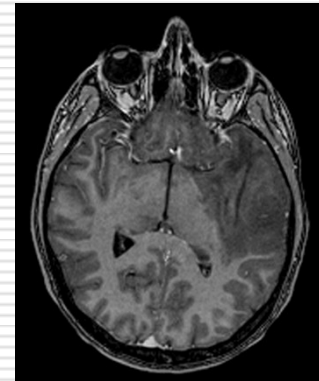
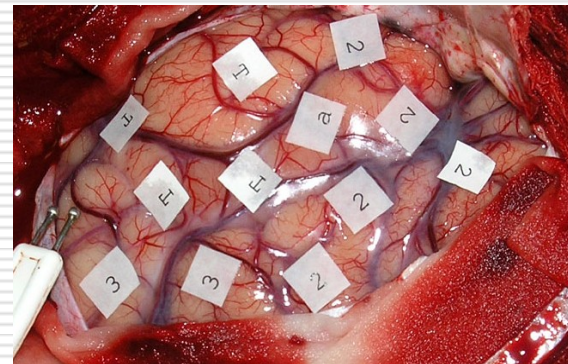


Neurooncology

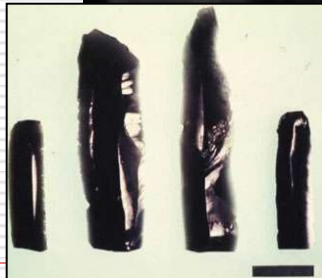
Department of Neurosurgery FH Brno

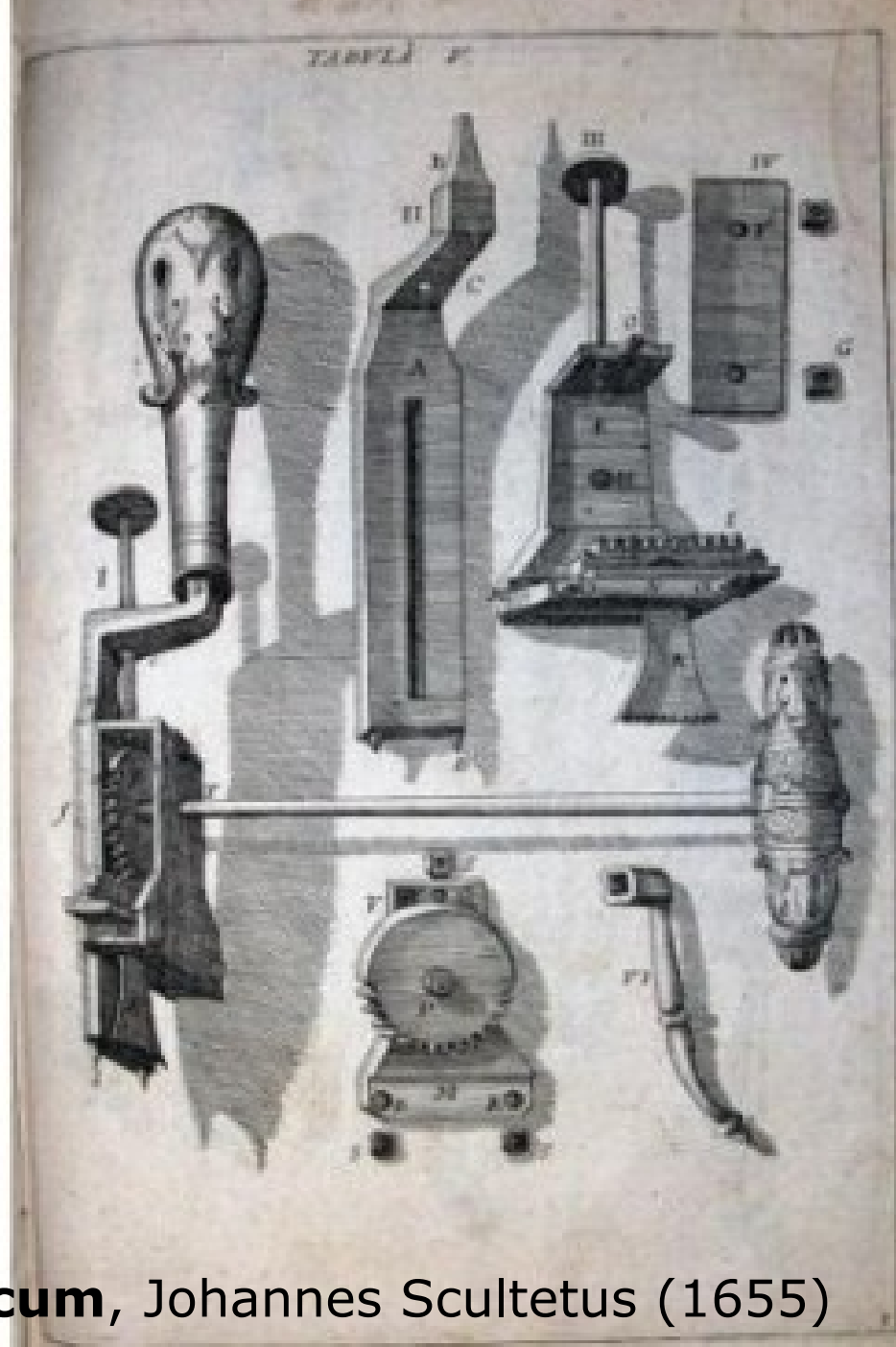


 FAKULTNÍ
NEMOCNICE
BRNO



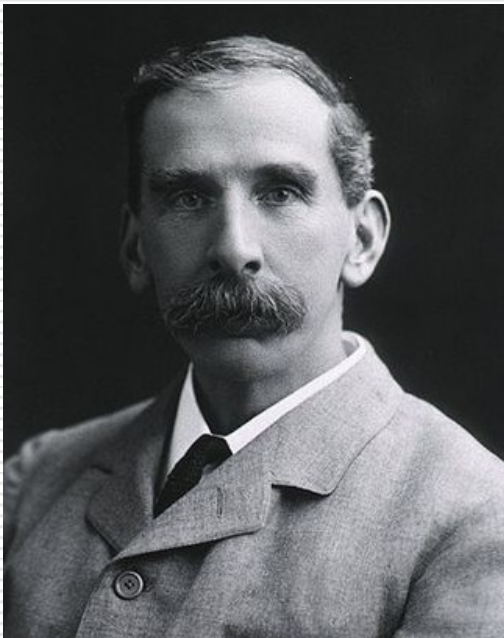
Neurosurgery in the Past...





Armamentarium chirurgicum, Johannes Scultetus (1655)

The Beginnings of Modern Neurosurgery

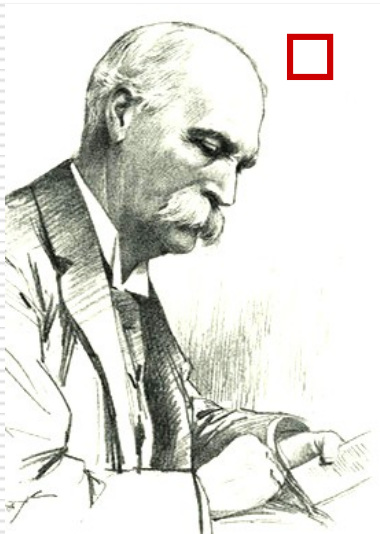


- **Victor Horsley (1857-1916)**
 - first specialized neurosurgeon, the founder of modern neurosurgery
 - 1887 spinal tumor from laminectomy, transcranial pituitary tumor surgery
-

The Beginnings of Modern Neurosurgery

□ **Pierre Paul Broca:**

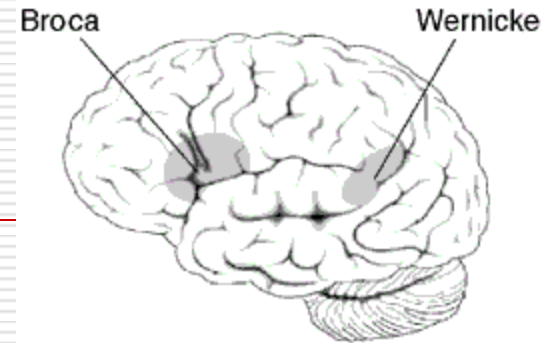
- 1876 -localization and drainage of brain abscess



□ **William Macewan:**

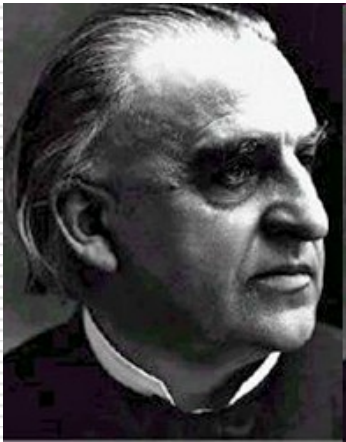
- 1879-localization and excision of brain tumor (meningioma)
 - 1883-spinal laminectomy
-

Localization of Function



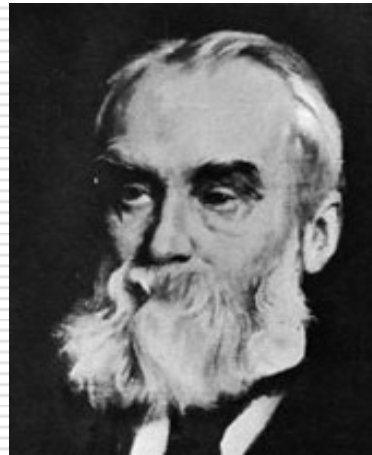
Jean-Martin Charcot

(1825–1893)



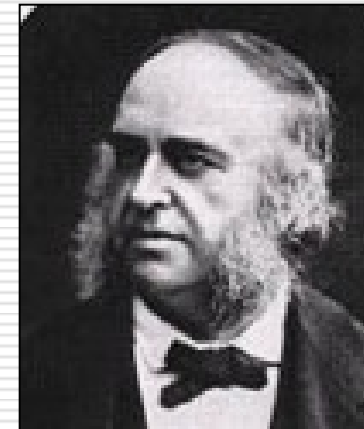
John Hughlings

Jackson (1835-1911)



Paul Pierre Broca

(1824–1880)



Cerebral localization of function.

David Ferrier

1881, International Medical Congress,
London



Harvey Cushing
(1869-1939)



WHO Classification, Incidence

1. Neuroepithelial Tumors

- | | | |
|----|--|------|
| 1. | Astrocytic Tumors | 38% |
| 2. | Oligodendroglial Tumors | 3% |
| 3. | Oligoastrocytic Tumors | 1% |
| 4. | Ependymal Tumors | 2,3% |
| 5. | Choroid Plexus Tumors | 0,3% |
| 6. | Tumors of the Pineal Region | |
| 7. | Neuronal and Mixed Neuronal-Glial Tumors | |
| 8. | Other Neuroepithelial Tumors | |
| 9. | Embryonal tumors | |

2. Tumors of Cranial and Paraspinal Nerves 7%

3. Tumors of Meningothelial Cells 26%

4. Tumors of the Haematopoietic System 3,5%

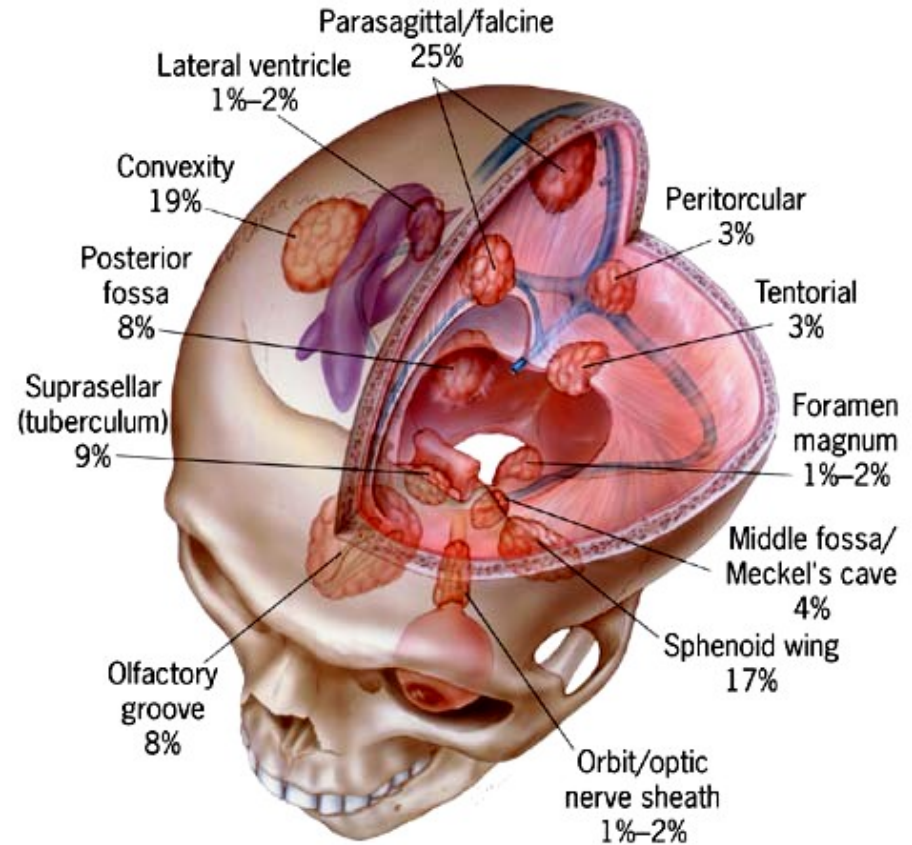
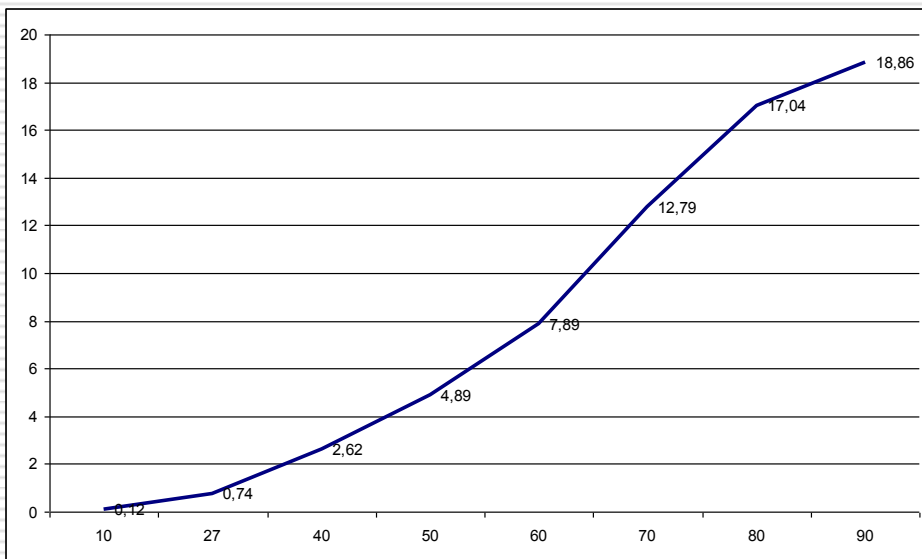
5. Germ Cell Tumors

6. Tumors of the Sellar Region

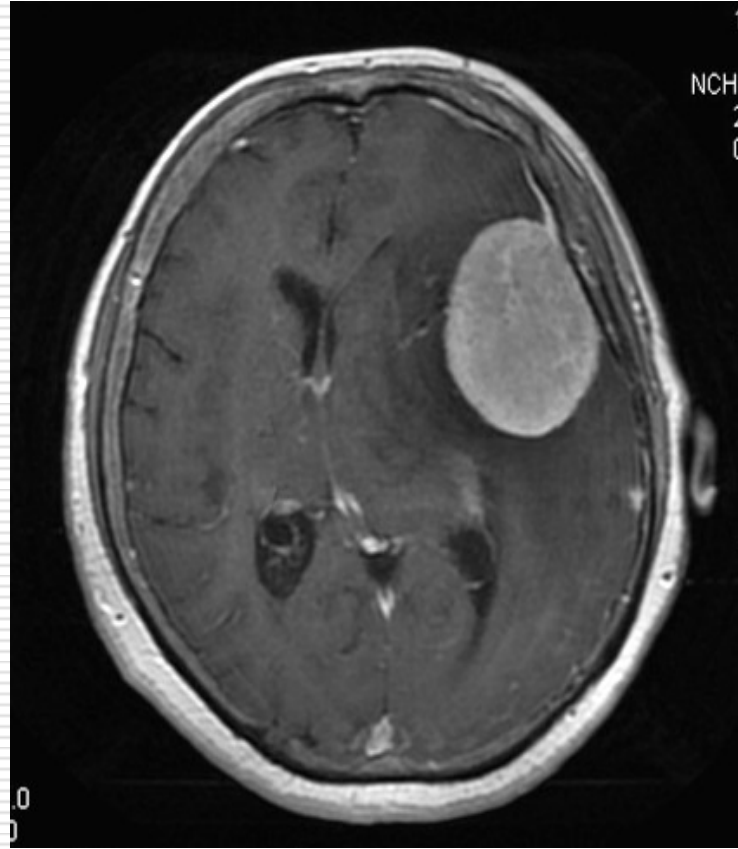
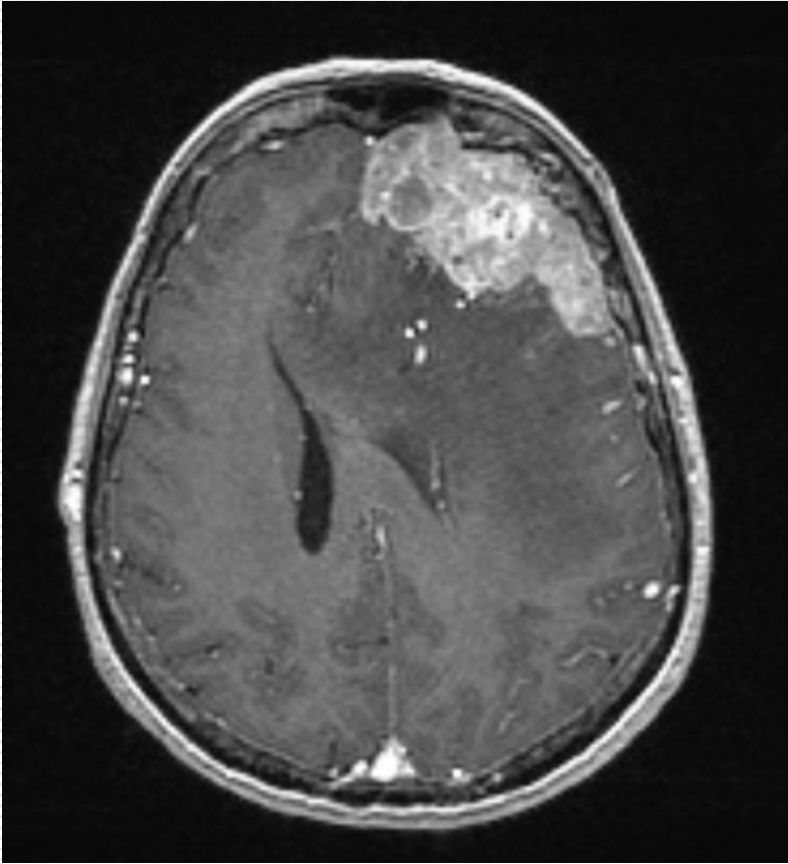
7. Metastatic Tumors

Meningioma

The incidence of meningioma is given 7-8 per 100 000, but much of it is asymptomatic (perhaps up to 70 %...)



Meningioma



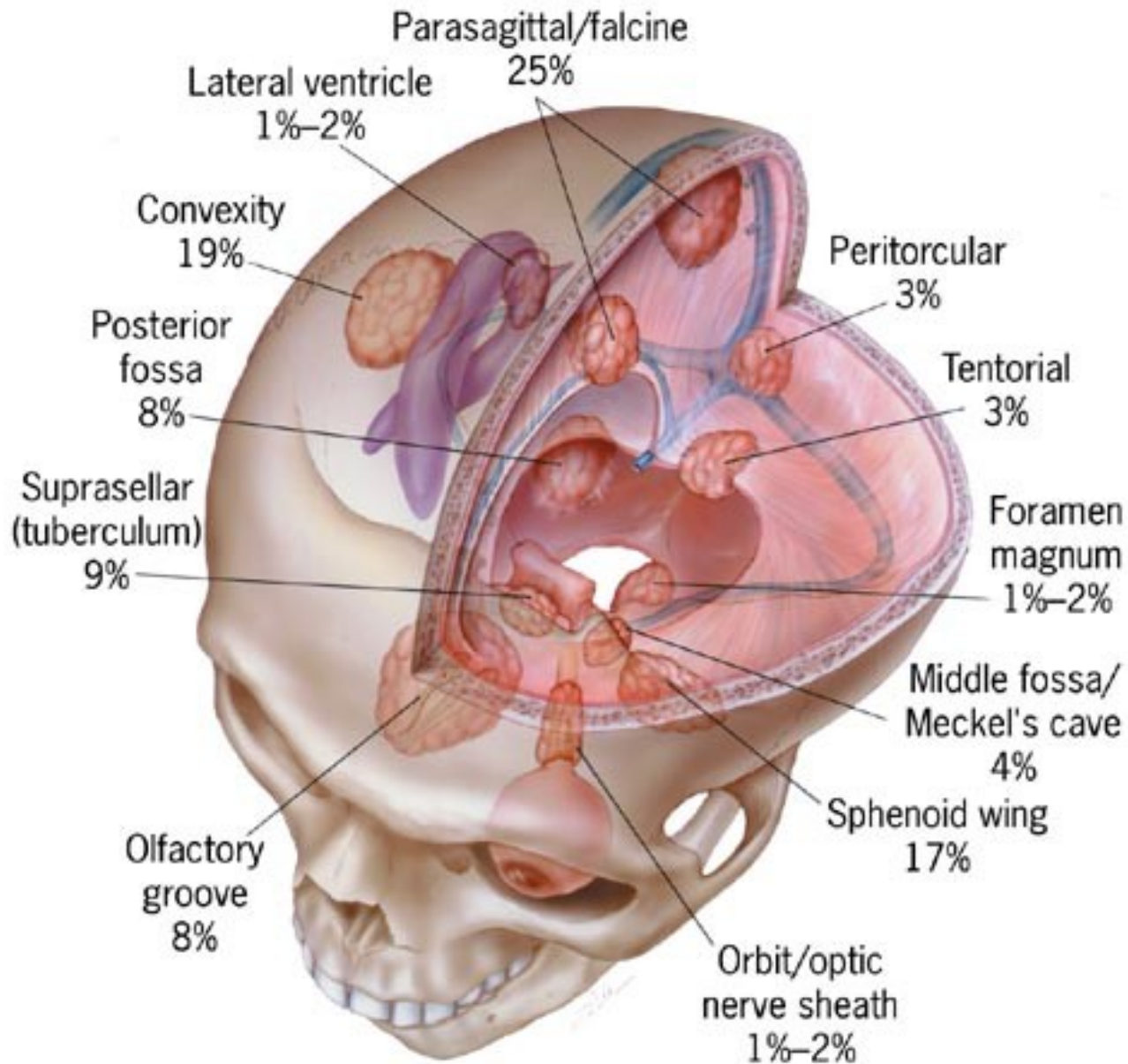
Meningioma

- **Grade I:** Meningiomas with low risk of recurrence or aggressive behavior
(Meningiomafibrous (fibroblastic), Transitional, (mixed)Psammomatous, Angiomatous, Microcystic, Secretory, Lymphoplasmacyte-rich, Metaplastic)

 - **Grade II:** Meningiomas with high risk of recurrence or aggressive behavior
(Atypical, Clear cell, Chordoid)

 - **Grade III:** Meningiomas with very high risk of recurrence or aggressive behavior
(Rhabdoid, Papillary, Anaplastic (malignant))
-

Meningeoma - localisation



The Goal of Procedure

□ Removal of a meningioma - radical resection to prevent recurrence

1. Total tumor resection, the dura mater and cranial bone resection, replacement of dura and bone by autogenous or artificial grafts
 2. Total tumor resection, coagulation of dura mater and restoration of bone
 3. Total, without resection of dura, possibility of extradural residue of meningioma (cavernous sinus)
 4. Partial tumor resection
 5. Simple decompression or biopsy only
-

3244/2000
01-OCT-1954
11:26
21-DEC-2000
IMAGE 159
SER 1-6

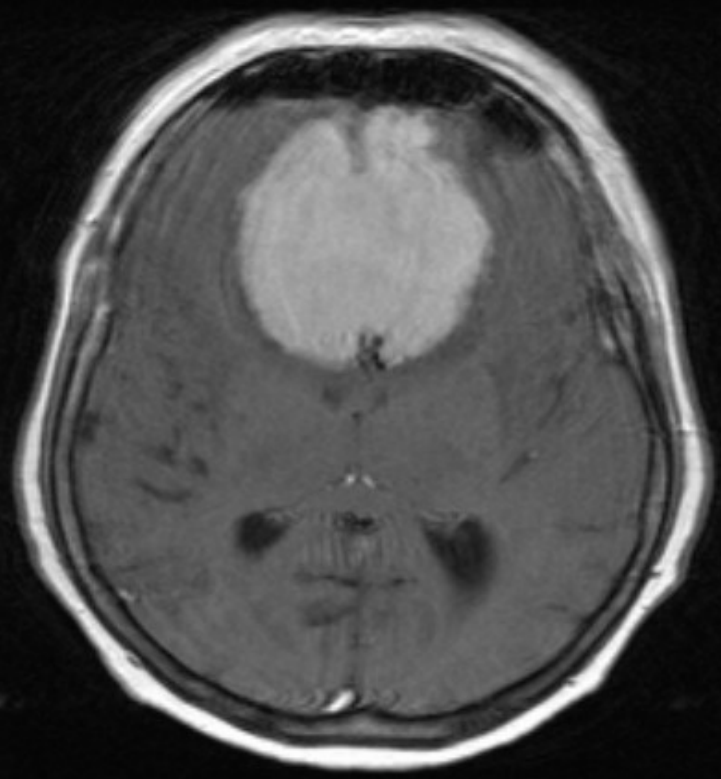
MAGNETOM IMPAC
H-SP-CR VB33
+ : F A

R

Post CM
sel
R D
TR 600.0
TE 15.0/1
TA 04:12
AC 2

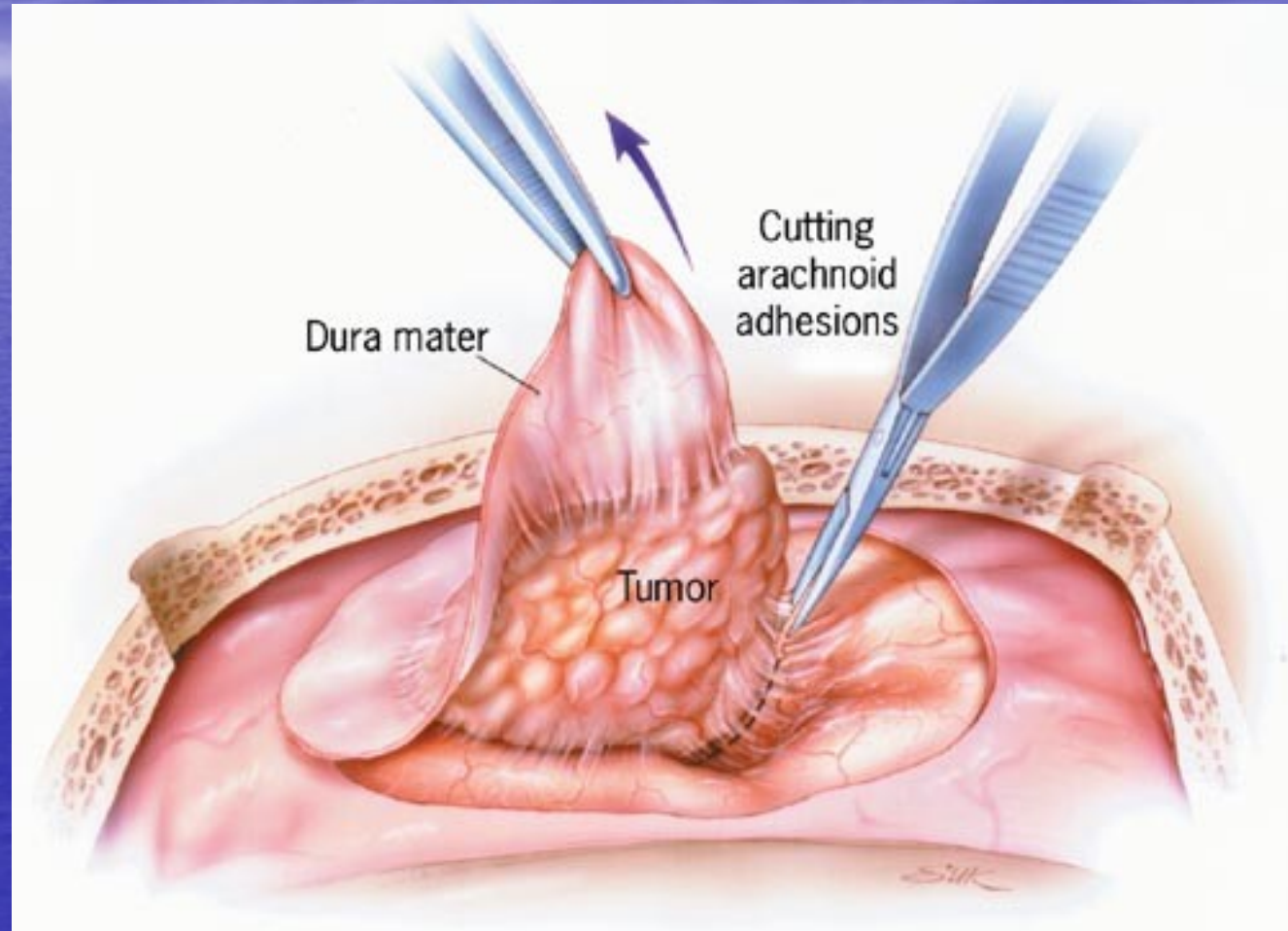
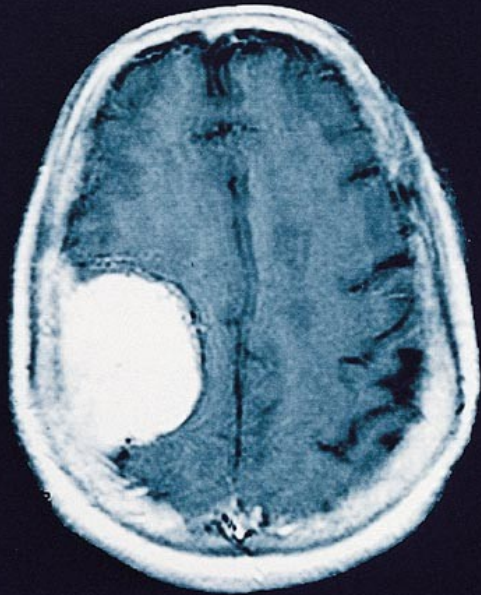
SP 25
SL 5
FoV 175*2
202 *256
Tra>Cor -
W 14
C 8

MOZEK
20-ML MAGNEVTST T V

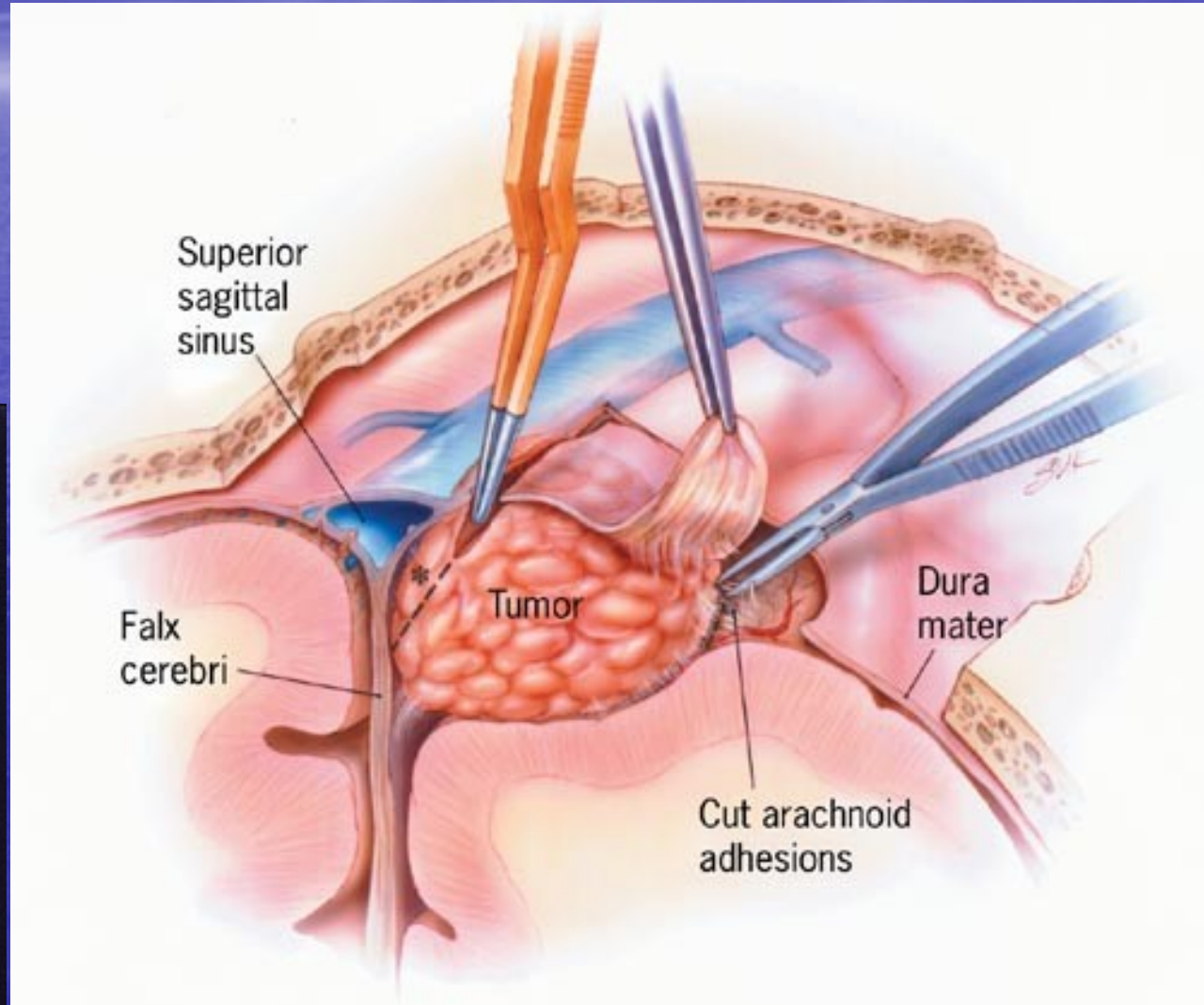
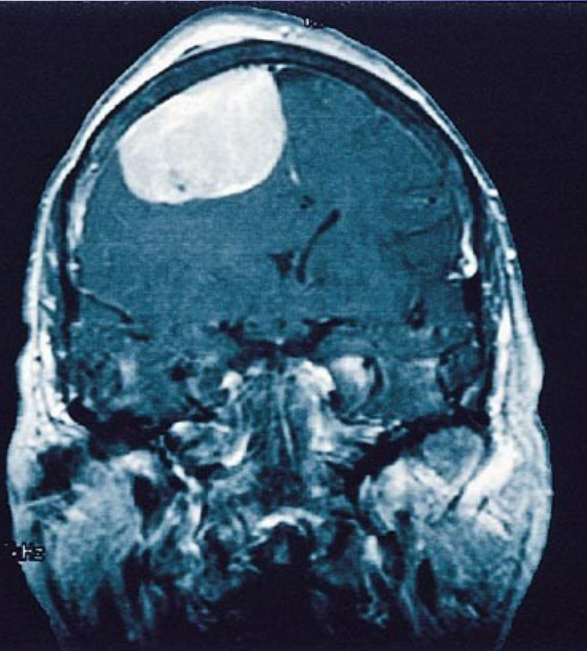
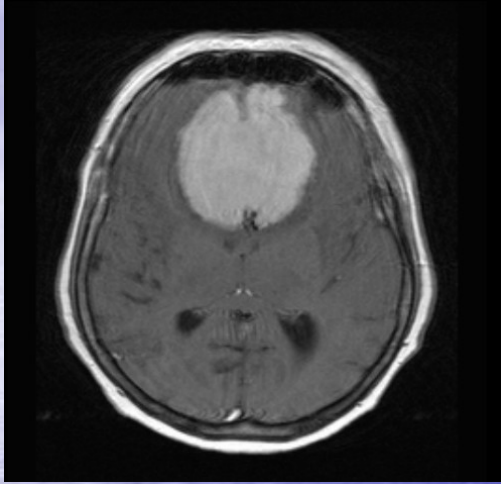




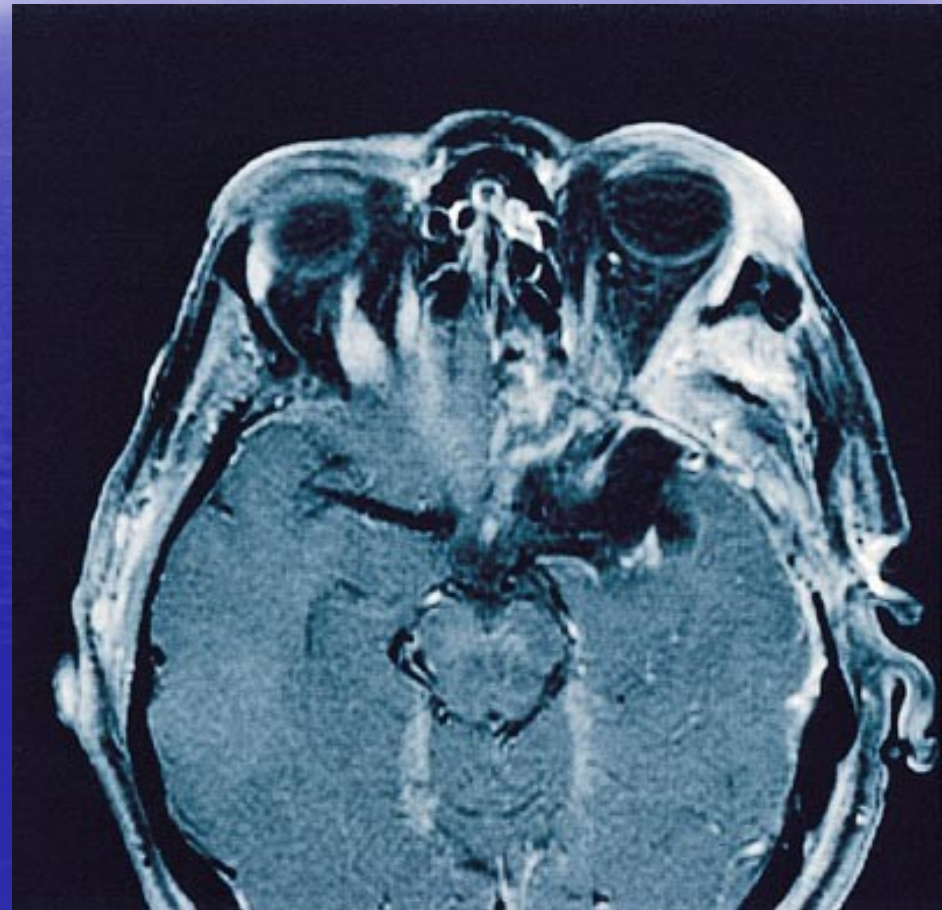
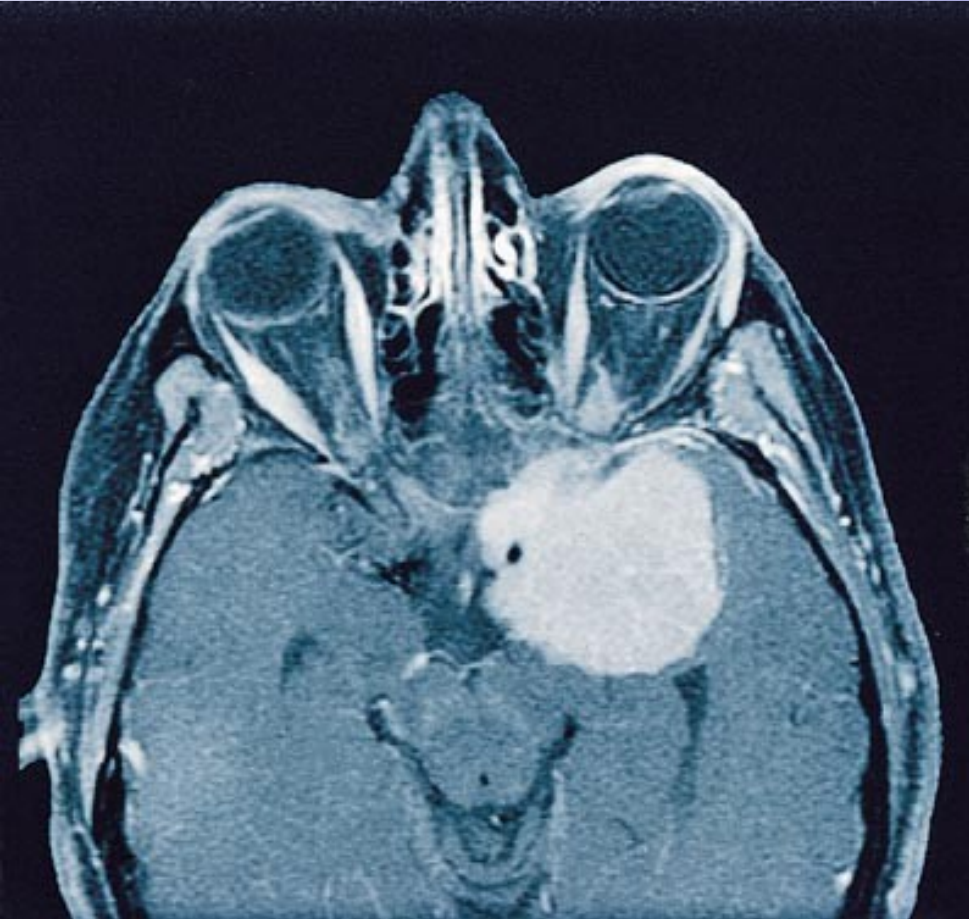
Convexity meningeomy



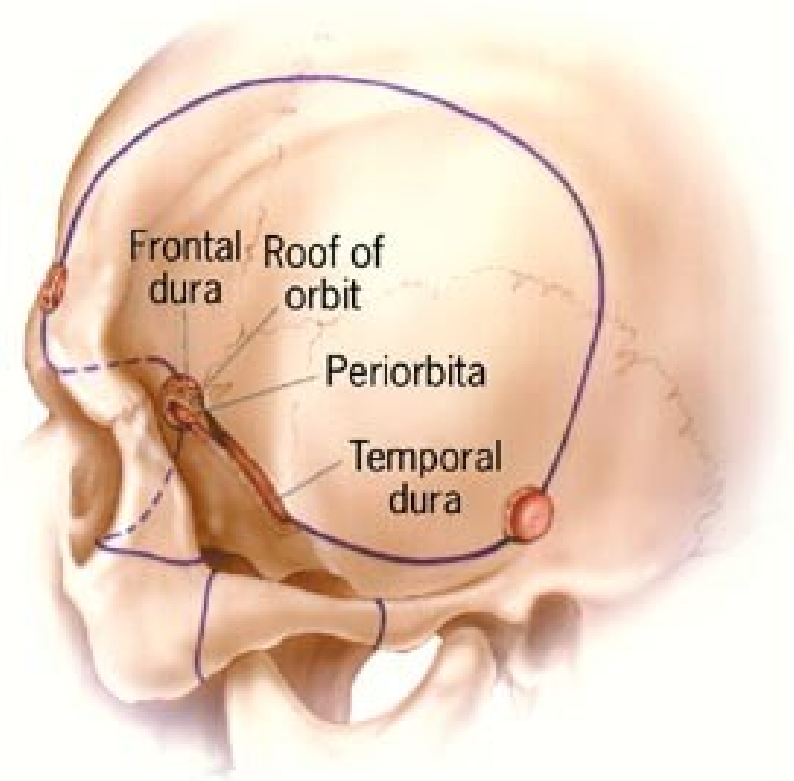
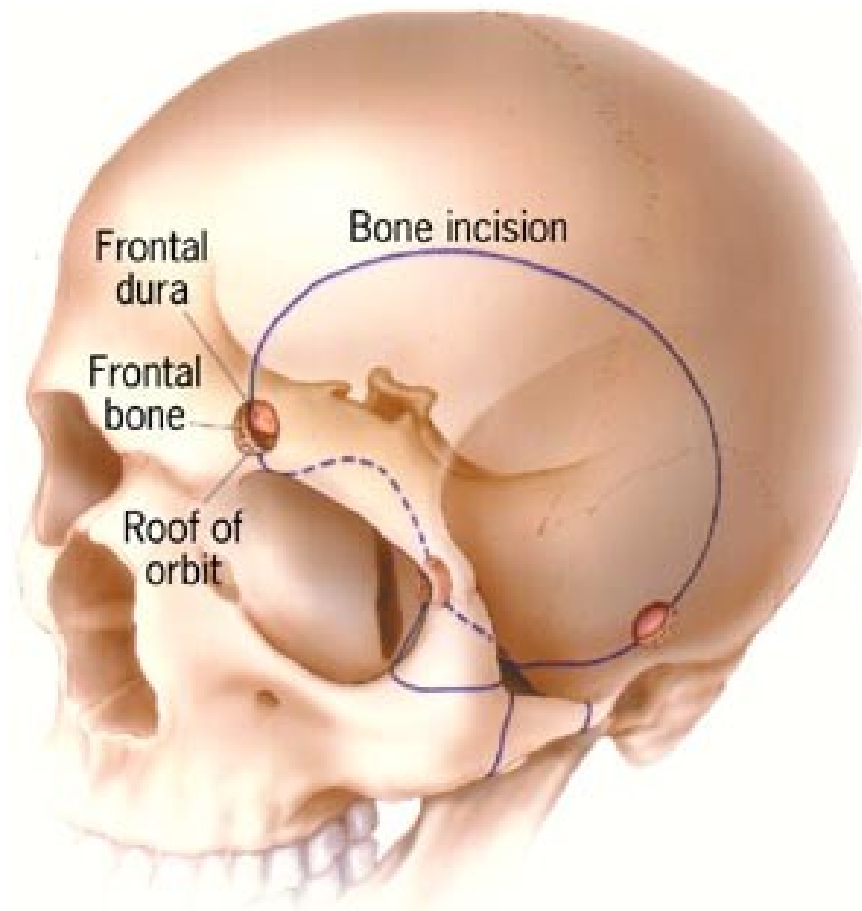
Parasagittal meningeoma



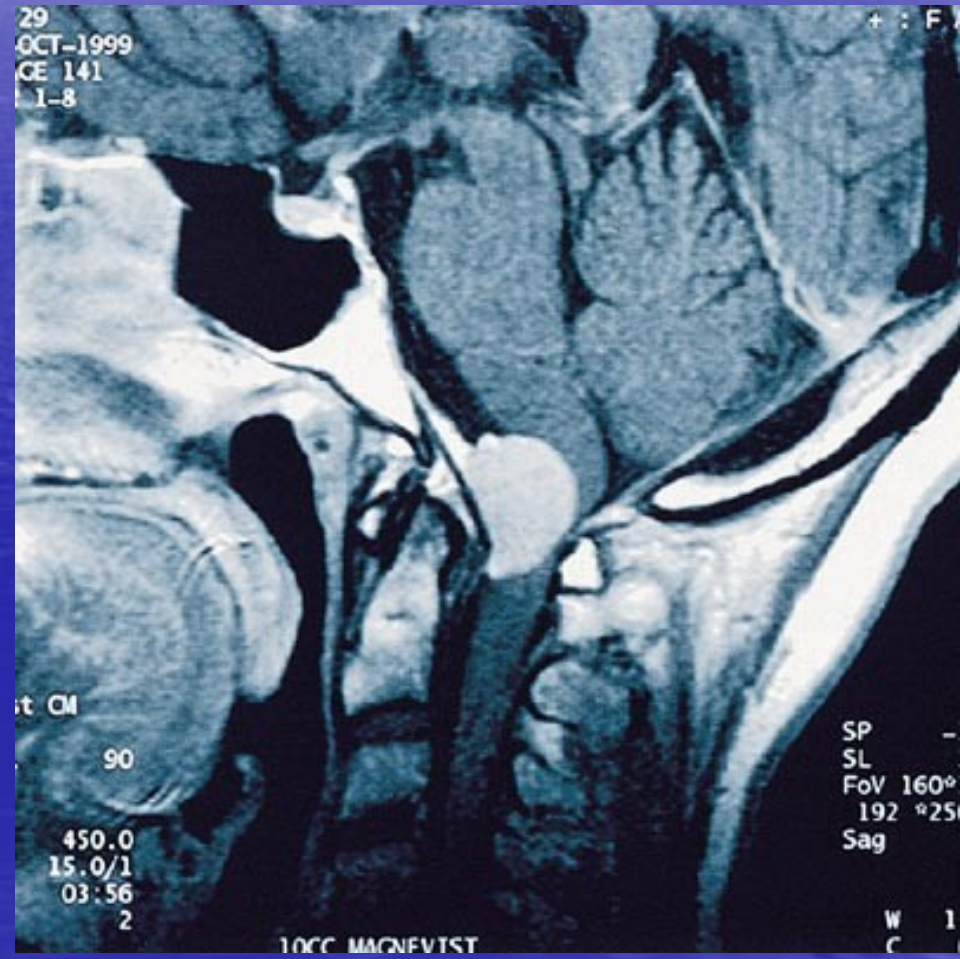
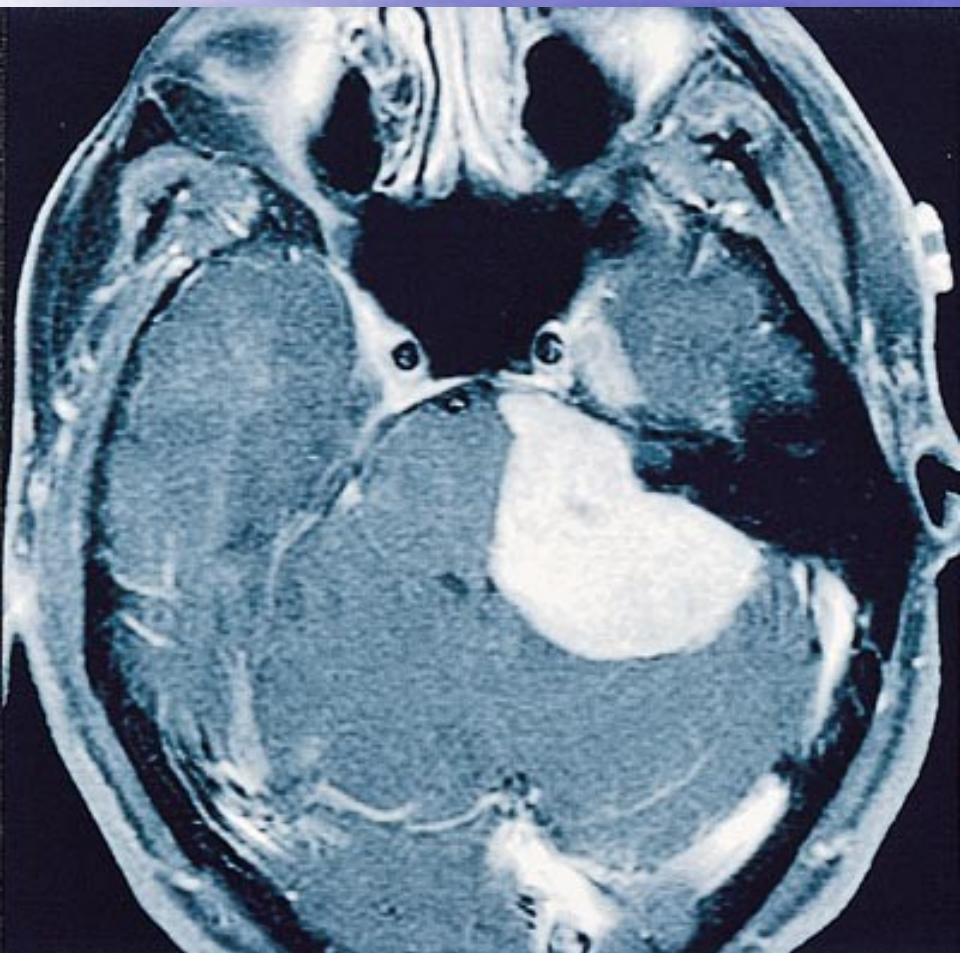
Meningeoma pre/post surgery



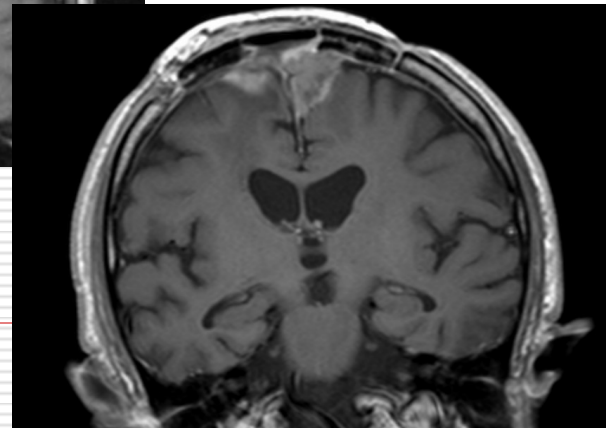
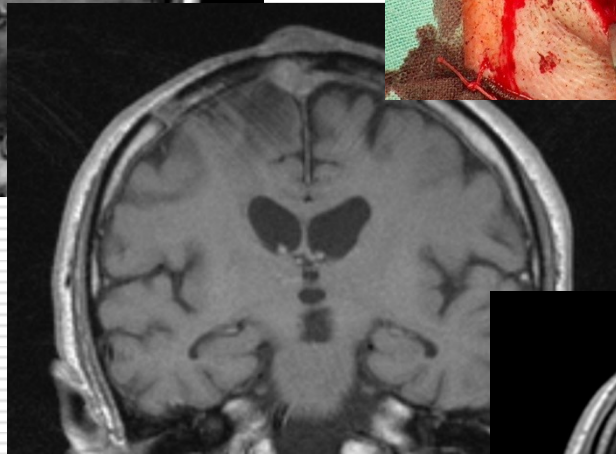
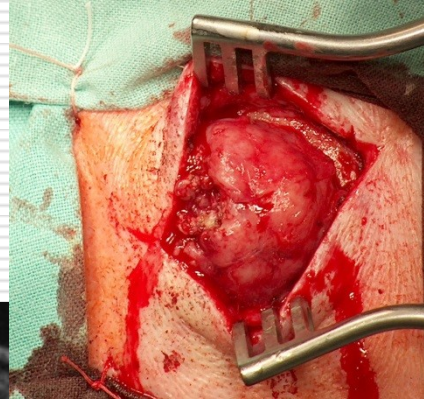
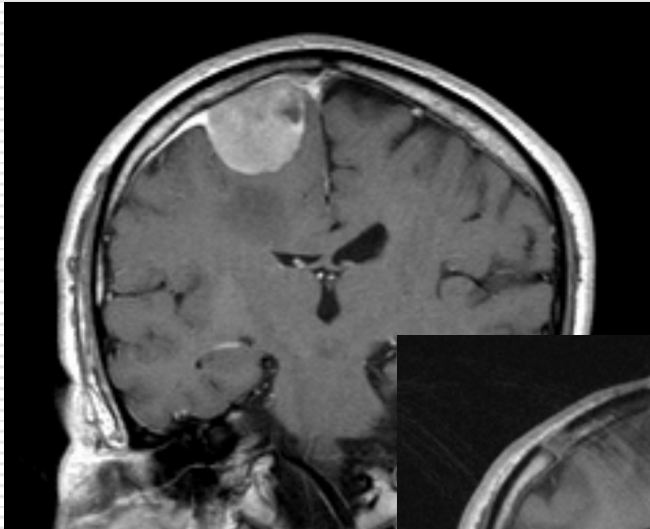
Meningeoma – appr.



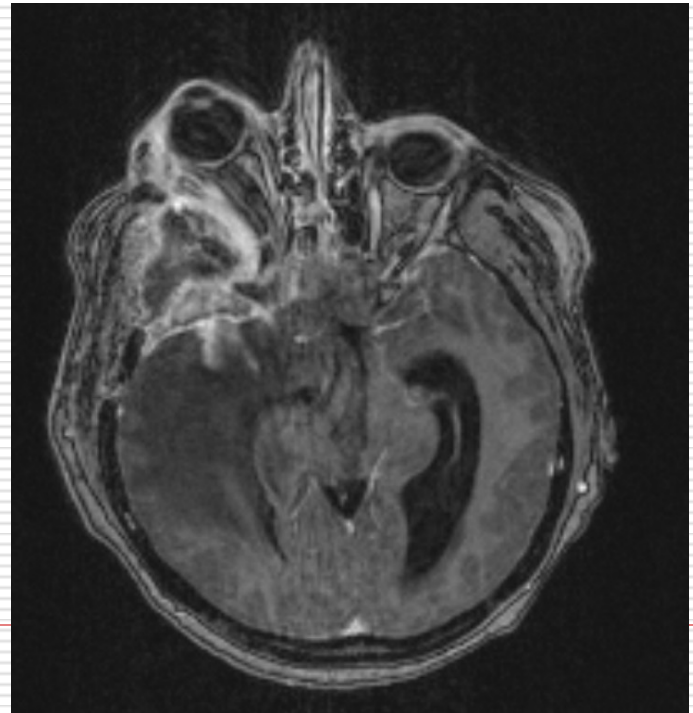
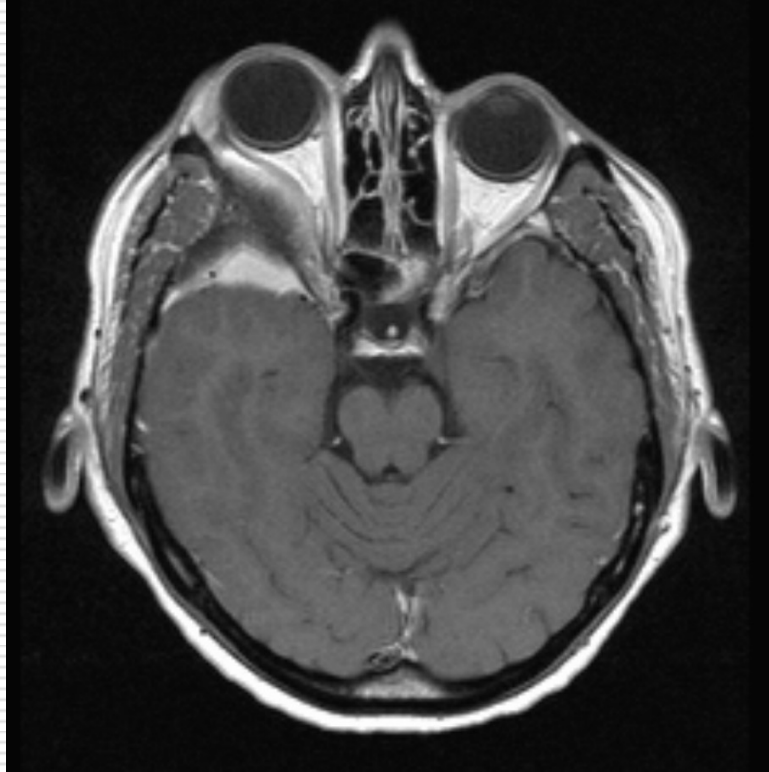
Meningeoma infratentorial

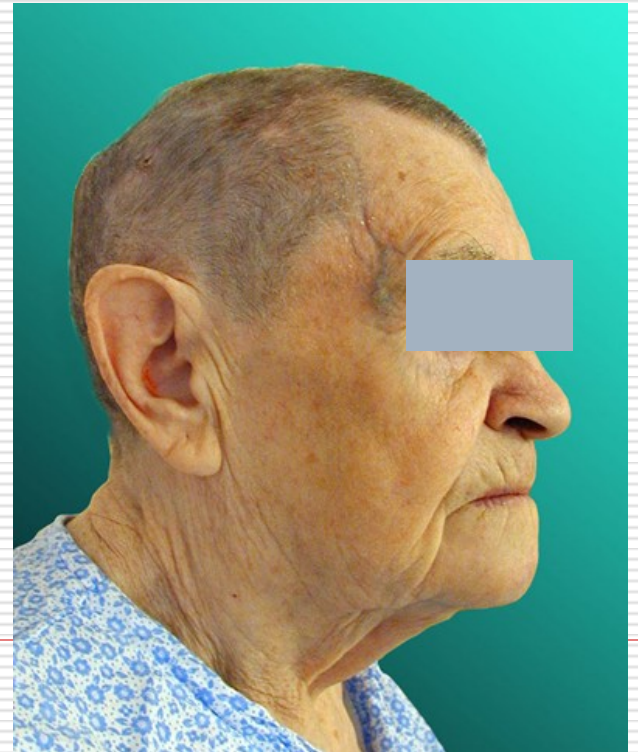


Case 1 – meningiom G I



Case 2 - meningeom G I





Glioma

- 40 - 50% primary brain tumors

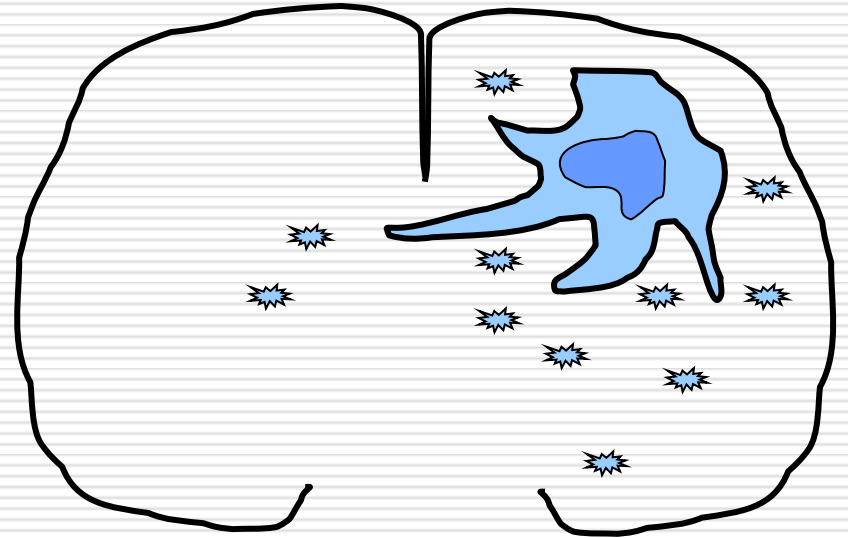
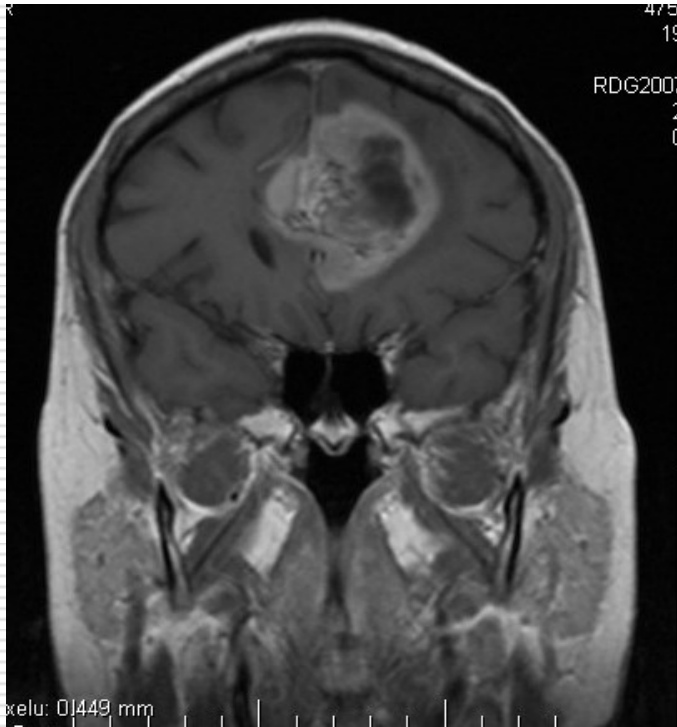
1) Low-grade glioma

- Pilocytic Astrocytoma (G1)
- Diffuse Astrocytoma (G2) – fibrillary, protoplasmic, gemistocytic
- Oligoastrocytoma (G2)
- Oligodendroglioma (G2)
- Ependymoma (G2)

2) High-grade glioma

- Anaplastic Astrocytoma (G3)
 - Glioblastoma Multiforme (G4)
 - Anaplastic Oligodendroglioma (G3)
 - Anaplastica Ependymoma (G3)
-

Intraaxial brain tumors – cells migration



The Goals of Malignant Tumor Surgery

Can never remove all of the tumor

How much can be removed depends on:

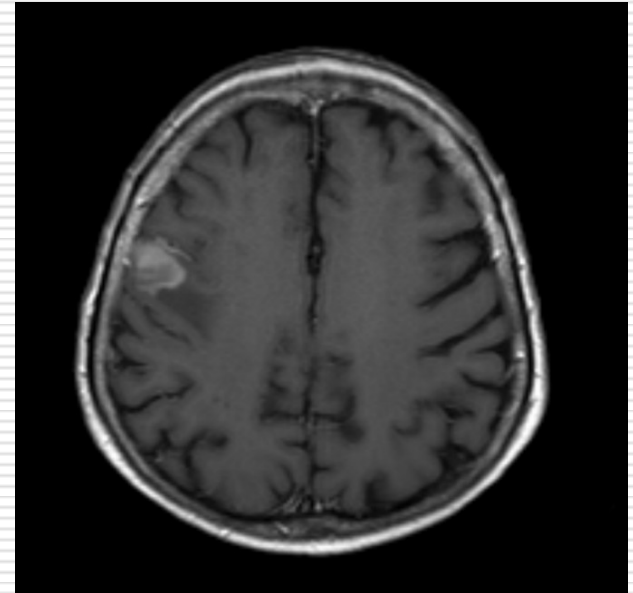
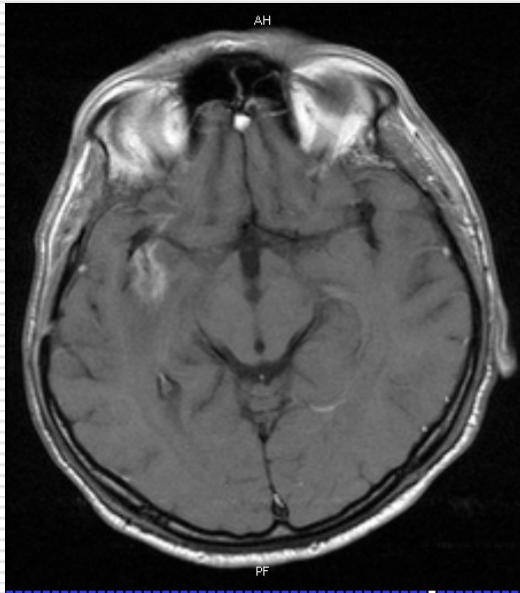
- the type of glioma,
 - Location within the brain
-

The Goals of Malignant Tumor Surgery

1. Providing diagnosis
 2. Relieving symptomatic mass effect
 3. “Setting up” postoperative externally delivered therapies
 4. Prolonging of survival through cytoreduction
 5. Applying locally-delivered therapies
-

Providing Diagnosis

□ Glioma*MTS*abscess*lymfoma



Relieving Mass Effect

- High grade glioma – improvement of neurological symptoms
 - Low grade - removal of the epileptogenic area
-

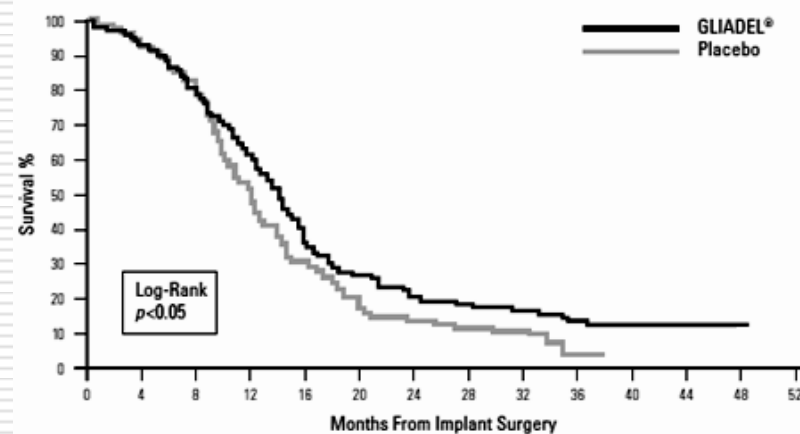
Preparing for Adjuvant Therapy

Resection and TMZ – EORTC 26981 (Stupp)

	2-year survival		median survival	
	+TMZ	-TMZ	+TMZ	-TMZ
GTR	37%	14%	18m	14m
STR	23%	9%	14m	12m
B	10%	5%	9m	8m

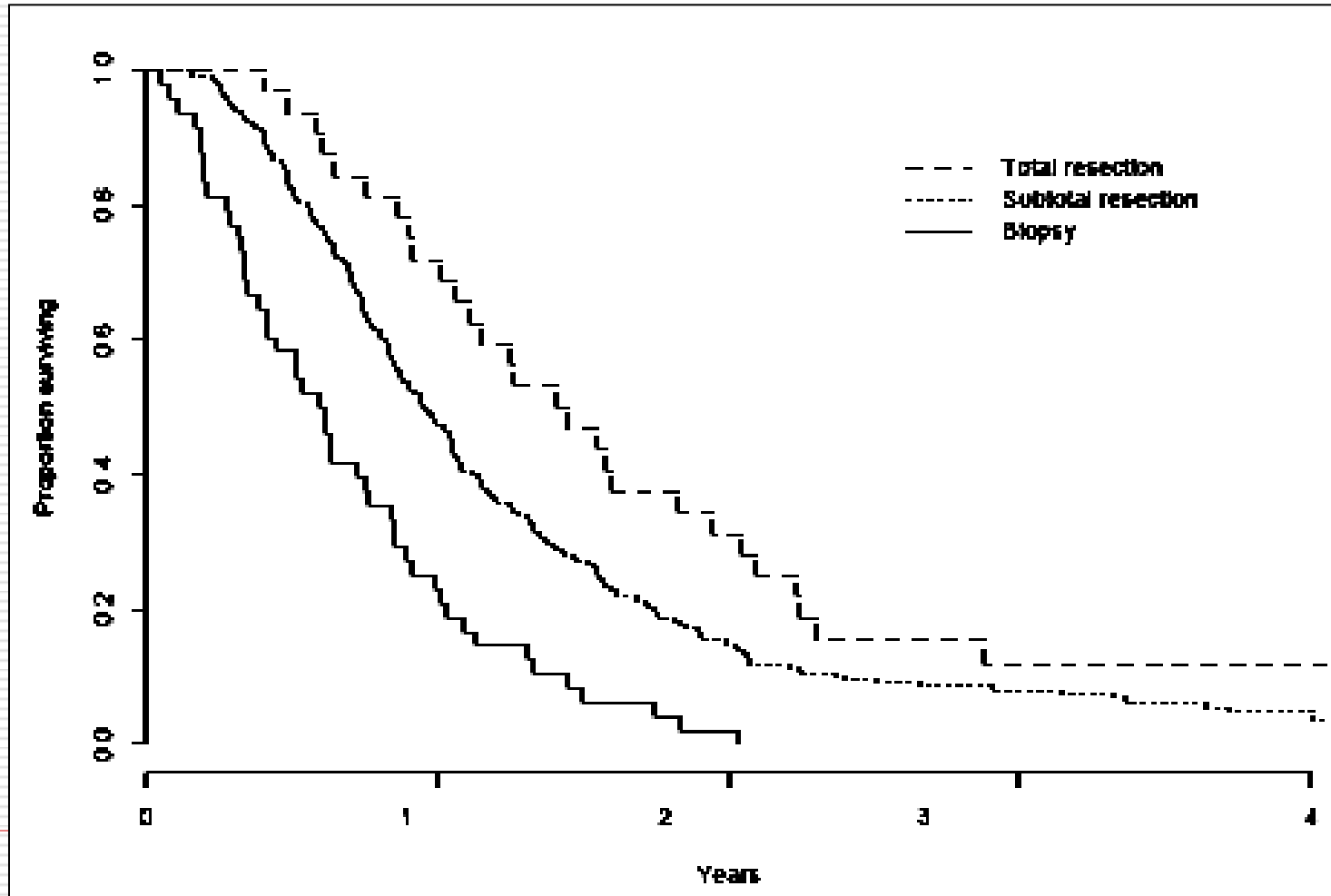
Application of Topical Therapy

□ Gliadel (Carmustin)



□ *Cerepro - sitimagene ceradenovec (GMO adenovirus + gancyclovir) – 3/2010 cancelation of authorization*

Prolonging Survival – Cytoreduction



Extent of Resection Value

Do 1985

1986-1990

1990-1995

1996-2000

LAWS

SOFFIETTI

PHILIPPON

PIEPMEIER

WHITTON

ITO

KARIM

STEIGER

SHAW

BAHARY

NORTH

NICOLATO

SCERATTI

LEIGHTON

PEIPMEIER

JANNY

PERAUD

MEDBURY

RAJAN

VAN VEELEN

WHITTON

EYRE

SHAW

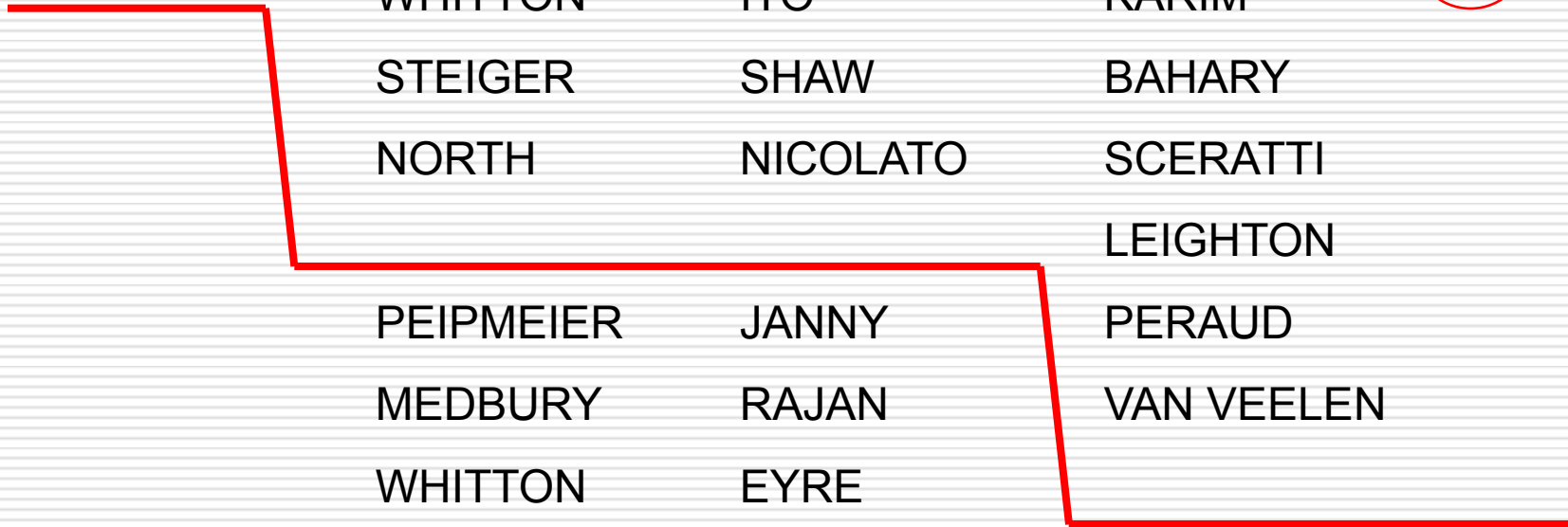
MIRALBELL

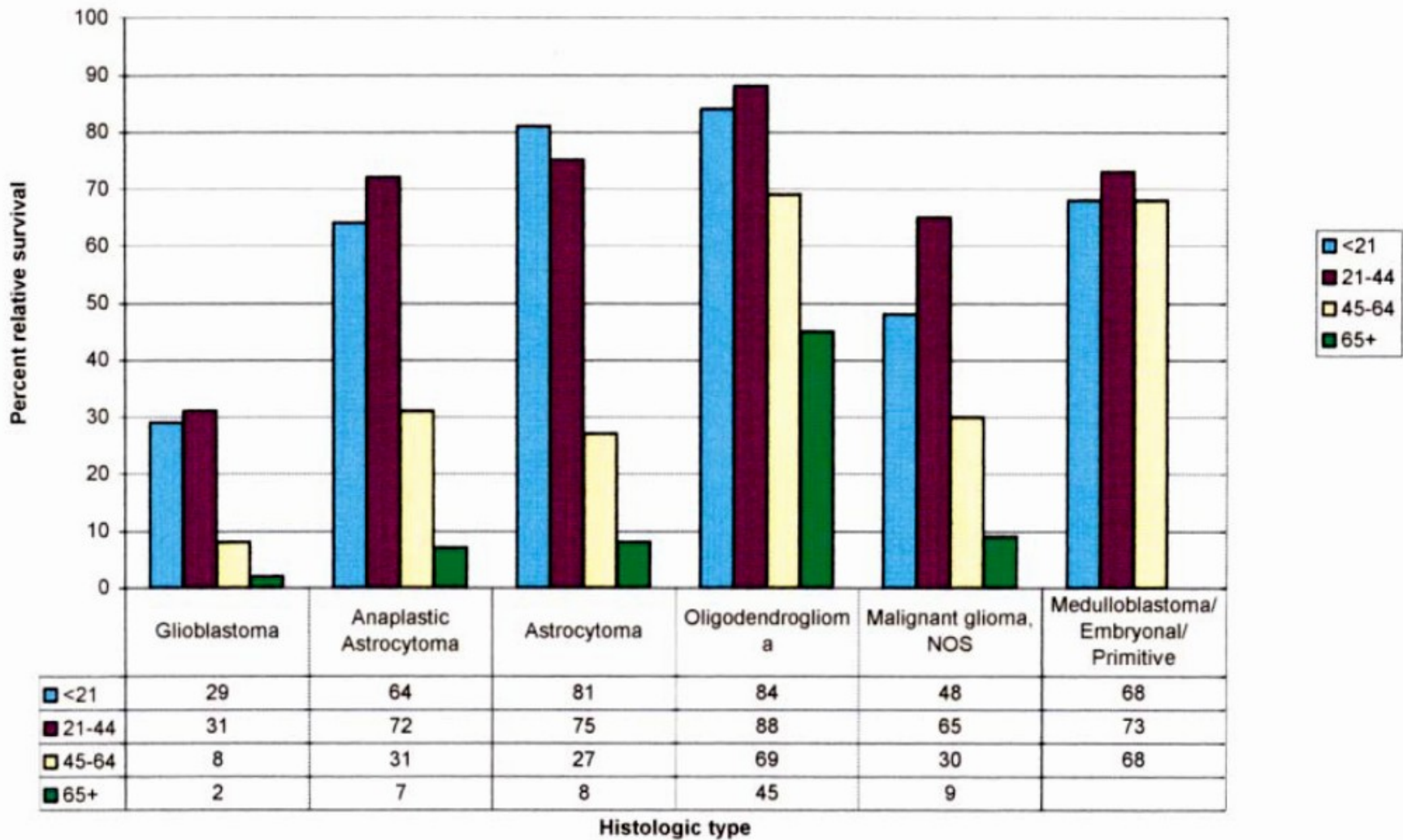
LOTE

SHAW

SHIBAMOTO

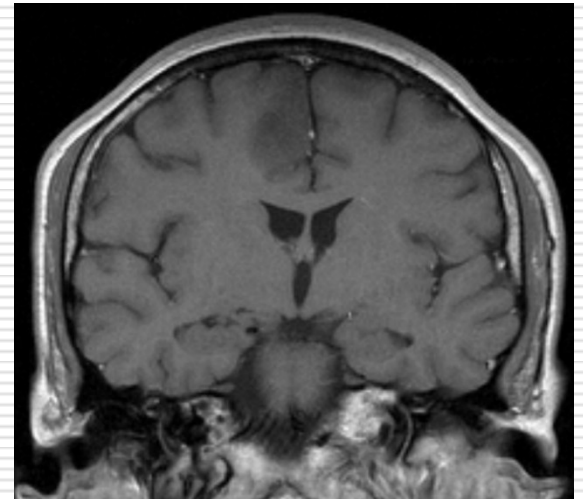
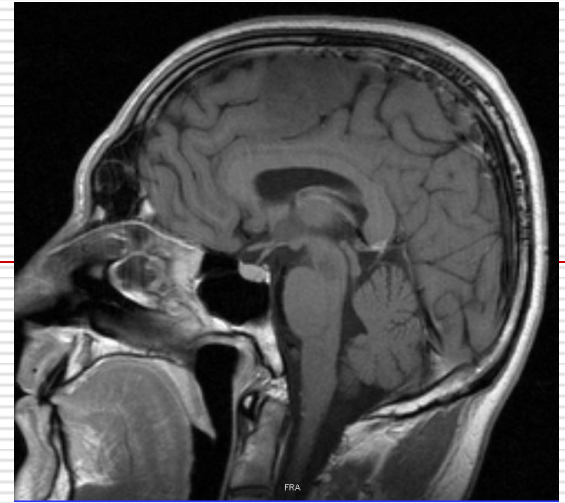
RUDOLER





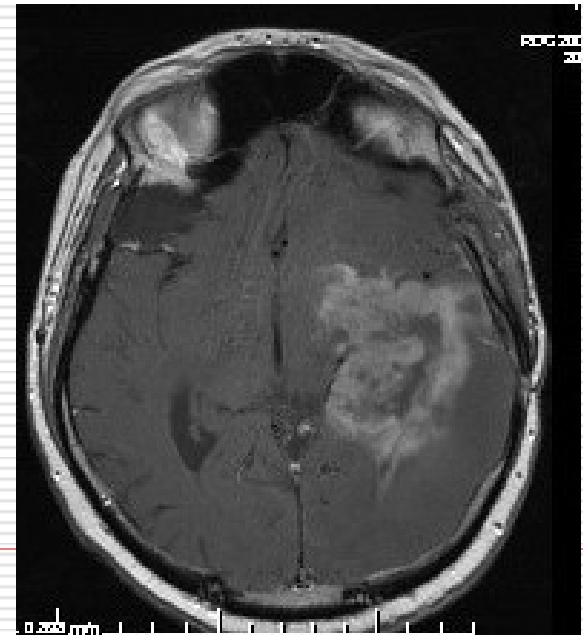
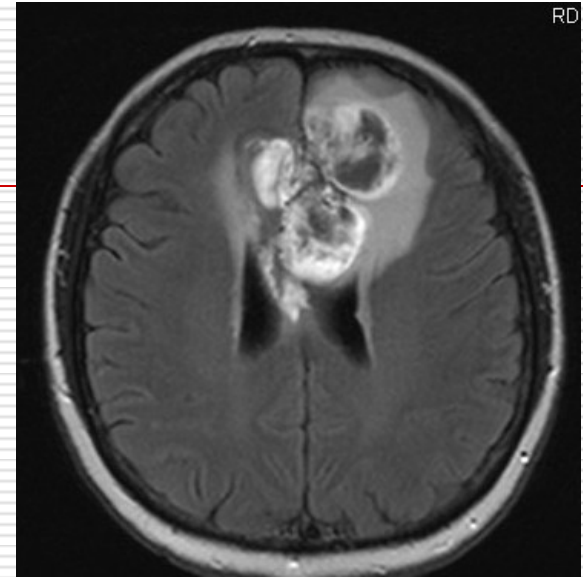
Indications for Surgery

- Low grade glioma
 - maximum profits given the relatively long median survival
 - quality of life preservation
 - the concept of brain plasticity



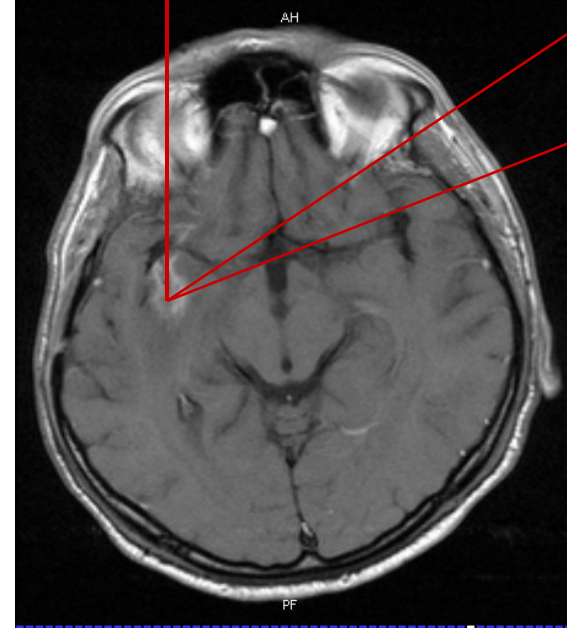
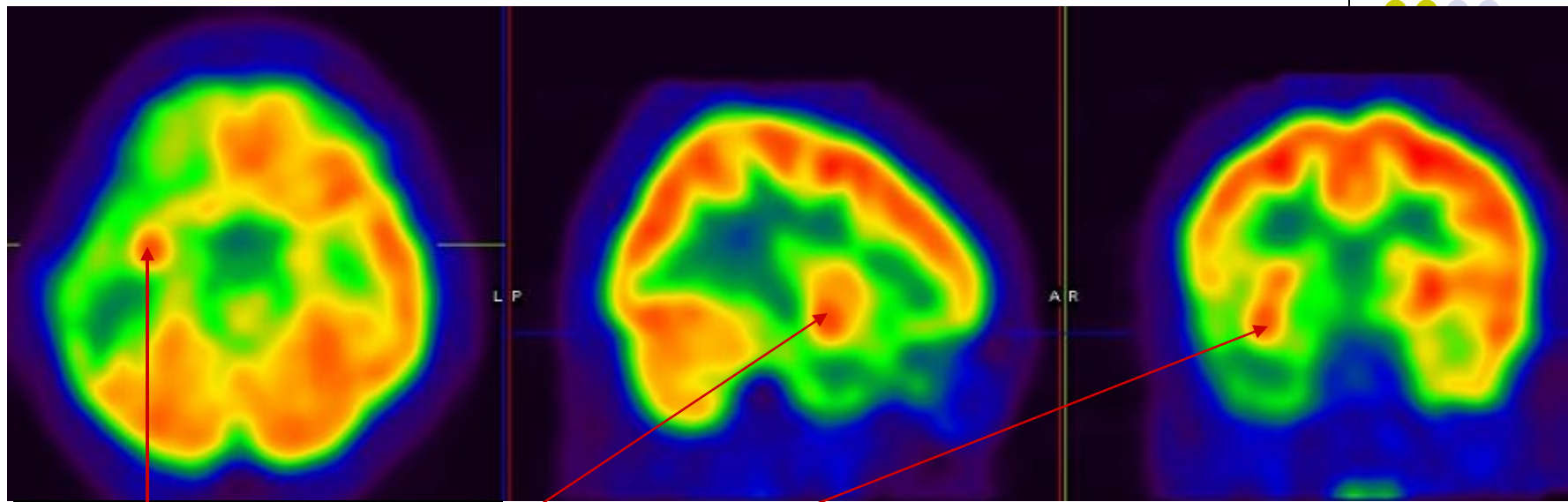
Indications for Surgery

- High grade gliomy
 - KPS
 - resectability





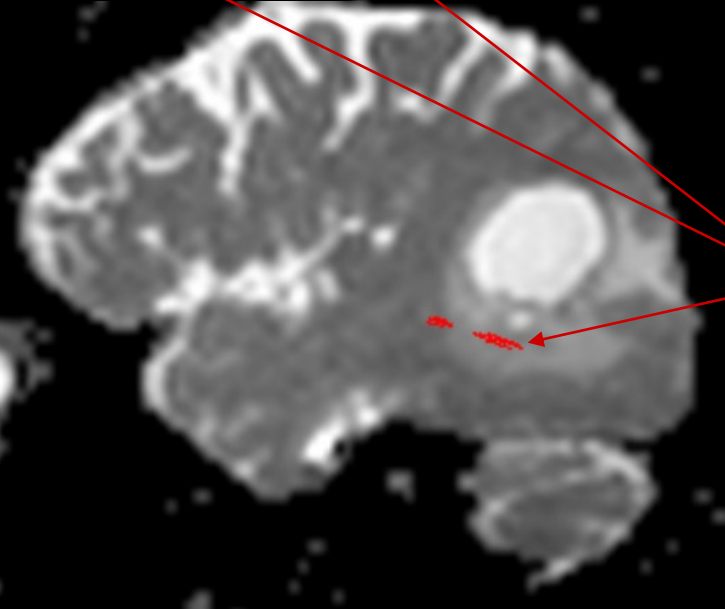
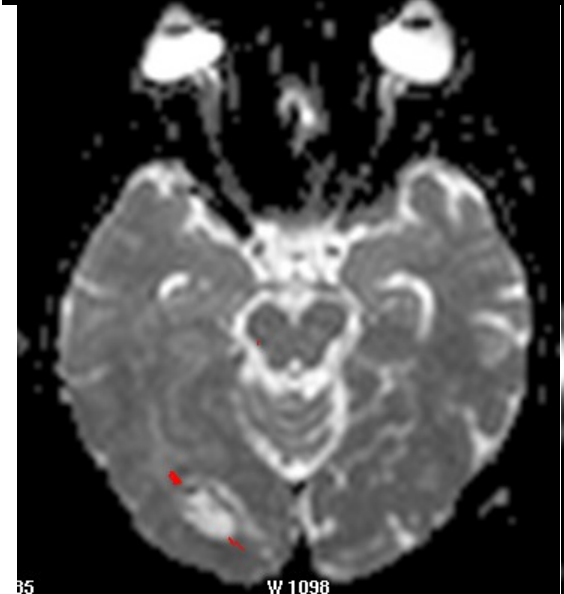
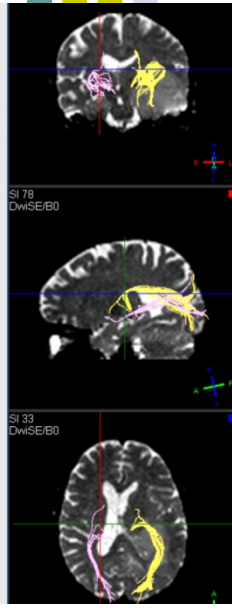
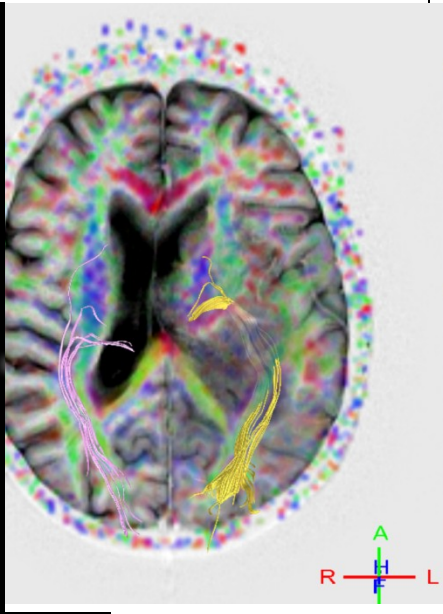
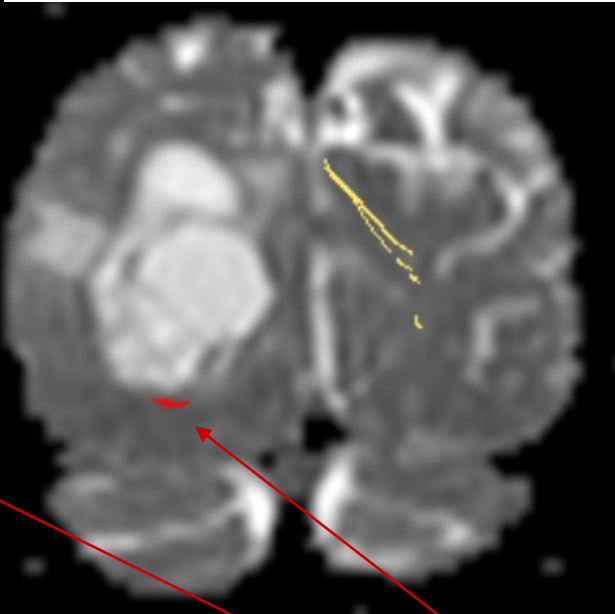
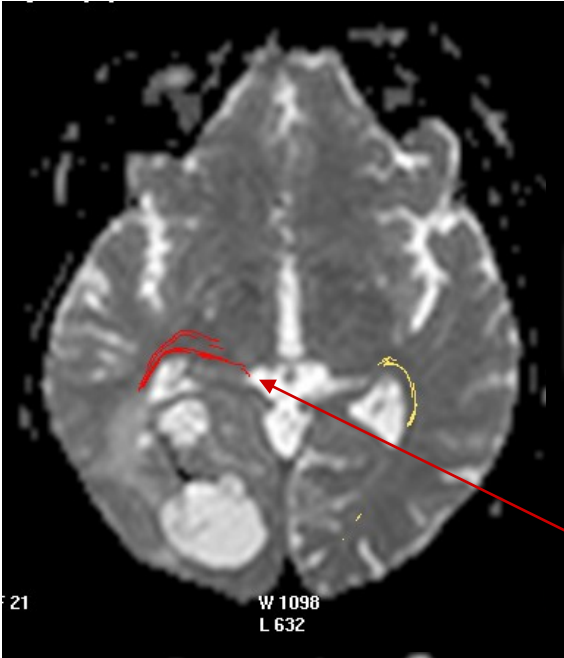
PET



C

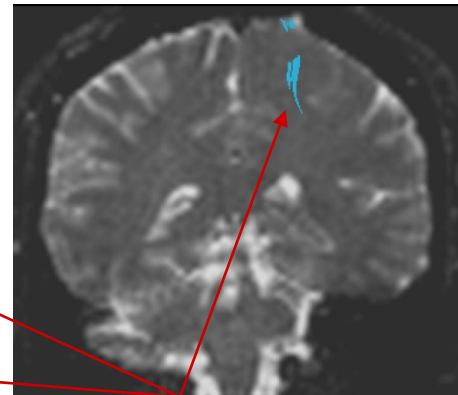
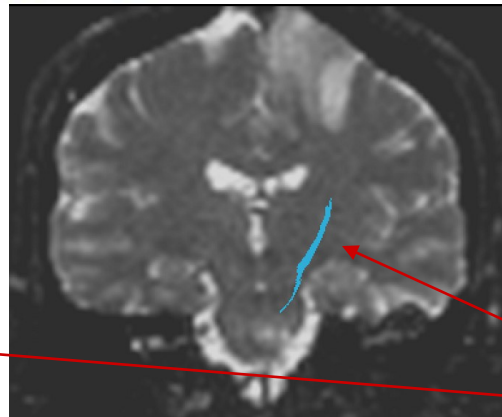
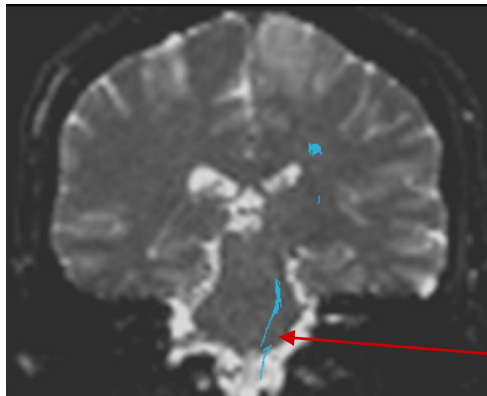
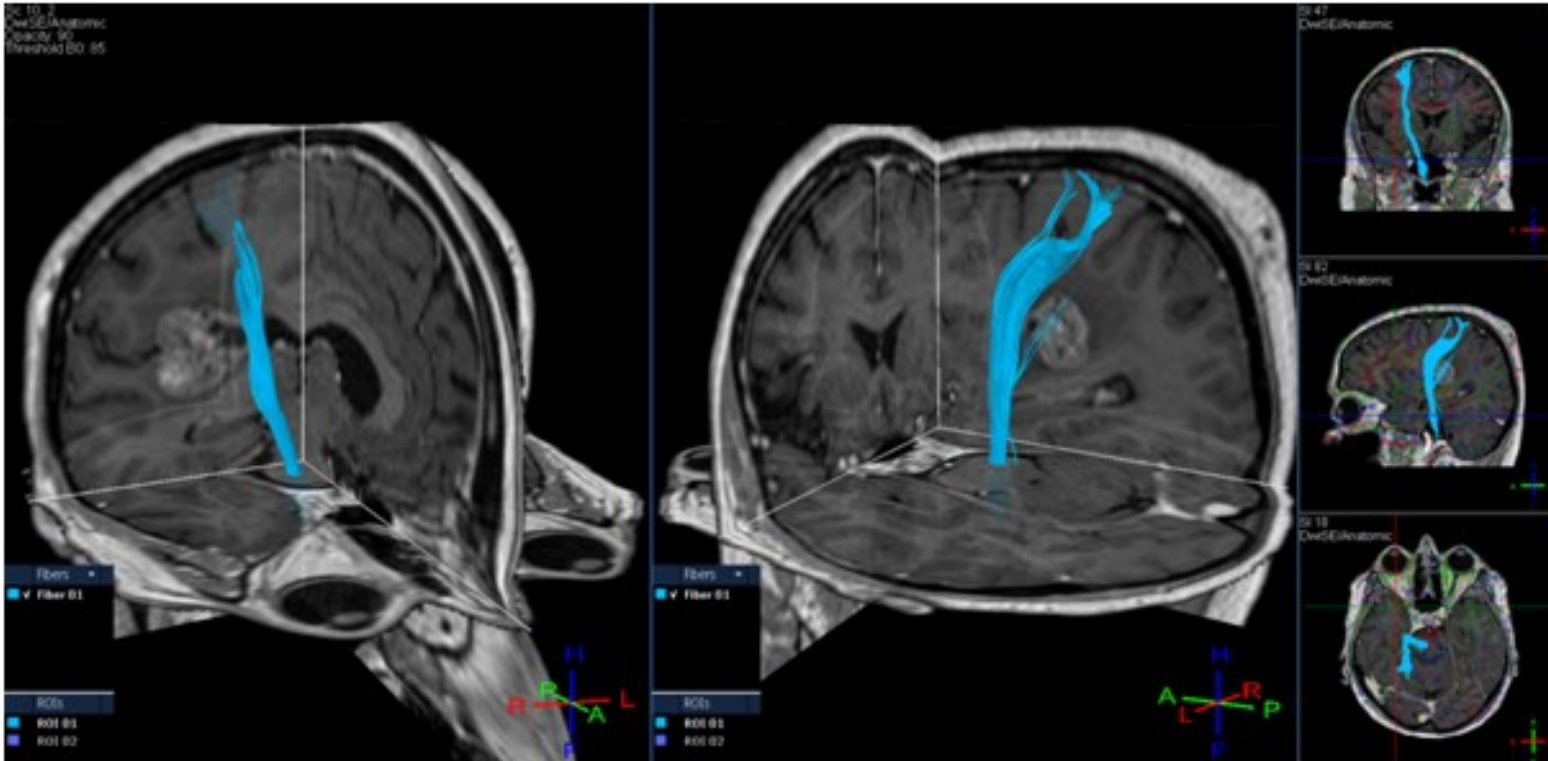
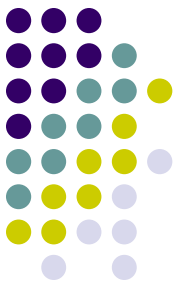
^{11}C -Methionin PET, ? 2011, MOU Brno

fMRI: DTI tractography 1.



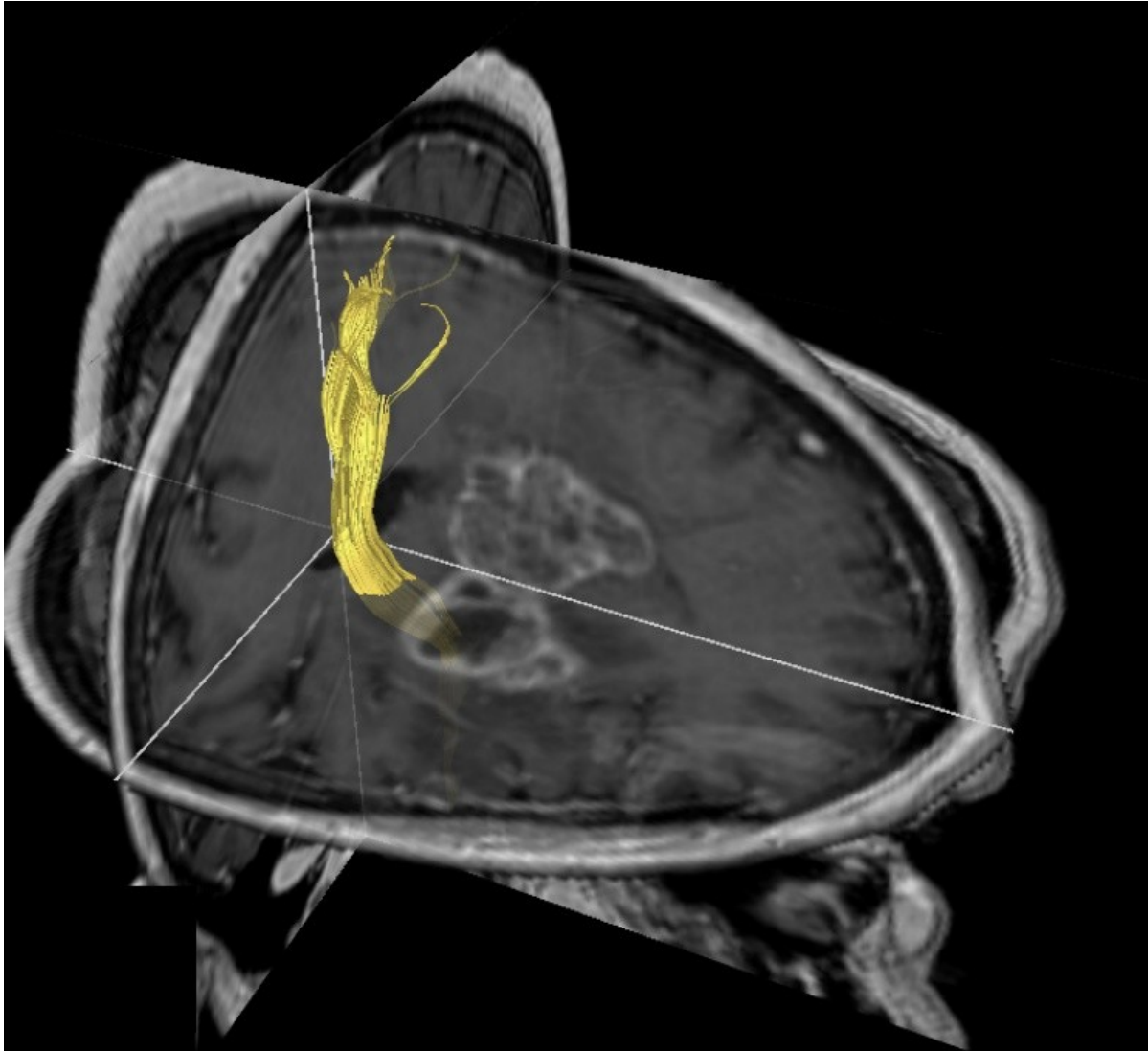
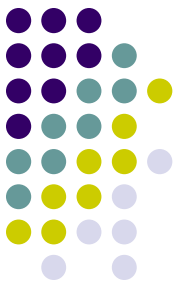
optická dráha

fMRI: DTI tractography 2



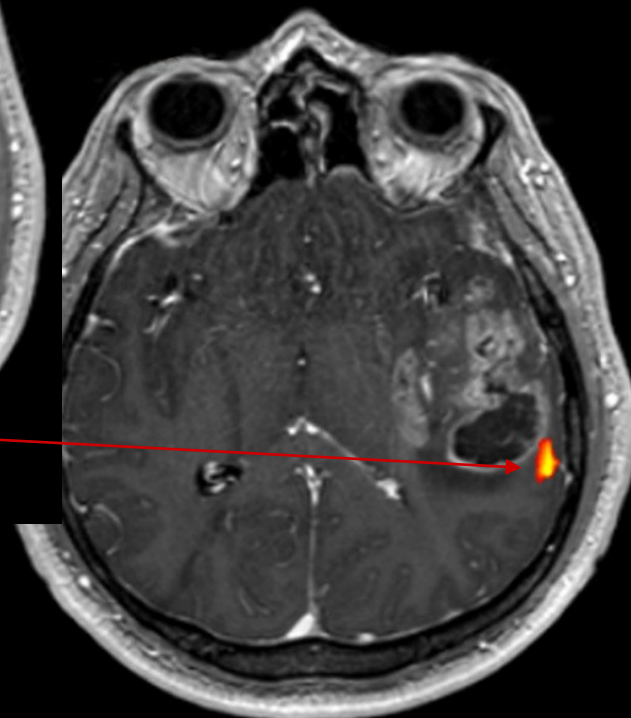
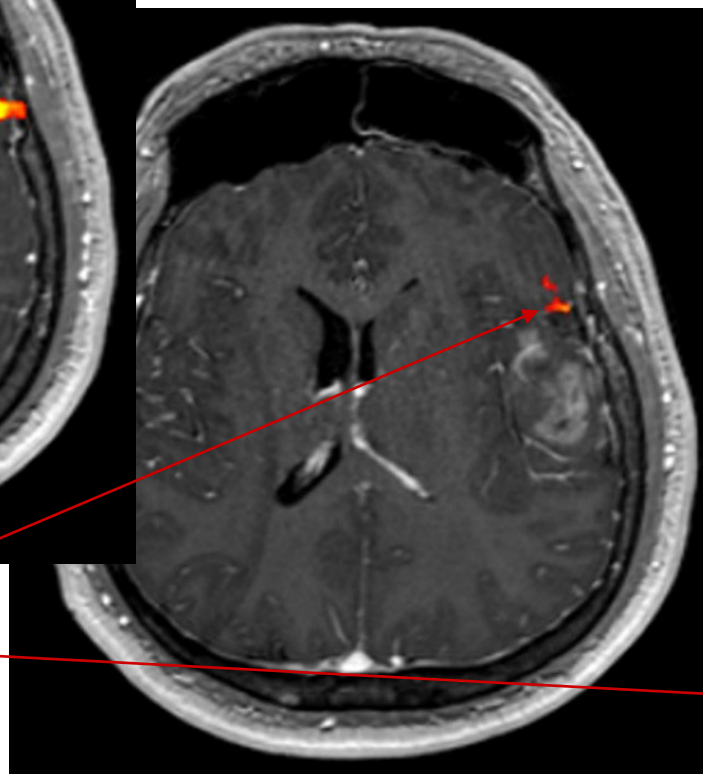
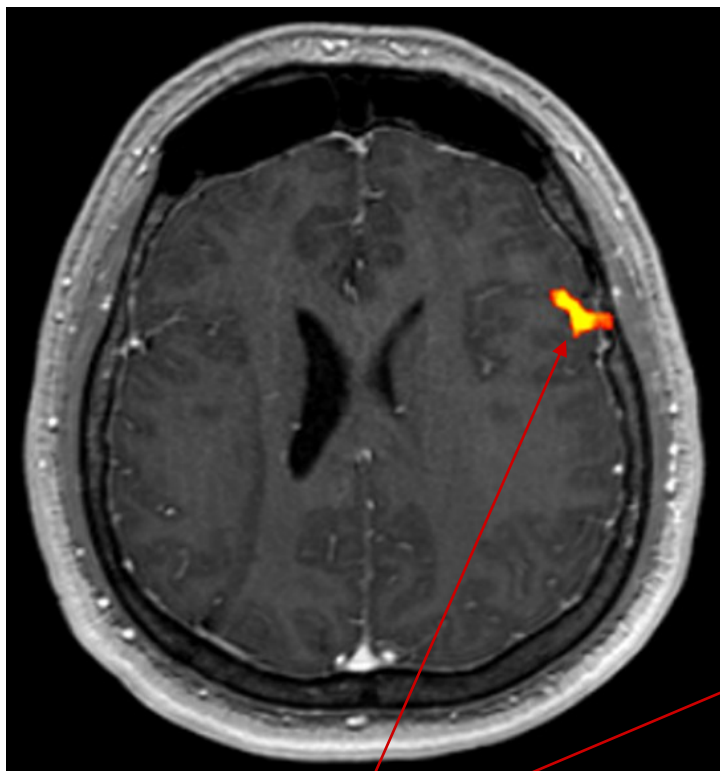
kortikospinální dráha

fMRI: DTI tractography 3



**kortikospinální
dráha**

fMRI: 3. VFT



centrum řeči

(test slovní plynulosti)

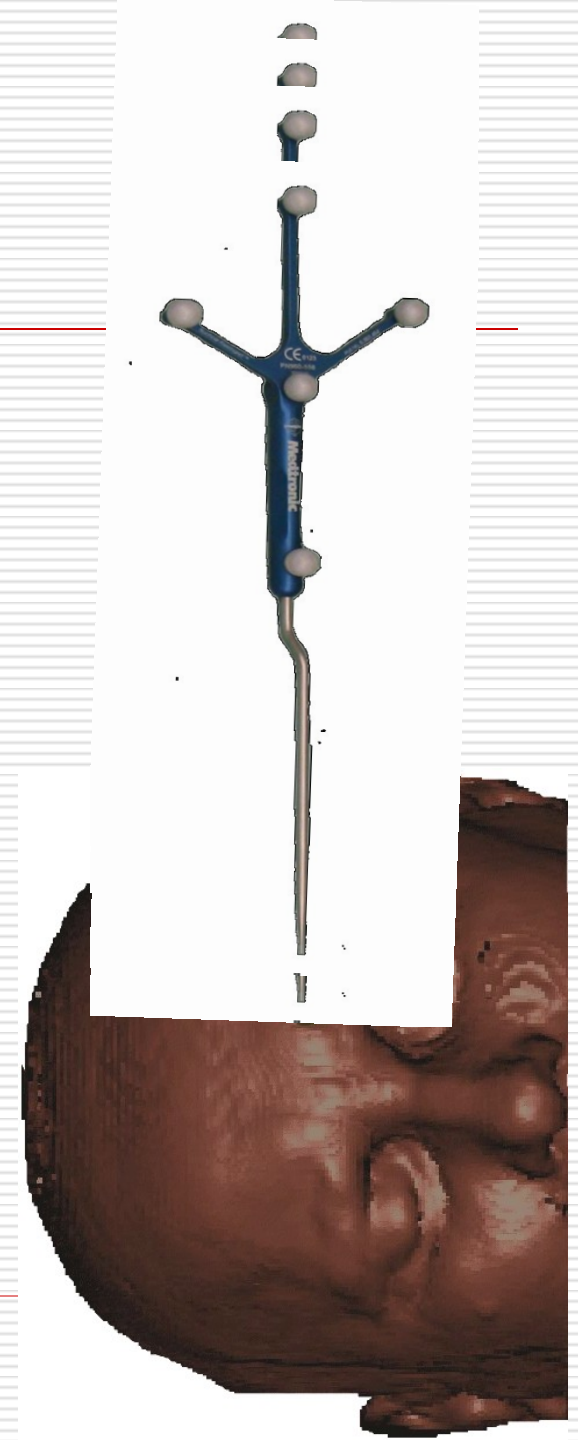
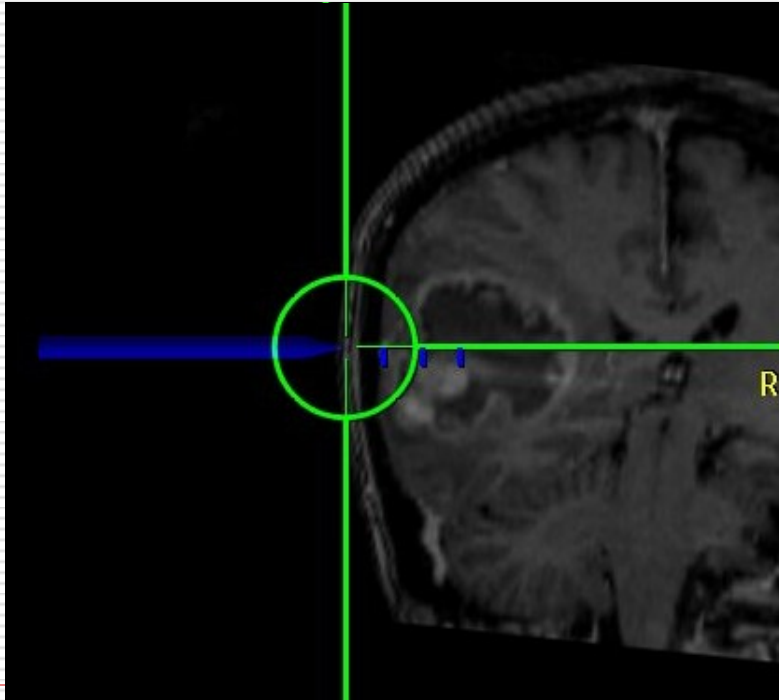
Intraoperative Navigation

Frameless

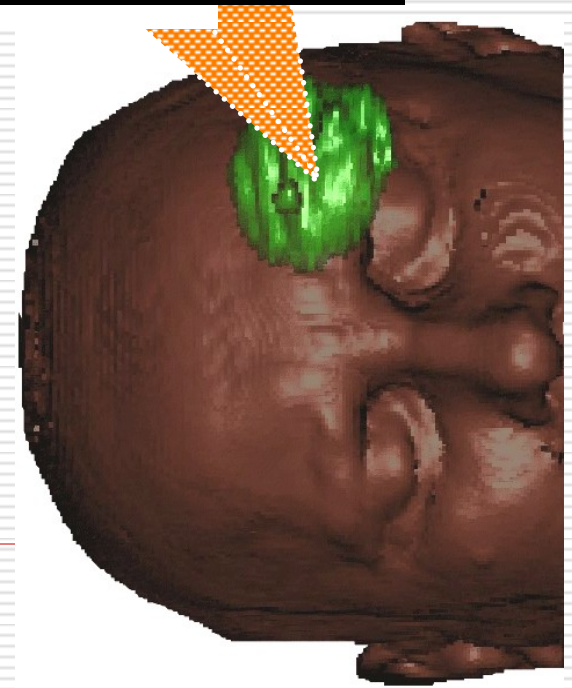
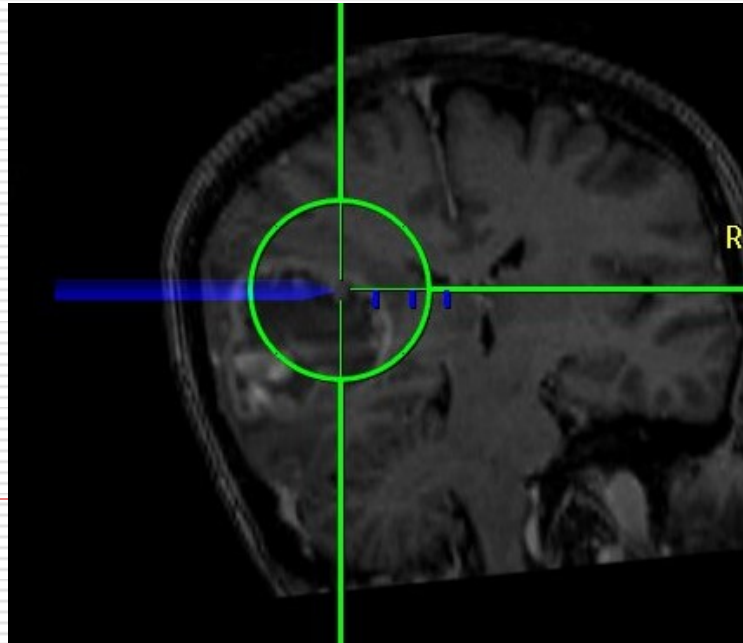
- The origin is a „frame“ placed firmly against the patient's head
- Location of instruments is registered by the camera, tools are freely moving



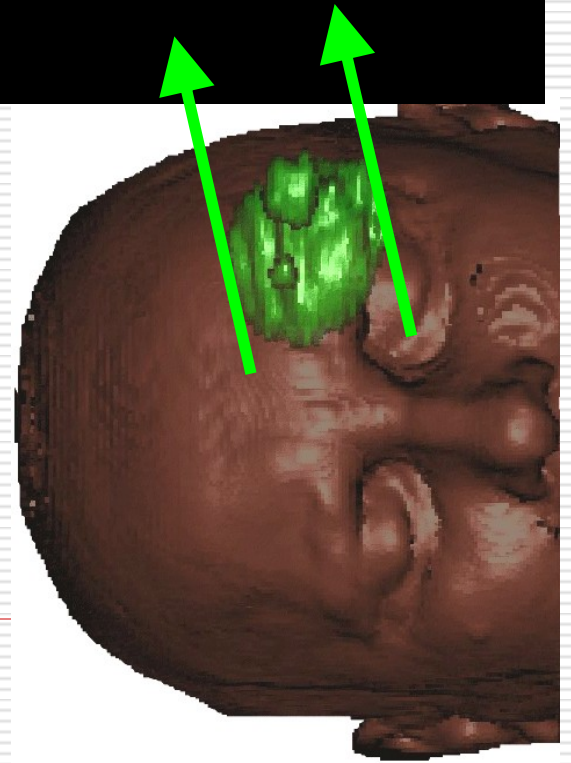
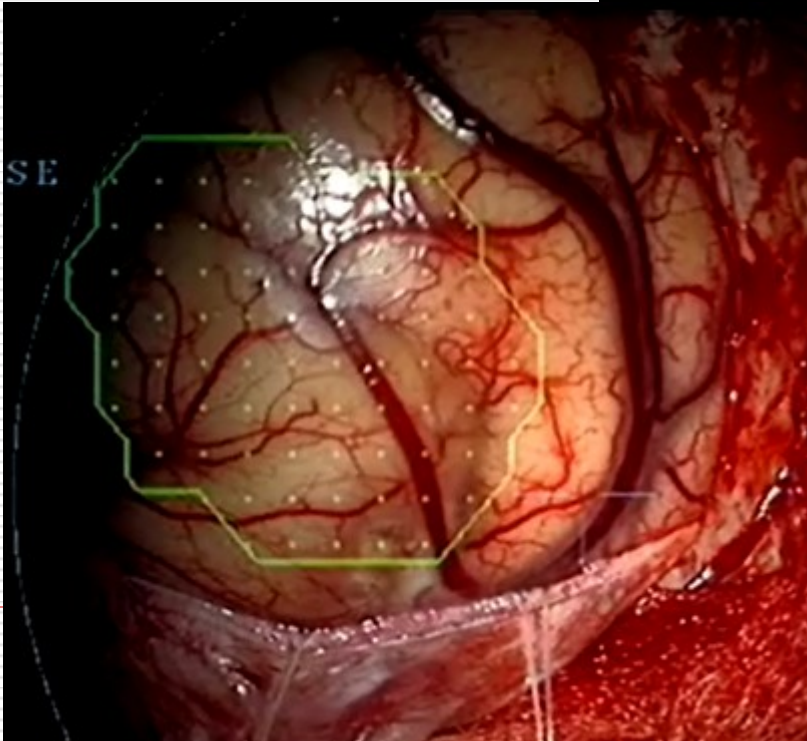
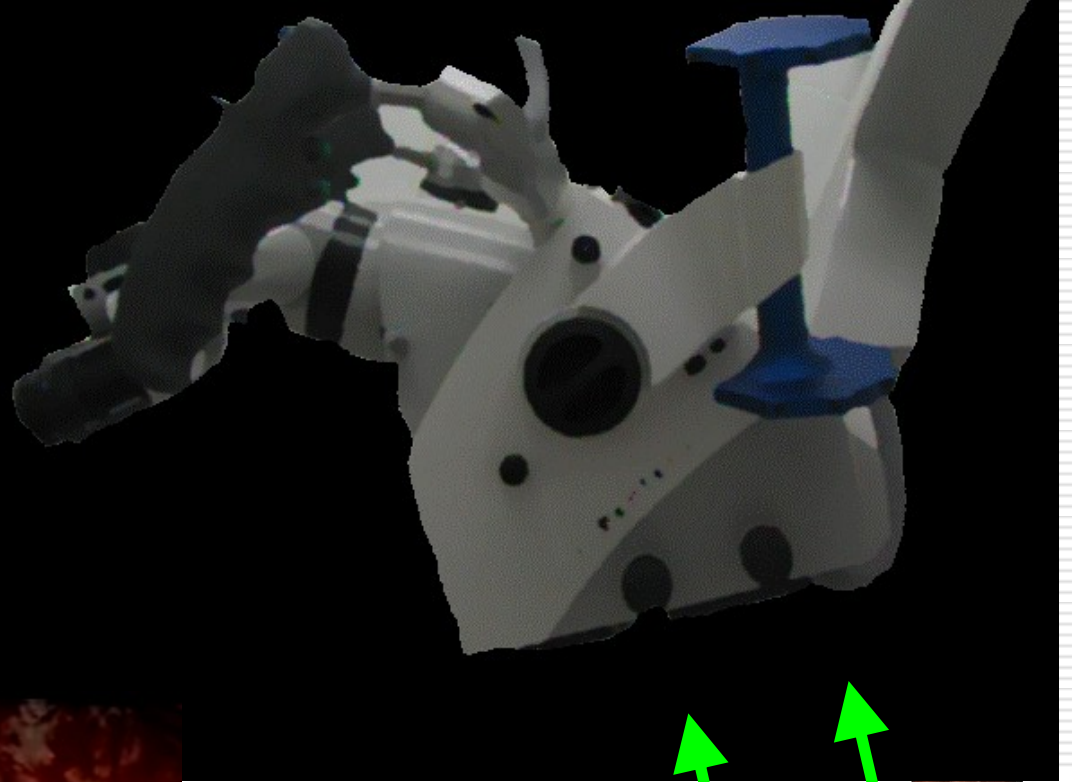
The Principles of Work with Navigation



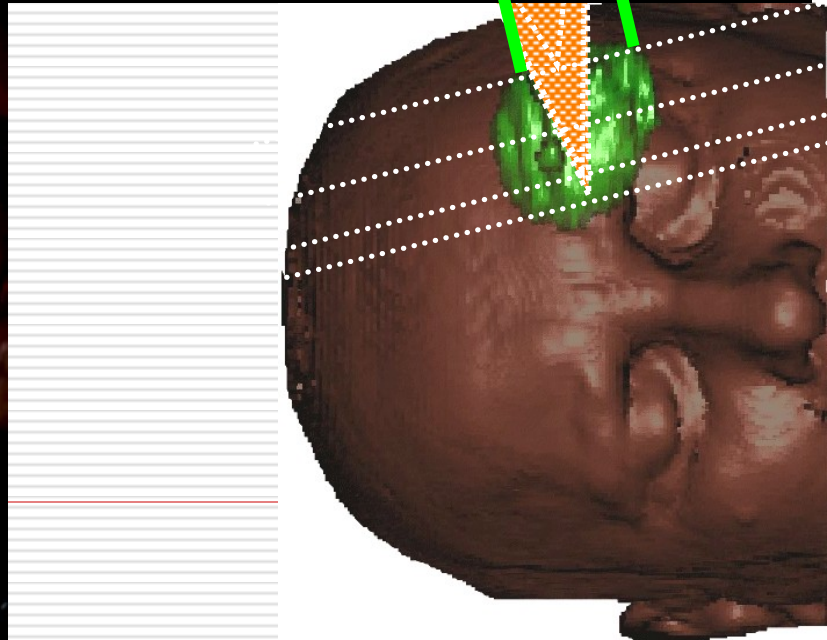
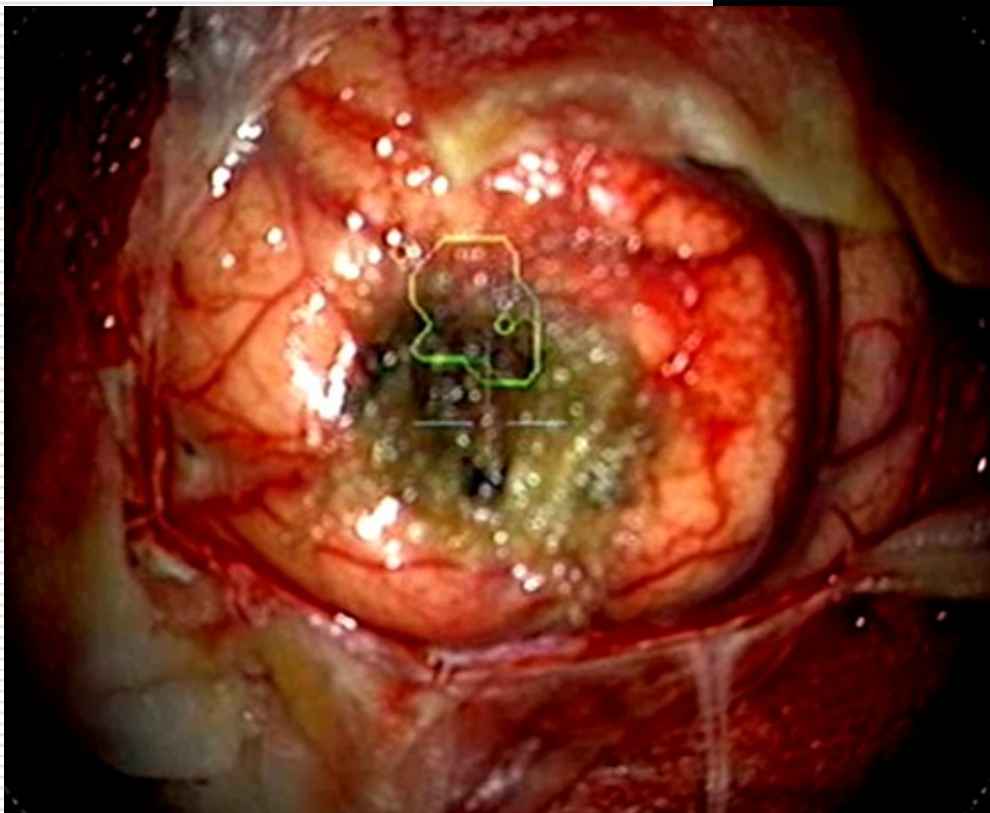
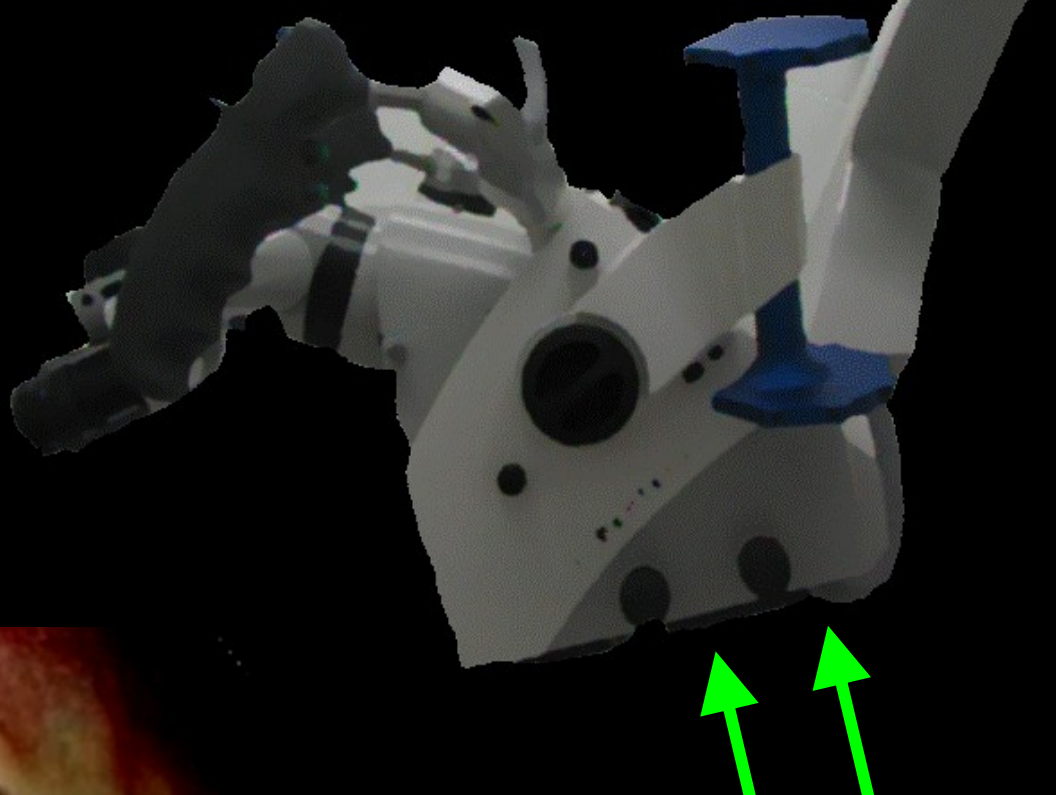
The image in the navigation monitor follow the movement of the microscope



Projection of lesion area
of view under the micro



Projection the border of
the relationship to focus



Intraoperative imaging

MRI On-line display
the progress of
tumor resection

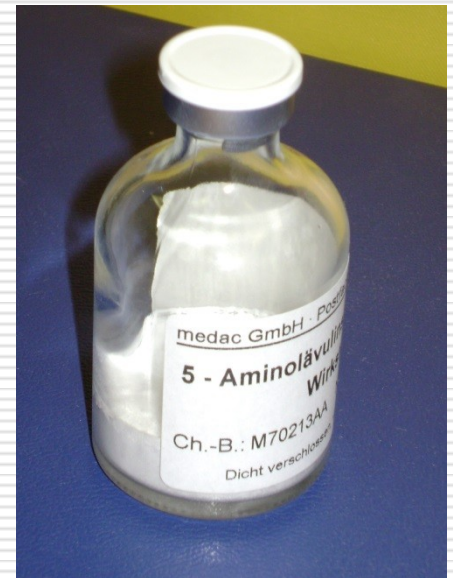


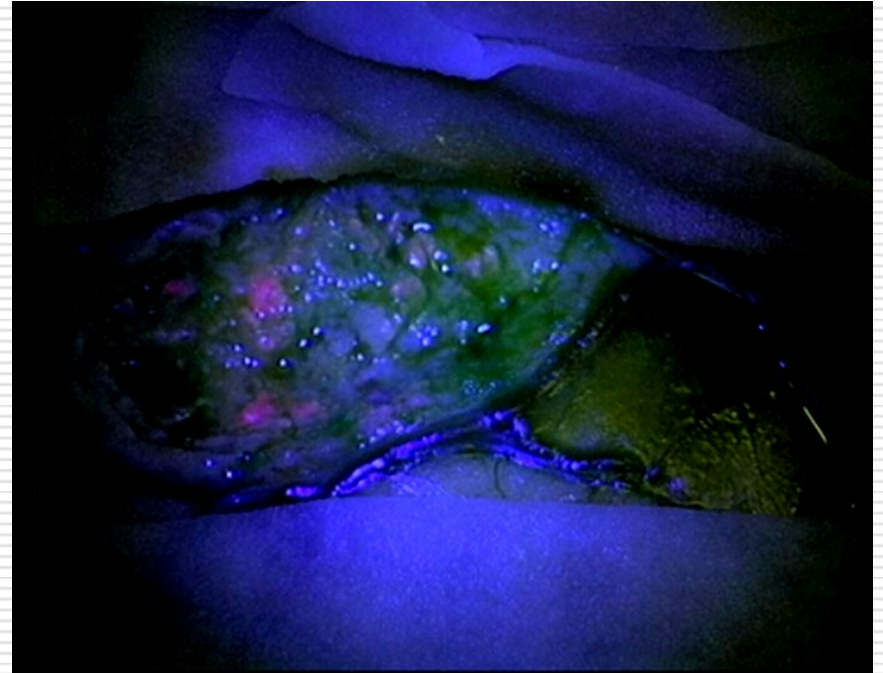
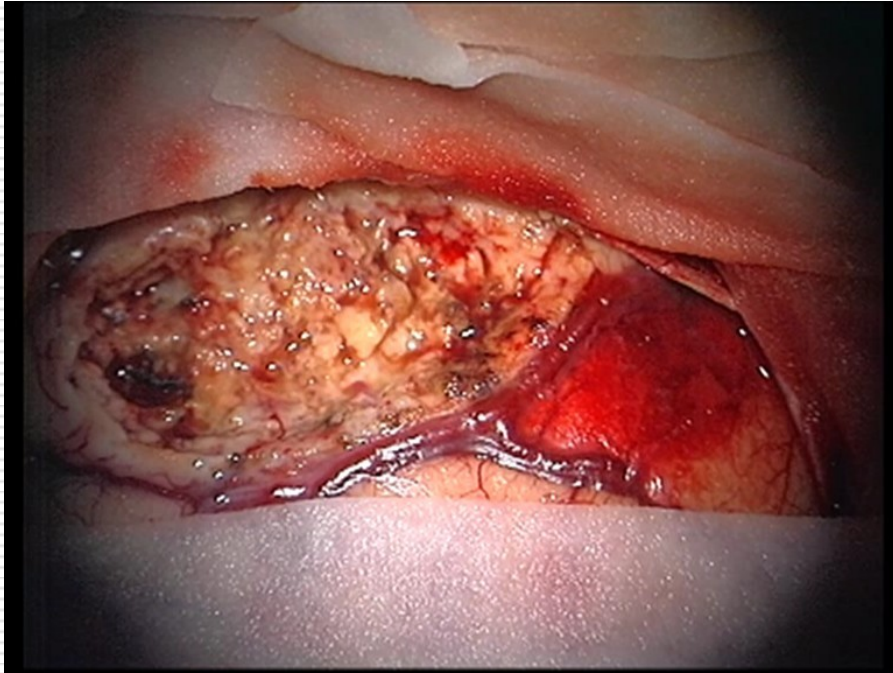
Fluorescent Technology

5-ALA causes the accumulation of porphyrins in tumor cells

Porphyrins are visualized in a modified microscope

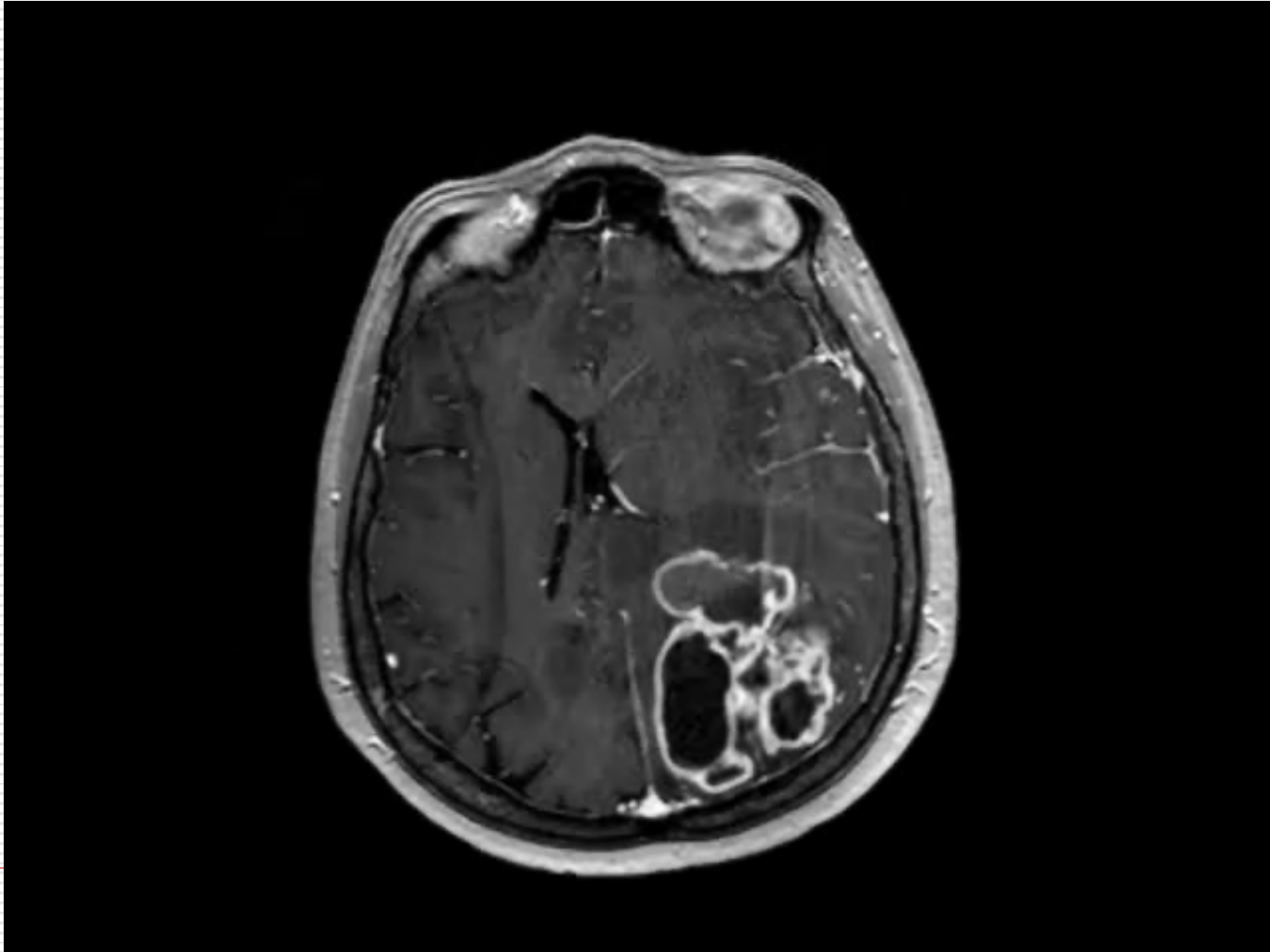
The boundaries of the tumor are better seen, because they are different colors from the surrounding tissue





- Visualization of the tumor using 5-ALA - insight into the resection cavity
-

Surgery



5-ALA, Results of the Study (322 patients)

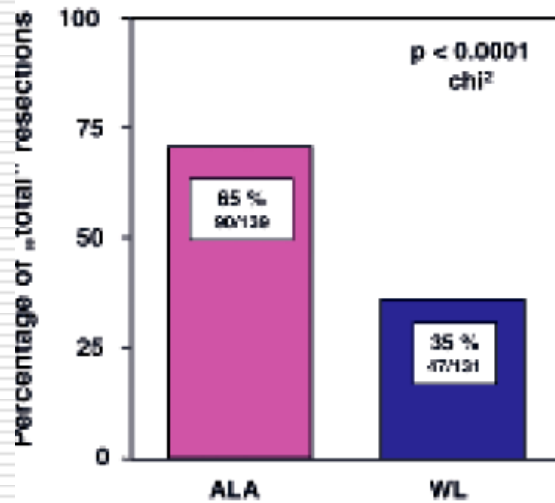


Fig. 4

Percentage of patients without residual tumour in early postoperative MRI (Full-Analysis-Set)

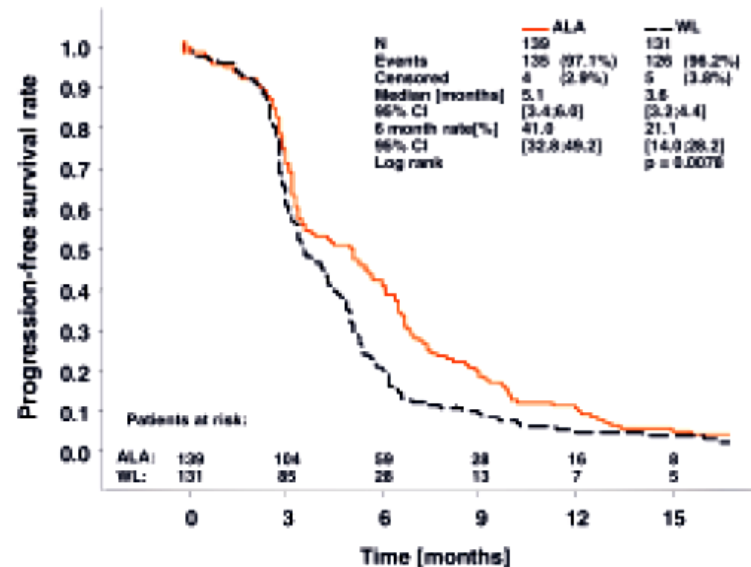


Fig. 5

Progression-free Survival - Kaplan-Meier estimates (Full-Analysis-Set)

Fluorescence-guided surgery with 5-aminolevulinic acid for resection of malignant glioma: a randomised controlled multicentre phase III trial. Stummer W, Pichlmeier U, Meinel T, Wiestler OD, Zanella F, Reulen HJ; ALA-Glioma Study Group. Neurochirurgische Klinik, Heinrich-Heine University, Dusseldorf, Germany

Electrophysiological methods

- EMG**
- NAP**
- MEP** (*including D-wave, I-wave*)
- SEP**
- AEP** (*BAEP, ABR*)
- VEP**
- EEG**
- EcoG PRSEP**
- DBS**
- MER**

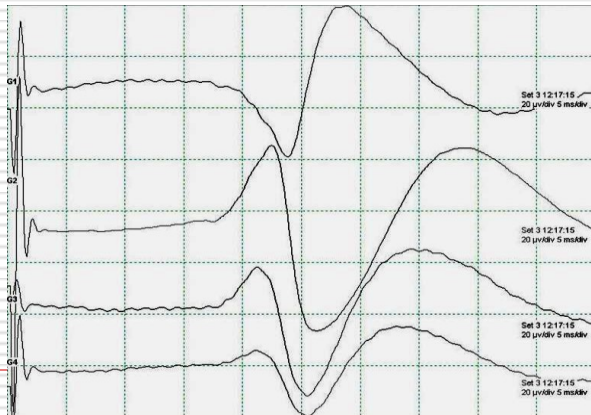
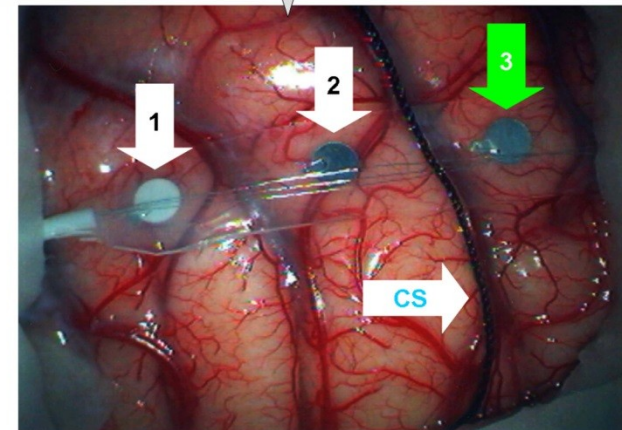
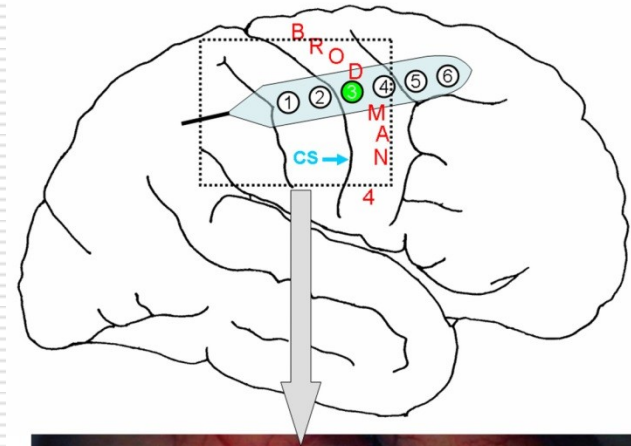


Monitoring in general anesthesia

- ❑ MEP- monitoring of motor pathway
 - ❑ SEP –phase reversal – Localization of the central sulcus
 - ❑ Direct stimulation – motor cortex, nuclei of cranial nerves, (IV. ventricle), stimulation of white matter – subcortical structures
-

SEP, PRSEP

- recording cortical potentials due to stimulation of peripheral nerves (medianus, tibialis)

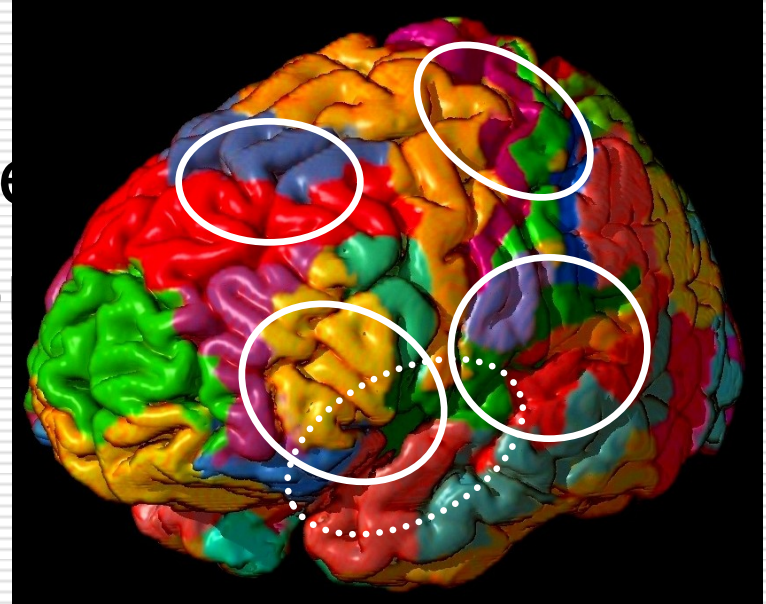


Awake craniotomy

- ❑ TIVA –Total Intravenous Anesthesia – propofol, ramifentanyl
 - ❑ Spontaneous ventilation throughout surgery
 - ❑ Local anesthesia of the skin flap and dura mater
 - ❑ Maximum patient comfort
-

Indicace of „awake surgery“ - localizacion

- cortex area of speech
- suplementar motor cortex
- Insular cortex
- somatosensory and motor cortex



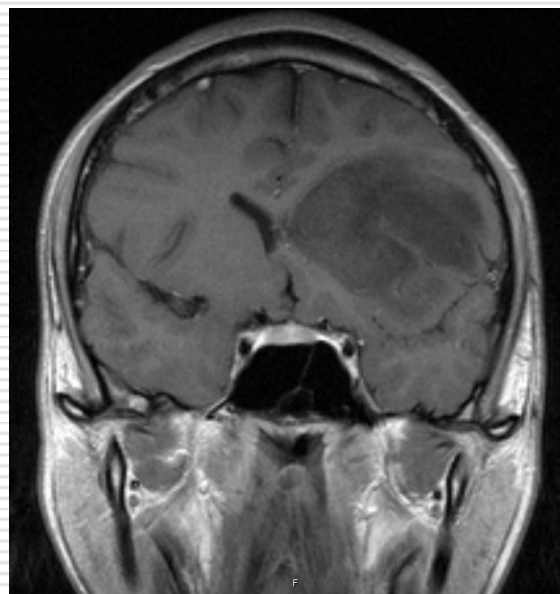
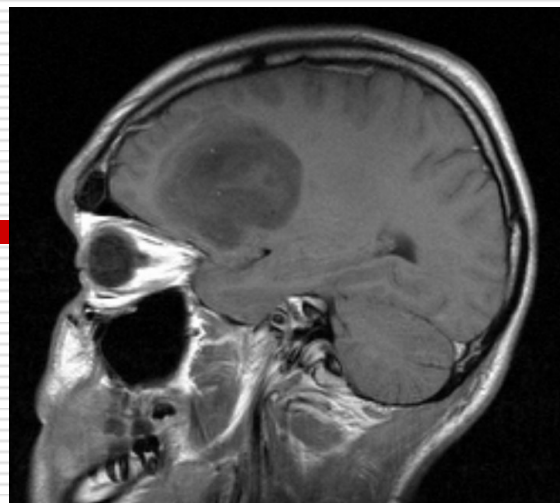
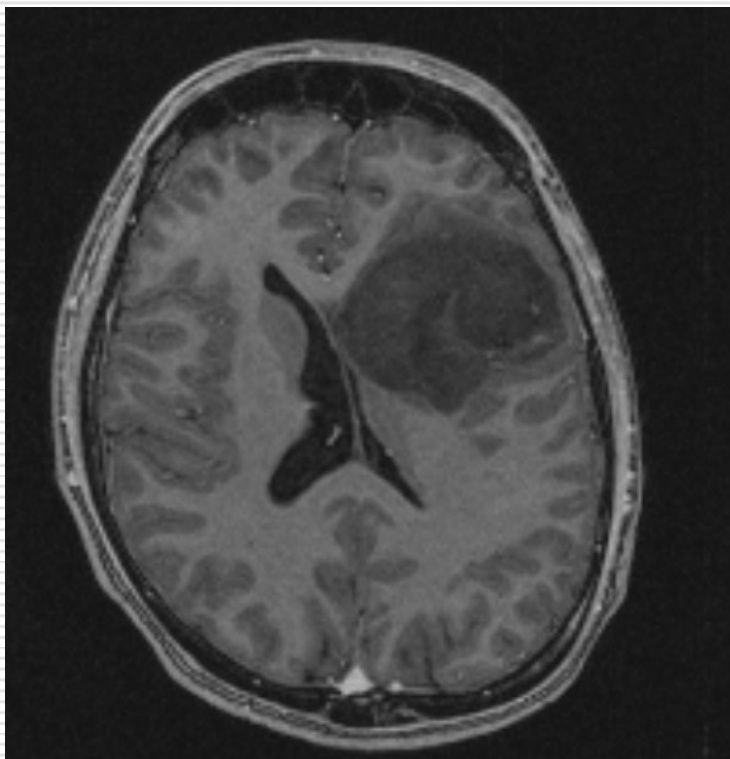


„Awake craniotomy“

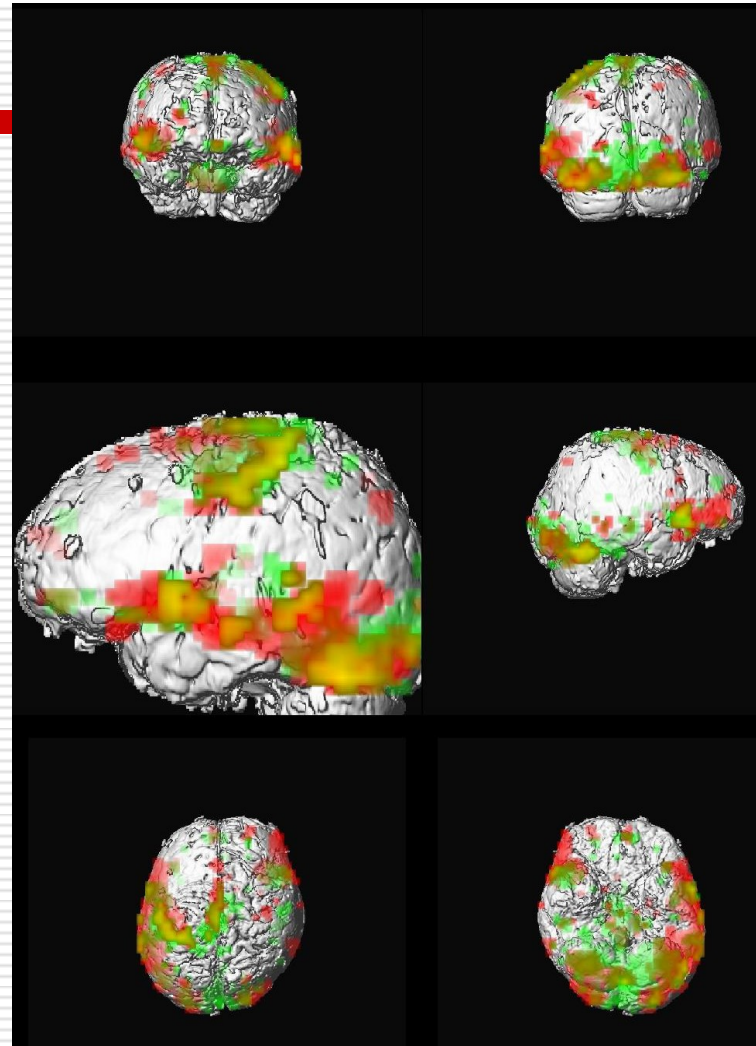
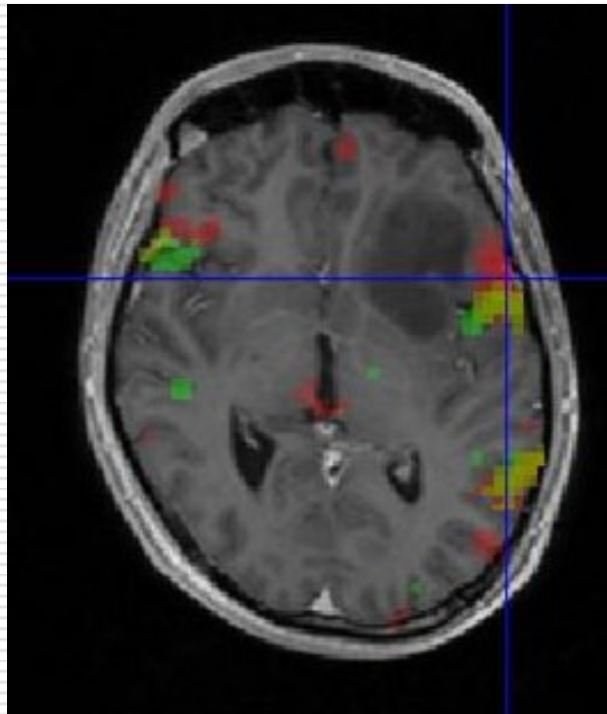
- operace s bdělou fází



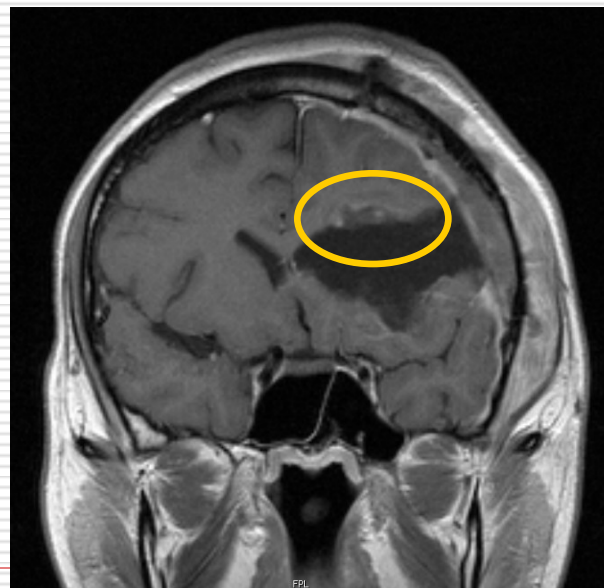
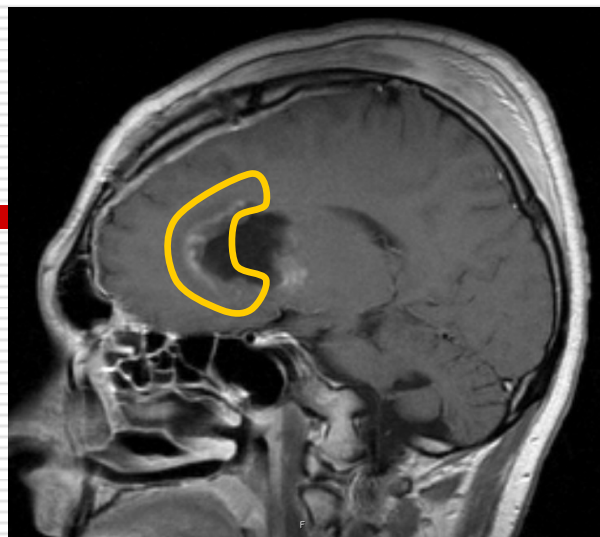
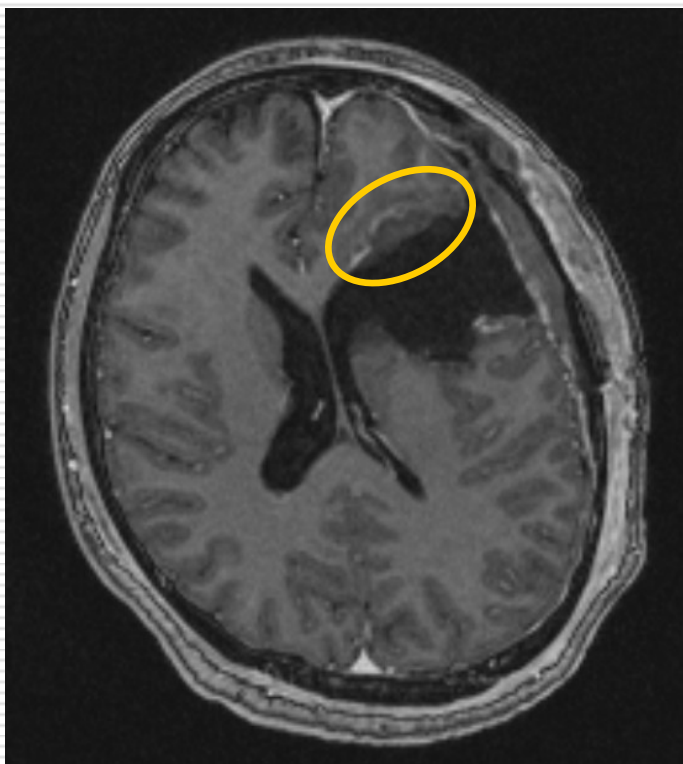
Case 1



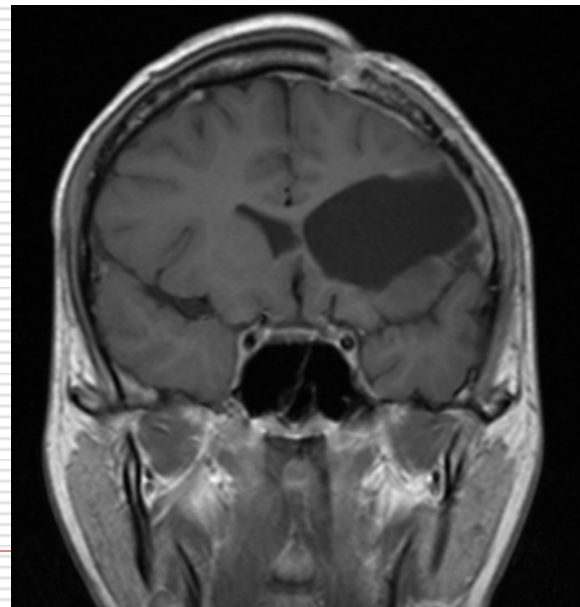
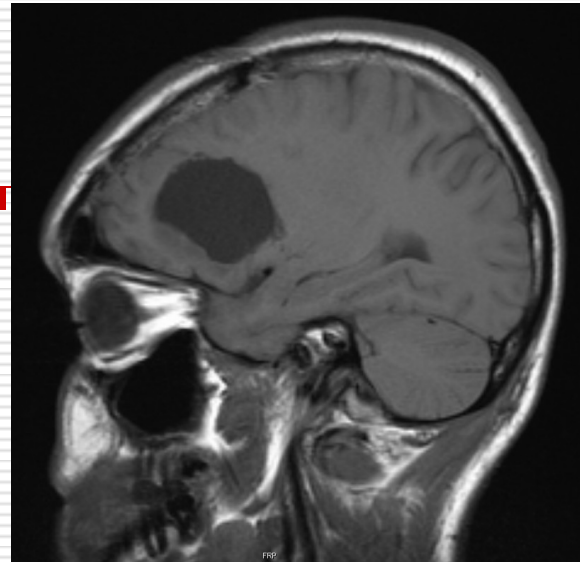
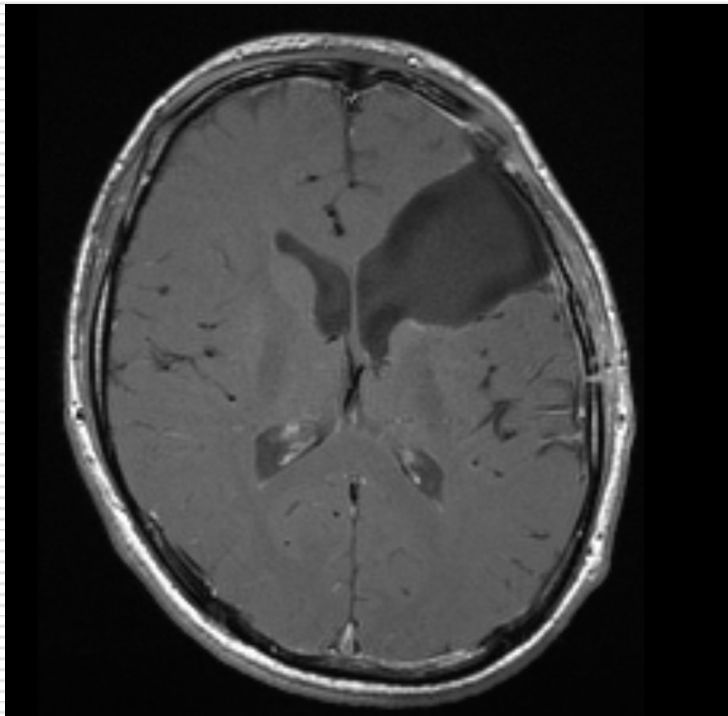
Case 3



Case 1



Case 1



Conclusion

- Complex use of monitoring procedures, functional MRI and navigation technology in brain glioma surgery leads to clearly improved the extent of resection
 - Especially in low grade gliomas allows in combination with early postoperative MR examination to achieve significantly better radicality than in the past
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