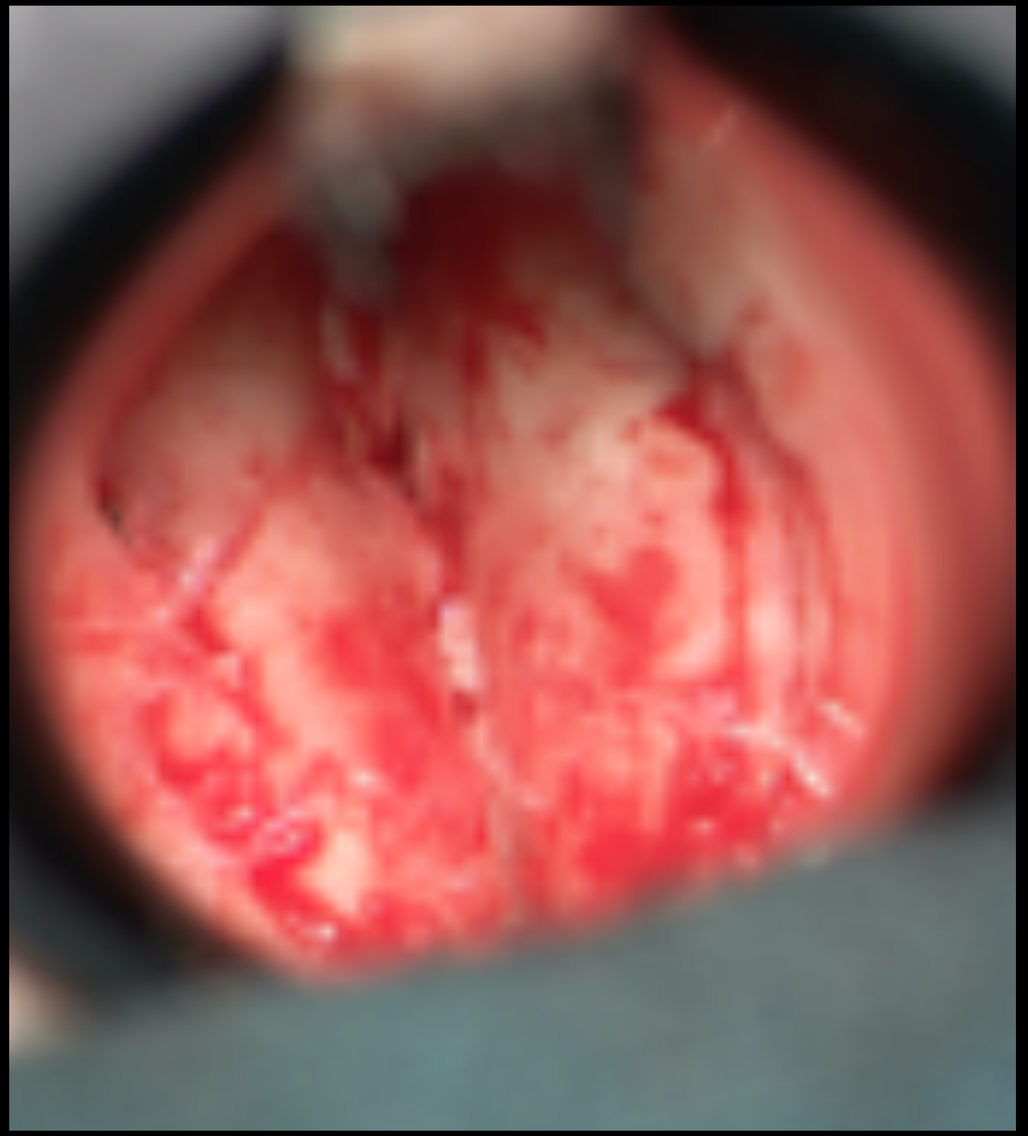

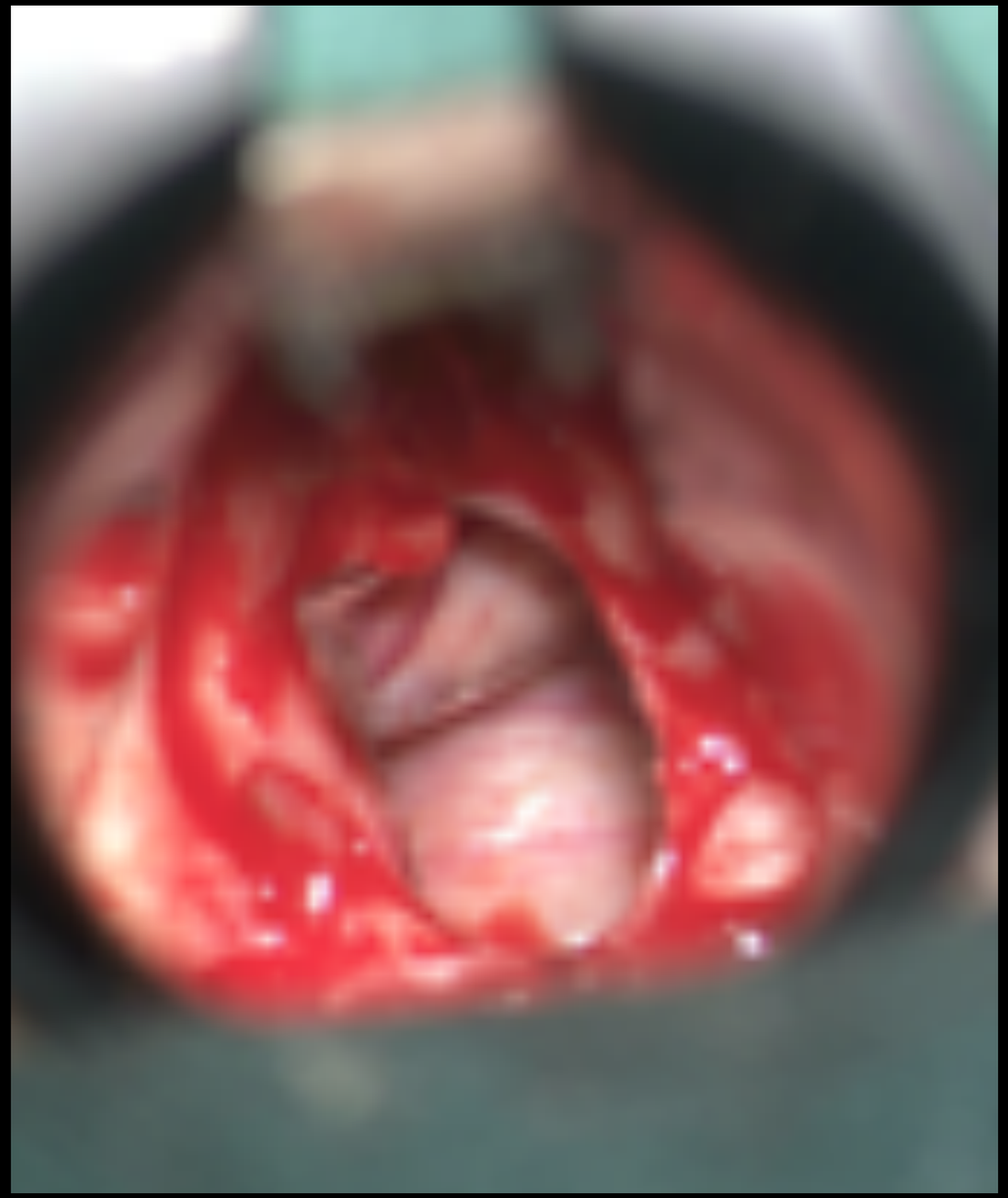

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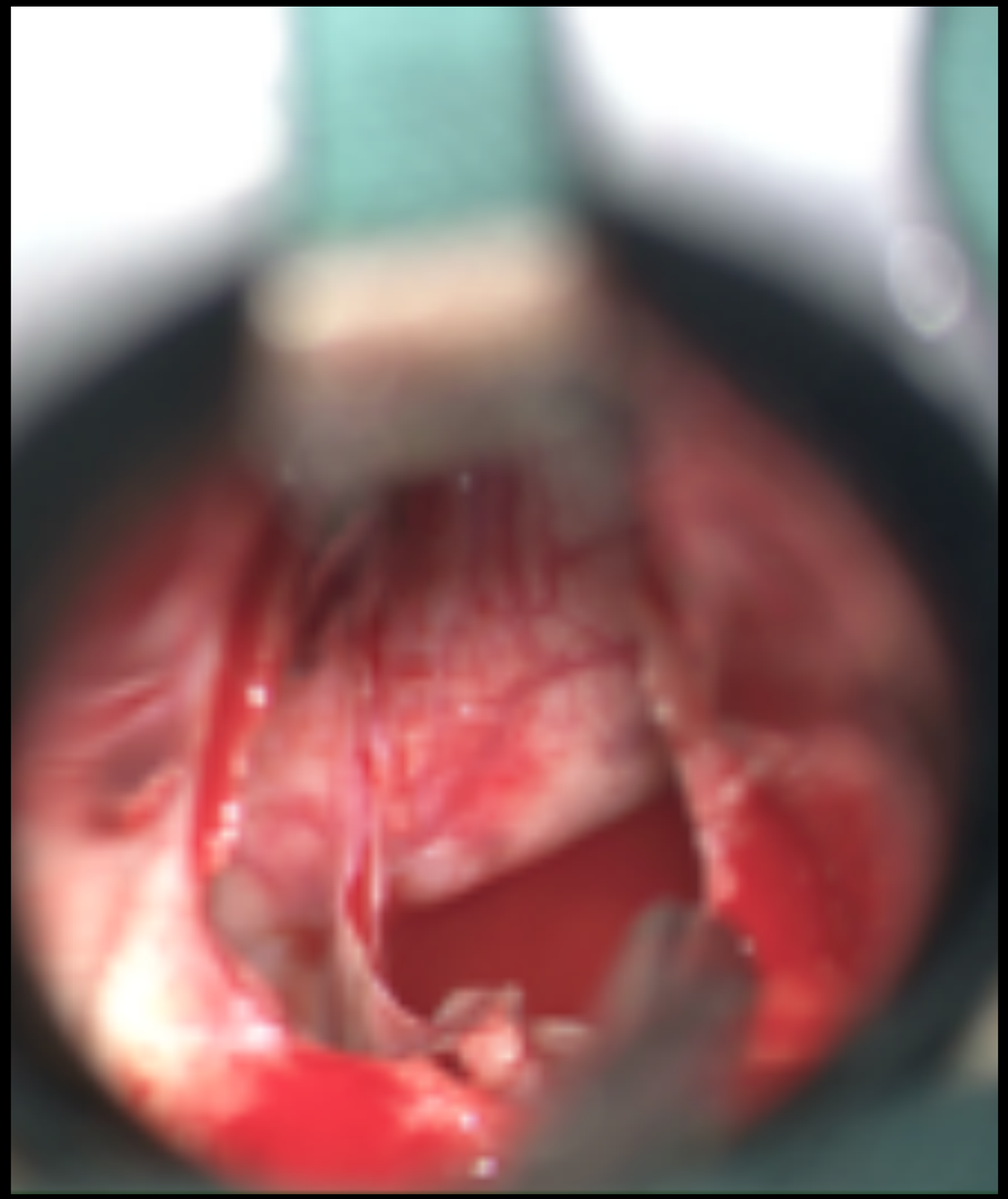

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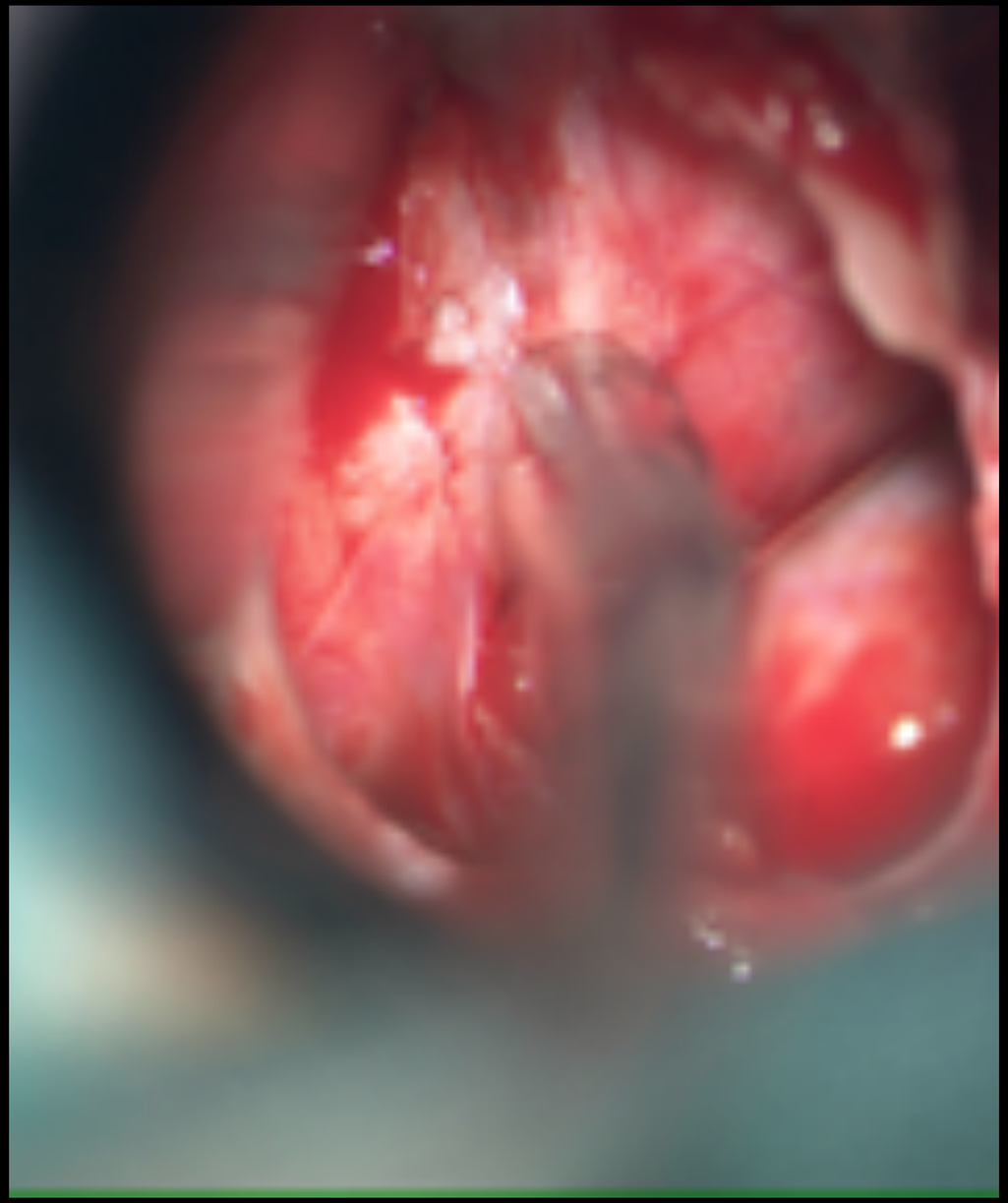

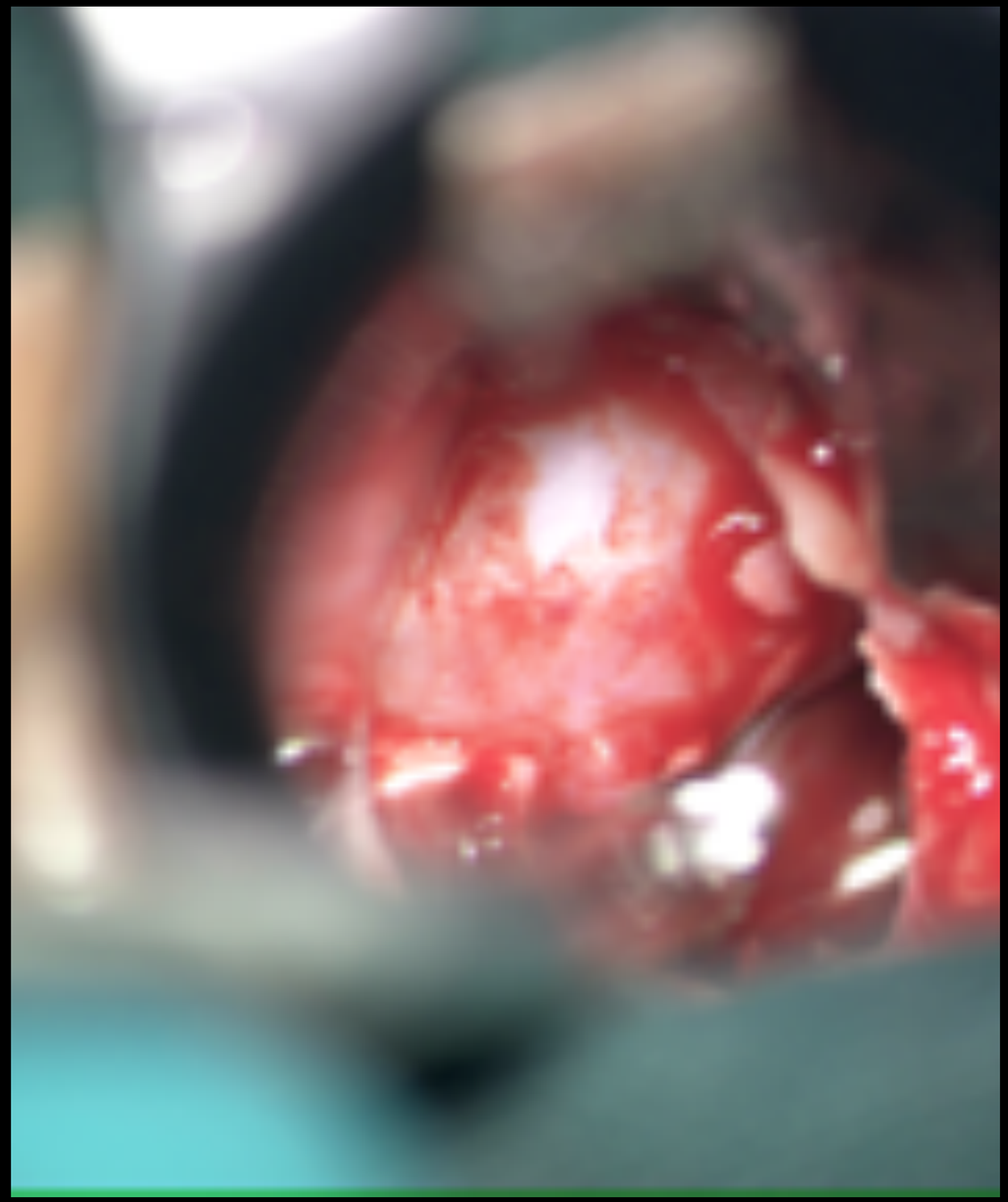

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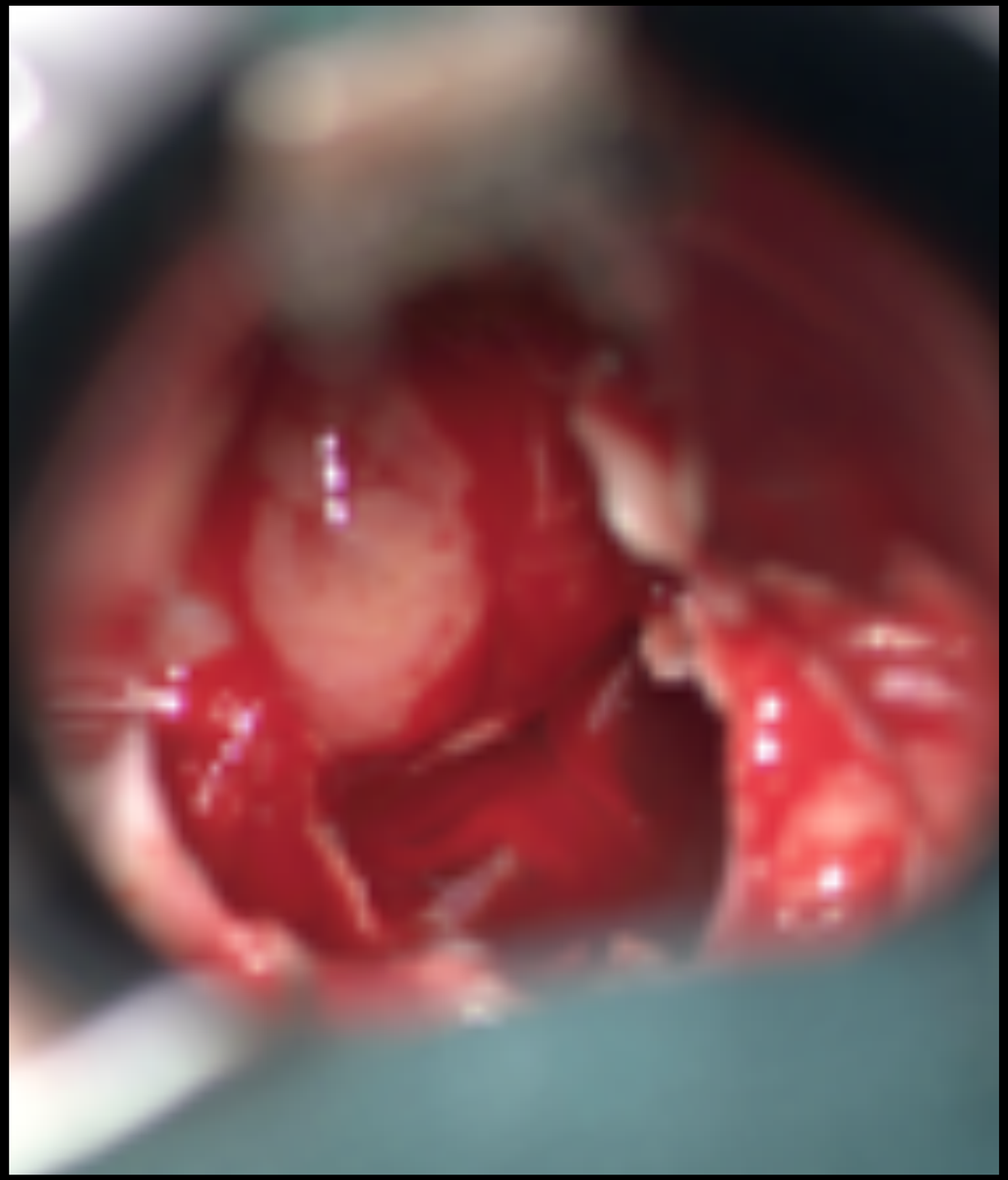

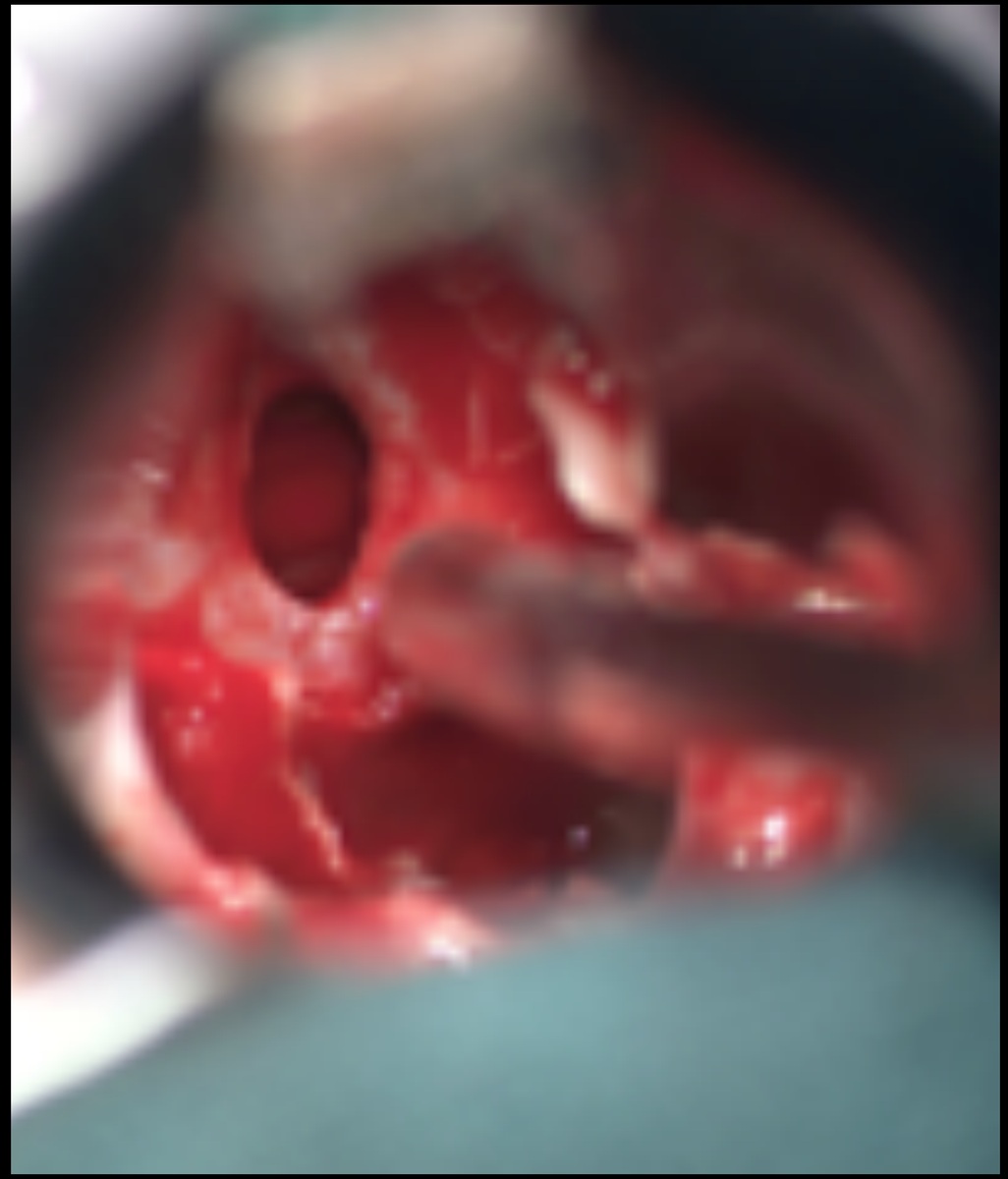

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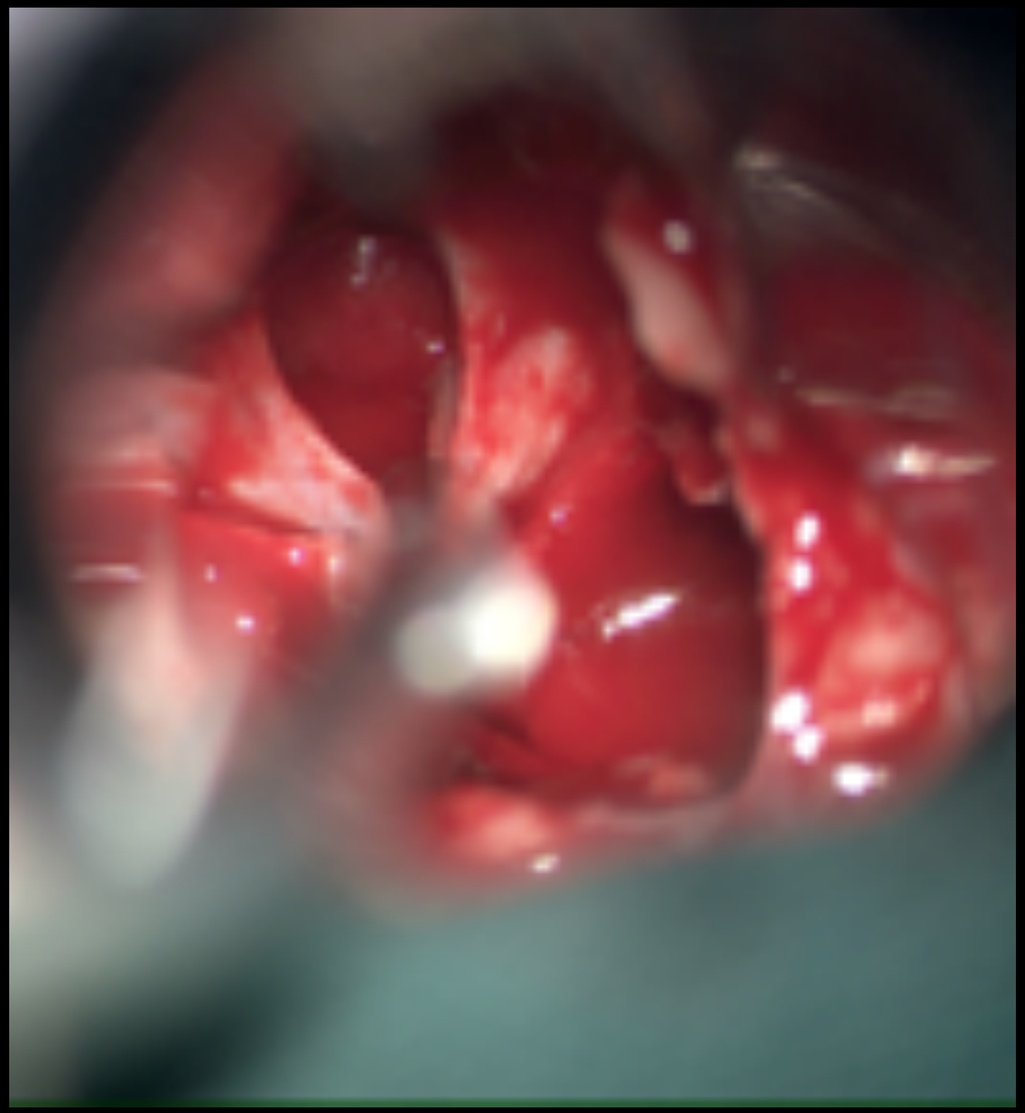

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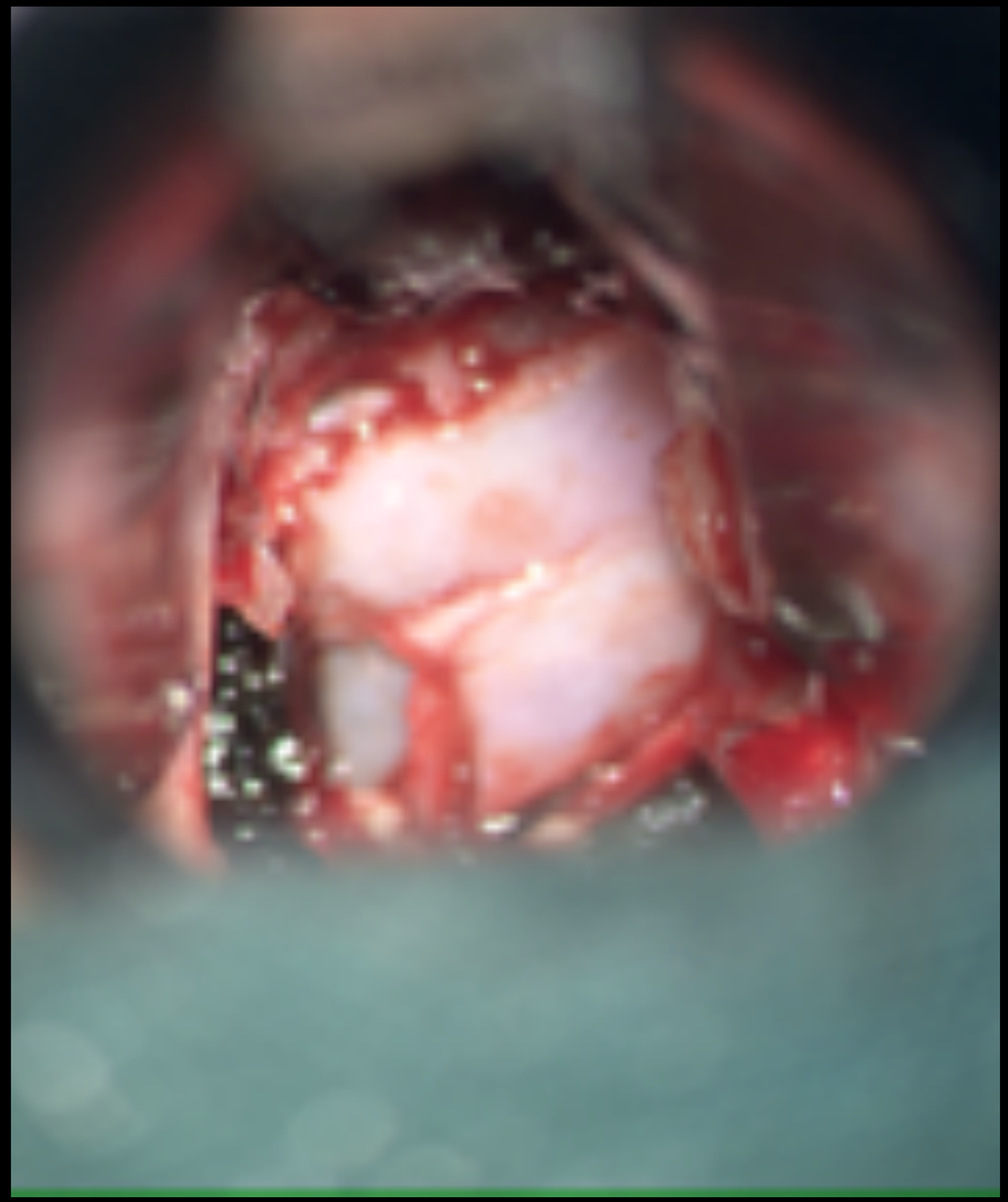

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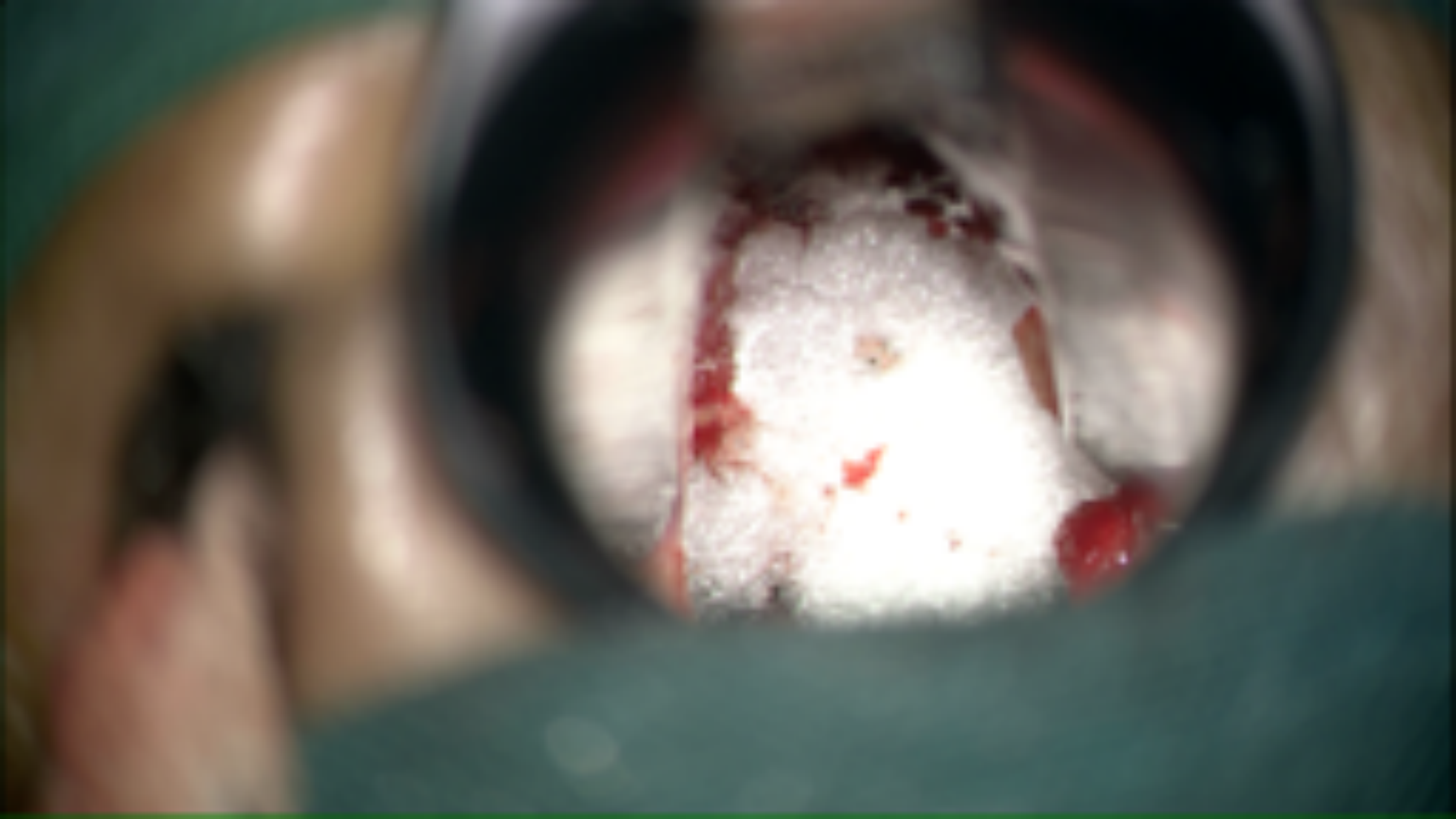
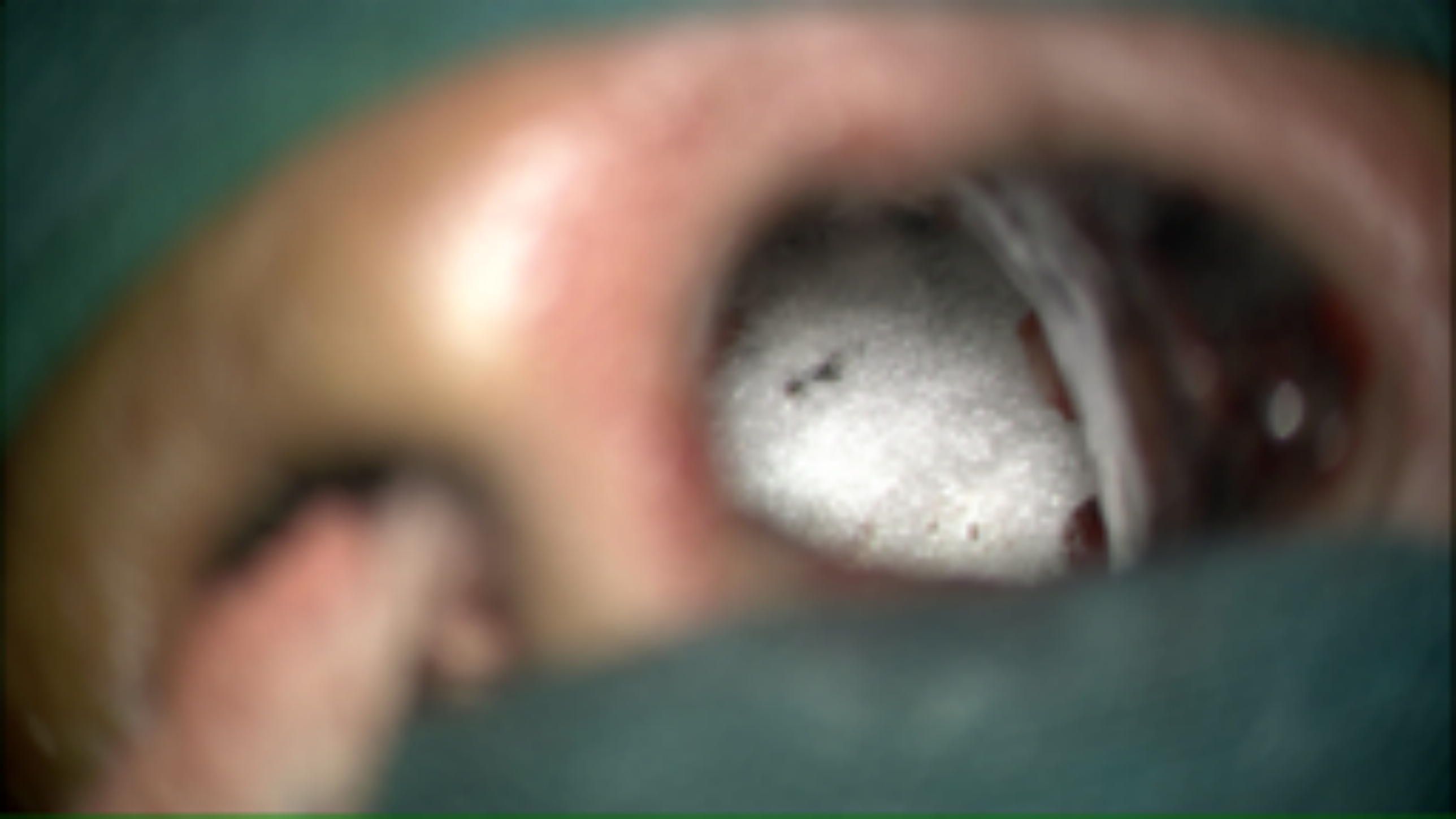
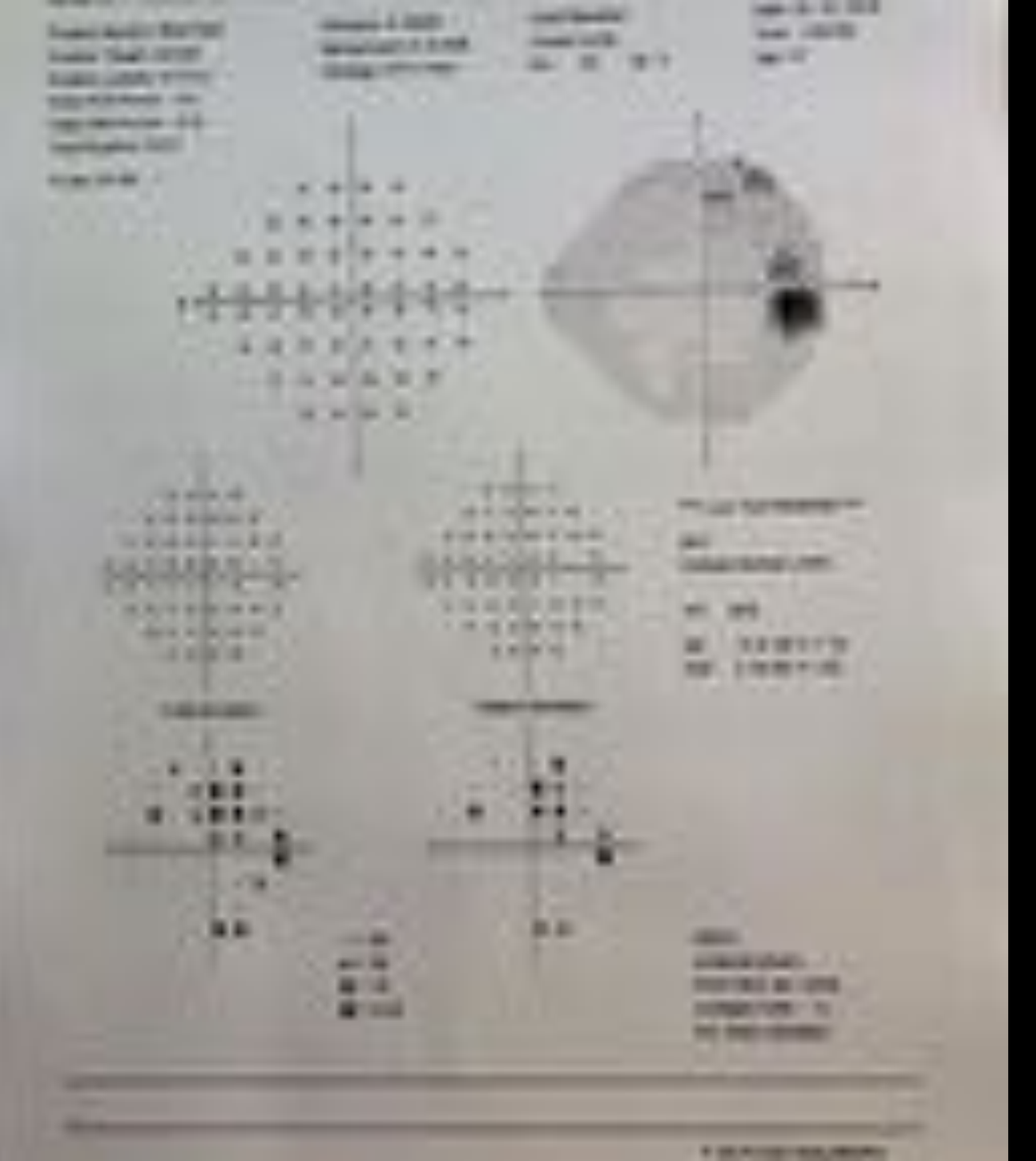
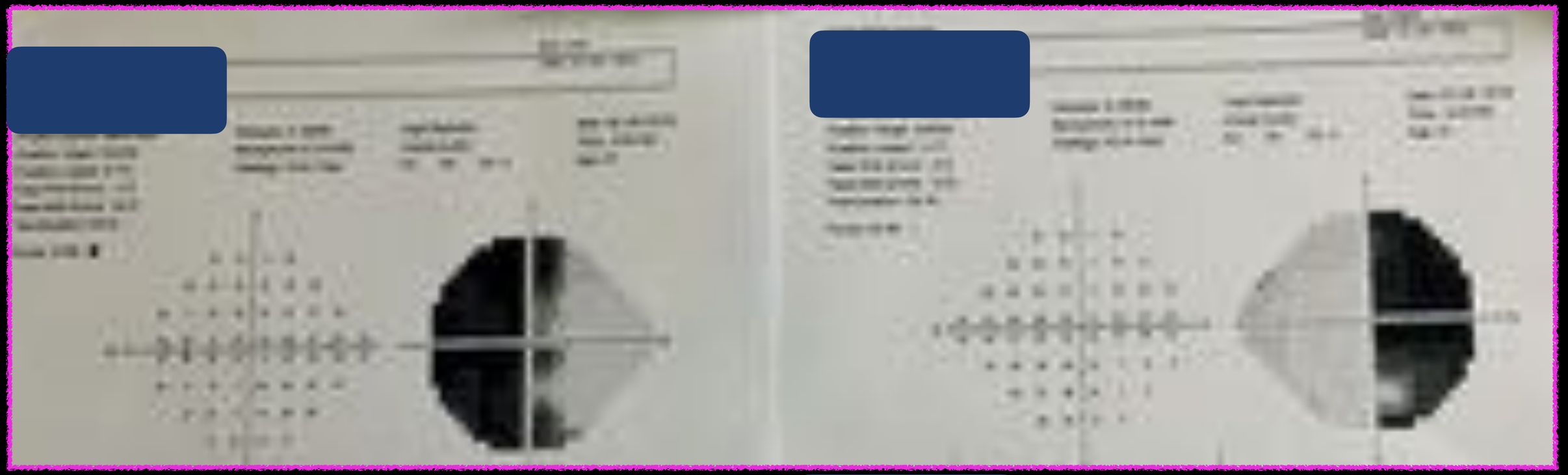
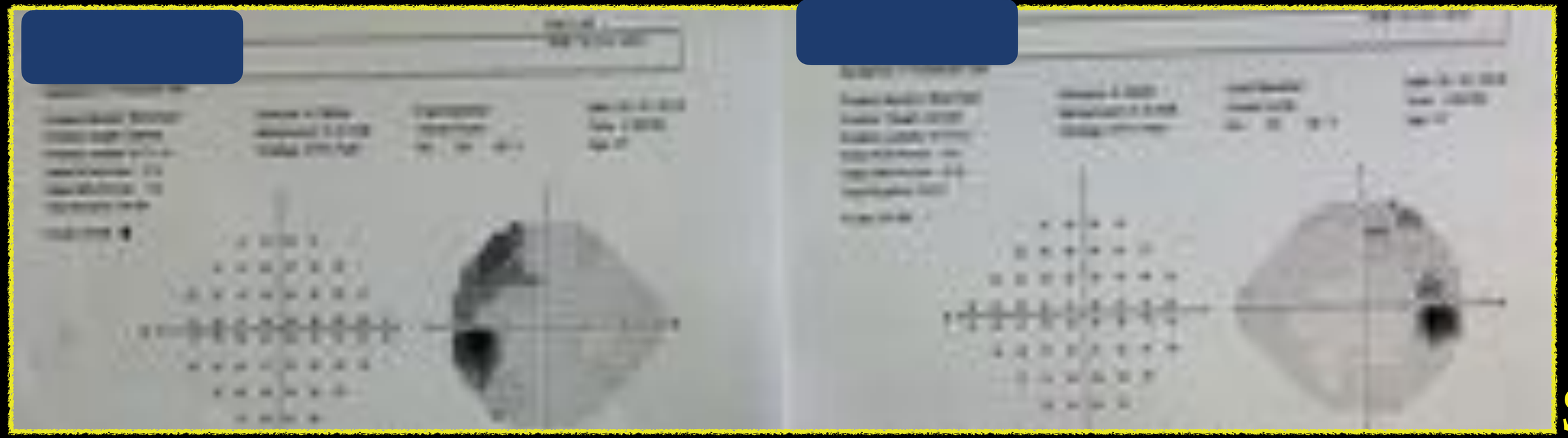




Left Eye







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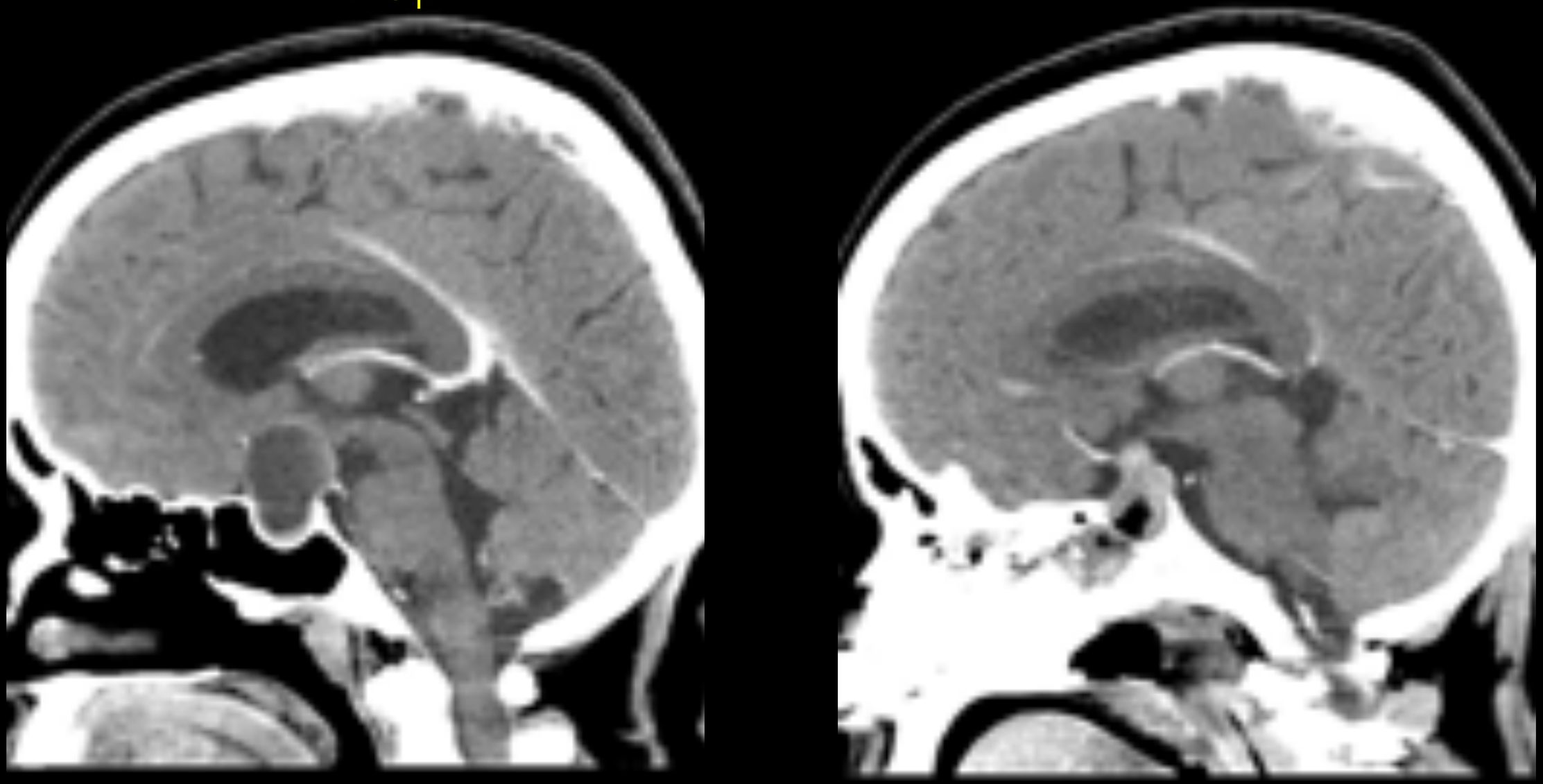
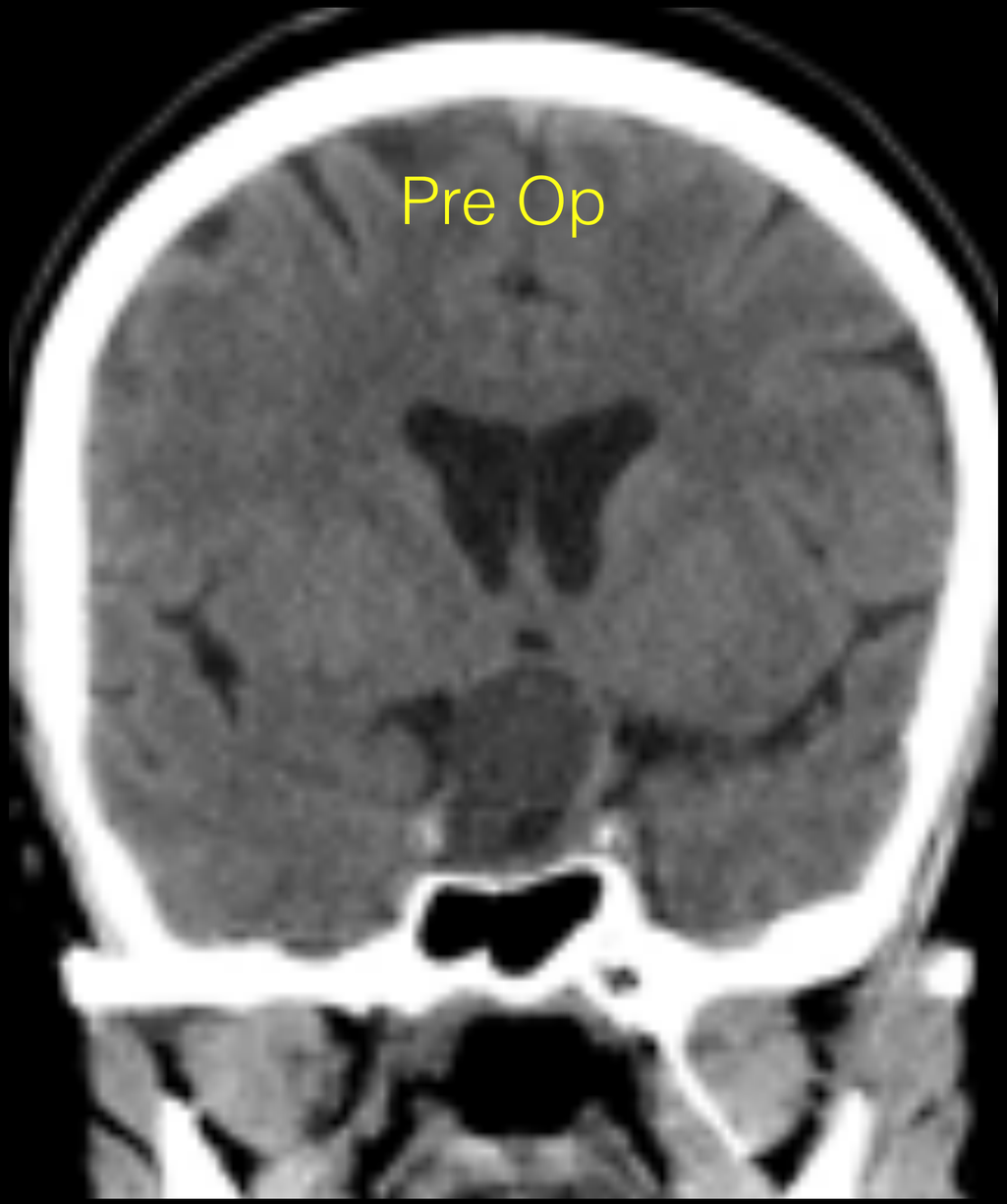

Pre Op



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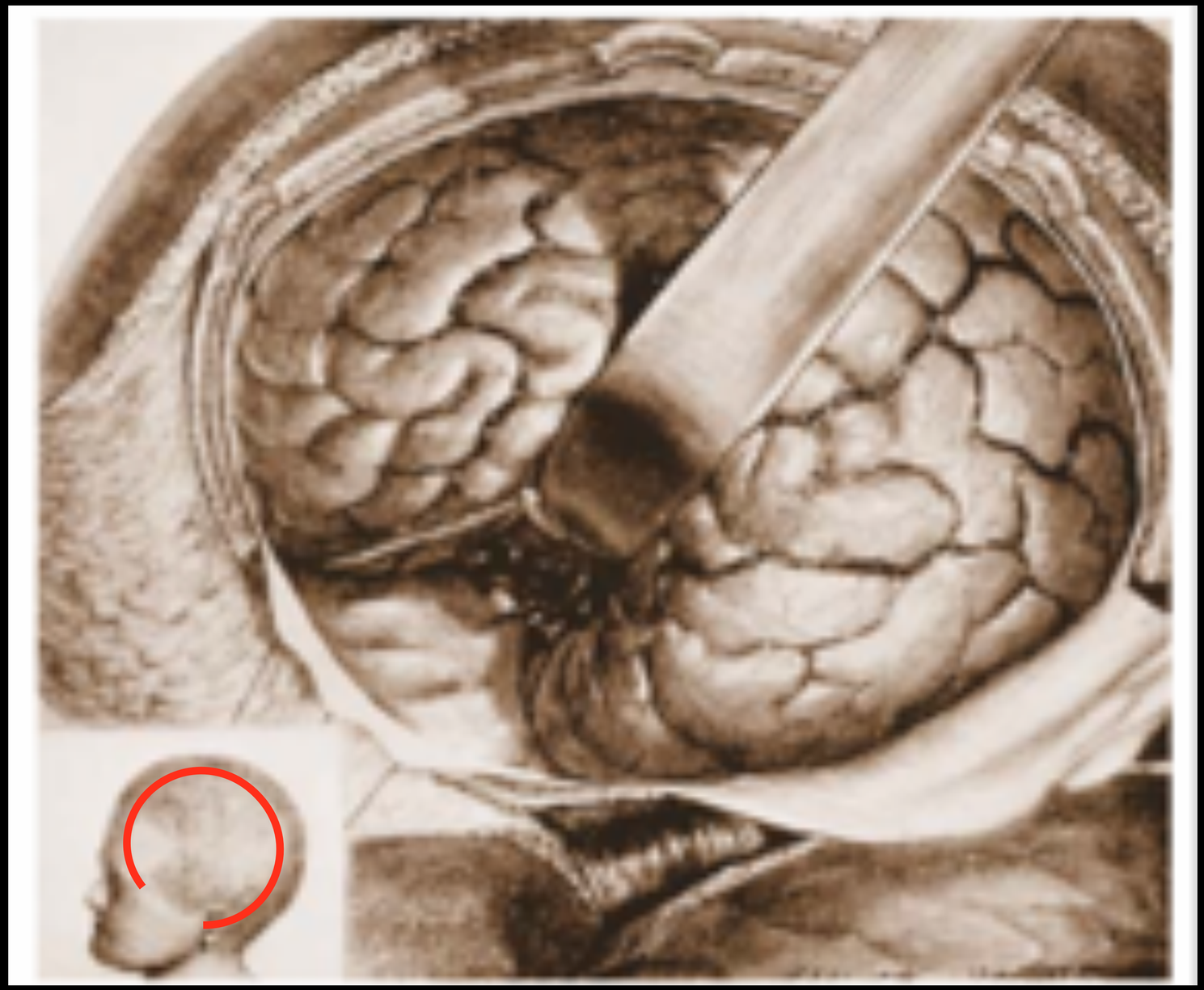
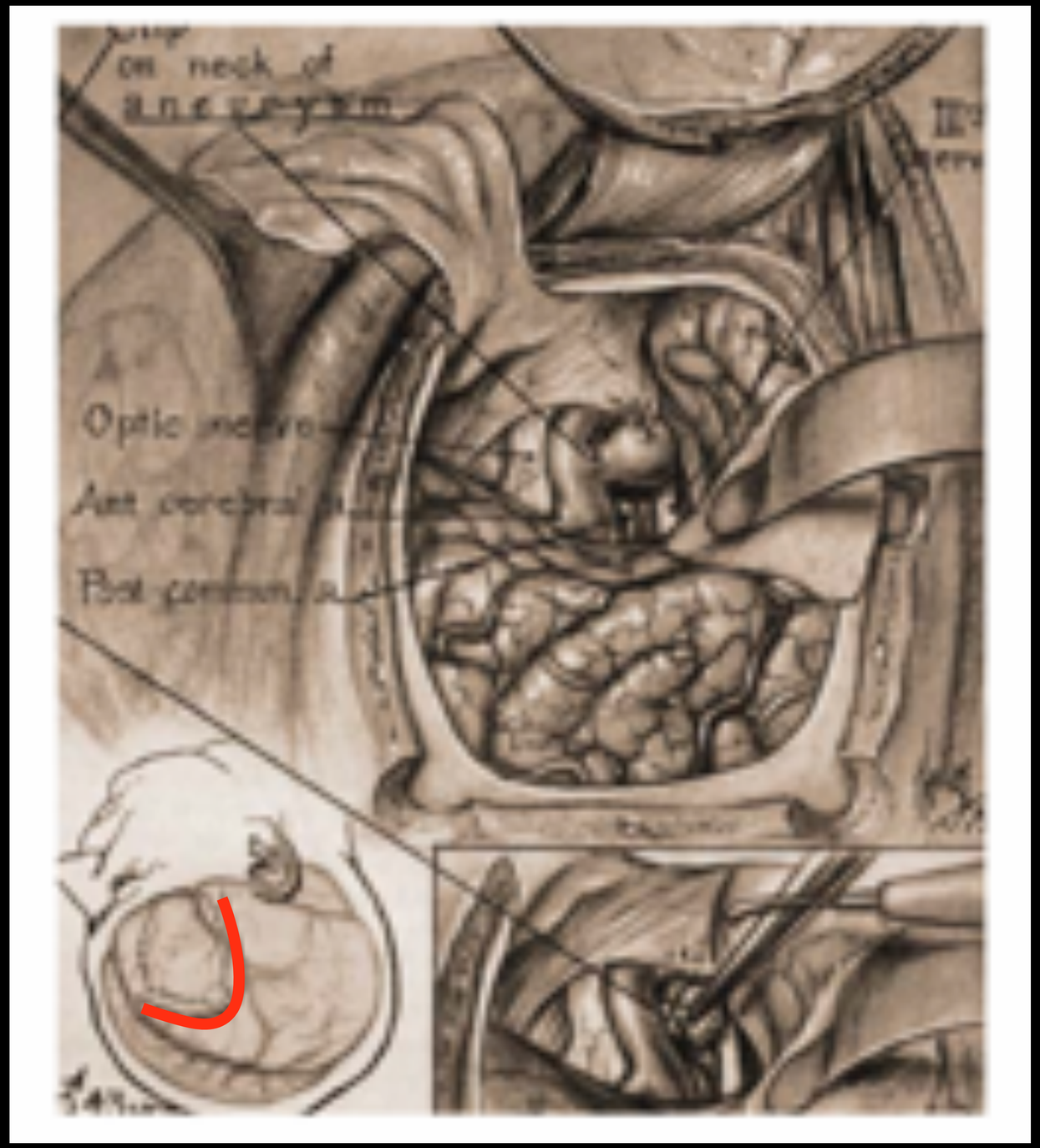


Prof Dandy

- 1920s: Dandy's Fronto temporal Craniotomy
- Exposure of sellar & Para sellar region
- Large Craniotomy to bring Light to Deep seated areas / Macro surgical instruments
- For Pituitary tumour, Left CN II severed to obtain optical monitoring of Tumour removal

SJ

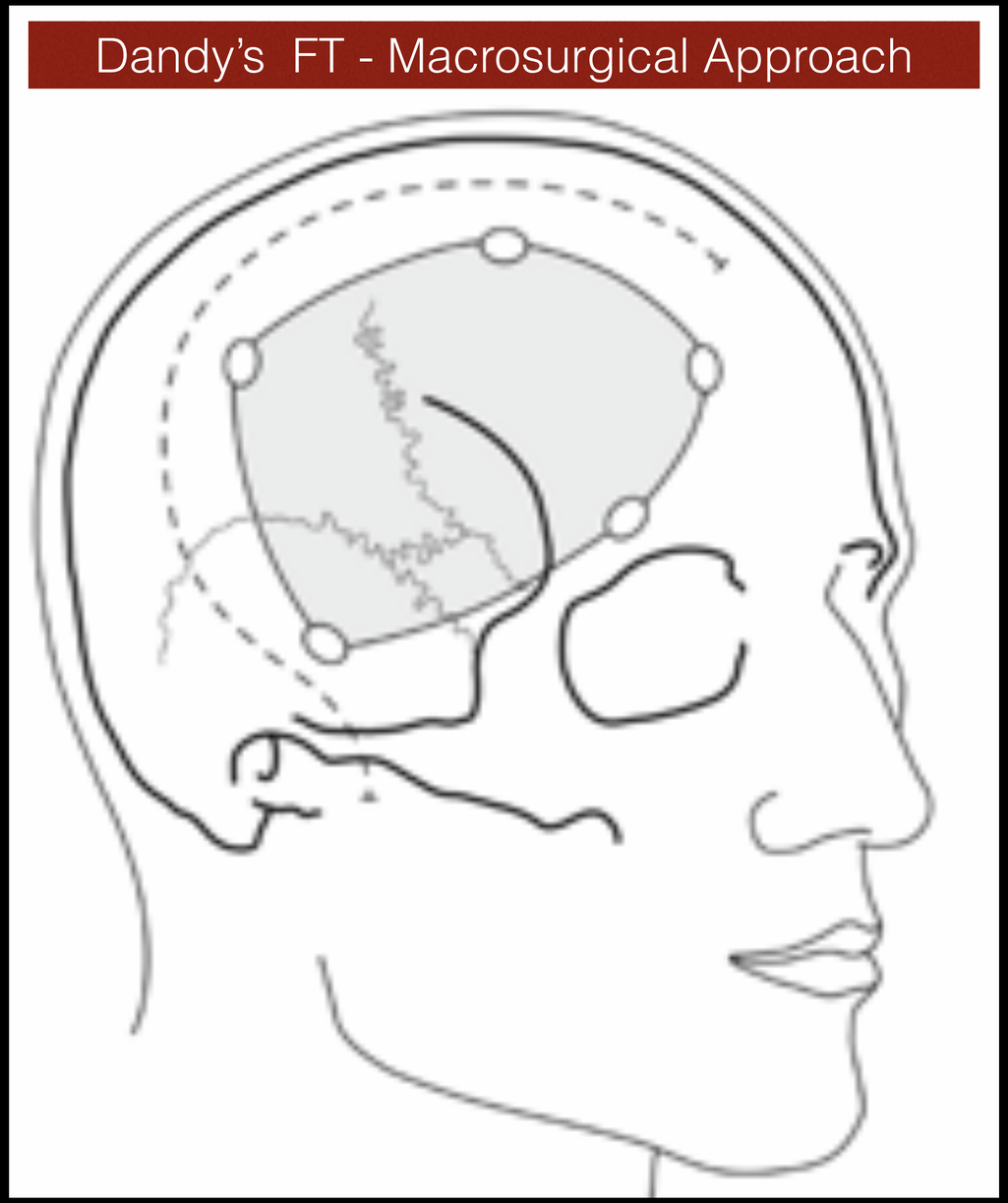


Learning Curve

- 1938: Dandy's Hypo physeal Approach
- Exposure of Supra sellar region
- First Clipping of Aneurysm
  [Oculomotor Palsy due to compression]

SJ

Dandy's FT - Macrosurgical Approach



Yasargil's Pterional Microsurgical

SJ

Supra orbital - Key Hole approach

SJ

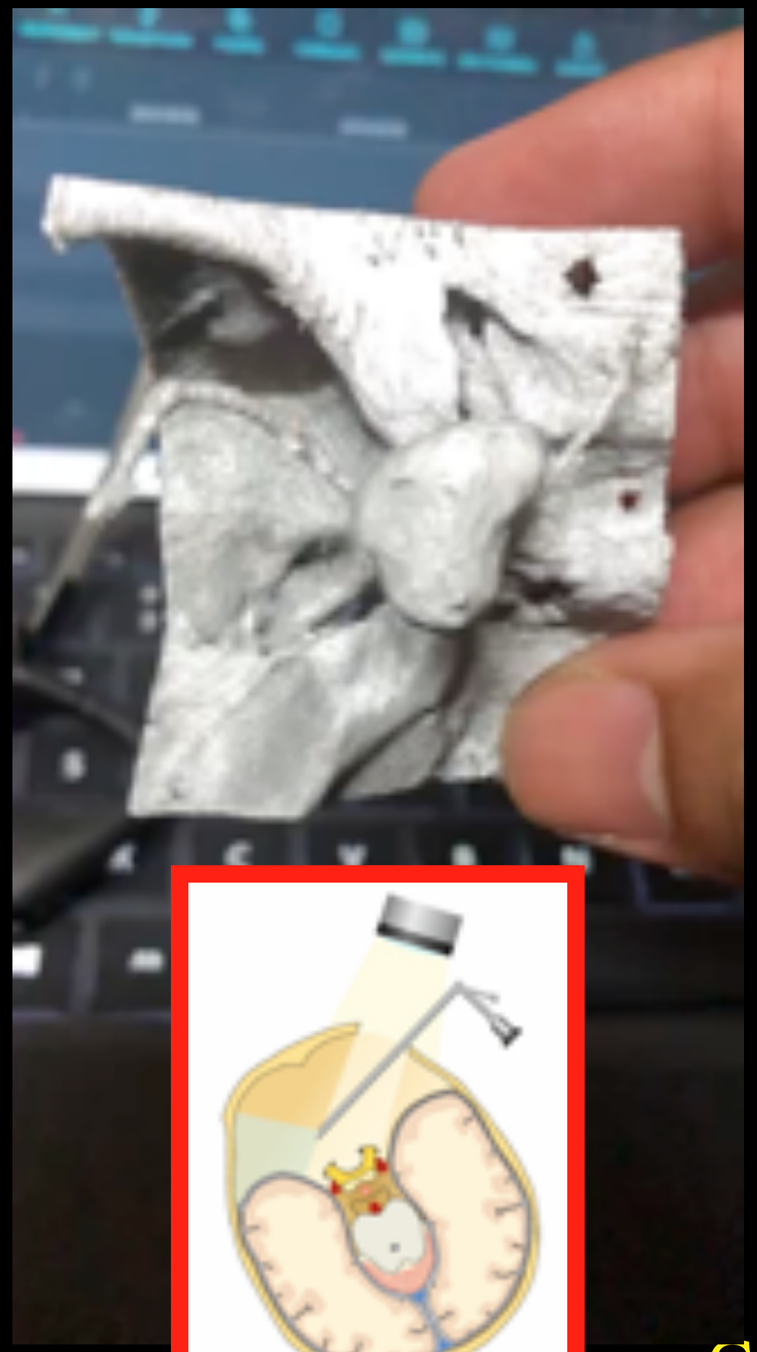
Aim of Key hole

- not the limited Craniotomy alone
- Philosophy of minimal invasive ness [MIS]
- Craniotomy: as limited as possible to offer minimal brain trauma, as large as necessary to achieve safe surgical dissection

SJ

Requirements

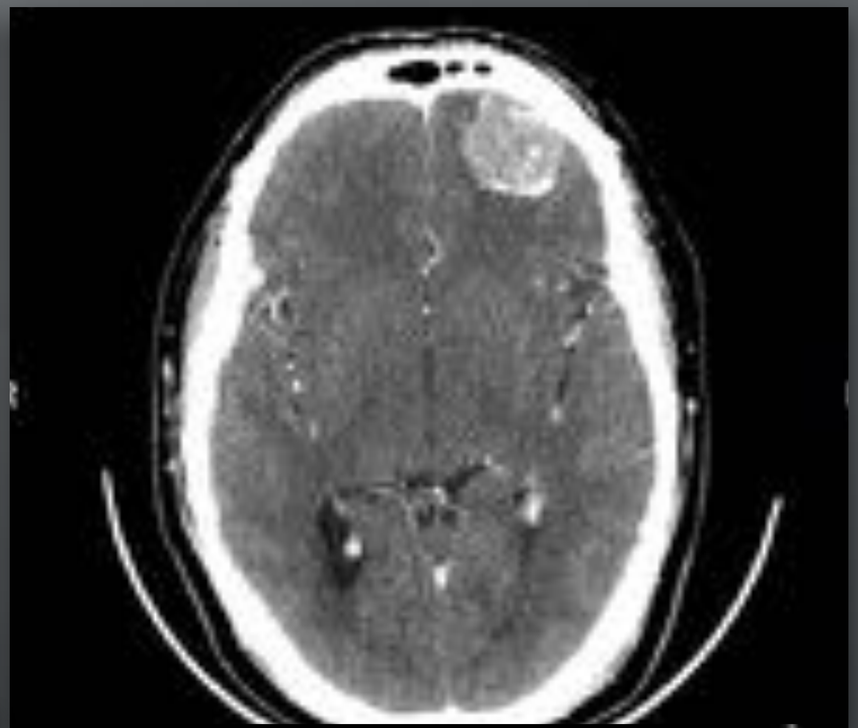
- Special Micro-instruments
- Microscope:
  - HD / ICG / Exoscope
- Navigation / Robotics
- Endoscope
- 3D anatomy
- USG / intra op CT-MRI / iONMonitoring

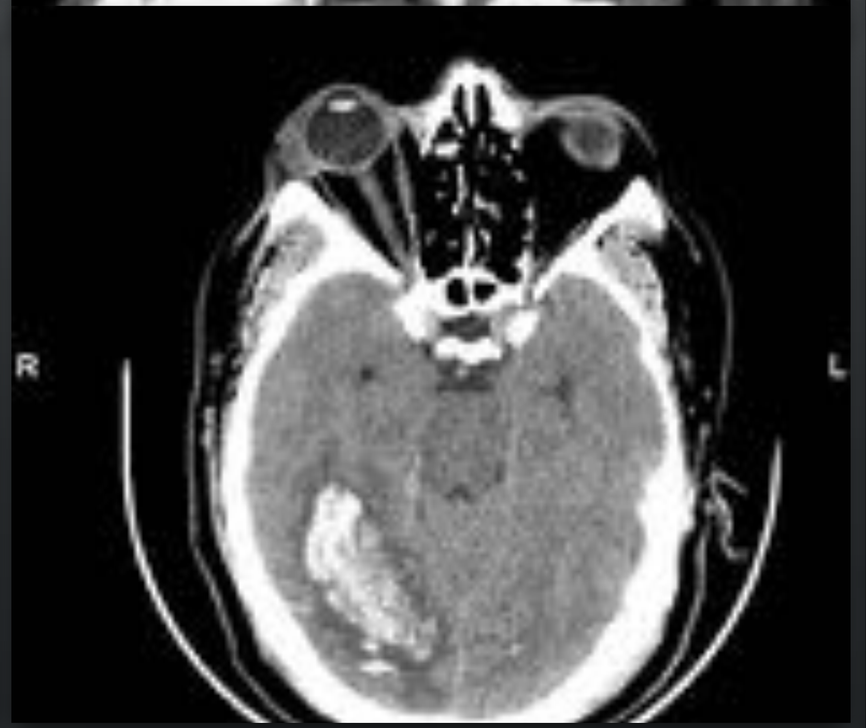


SJ

CLINICAL PRESENTATION

- 38 yrs Gentleman
- HA & Vomiting on 09/03/2018
- HT [5 yrs] on irregular treatment
- CTB & MRI: Transverse Sinus Thrombosis with Bleed
- Treated with Acitrom then Dabigatron 110 mg BD
- Readmitted on 14/06/2018 for SOL removal

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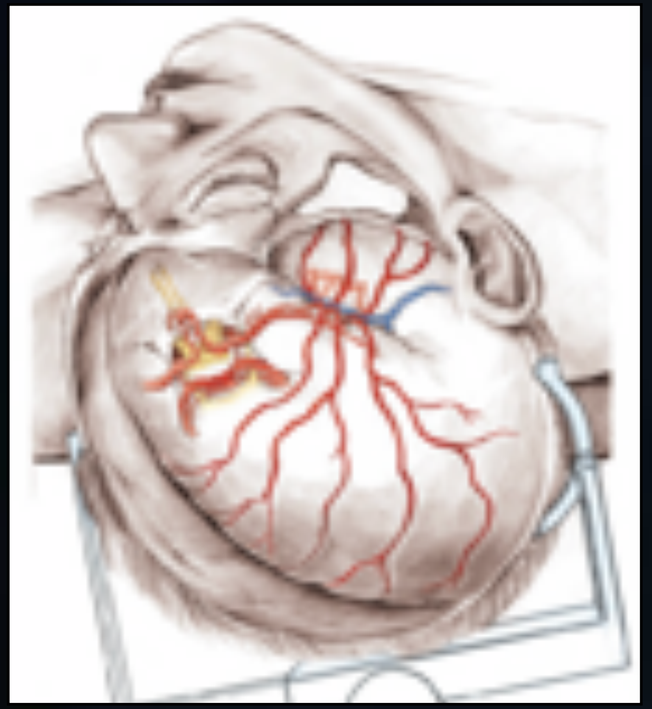

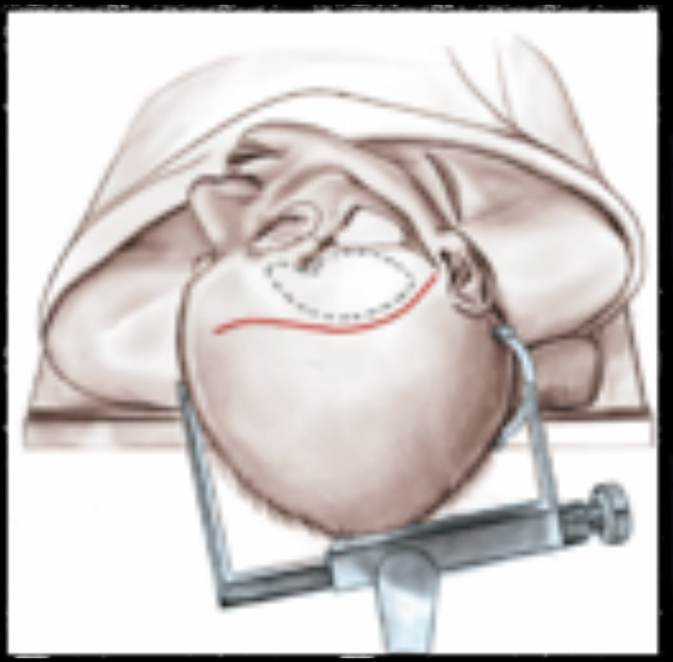

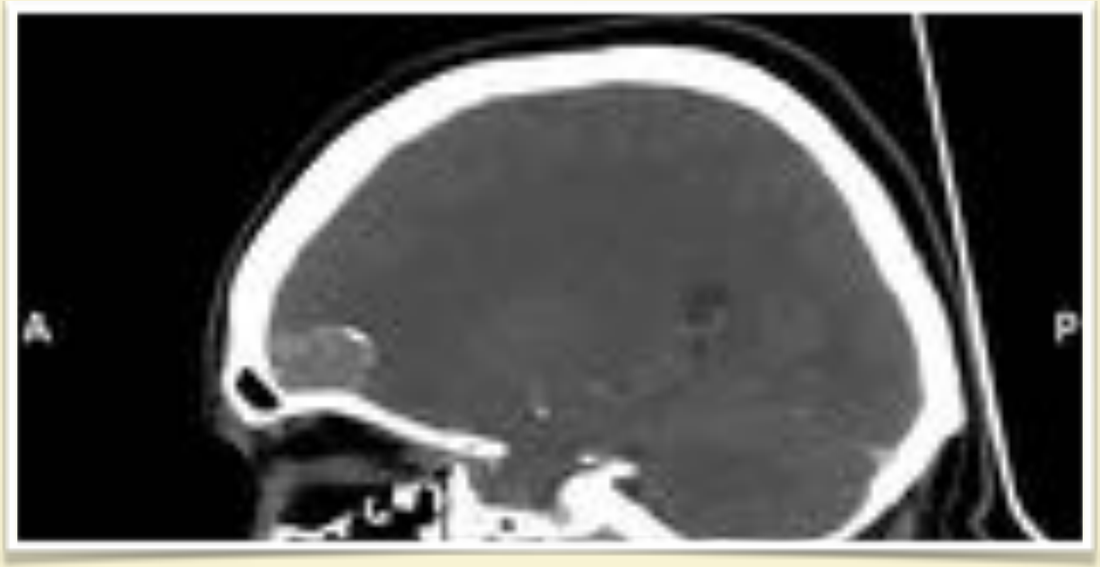
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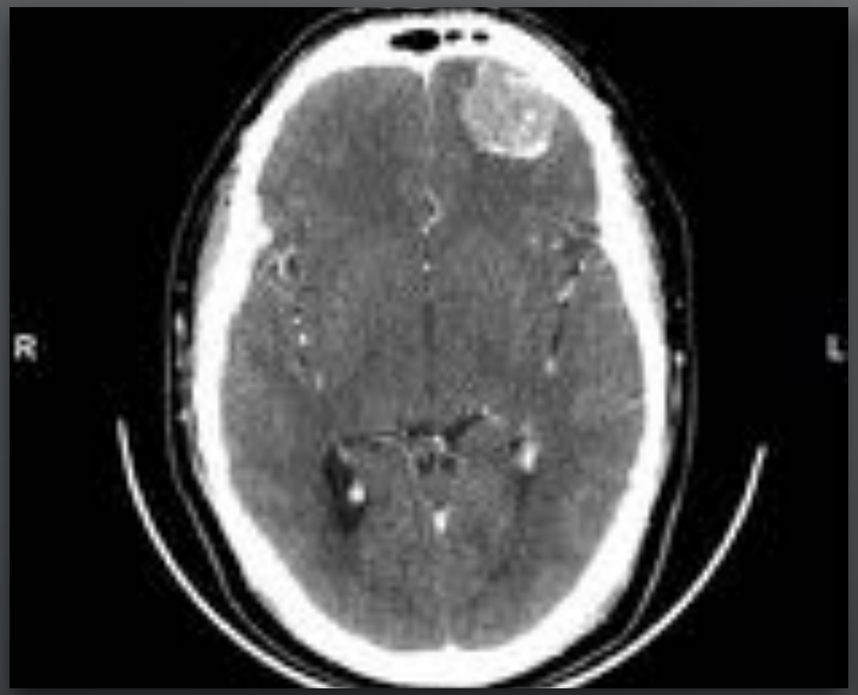

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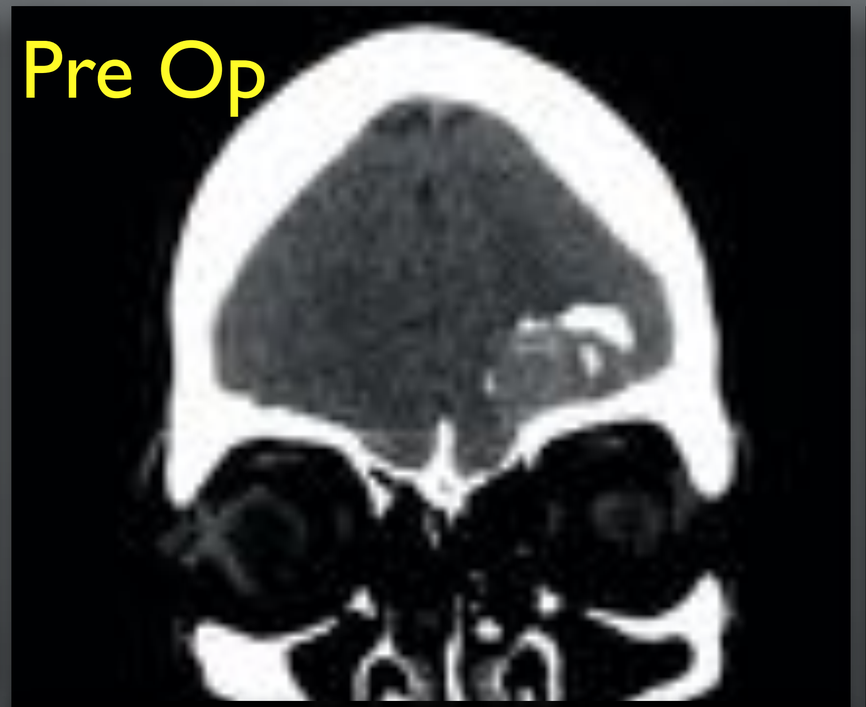
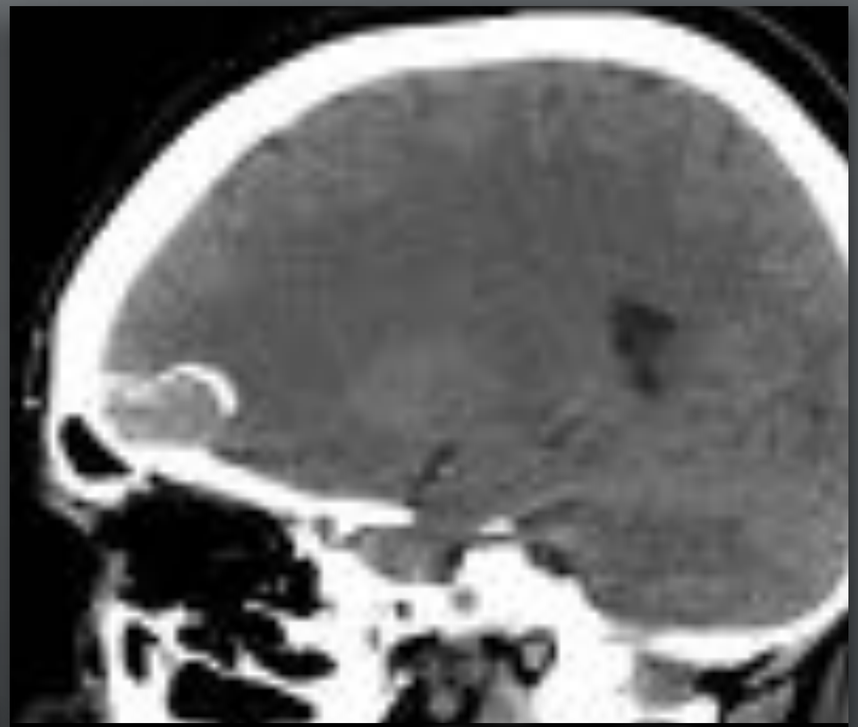
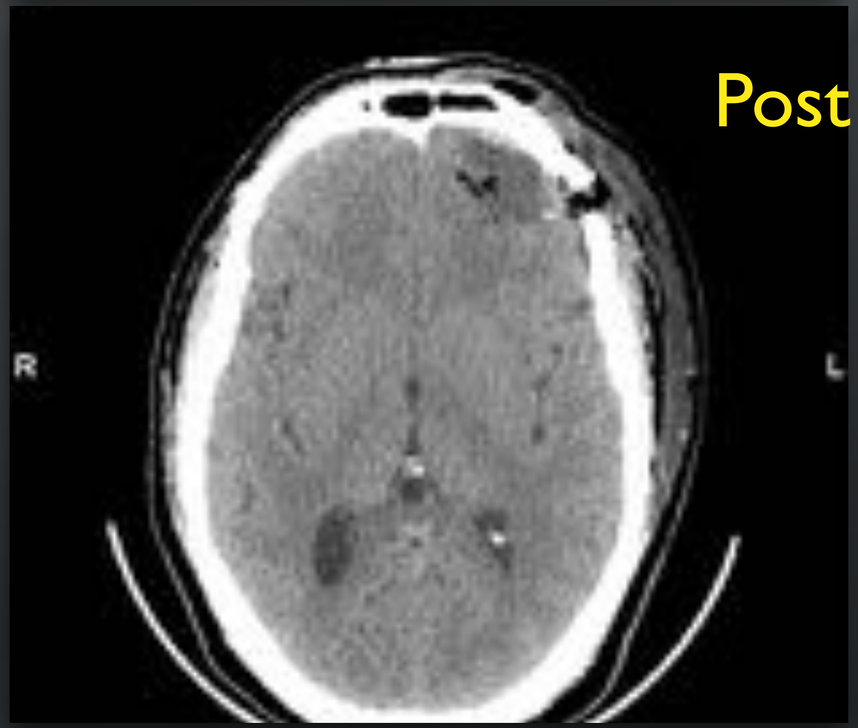
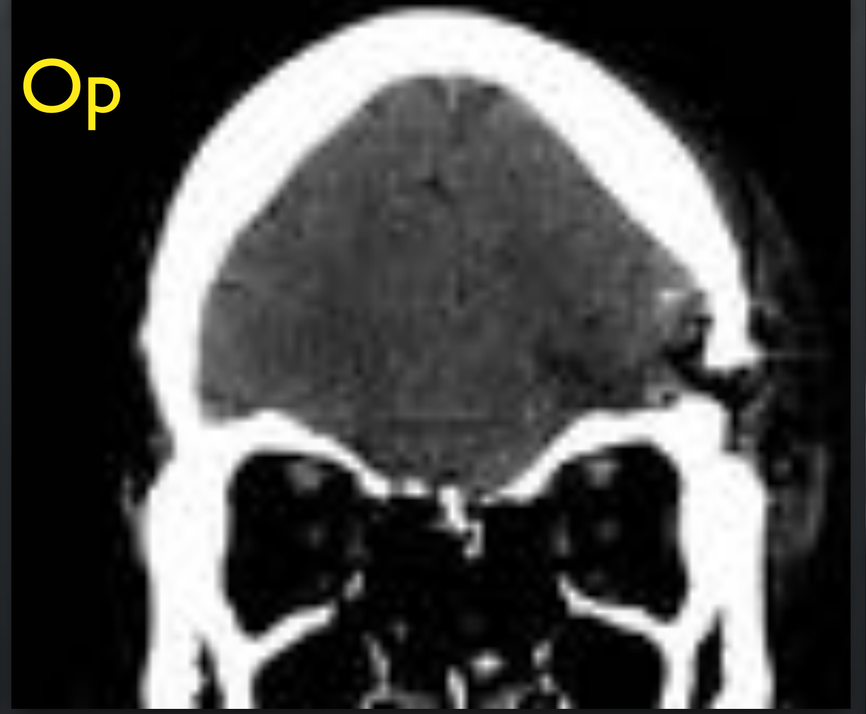






Post Op

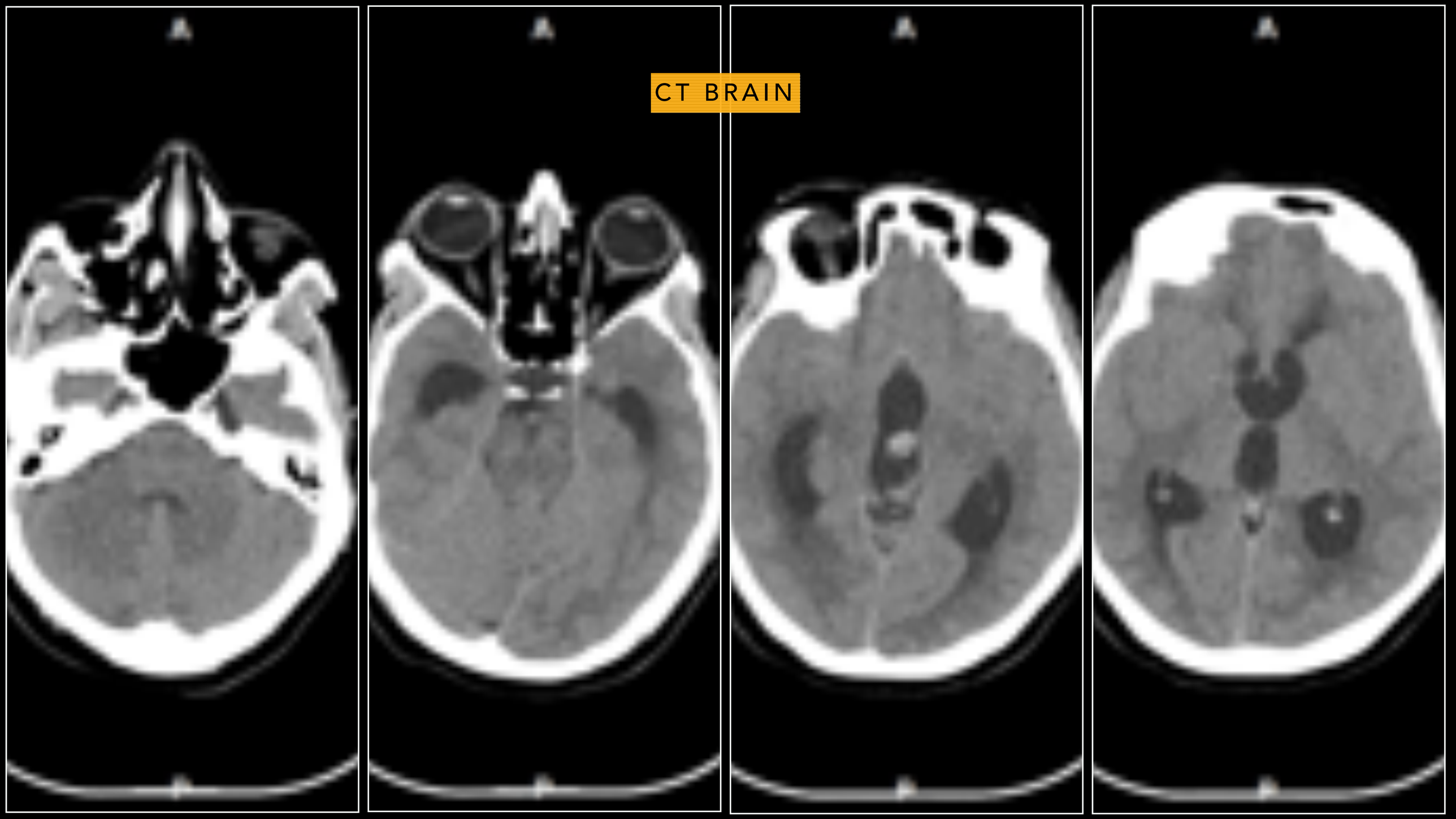


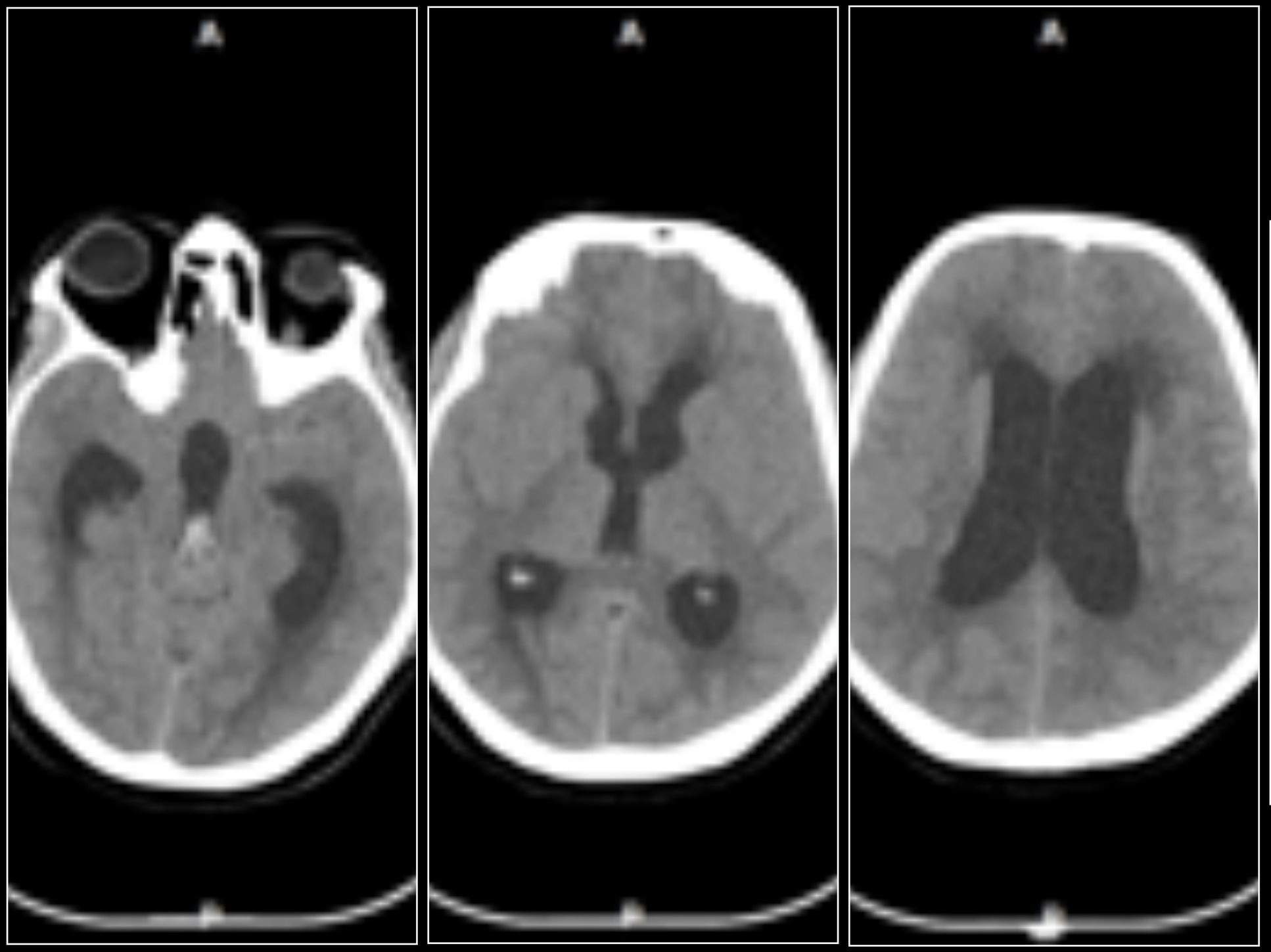
CLINICAL PRESENTATION

- 46 yrs Lady
- Known Psychiatric illness - Treated 2014 @ KMCH, Lost followup
- H/o Syncope / Diplopia and Incontinence - 1 wk duration
- Ref to Opthal evaluation from Psychiatry

CLINICAL PRESENTATION

- <u>Opthal Evaluation:</u>
- Fundus: Severe Disc edema
- Left > Right, > 6 diapter
- Left 6 th CN Palsy: Diplopia
- Ref to Neurology: Investigated-CT & MRI


CT BRAIN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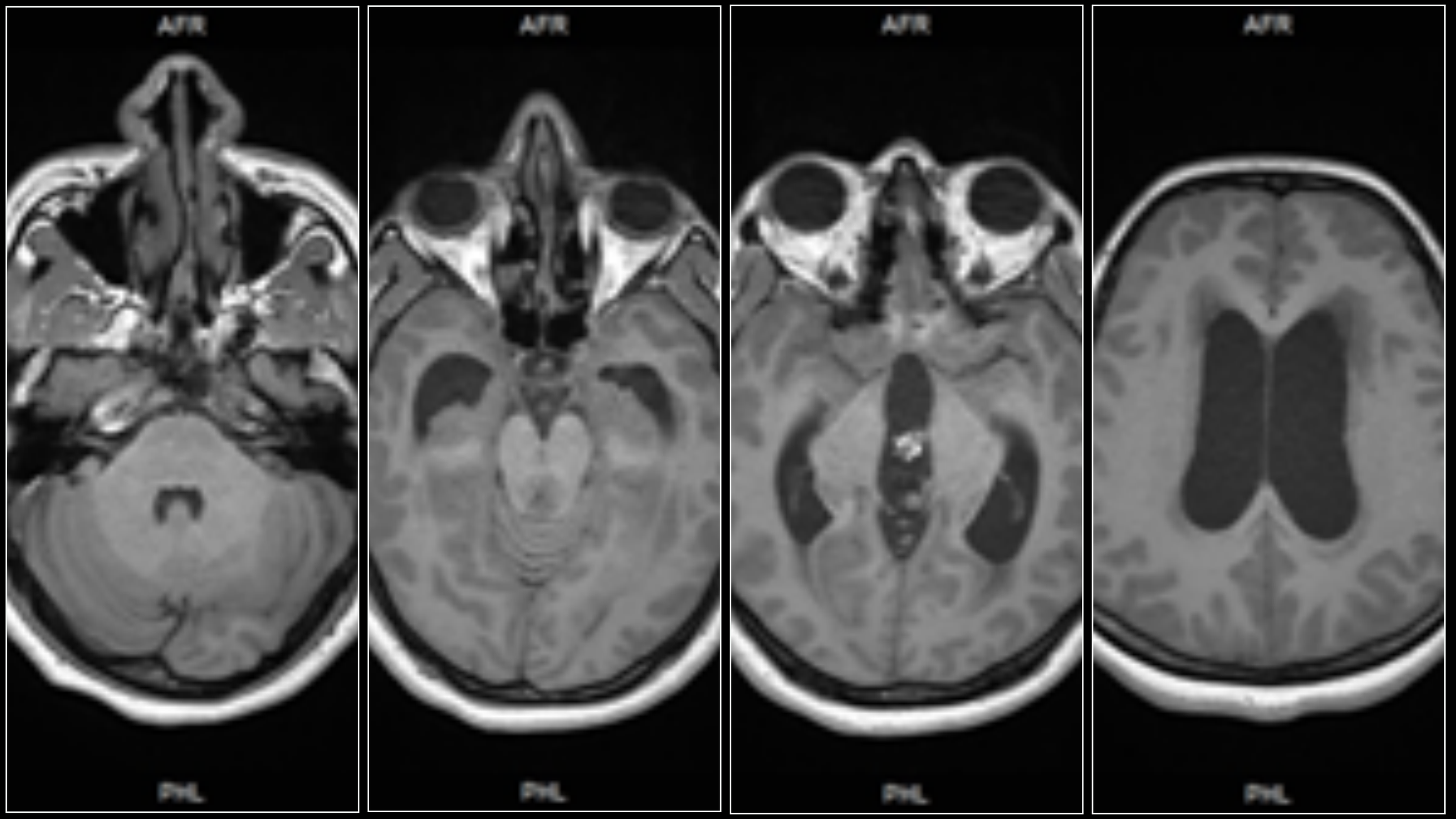
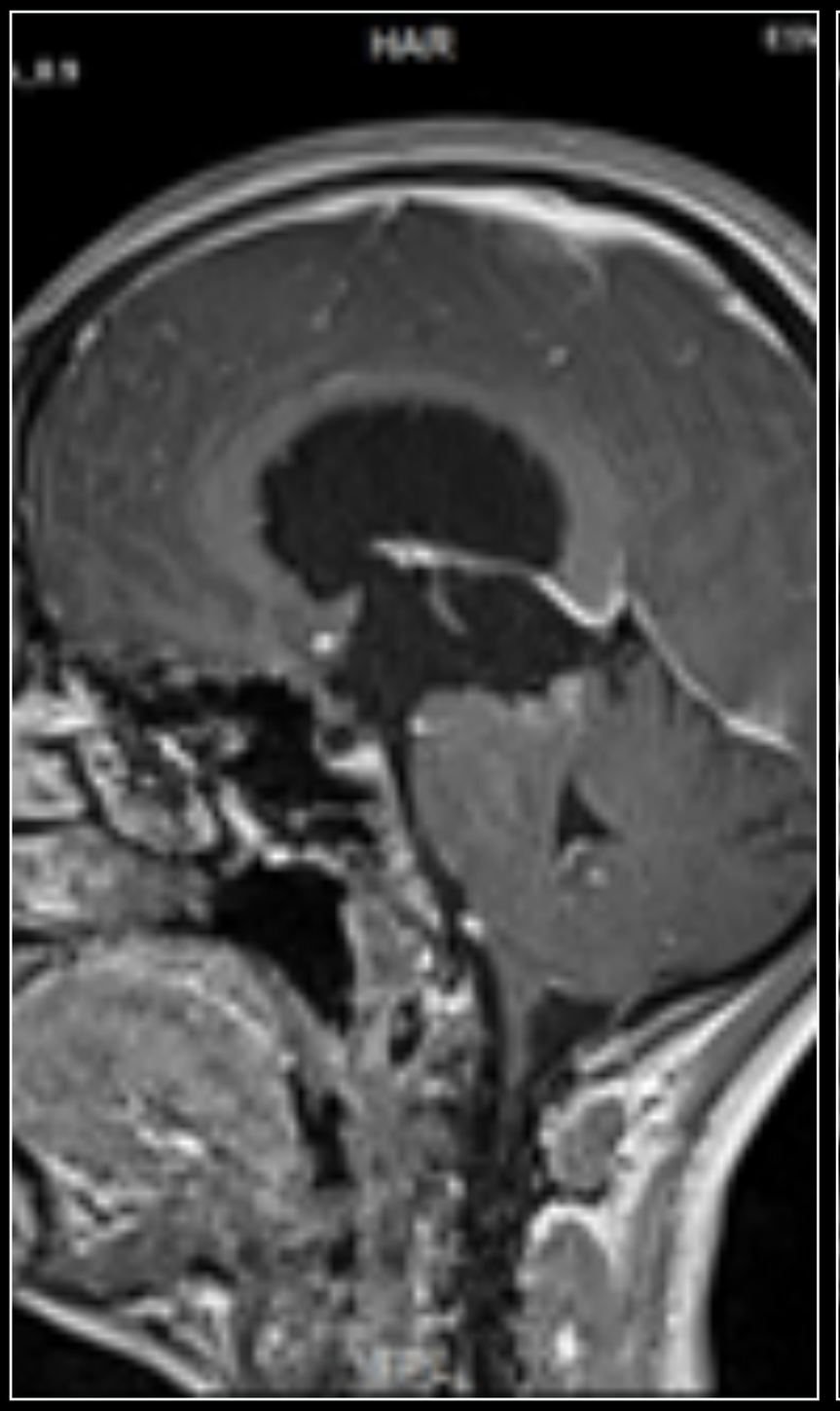
FAR


AFR
PHL
AFR
PHL
AFR
PHL
AFR
PHL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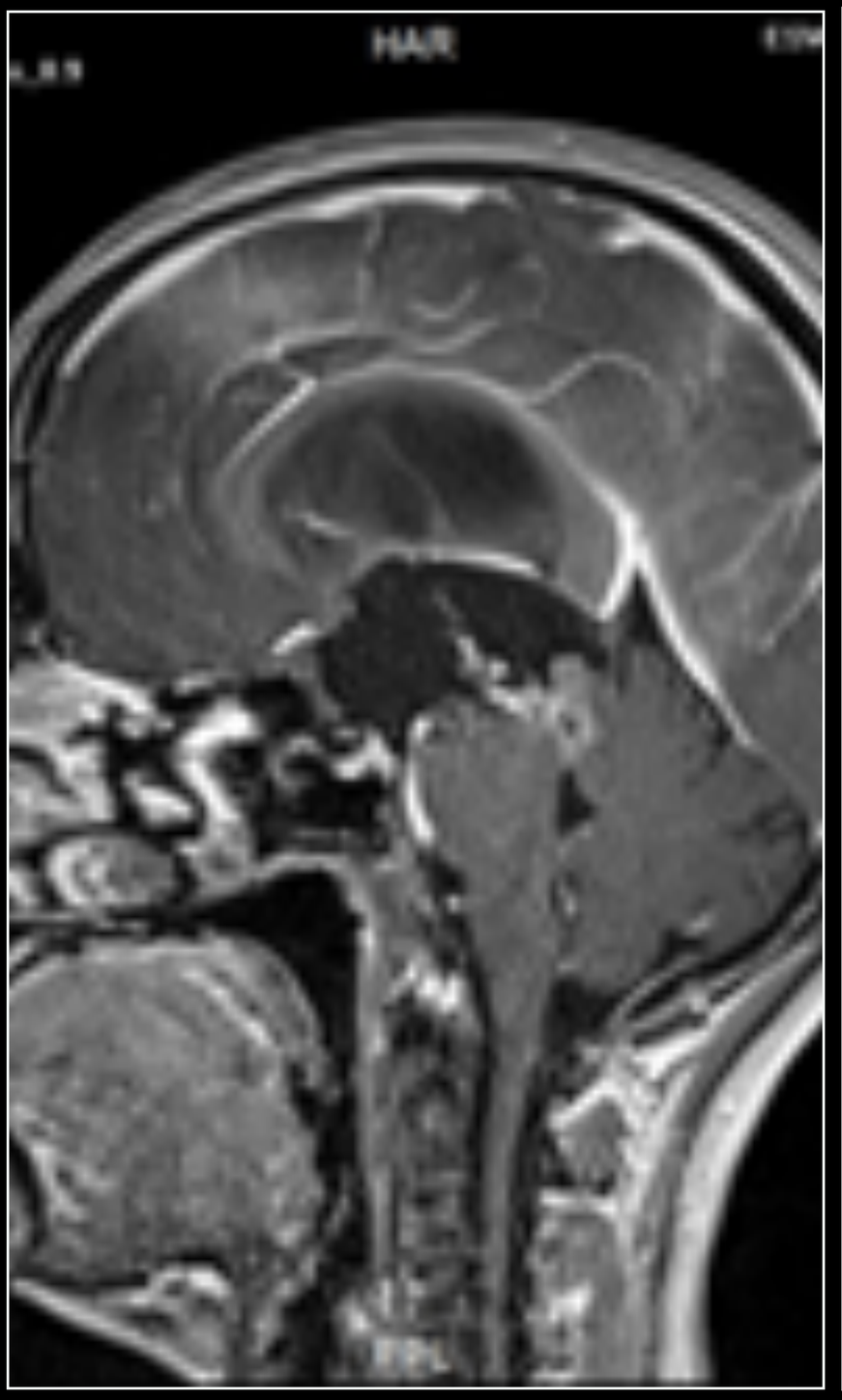
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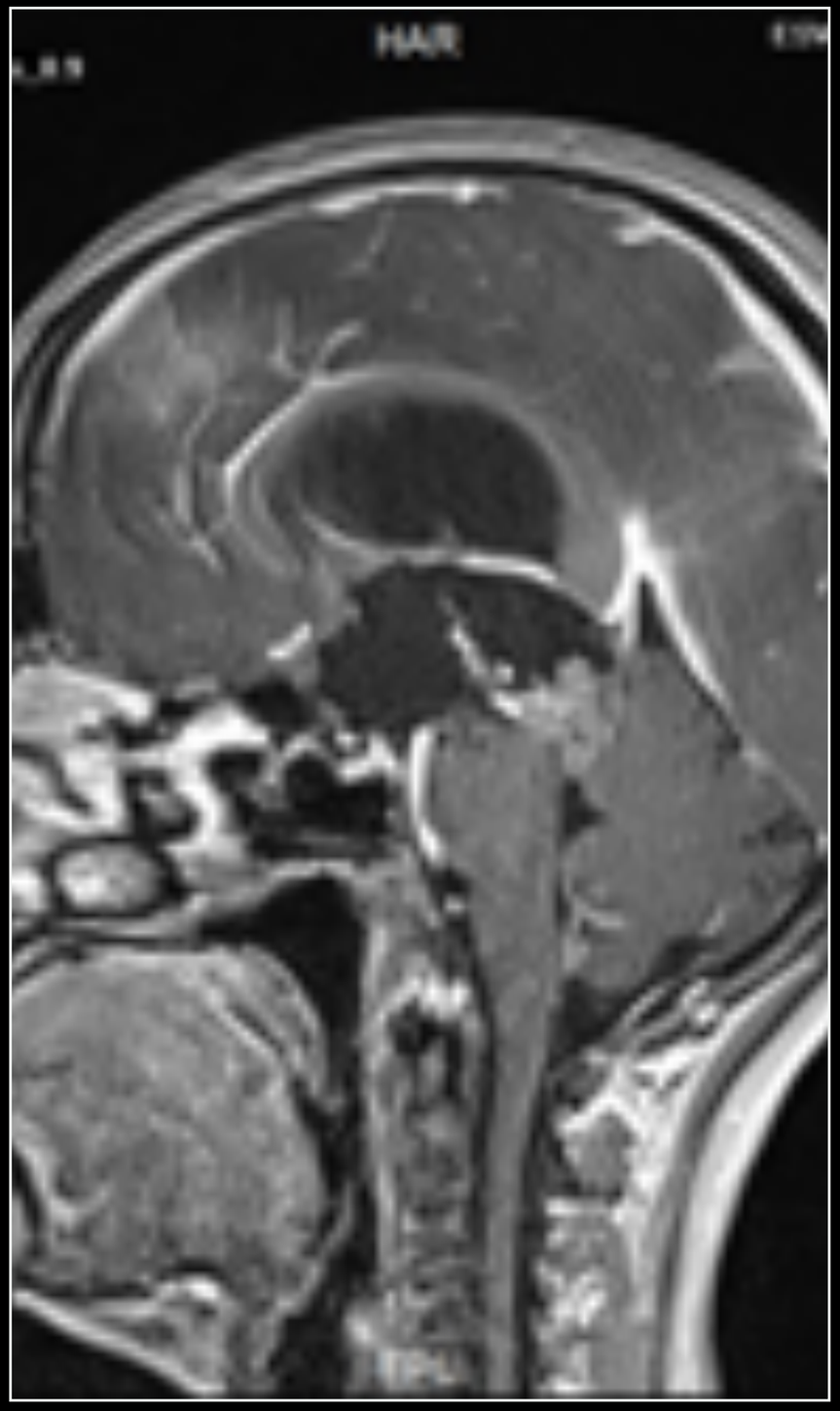
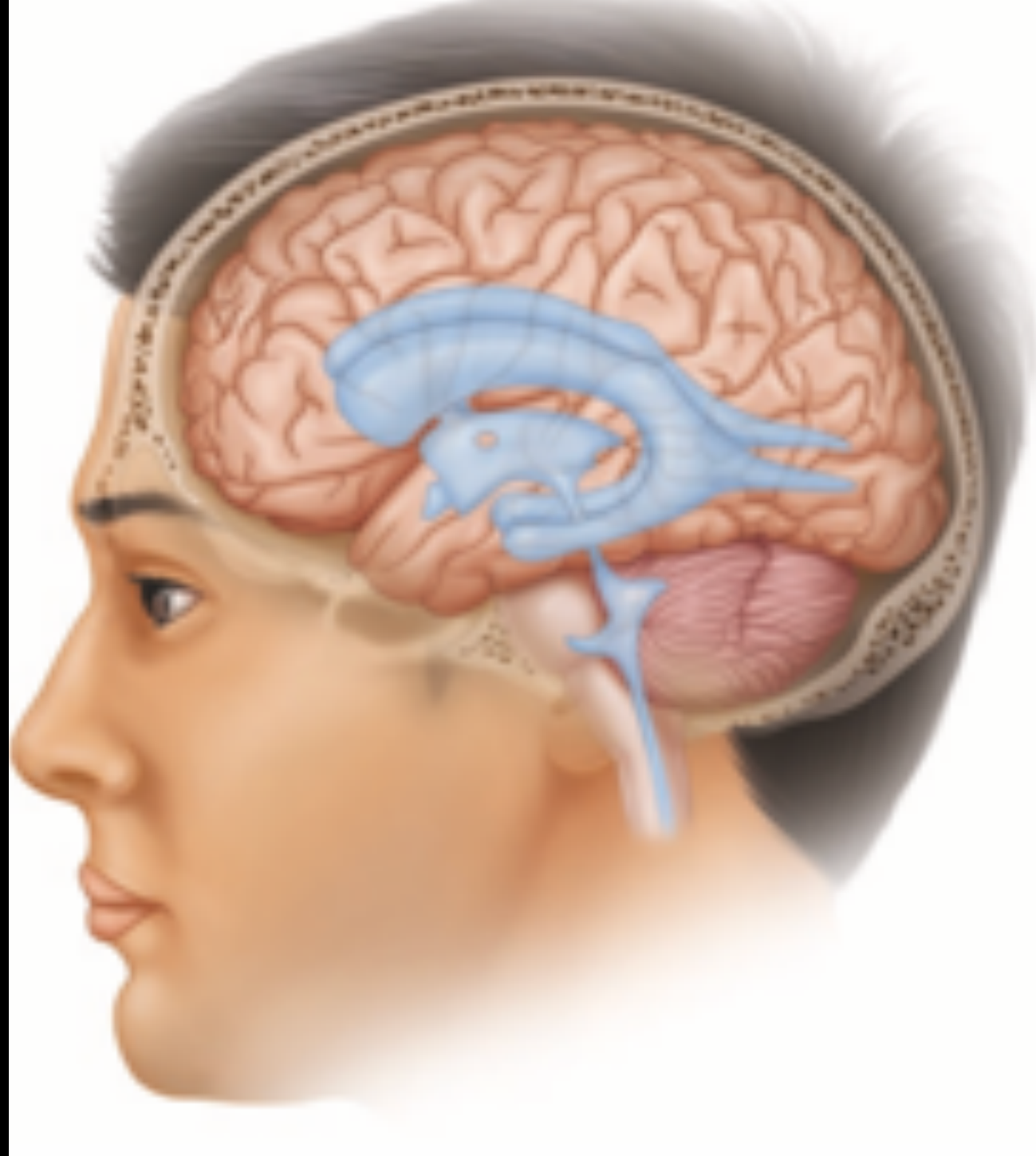
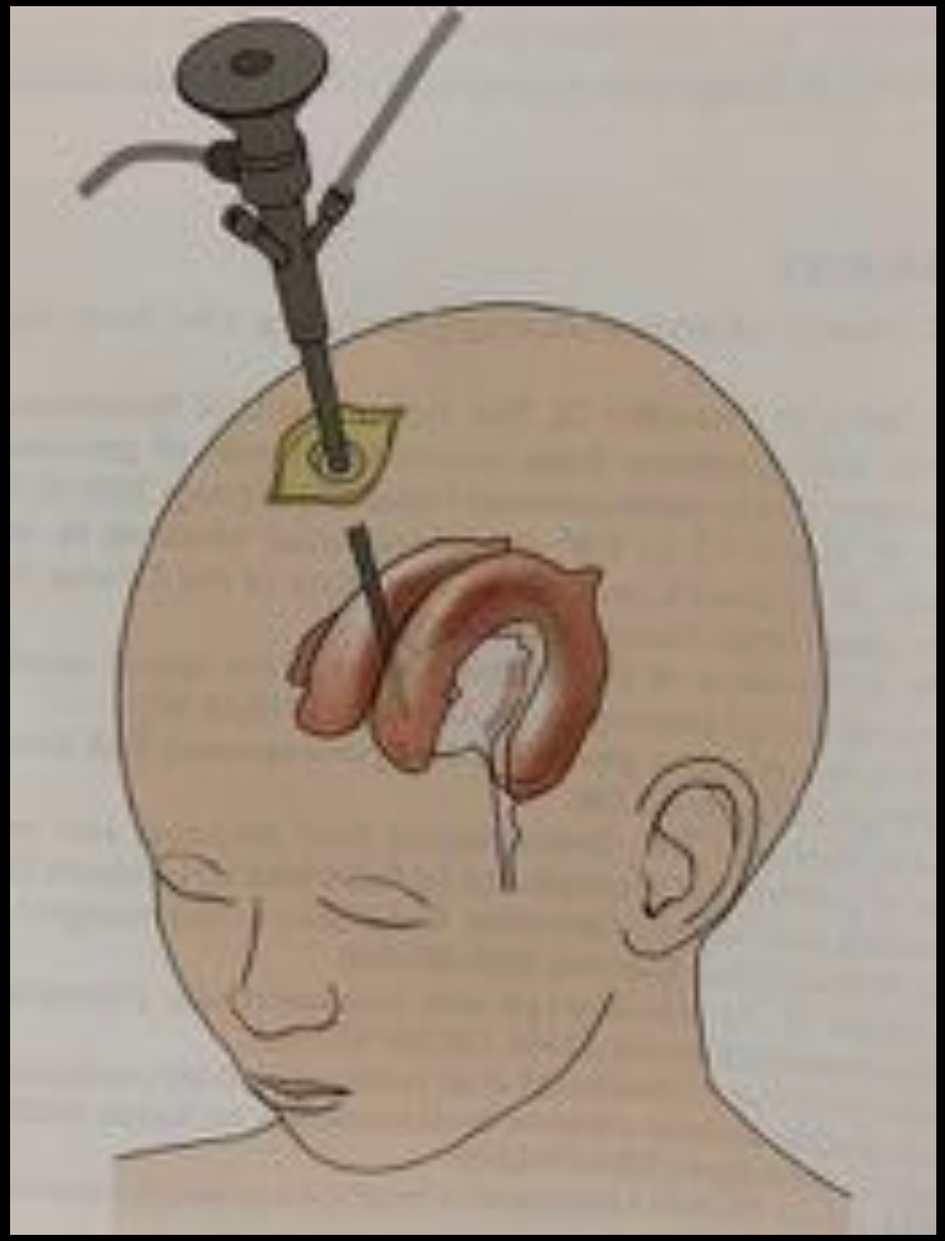

HAR

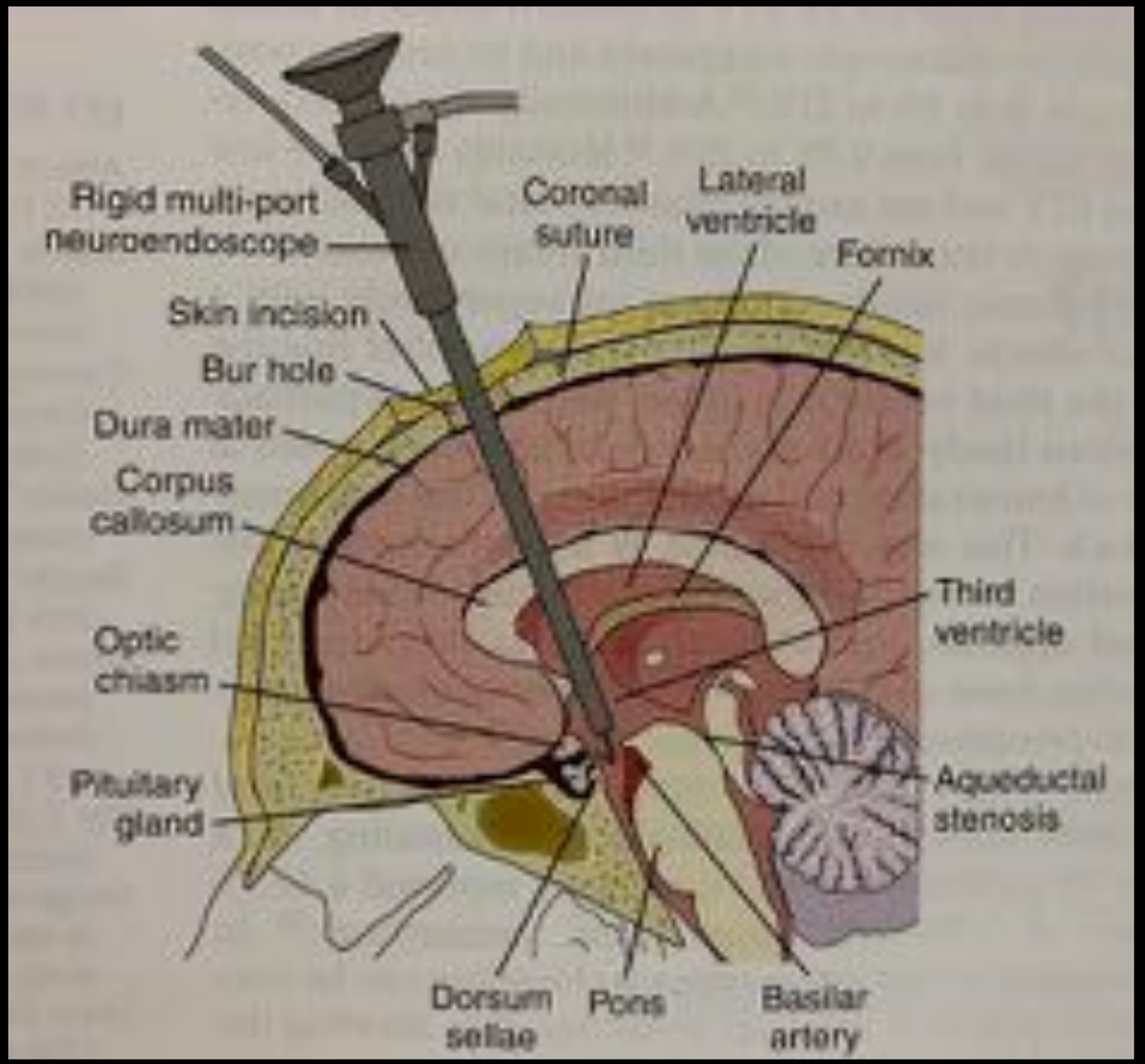
OPTIONS

- VP Shunt followed by Craniotomy and tumour biopsy
- ETV +/- Tumour biopsy
- CSF Diversion & Follow up

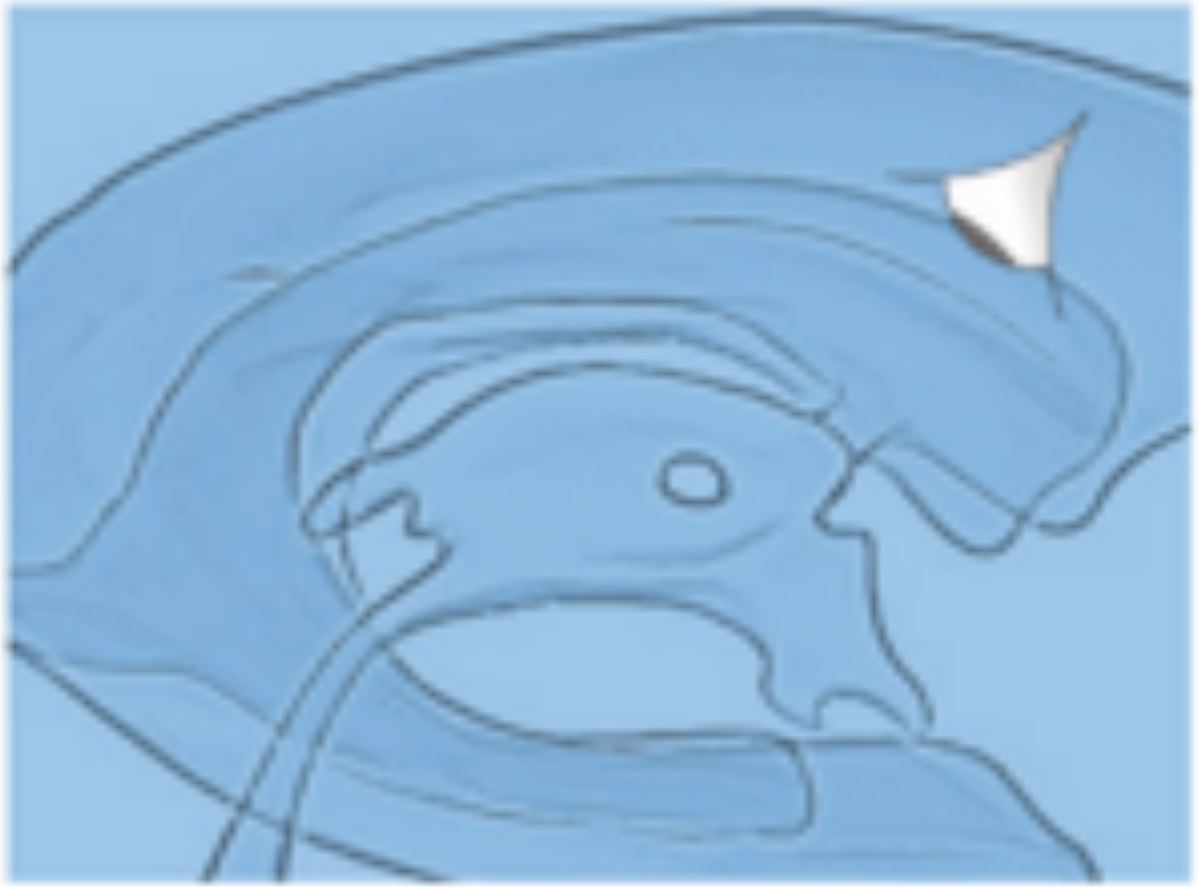
CSF DIVERSION

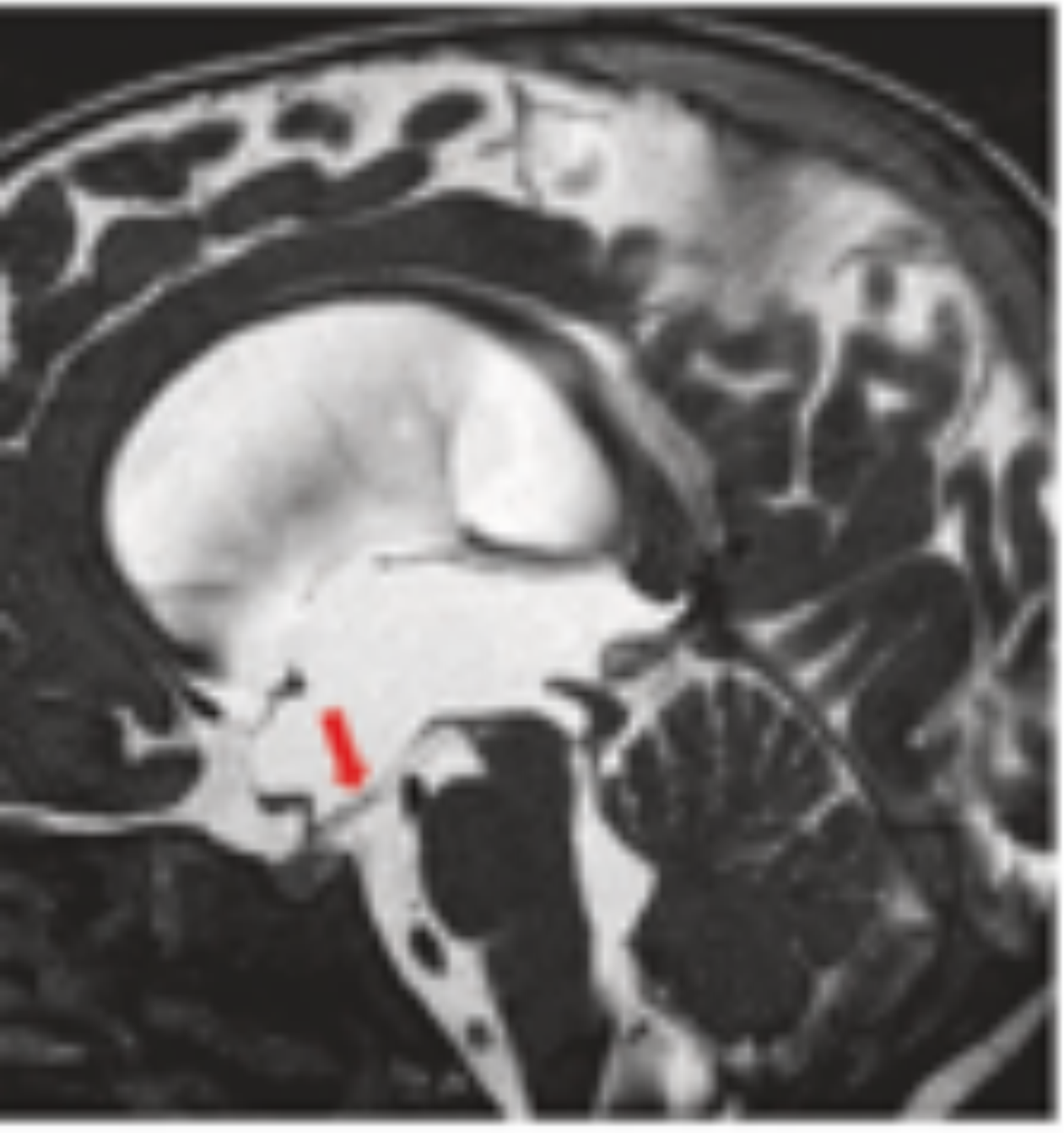


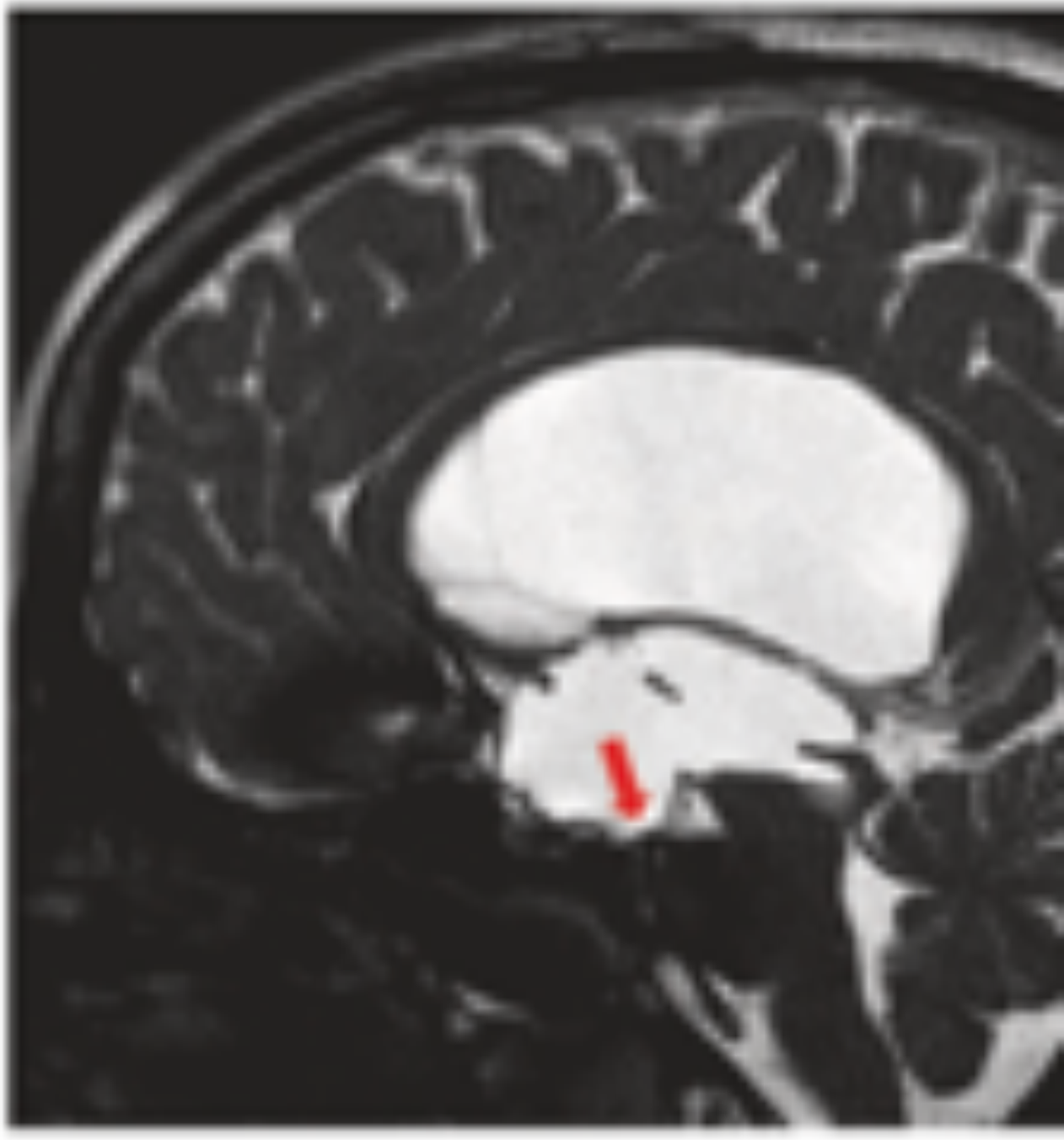


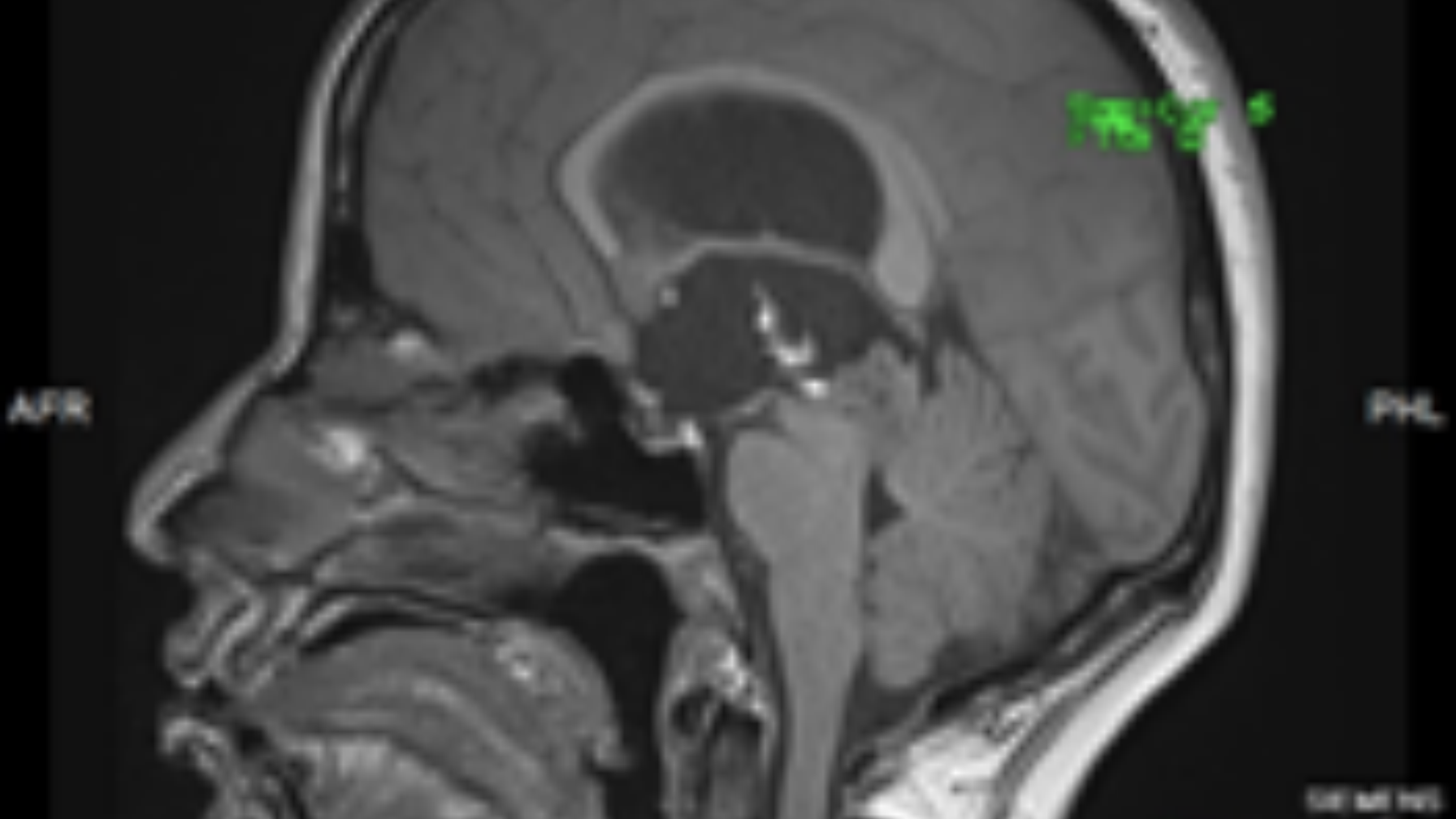

Rigid multi-port neuroendoscope
Coronal suture
Lateral ventricle
Fornix
Skin incision
Bur hole
Dura mater
Corpus callosum
Third ventricle
Optic chiasm
Aqueductal stenosis
Pituitary gland
Dorsum sellae
Pons
Basilar artery

SJ





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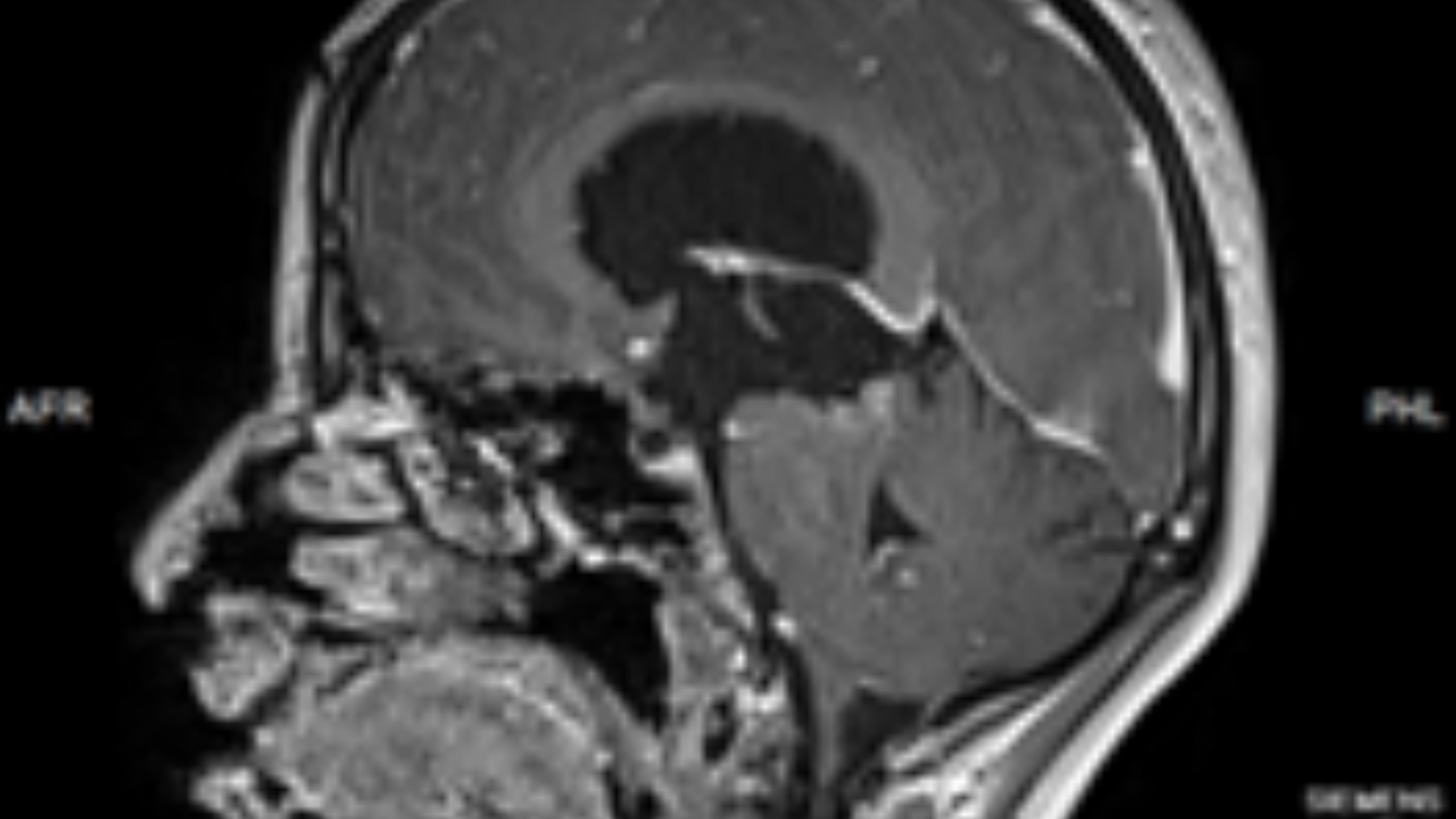
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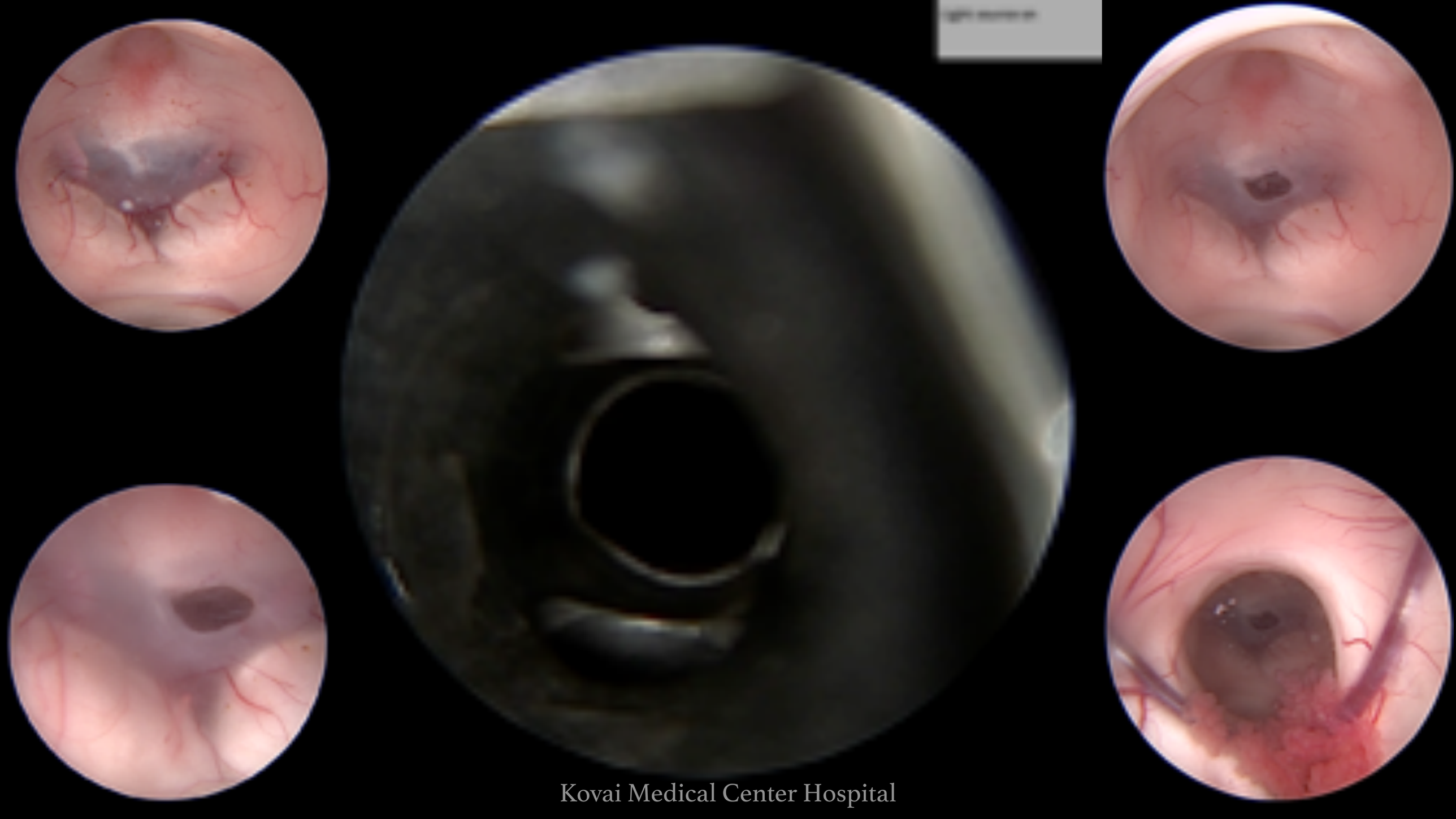
PHL

ENDOSCOPE

ENDOSCOPE



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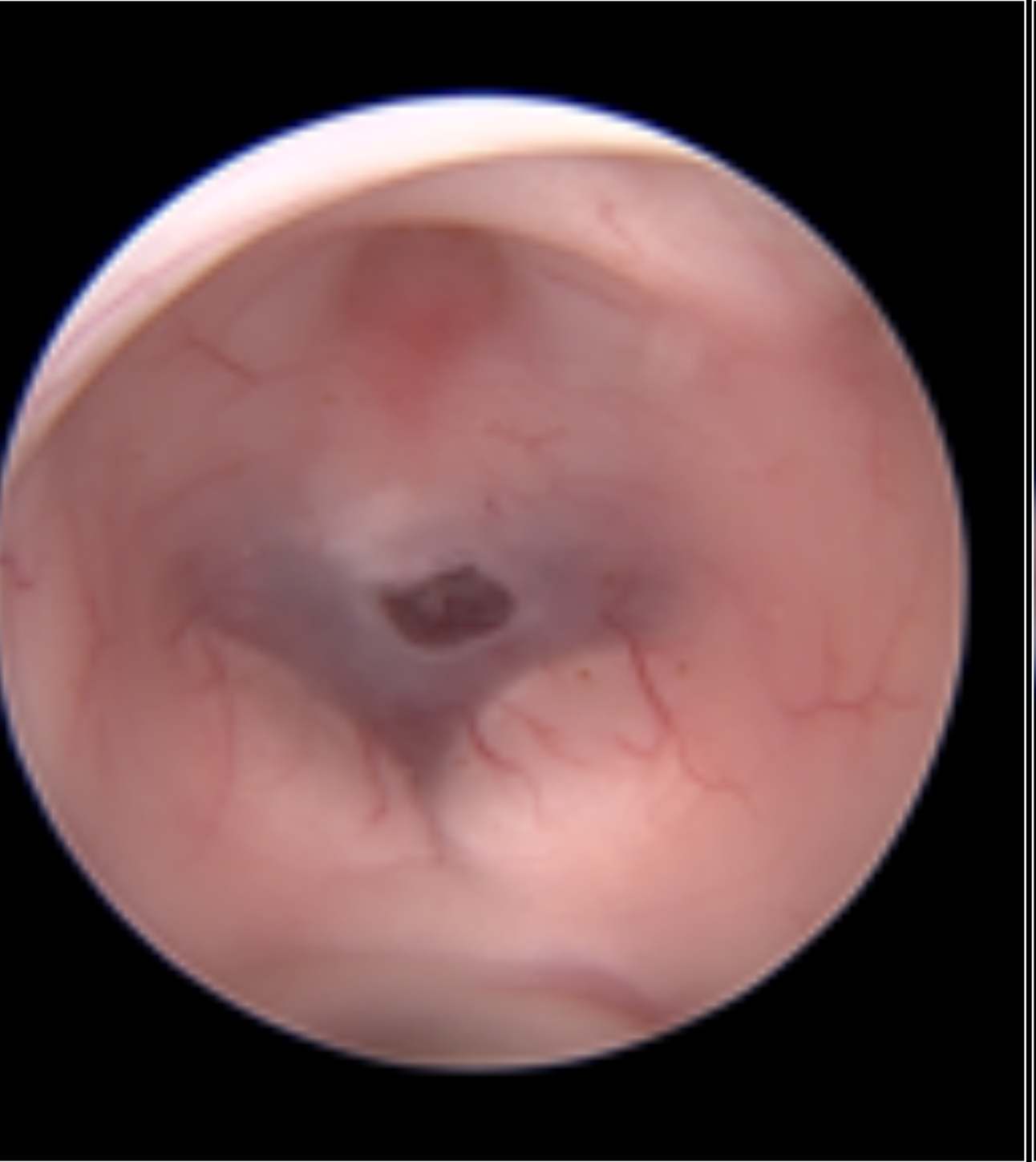
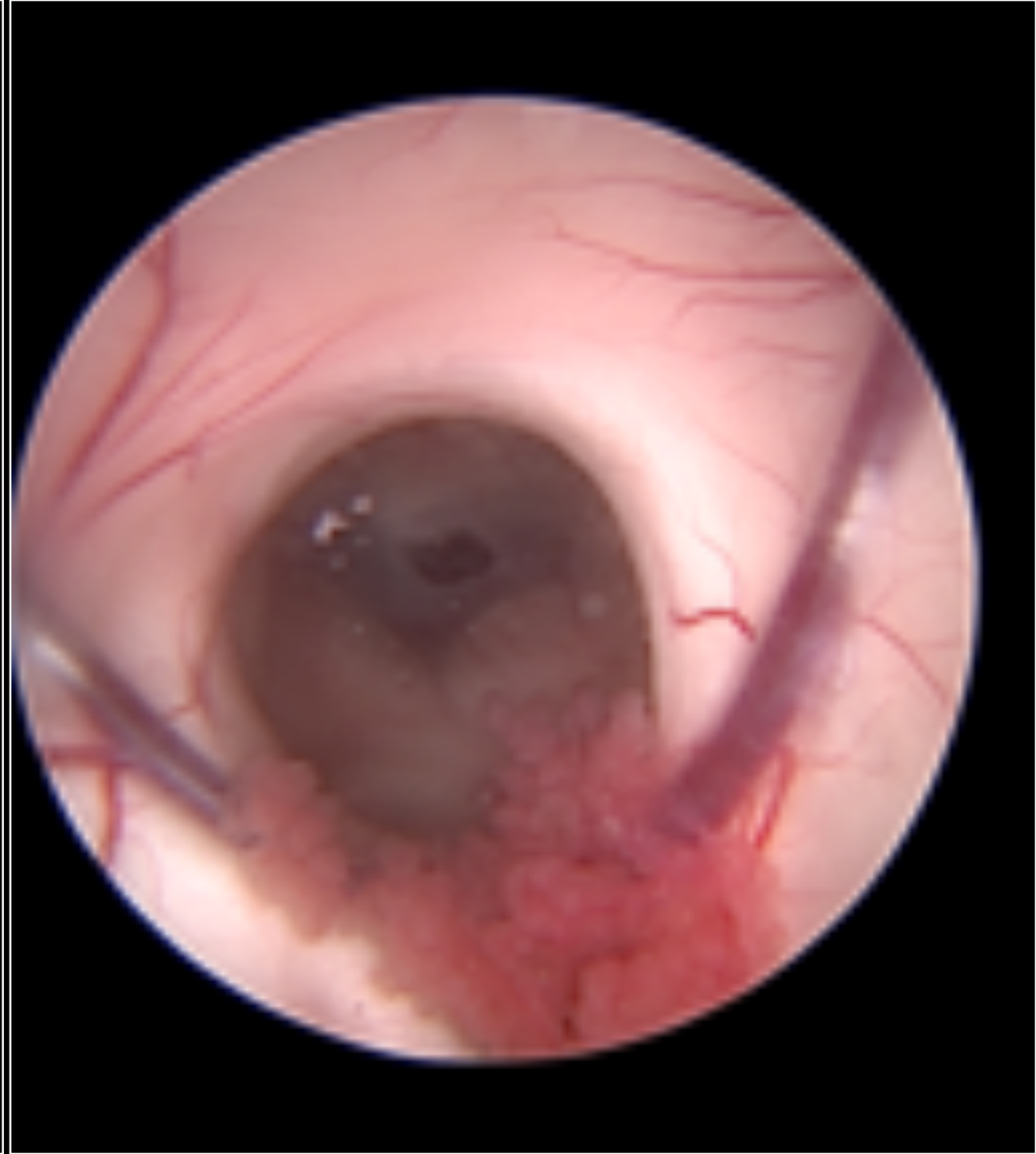
Suresh Jayabalan

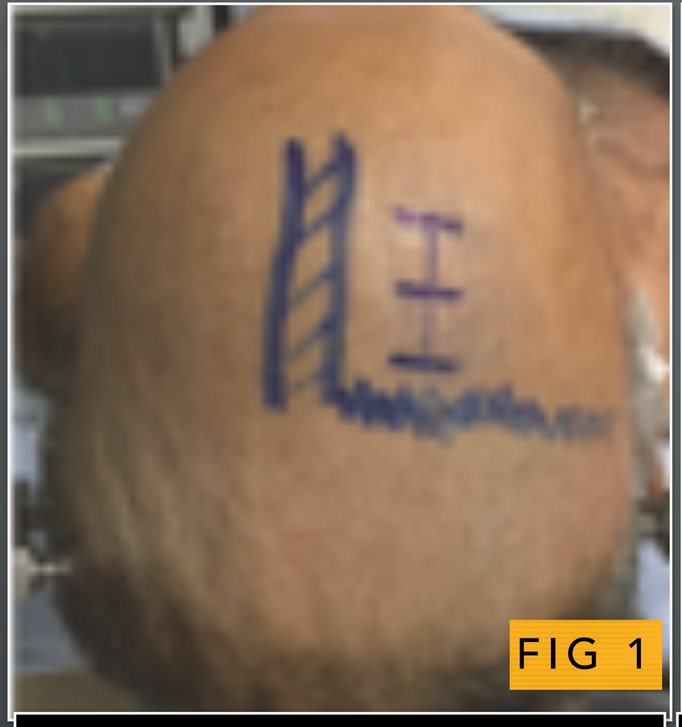


FIG 1

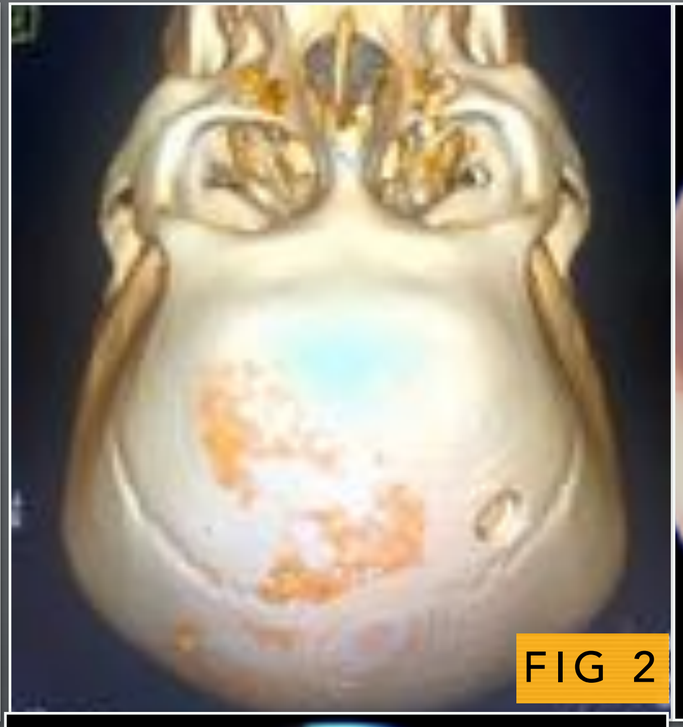


FIG 2

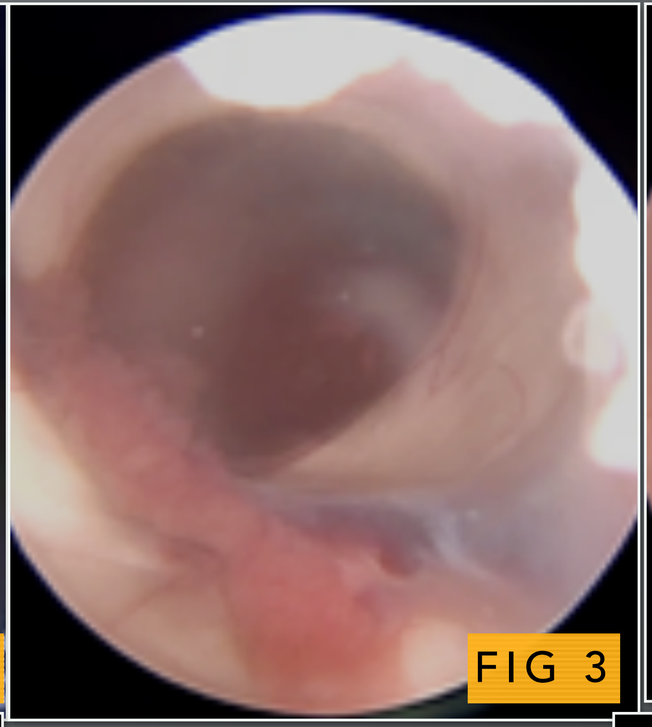
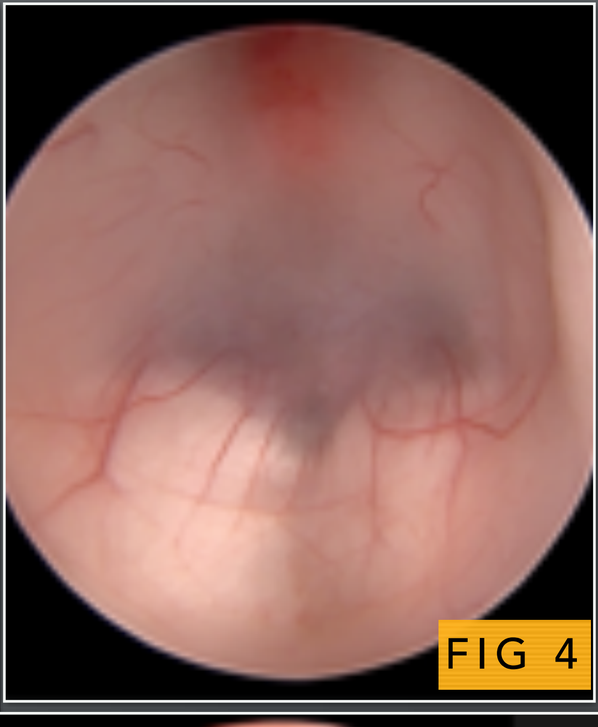


FIG 3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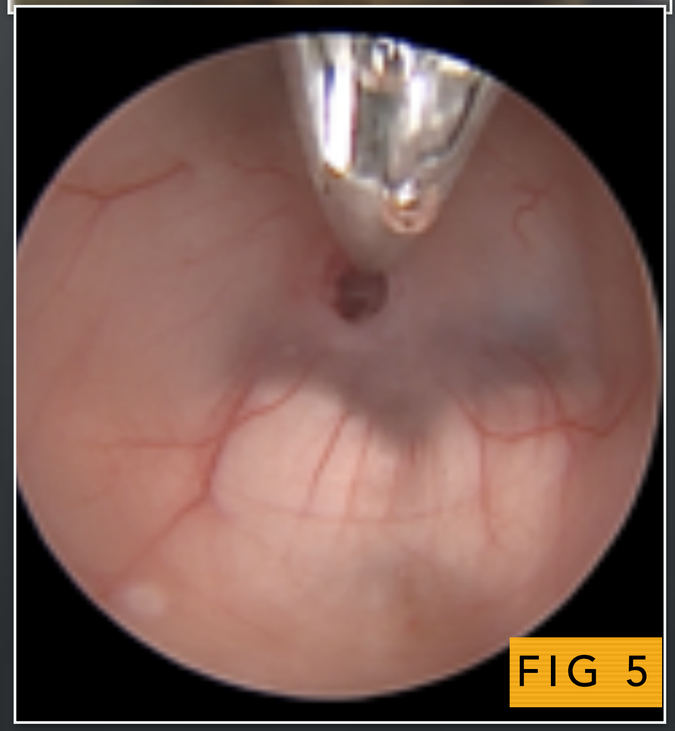


FIG 5

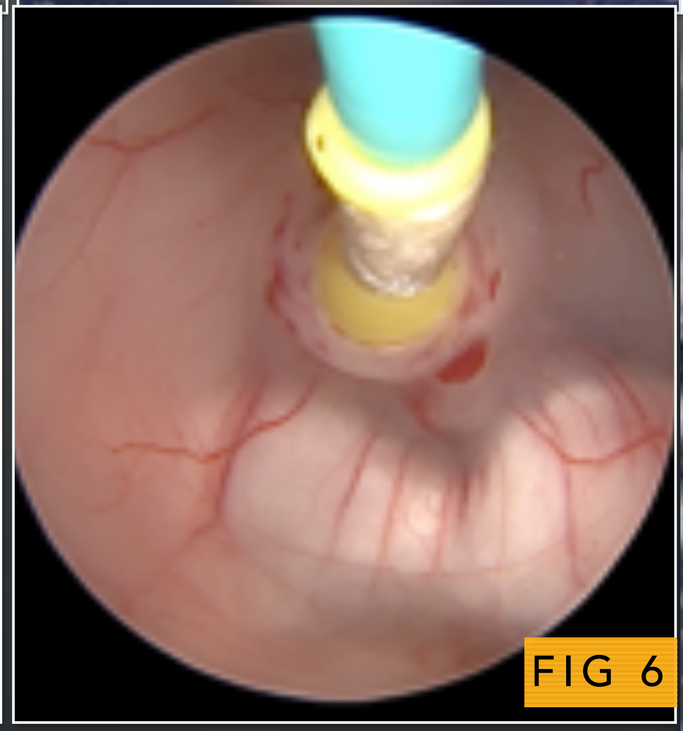


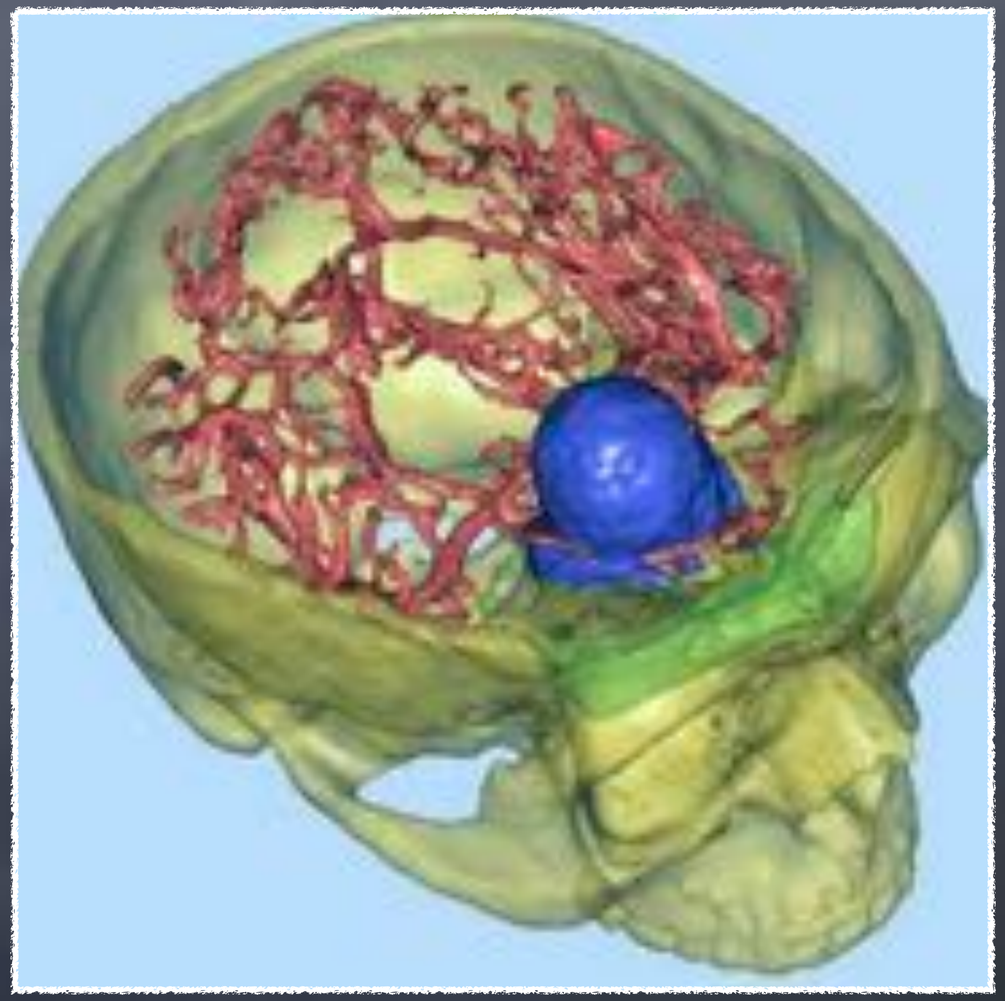
FIG 6

FIG 7


FIG 8

Neuro-oncology

3D printing technology has enabled MRI data to be translated into patient specific models depicting the associations between tumour, skull, vasculature, and surrounding non pathologic brain tissue



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- surgeons can recognise the location and extent of the tumour relative gyral/sulcal patterns and skull features
- additionally included printed regions of functional MRI (fMRI) activation determined from pre-surgical mapping paradigms in the model to demarcate areas of eloquent cortex that should be avoided in resection
- For young neurosurgeons 3D models are useful for orientation, pre-surgical training, planning of operative strategy including incision and craniotomy size.

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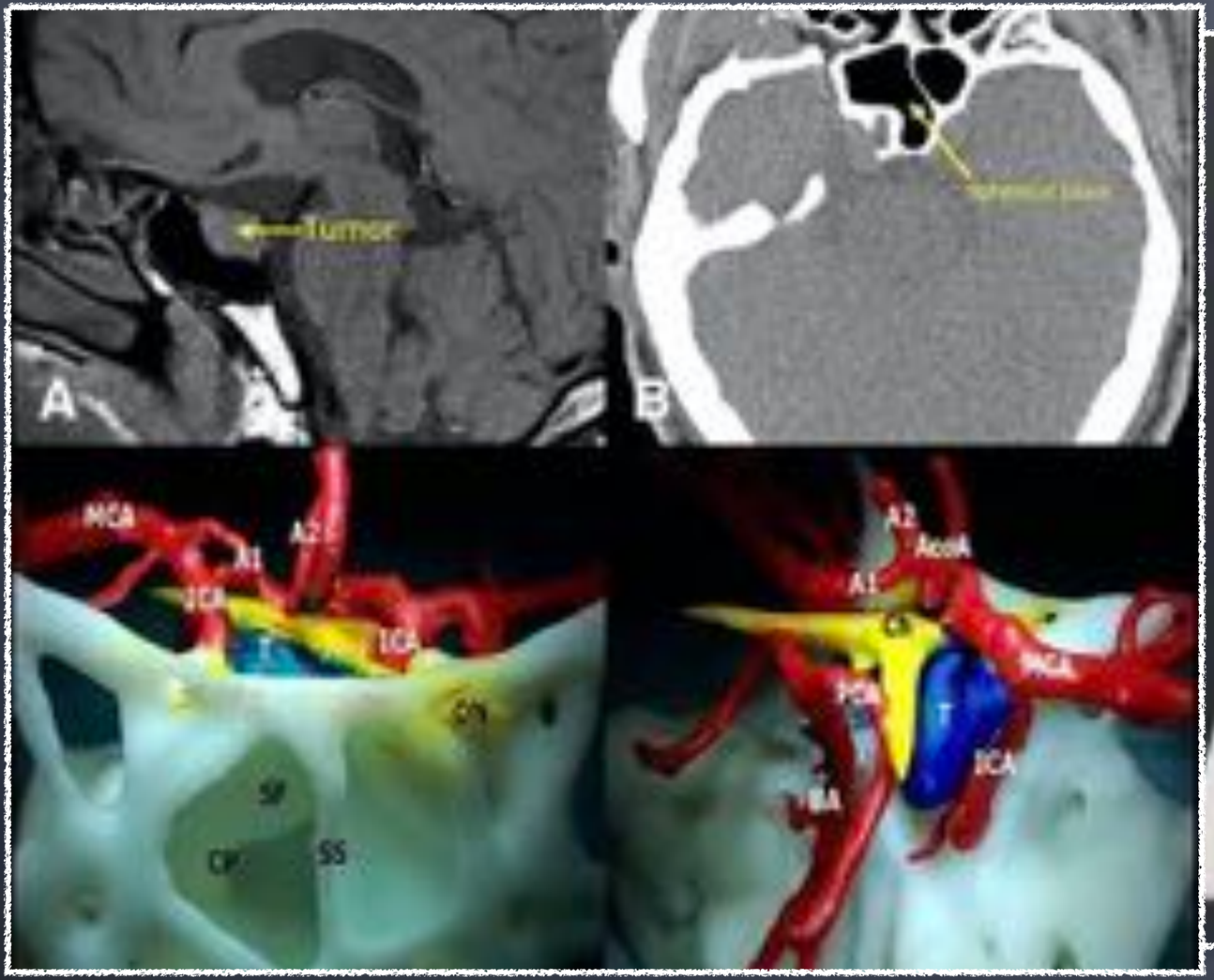

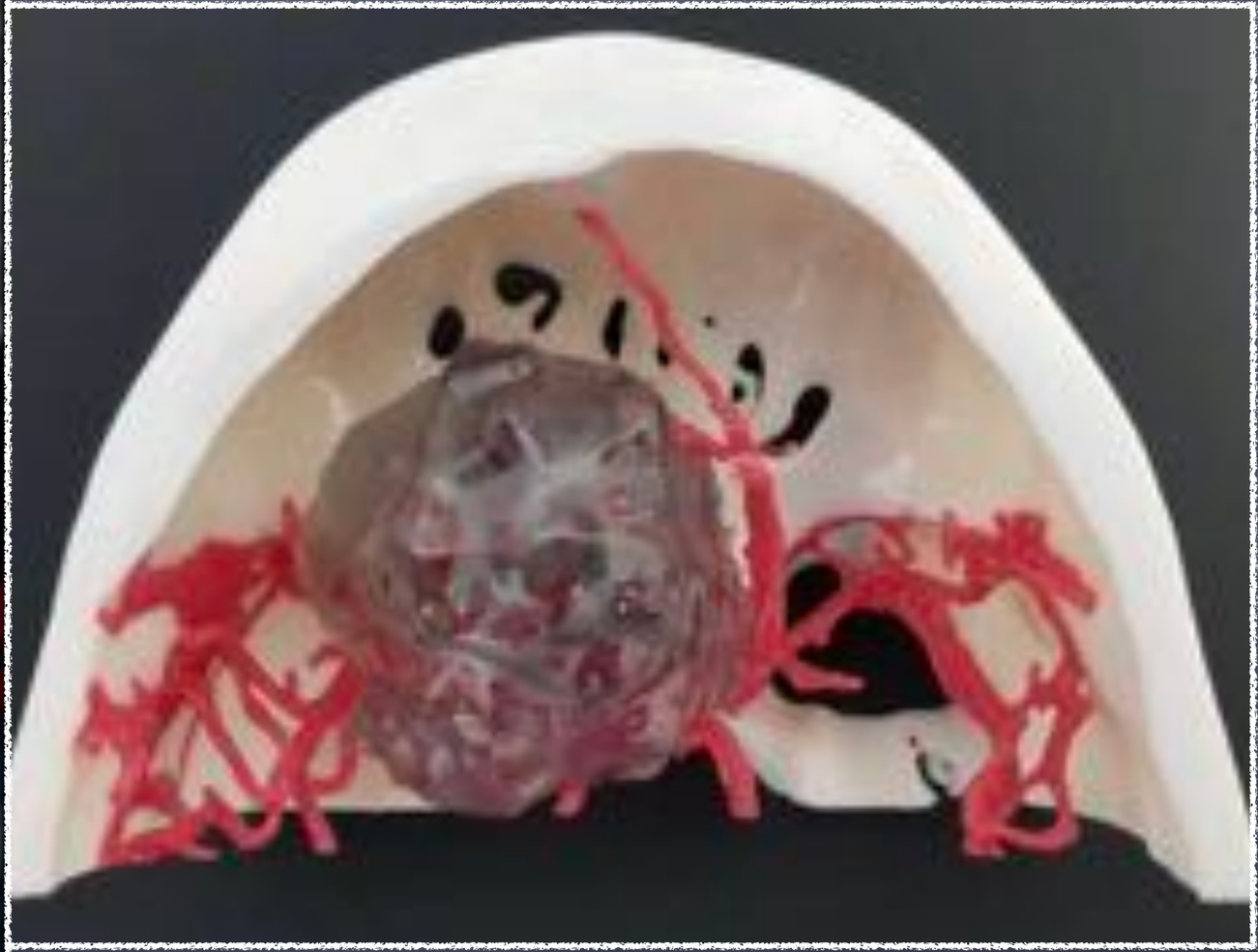

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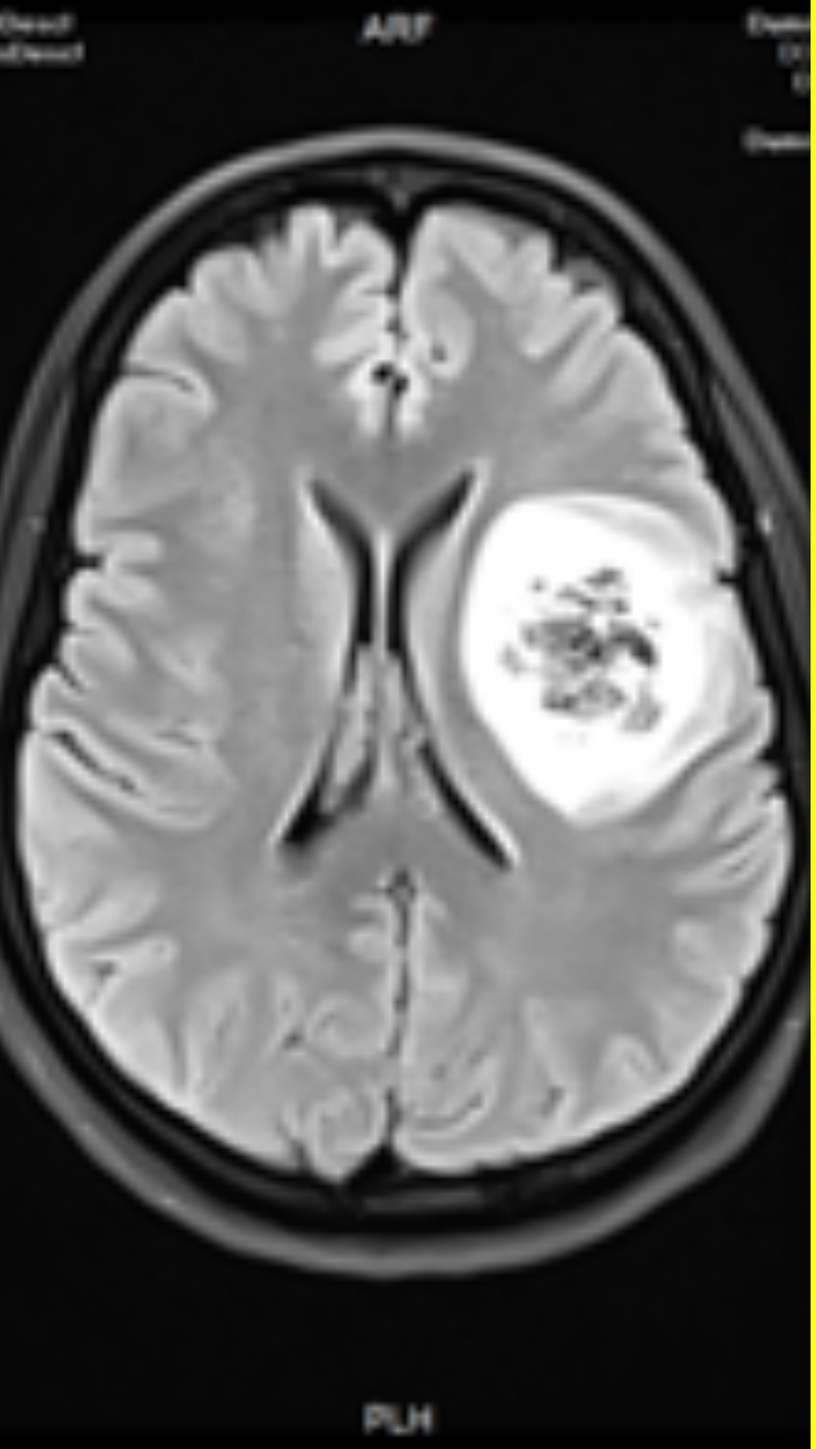
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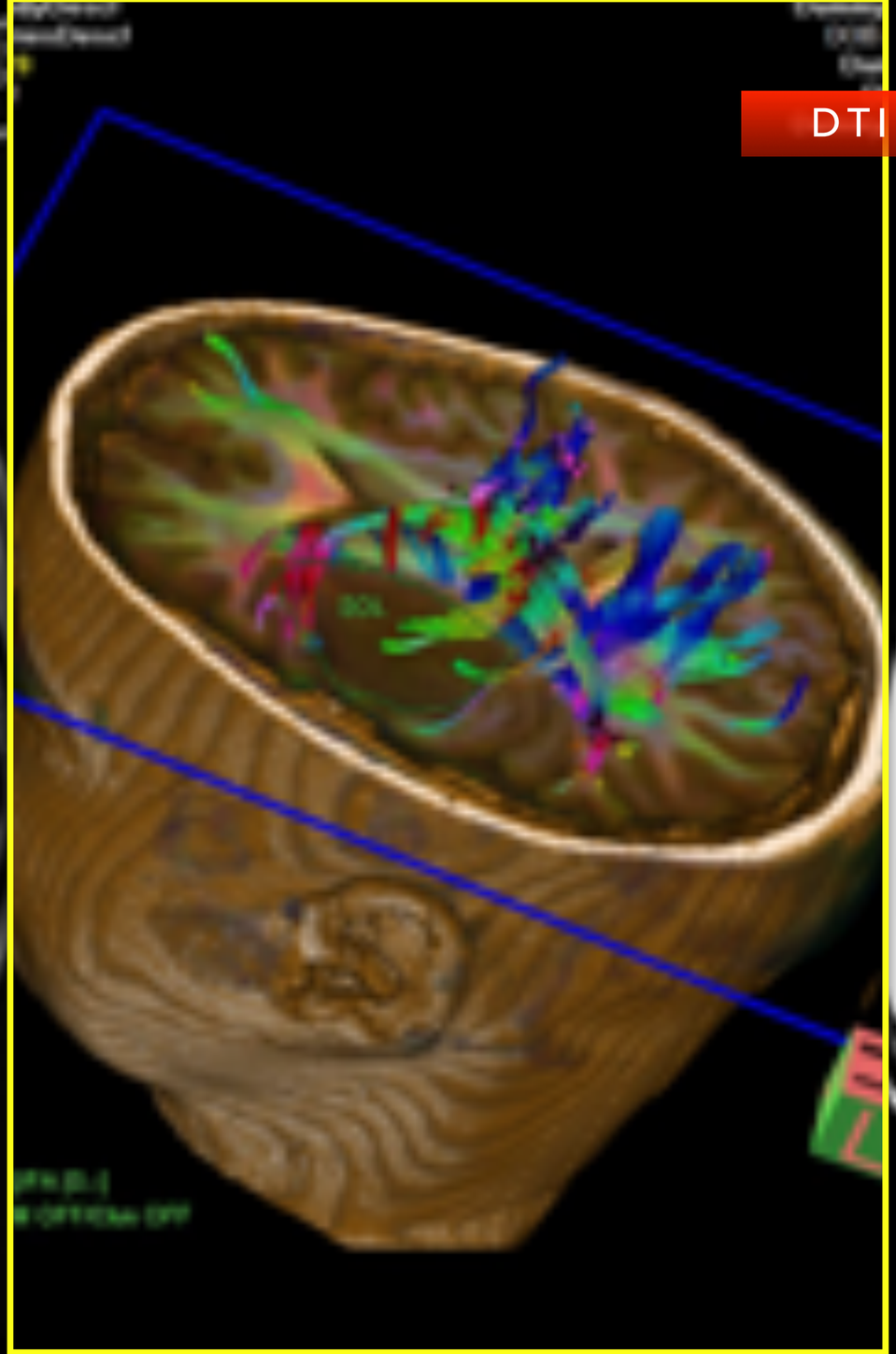
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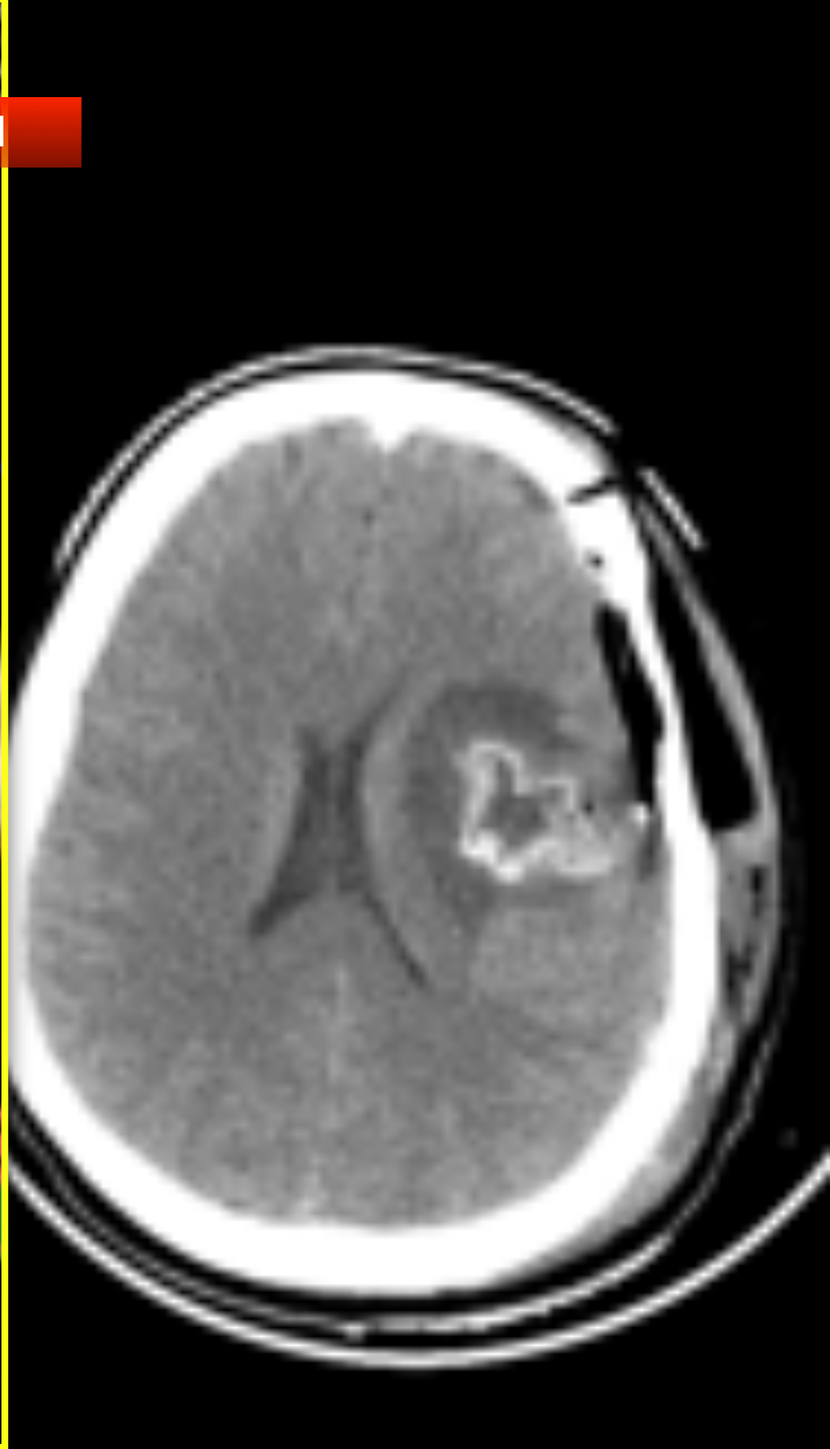

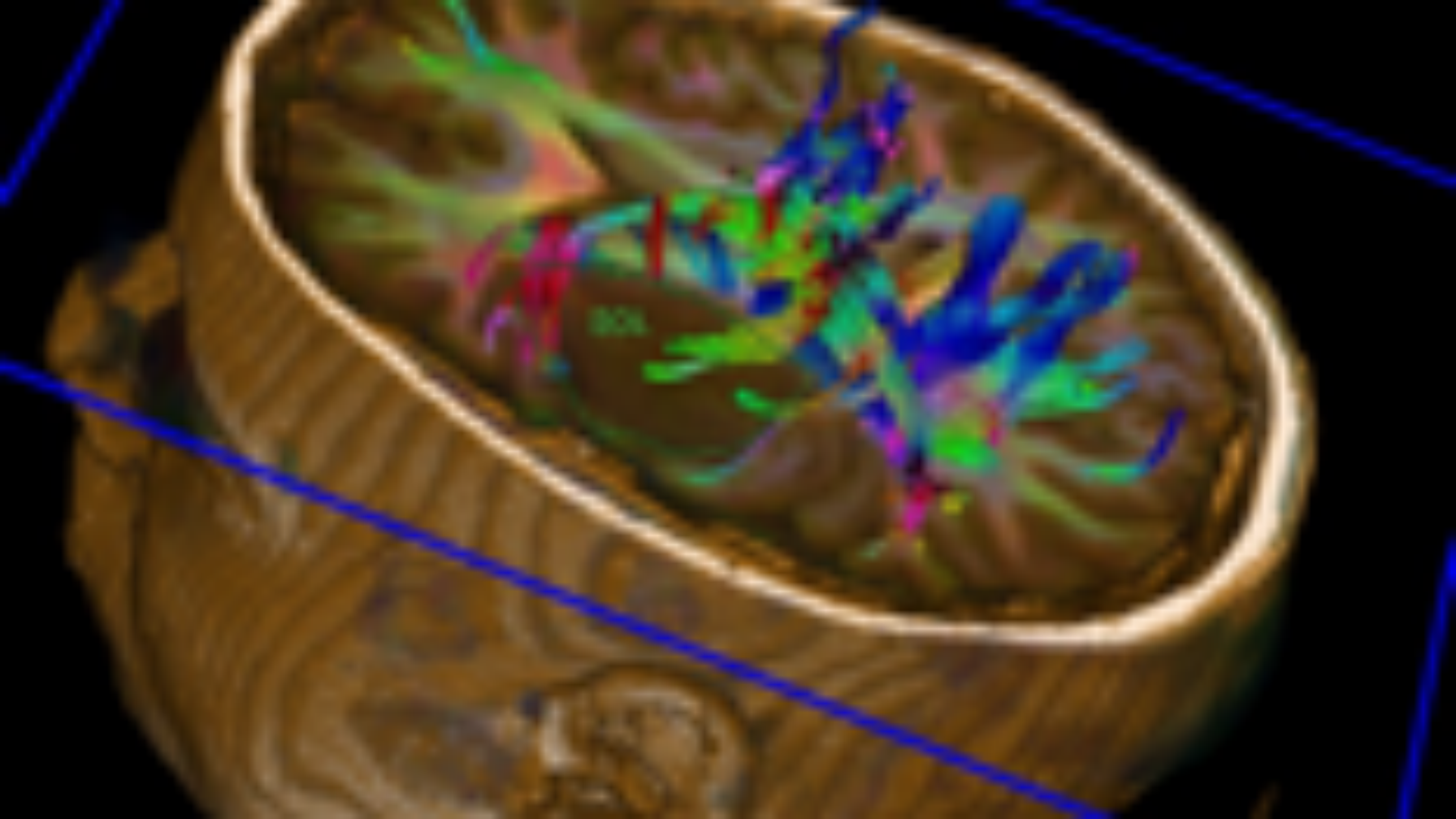
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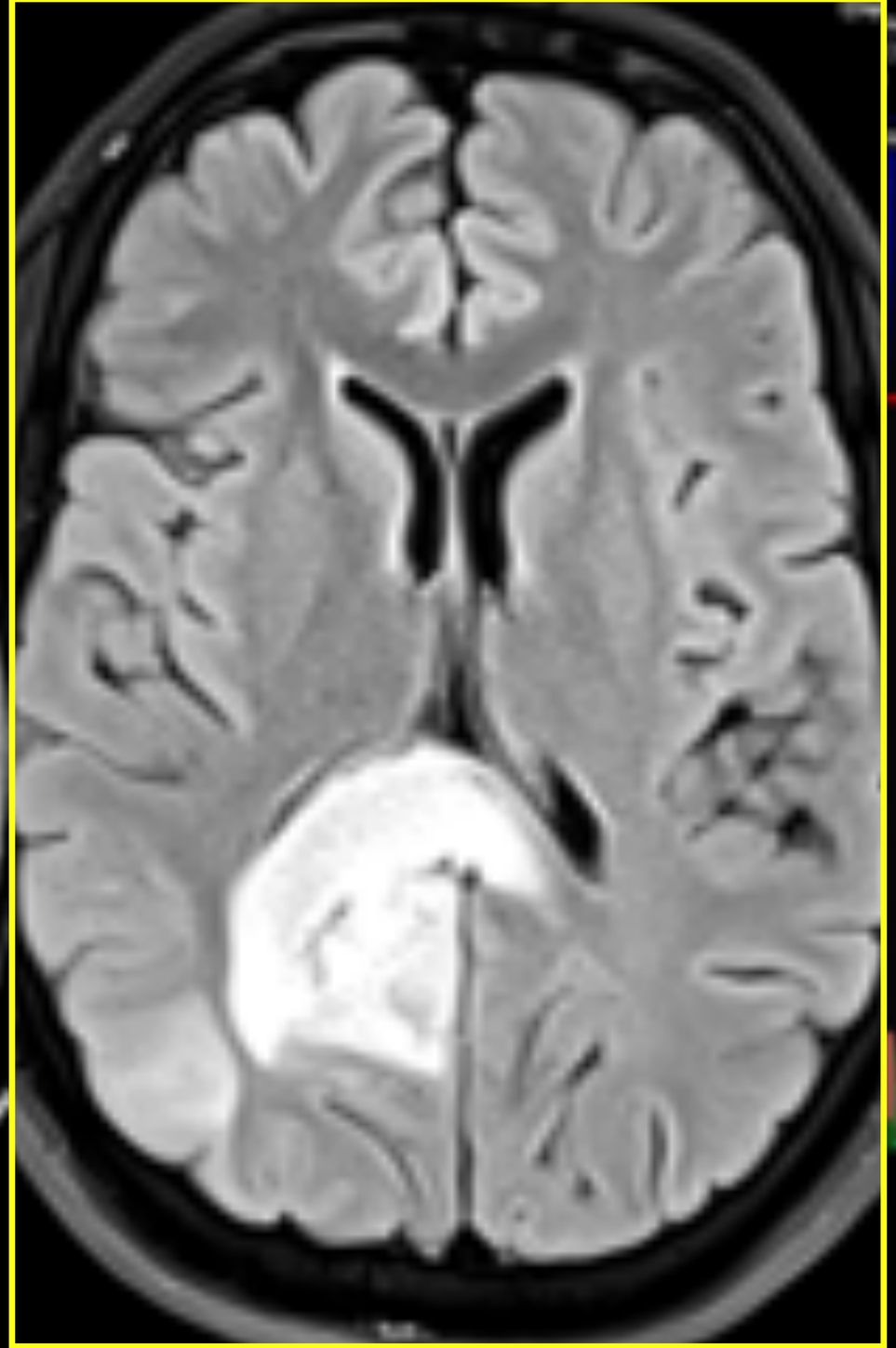

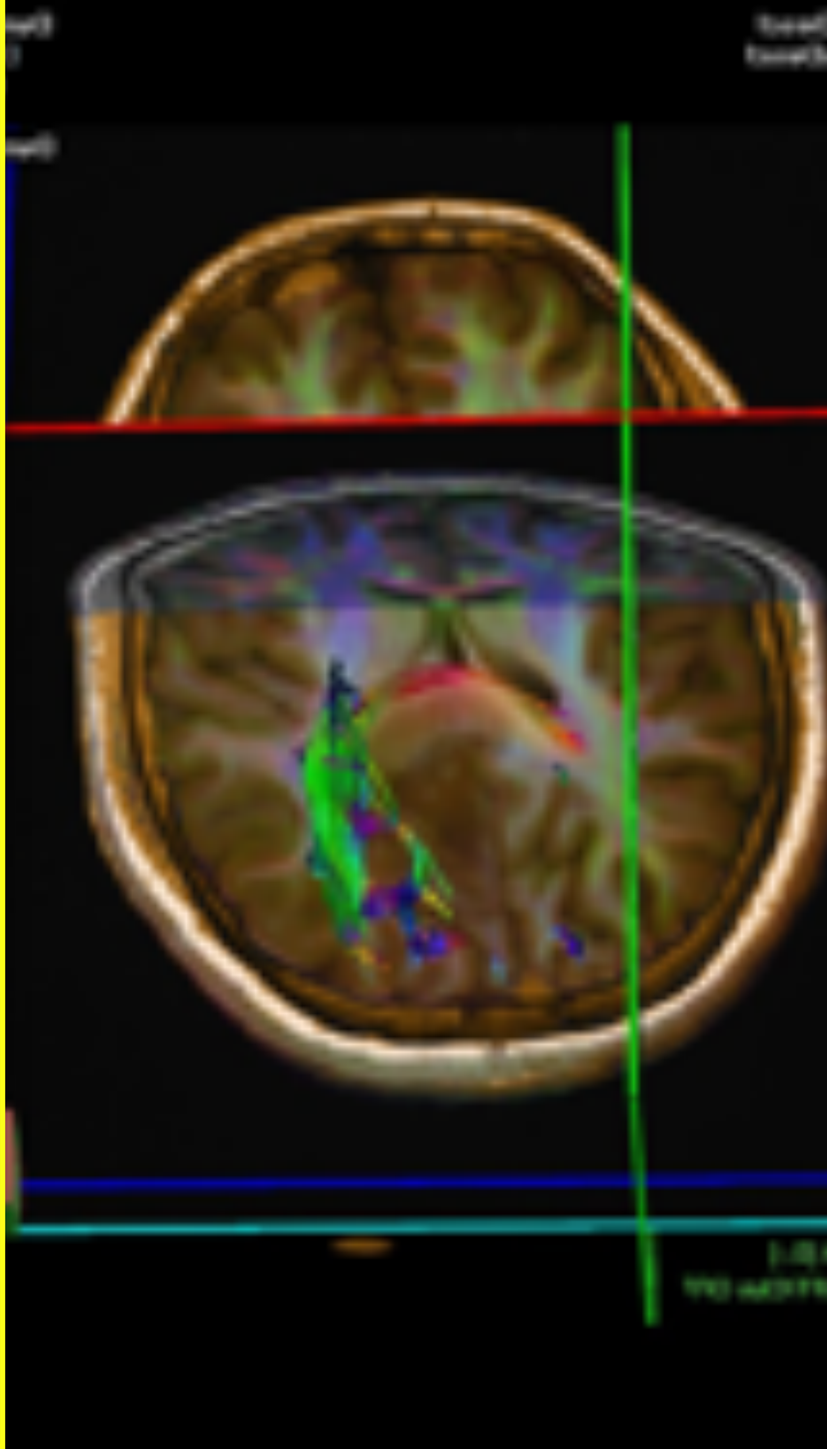

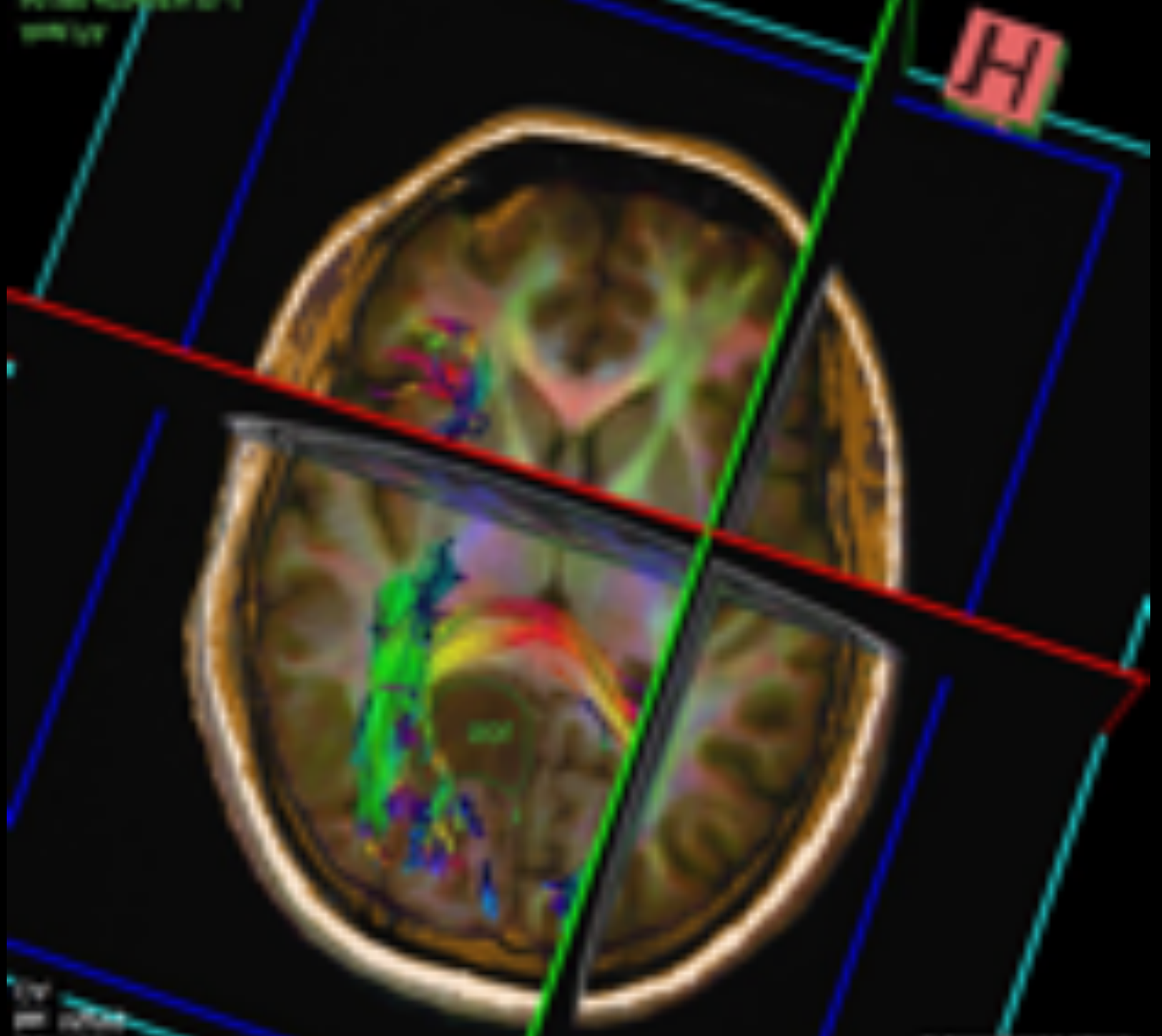
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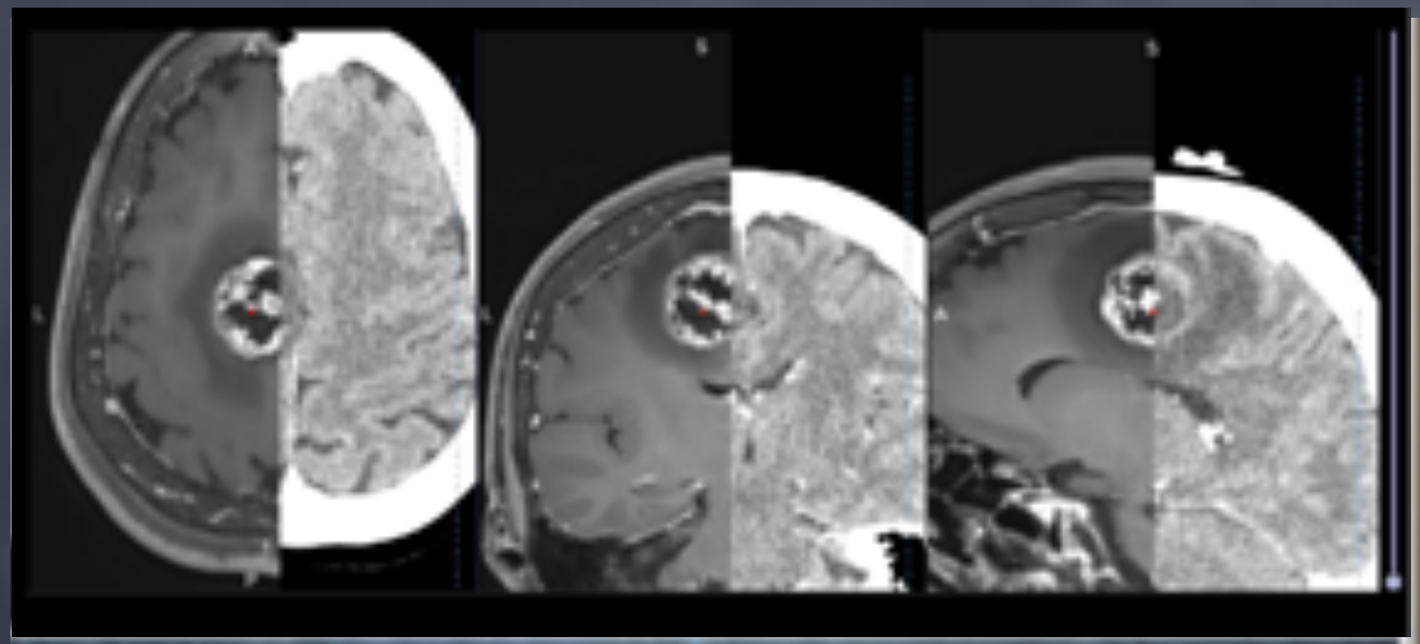

Glioma

Glioma- Scaffold

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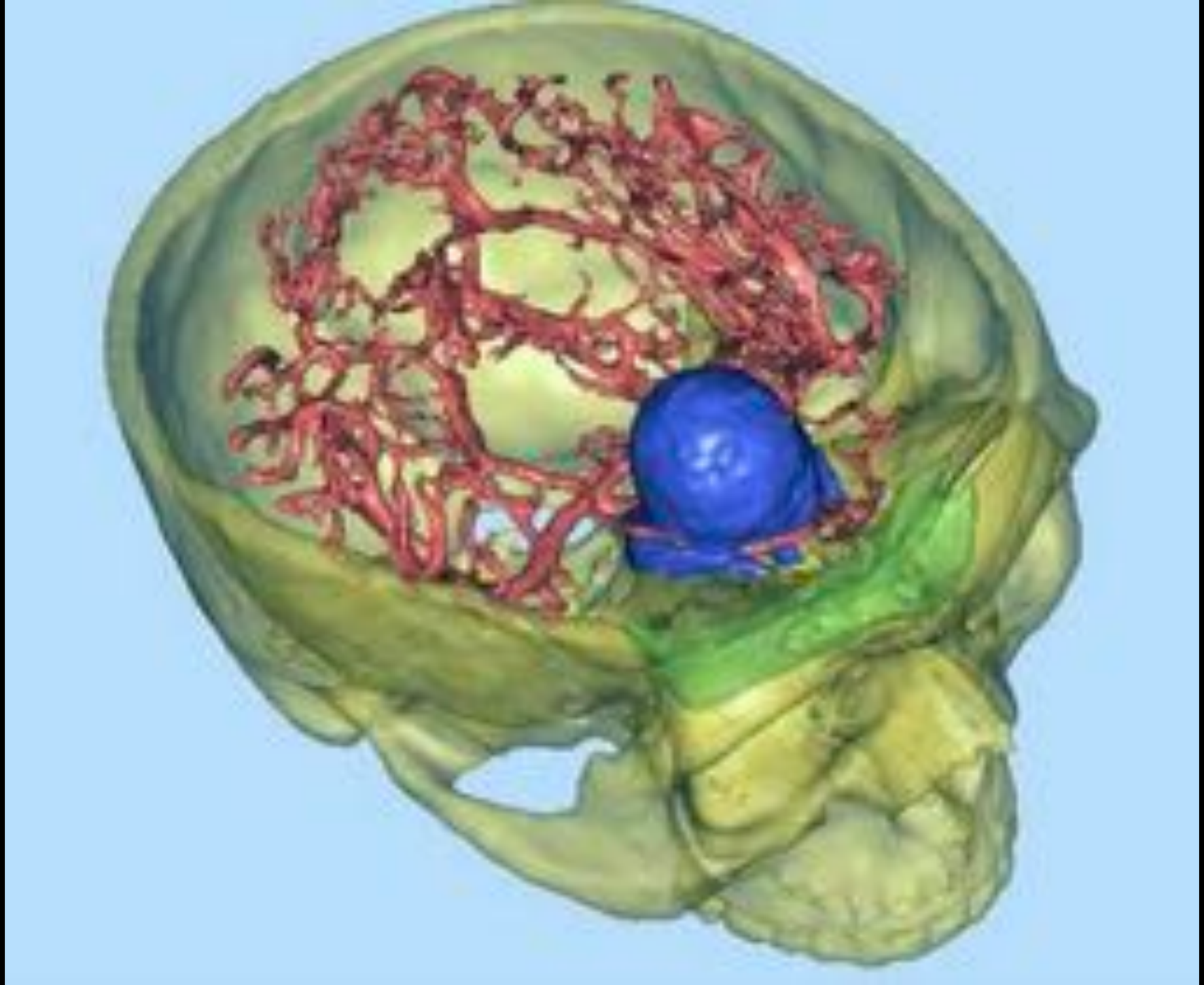

- In cases of complex anatomical abnormalities 3D printings helps in studying detail anomalous anatomy including abnormal vascular structures.
- Useful in selecting appropriate implant for patient specific needs.

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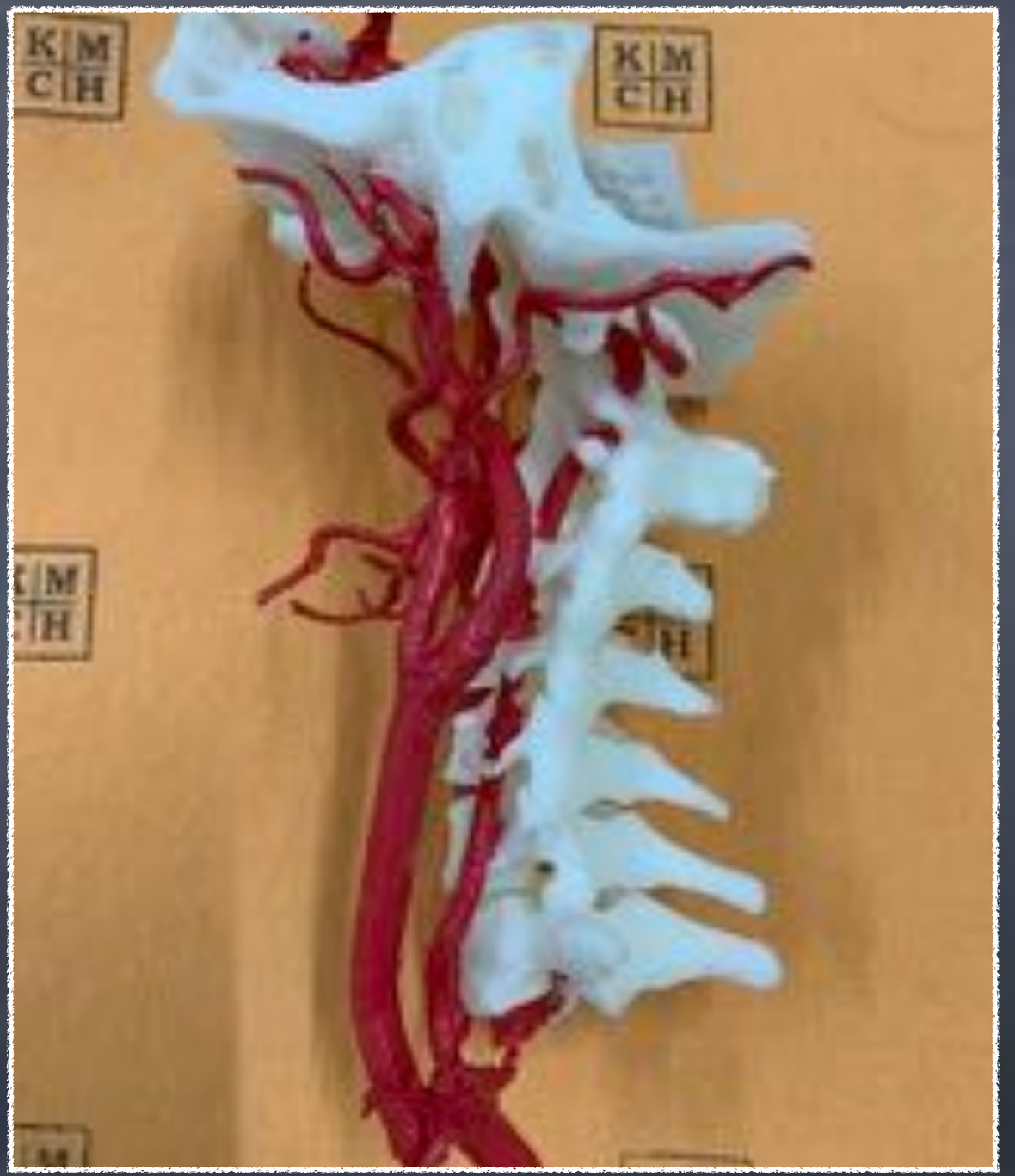
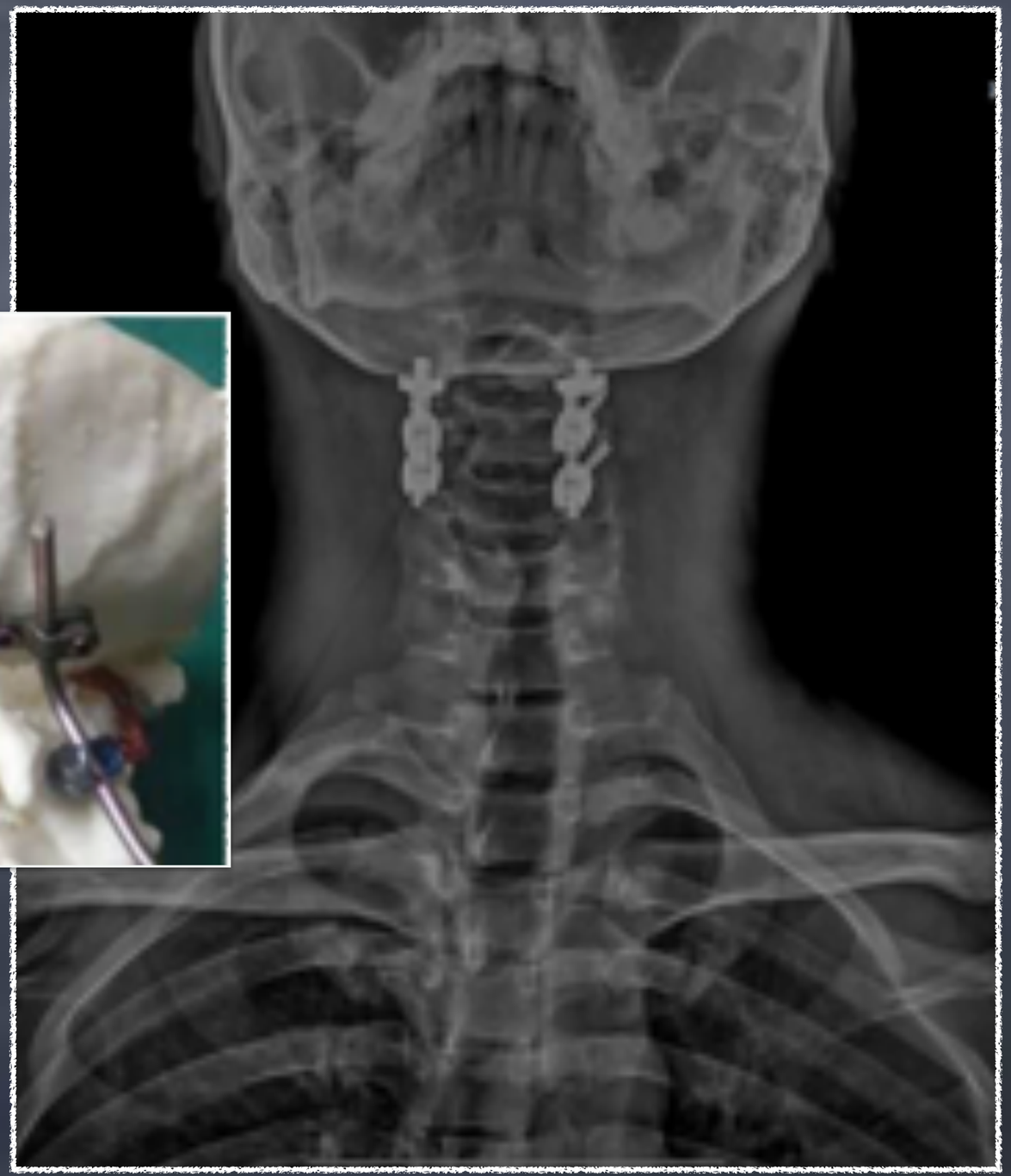

K M
C H
K M
C H



Education and training

- For young doctors learning can be made easy with the use of 3D models

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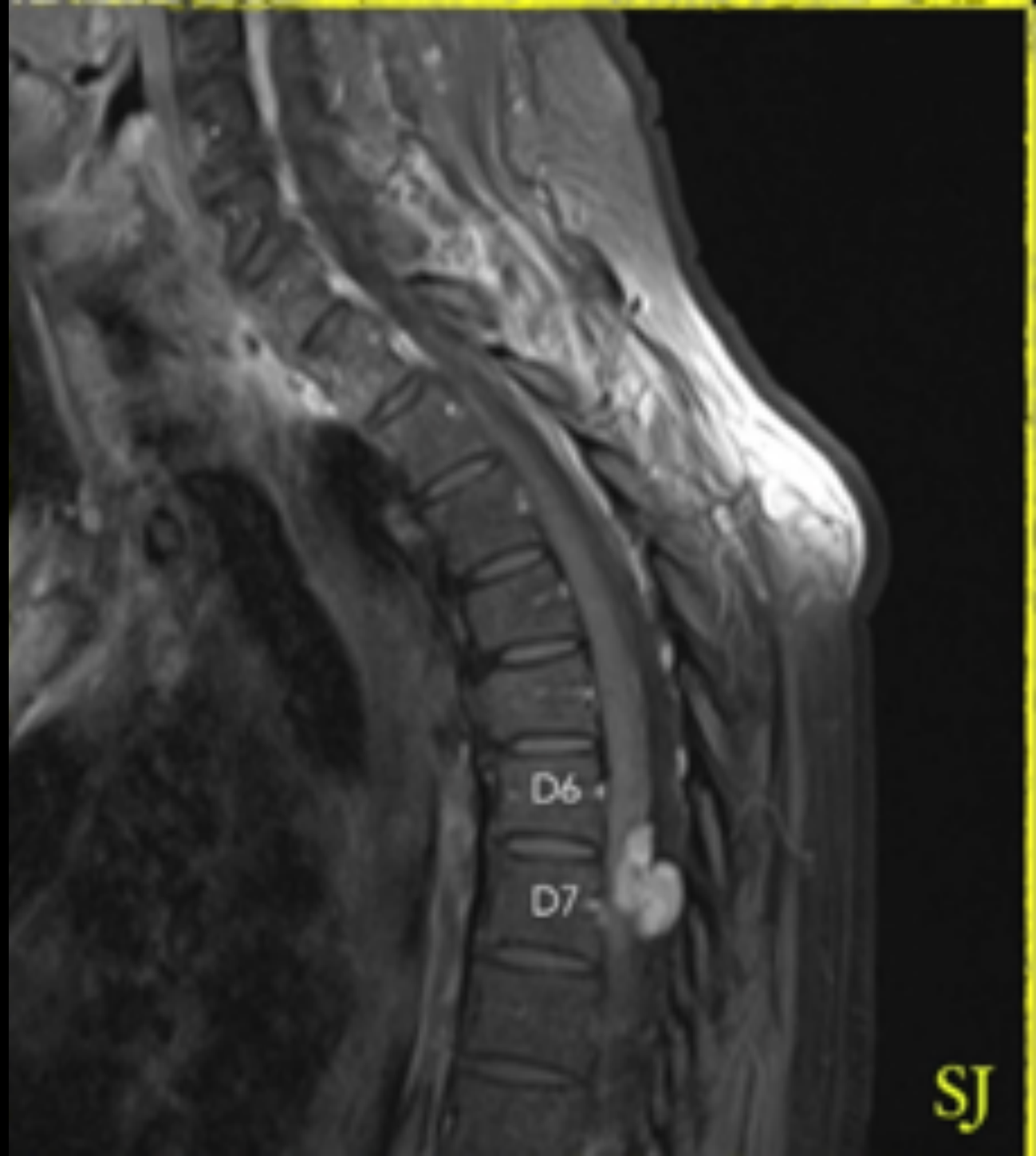
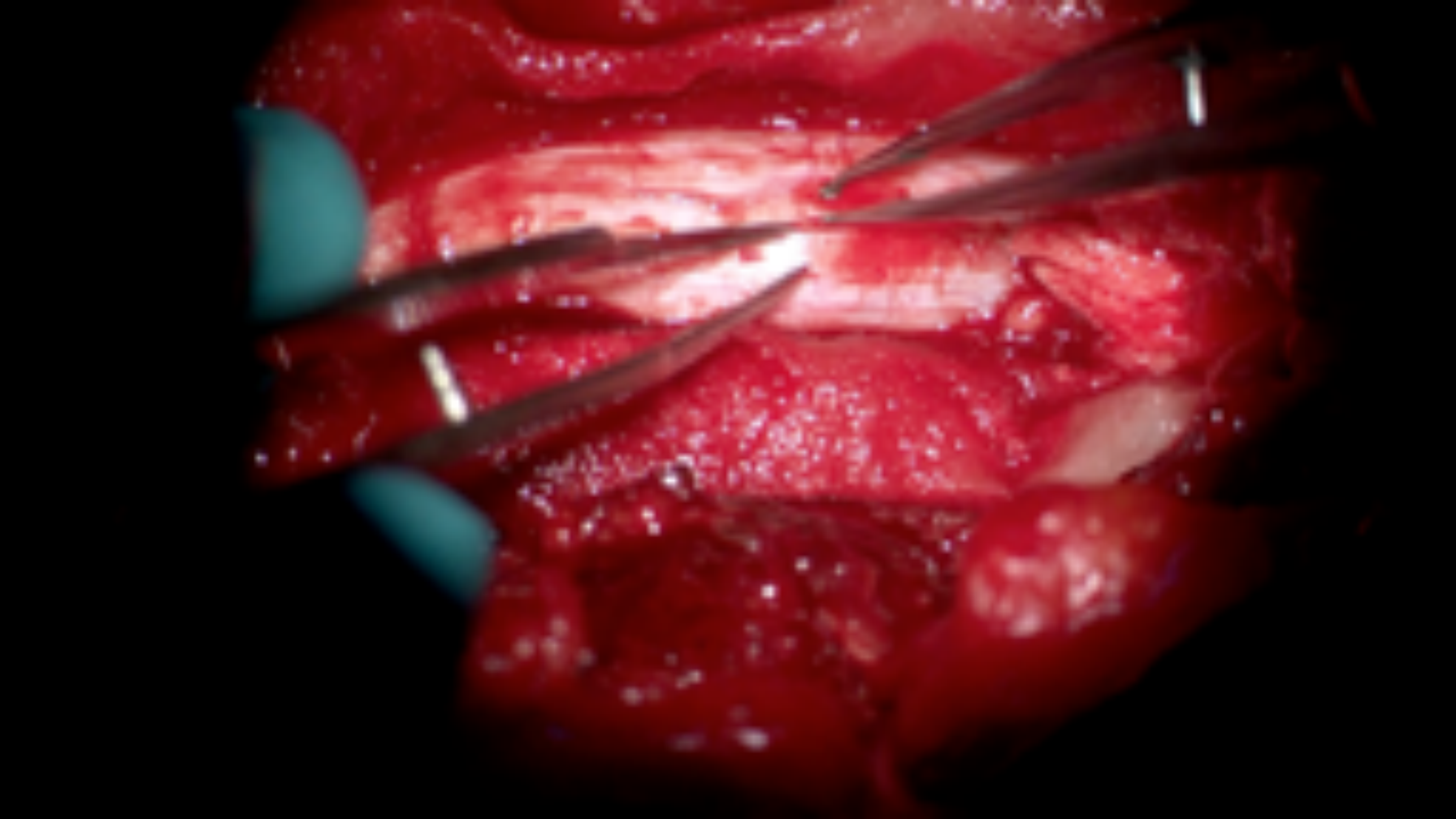
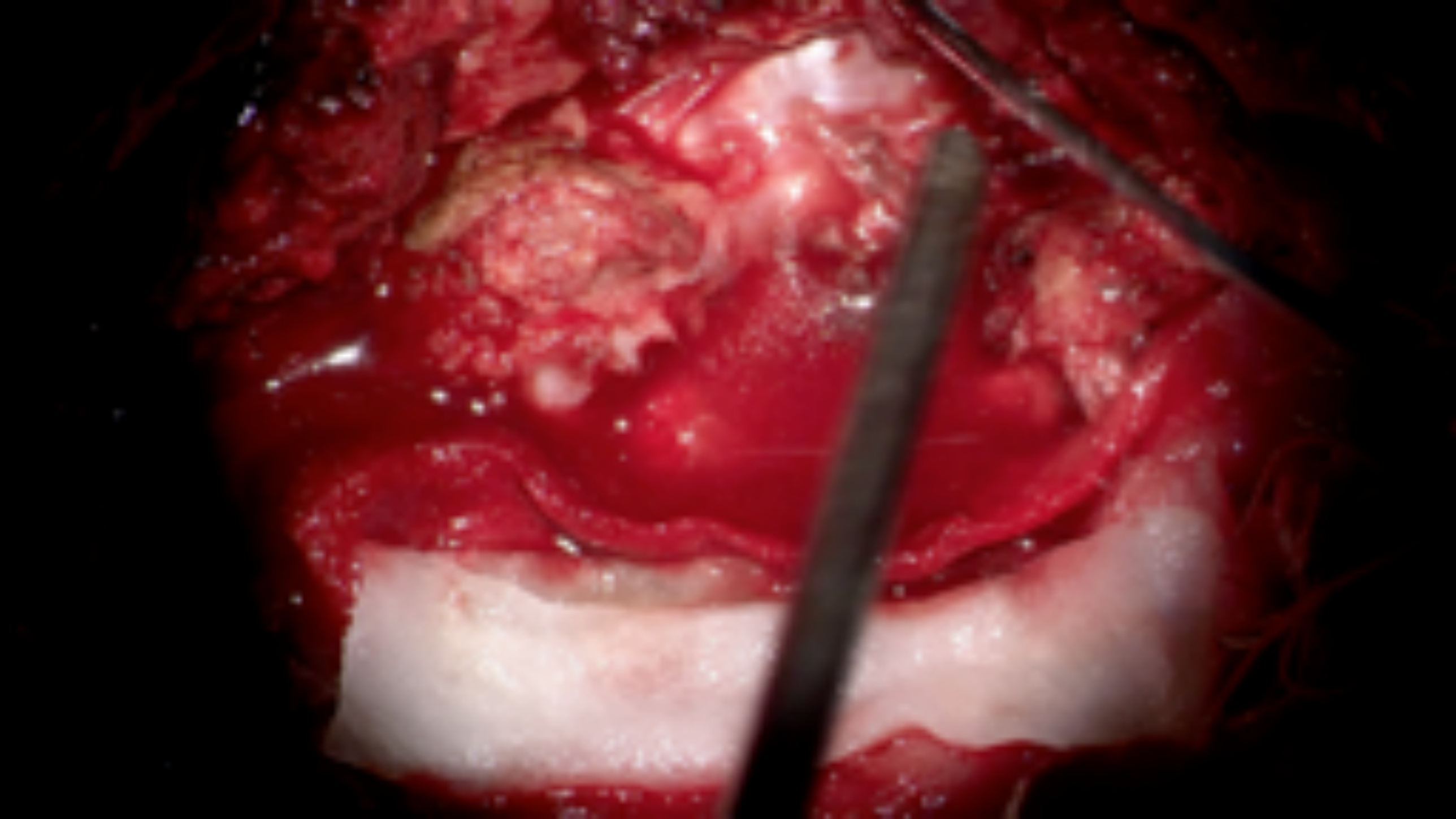
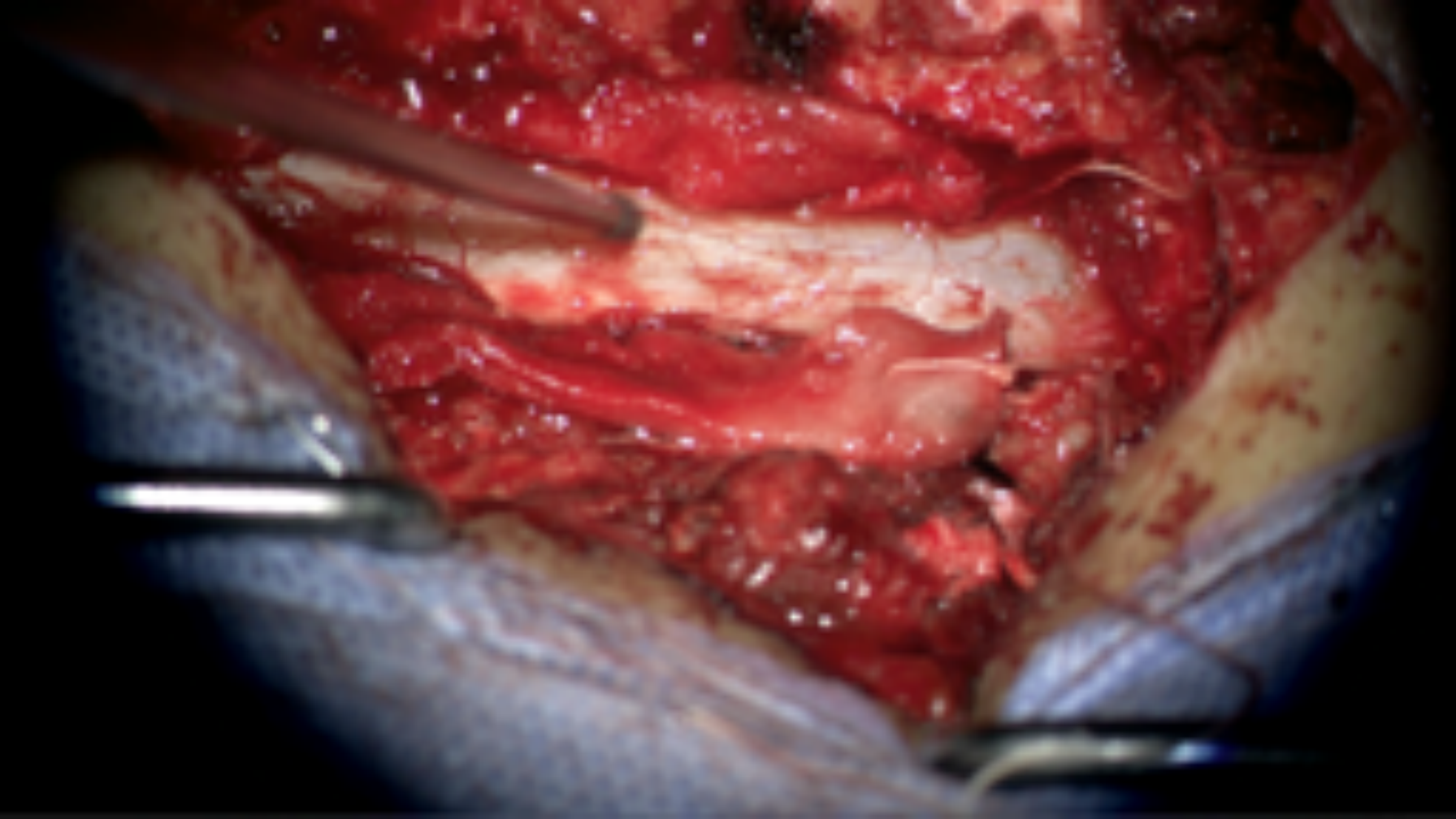
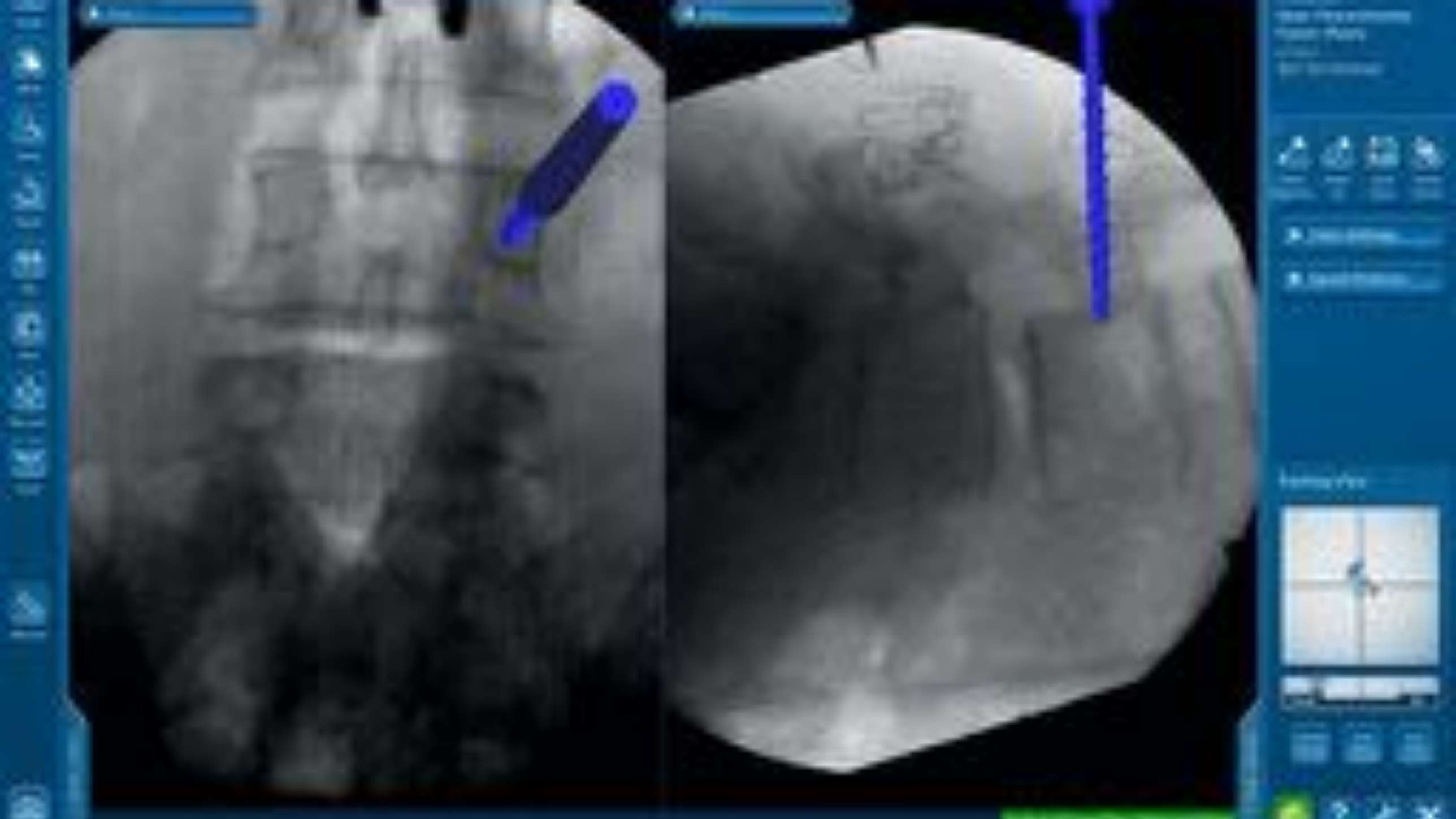
SPINAL TUMORS

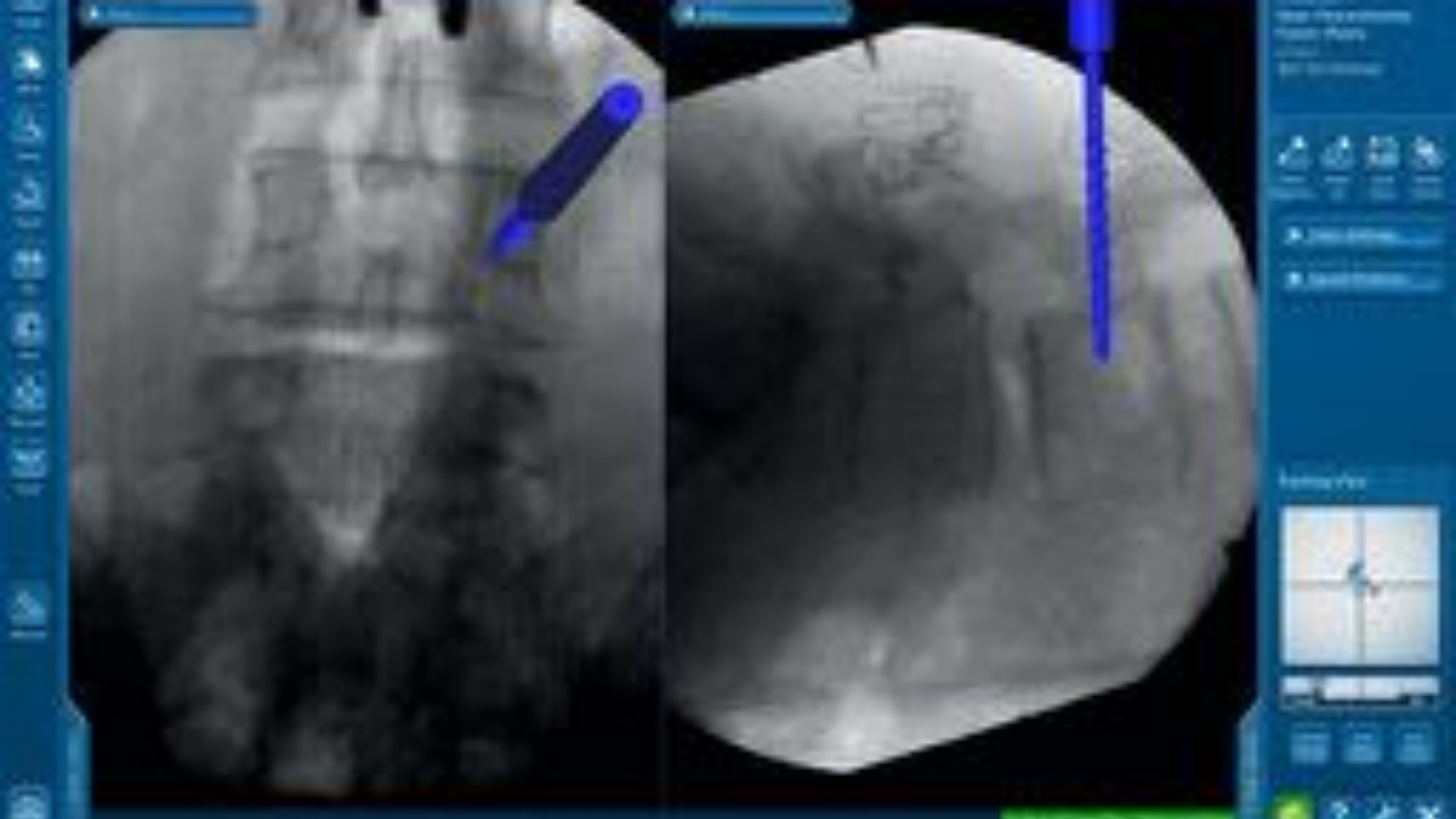


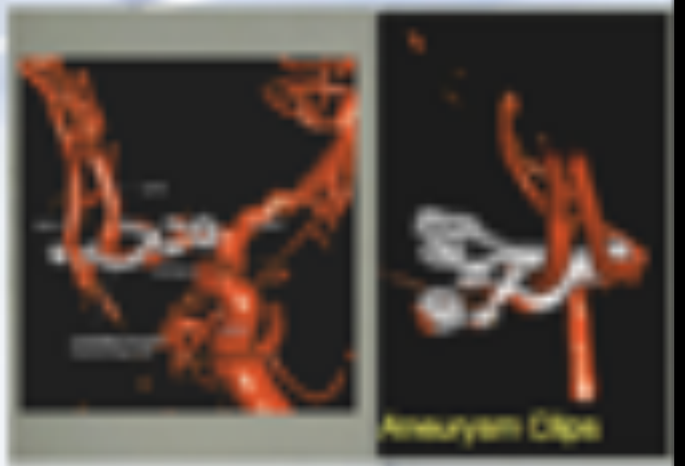












Aneurysm Clips

S8 Stealth Neuro Navigation

Ultrasonic Tissue Ablatio

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