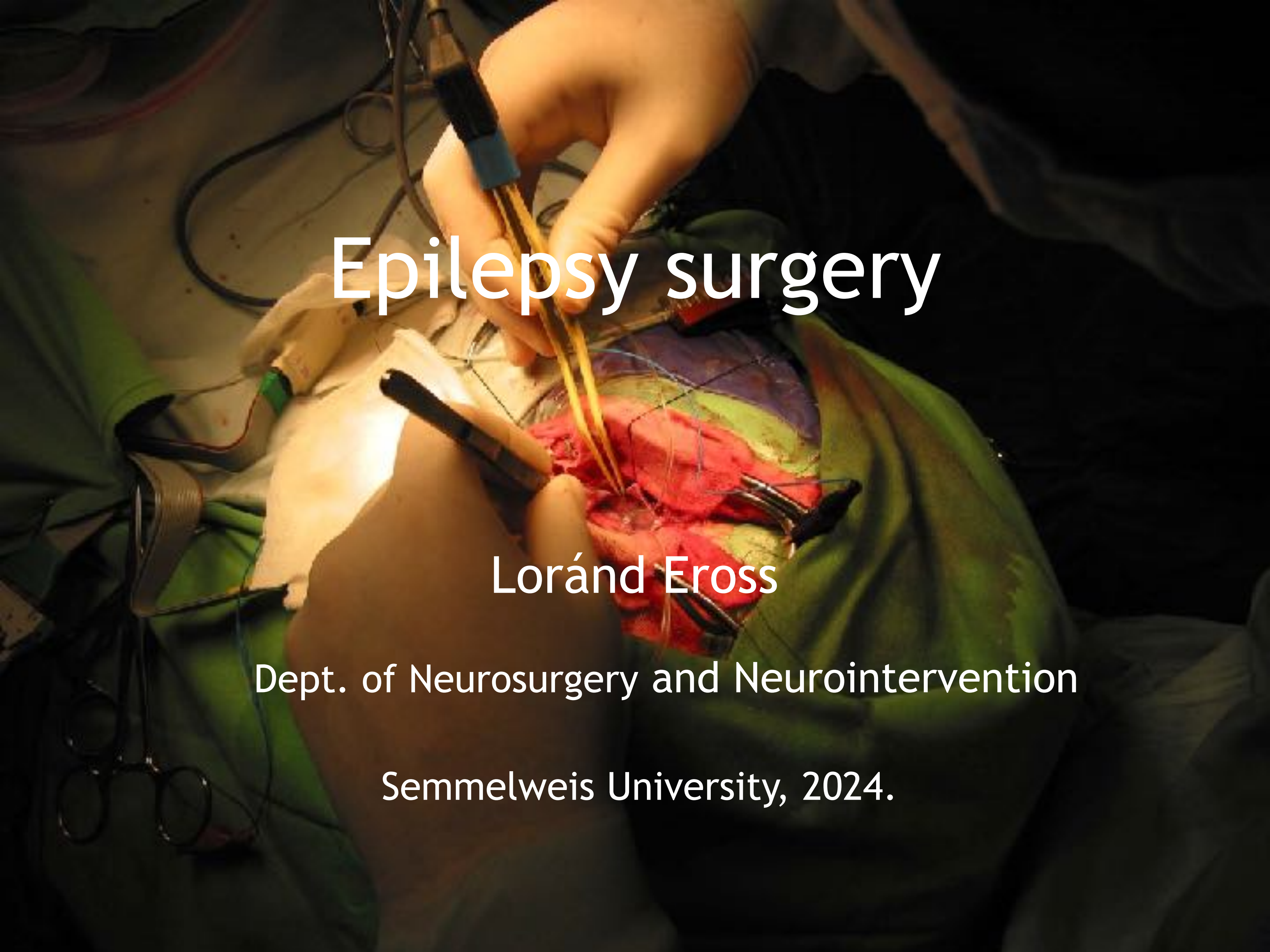


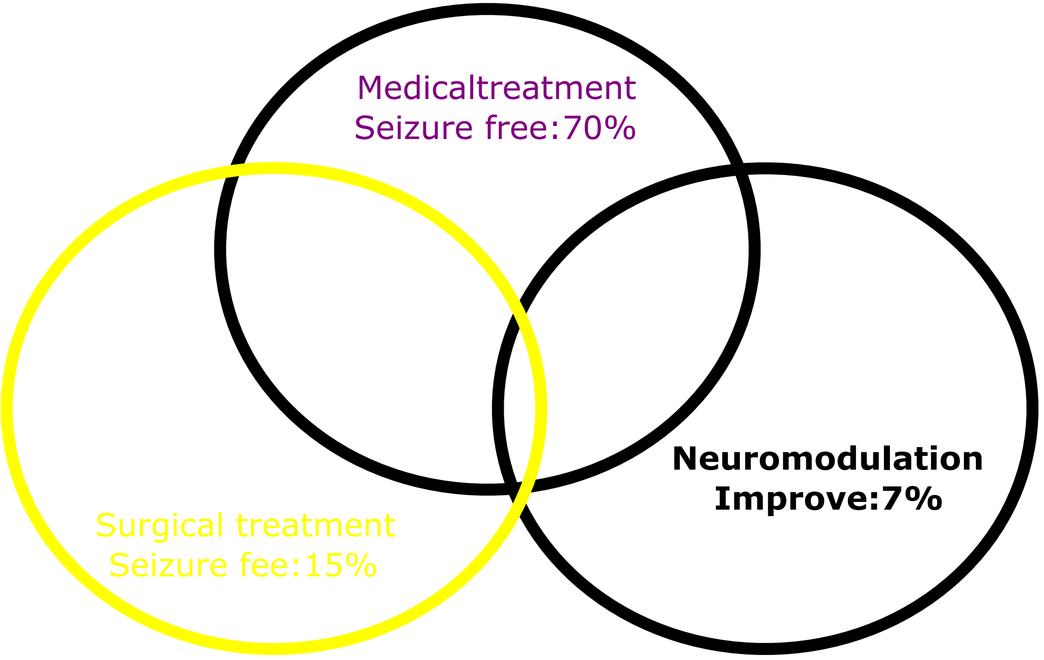
Epilepsy surgery

Loránd Eross

Dept. of Neurosurgery and Neurointervention

Semmelweis University, 2024.

Epilepsy surgery

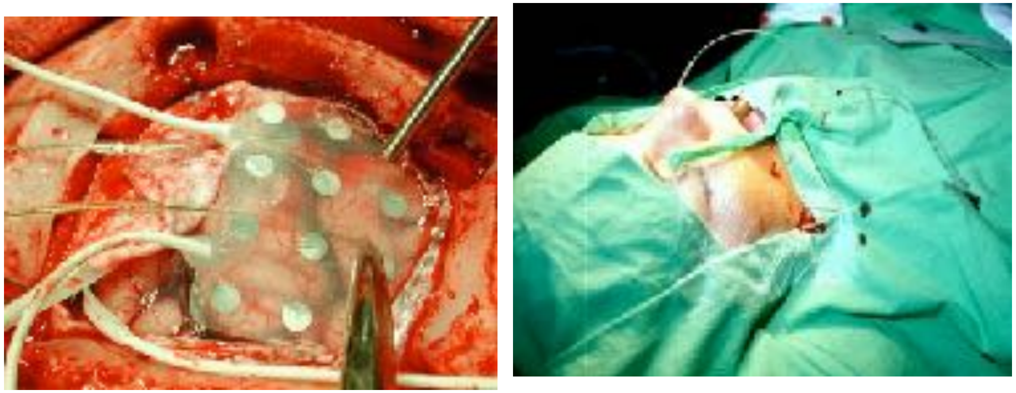


Epilepsy surgery

Montreal Neurological Institute1954

2011

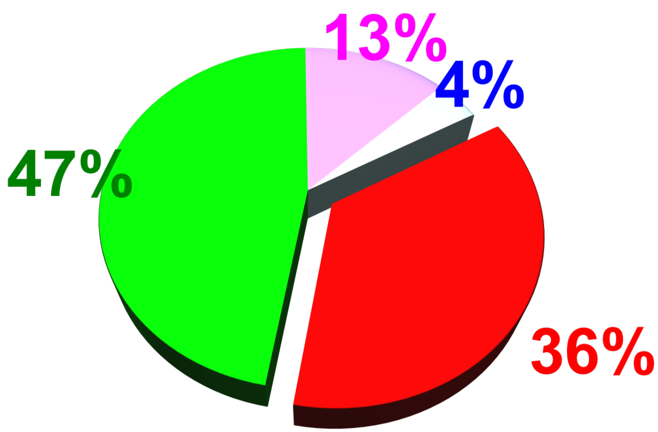
Neuronavigation



New intracranial electrodes

Medical treatment of the epilepsies

Patients without previous medication (n=470)



Seizure free after 1. AE

Seizure free after 2. AE

Seizure free after 3. or more AE

Drug resistant epielpsy

Kwan P, Brodie MJ. *N Engl J Med.* 2000;342:314-319

Worst prognostic factors of medical management in partial epilepsies

- Localization: temporal, multilobar
- MRI morfology: HS(11%), dual pathology(3%), dysgenesis(24%)
- Long duration(every 10 years increse the probability of refracterity 1.3 times)
- Early onset

„Drug-resistant patients are unlikely to become seizure-free through participation in future drug trials and should be evaluated for epilepsy surgery.”(Brodie)

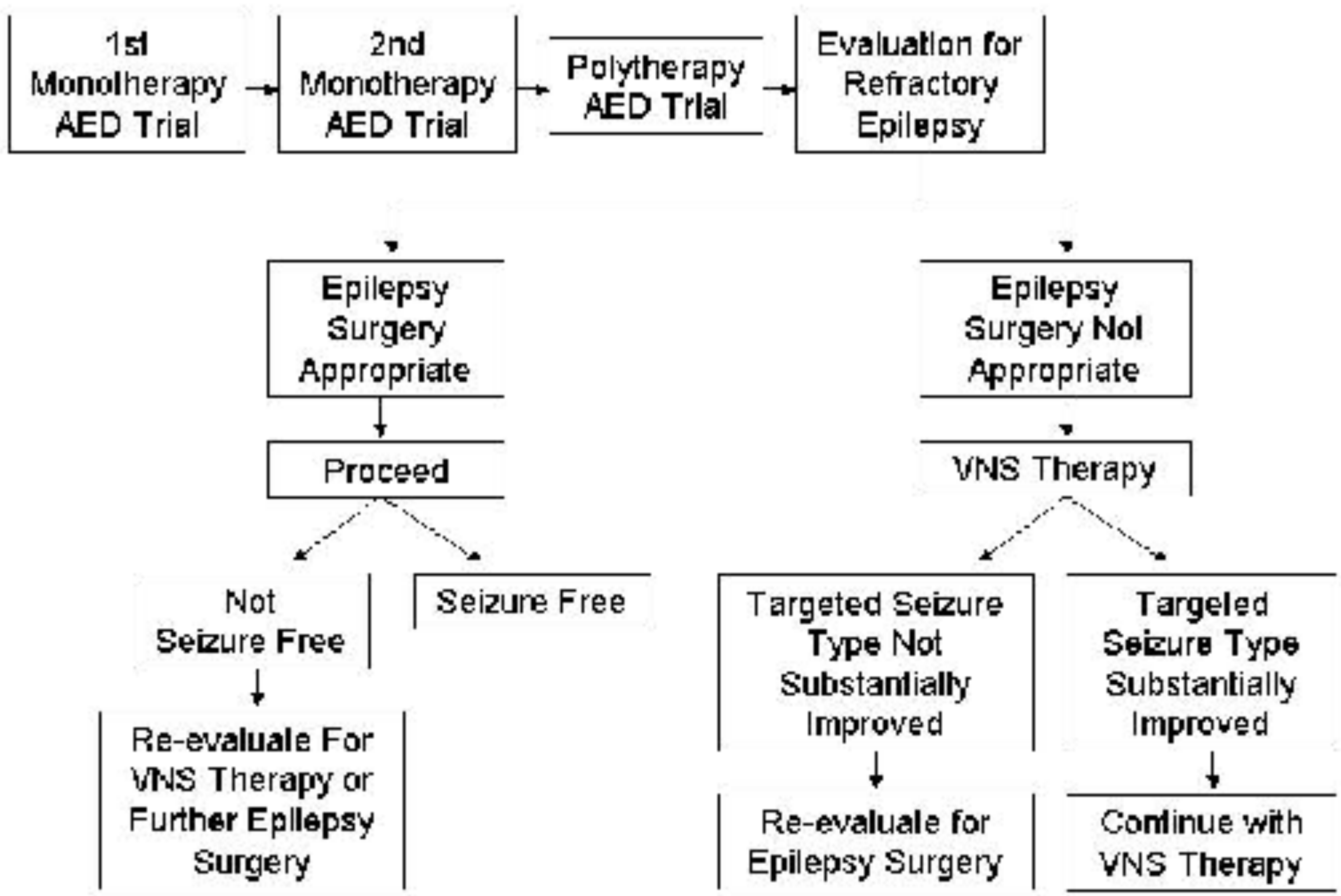
Indication of epilepsy surgery

- Drug resistency for two basic antiepileptic drugs in monotherapy

- Good prognosis of surgery:

1. Temporomedial epilepsy syndrome
2. Neocortical focal lesional epilepsy
3. Hemispheric epilepsy

Treatment algorythm for epilepsy



Epilepsy surgery

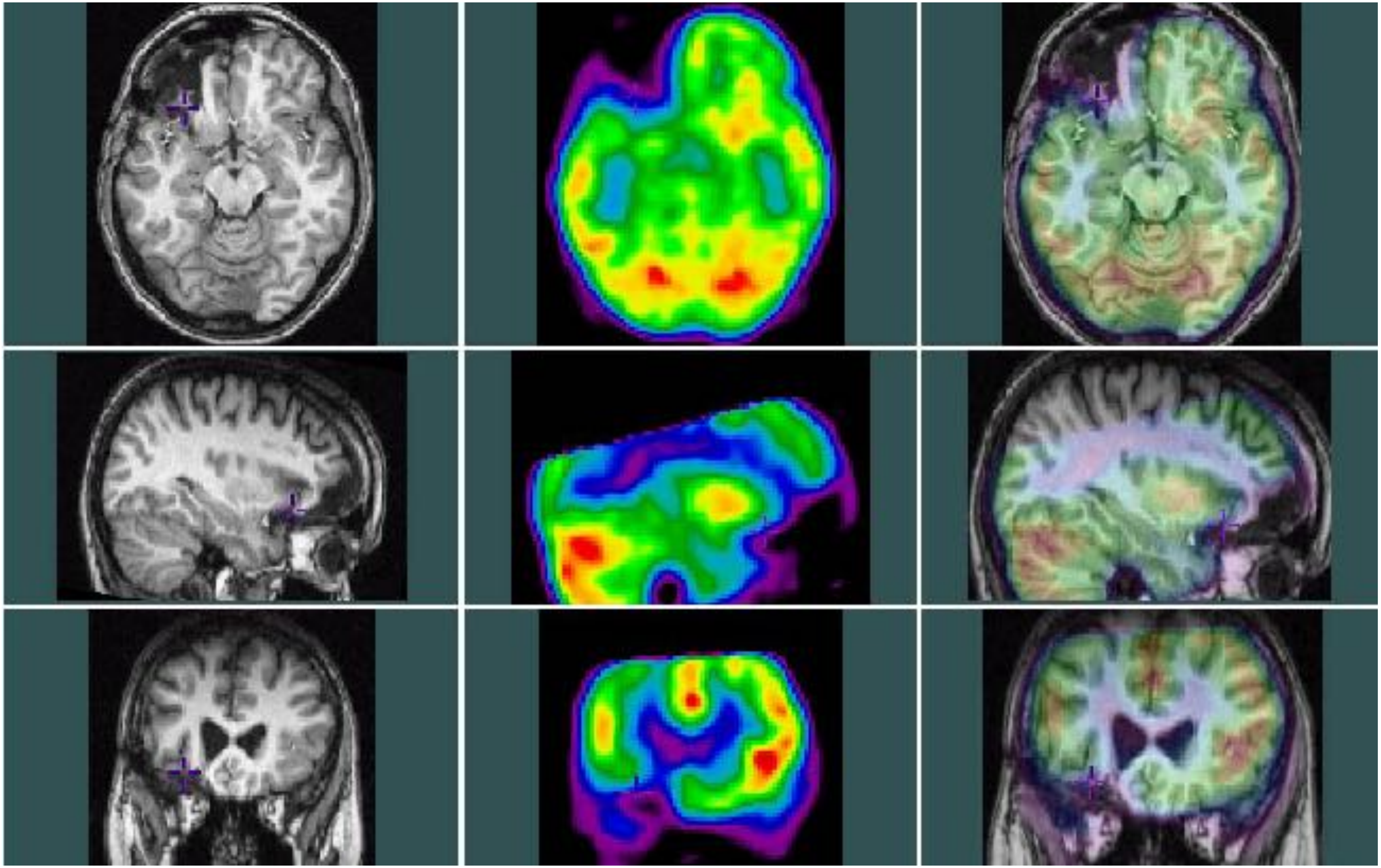
- Aim: to improve the psychosocial status of the patient with reduction or stop the seizures or changing seizure semiology.

Preoperative phase I.

- Aim: seizure origin hypothesis
- Noninvasive phase:
- Lesion oriented investigations (MRI)
- Interictal, ictal EEG
- Interictal and ictal SPECT, PET, fMRI, MEG, MSI

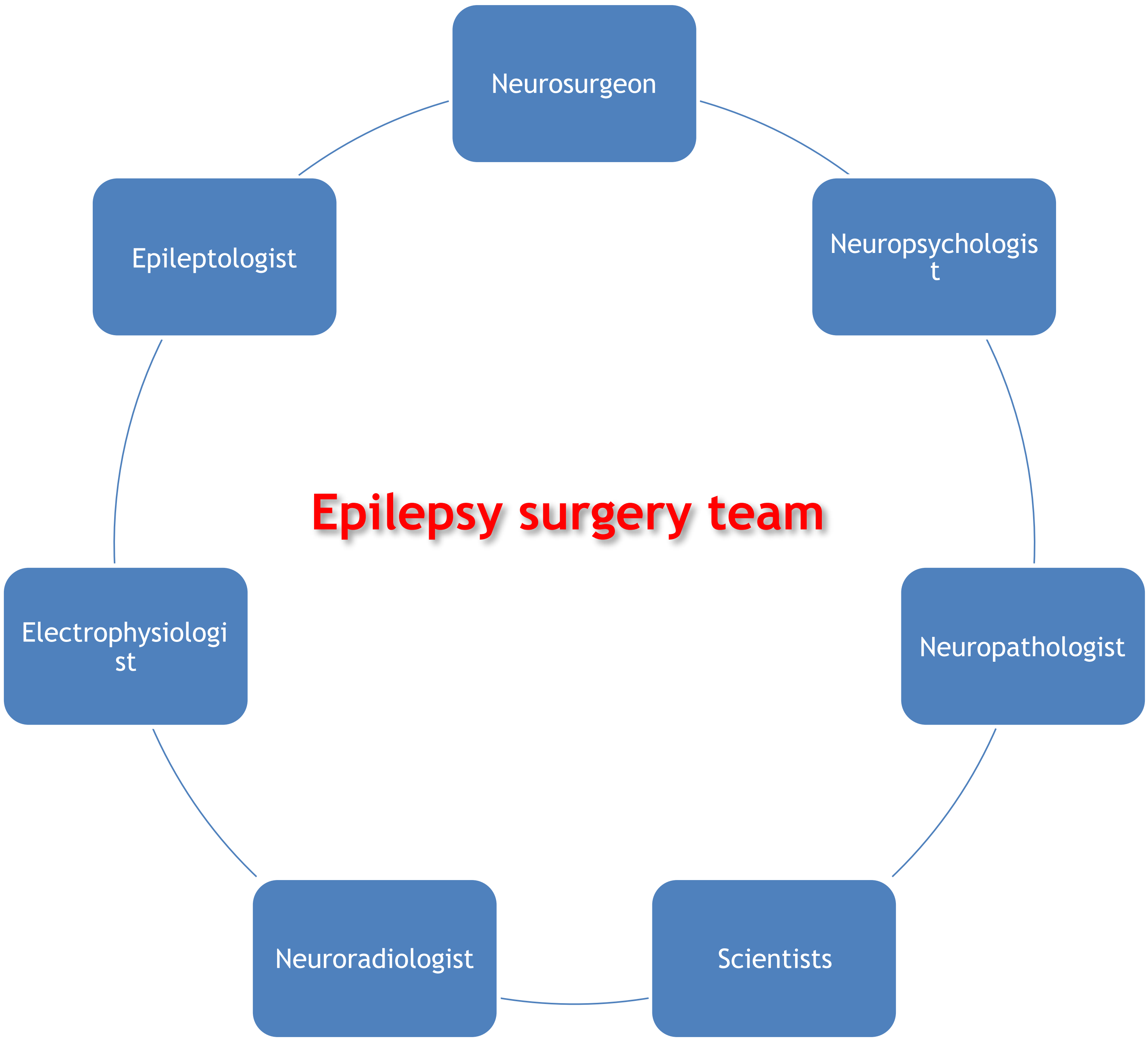
- The degree of convergence of non invasively obtained data with seizure origin hypothesis is established and decisions on further procedures are made
  - lesion oriented surgery
  - epilepsy oriented lesional surgery
  - surgery for epilepsy „sensu stricto„

MR-PET fusion in a patient with epilepsy



Preoperative phase II.
Invasive investigations

- Semi-invasive and invasive (subdural strips, grids, foramen ovale, intracerebral electrodes)
- Amytal test (dominant hemisphere, speech functions, memory)
- Decision: surgery? – type of procedure?


Neurosurgeon
Neuropsychologis
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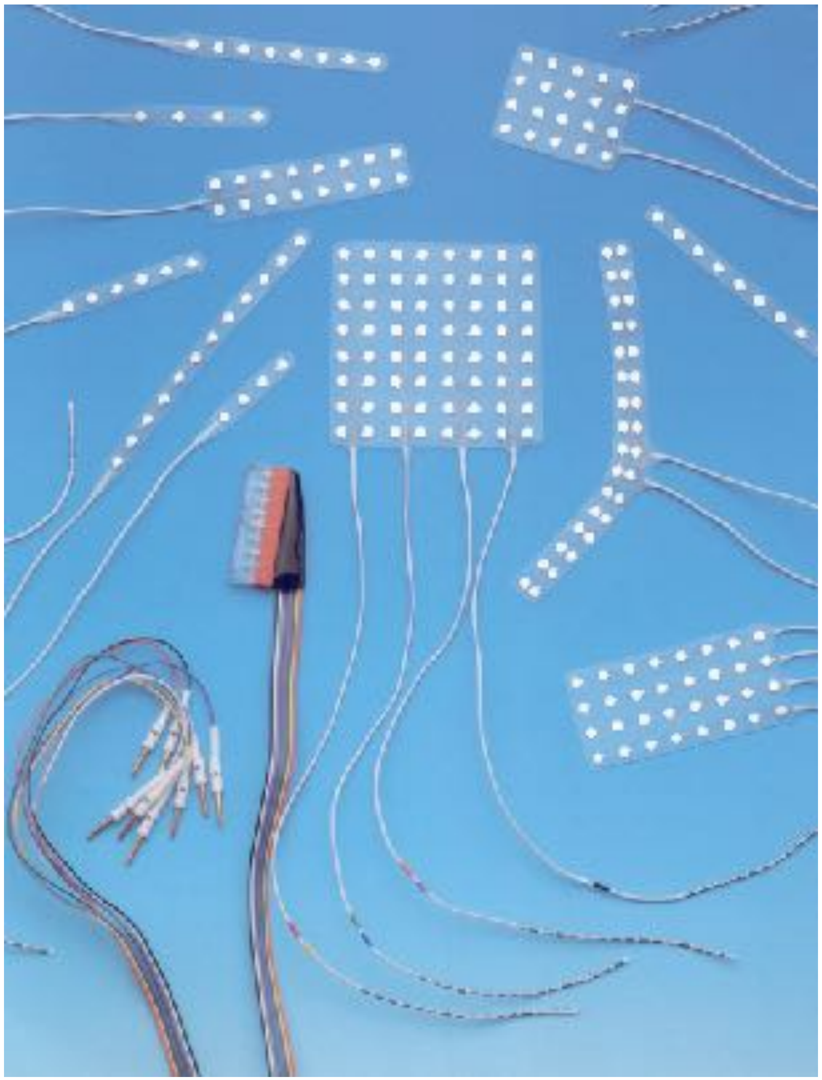
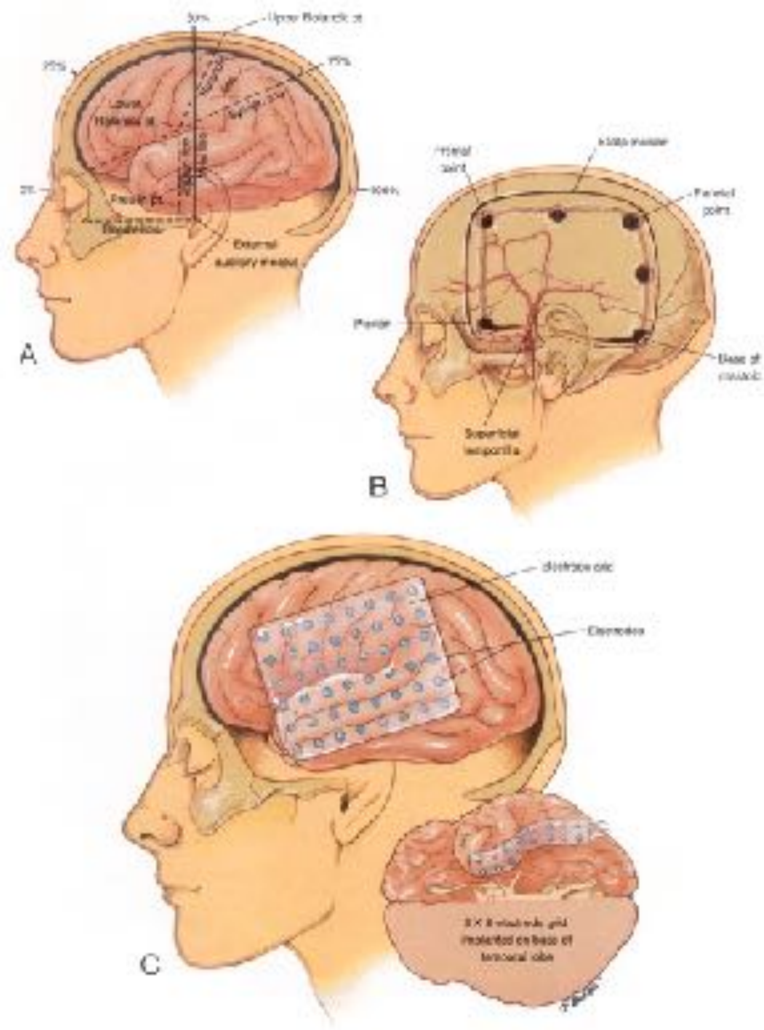
Neuropathologist
Scientists
Neuroradiologist
Electrophysiologi
st
Epileptologist
Epilepsy surgery team

Invasive electrodes: strips, grids





The aim to use intracranial electrodes

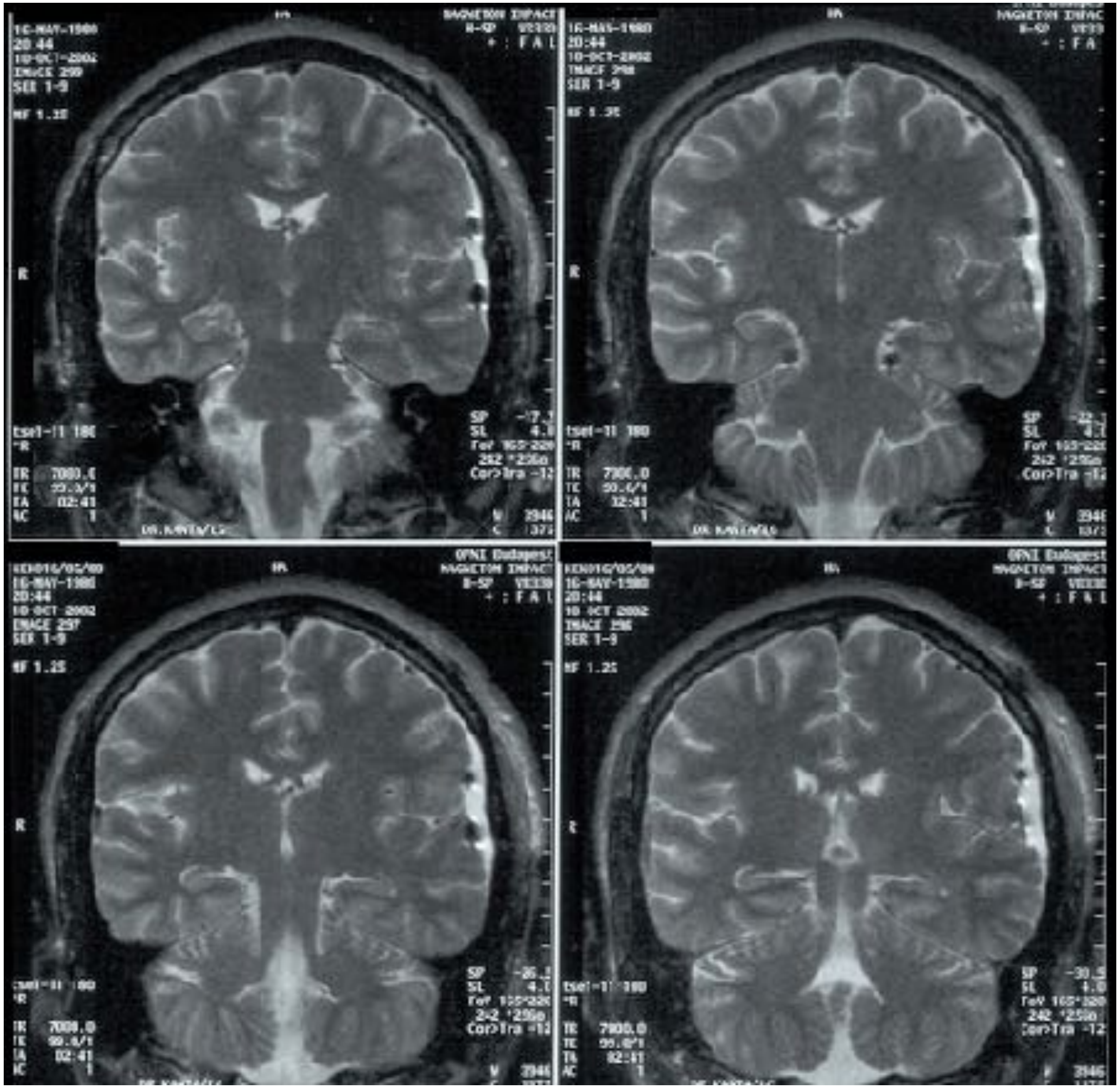
To find the seizure origin in space and describe the spatio-temporal seizure propagation

The role of invasive electrodes in epilepsy surgery

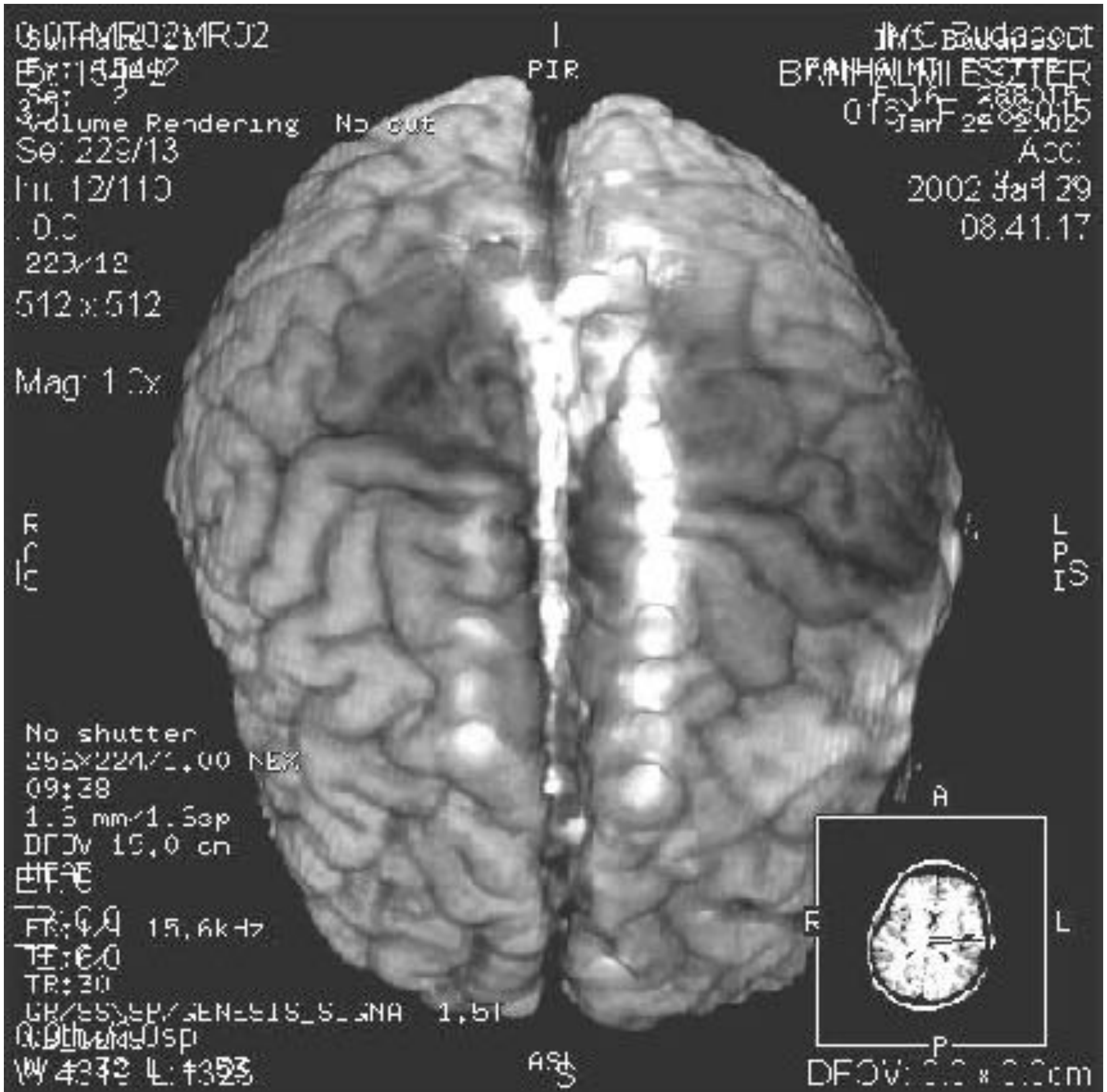
1. Semiology specific electrode implantation
2. Postoperative electrode localisation with MR-CT image fusion to interpretate the electroclinical findings
3. Intraoperative localisation technique to localise the invasive electrodes position during implantation

Subdural electrode localisation

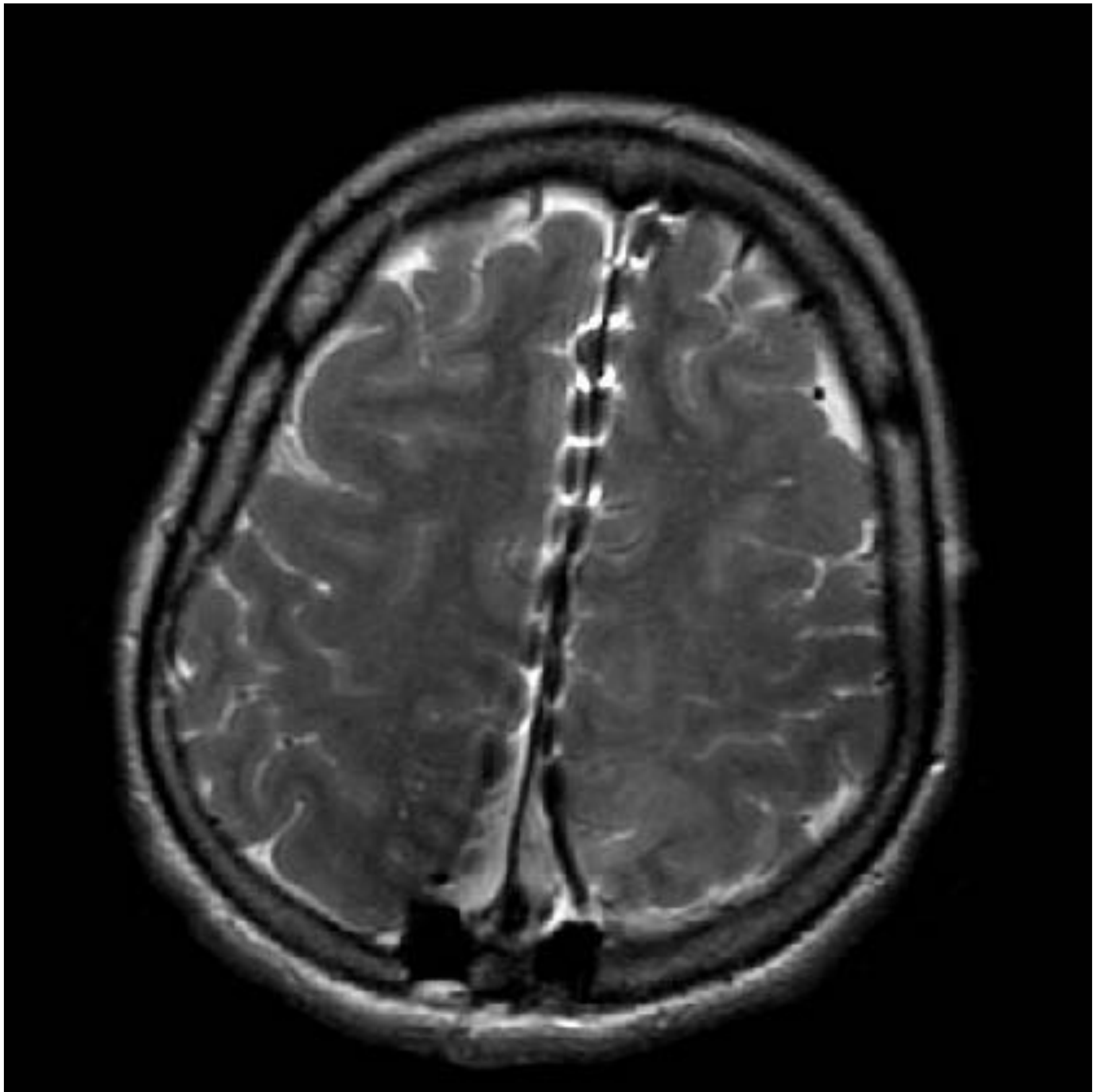
(Winkler 2000, Schulze-Bonhage 2002)



3D surface reconstruction (Barsi 2002)

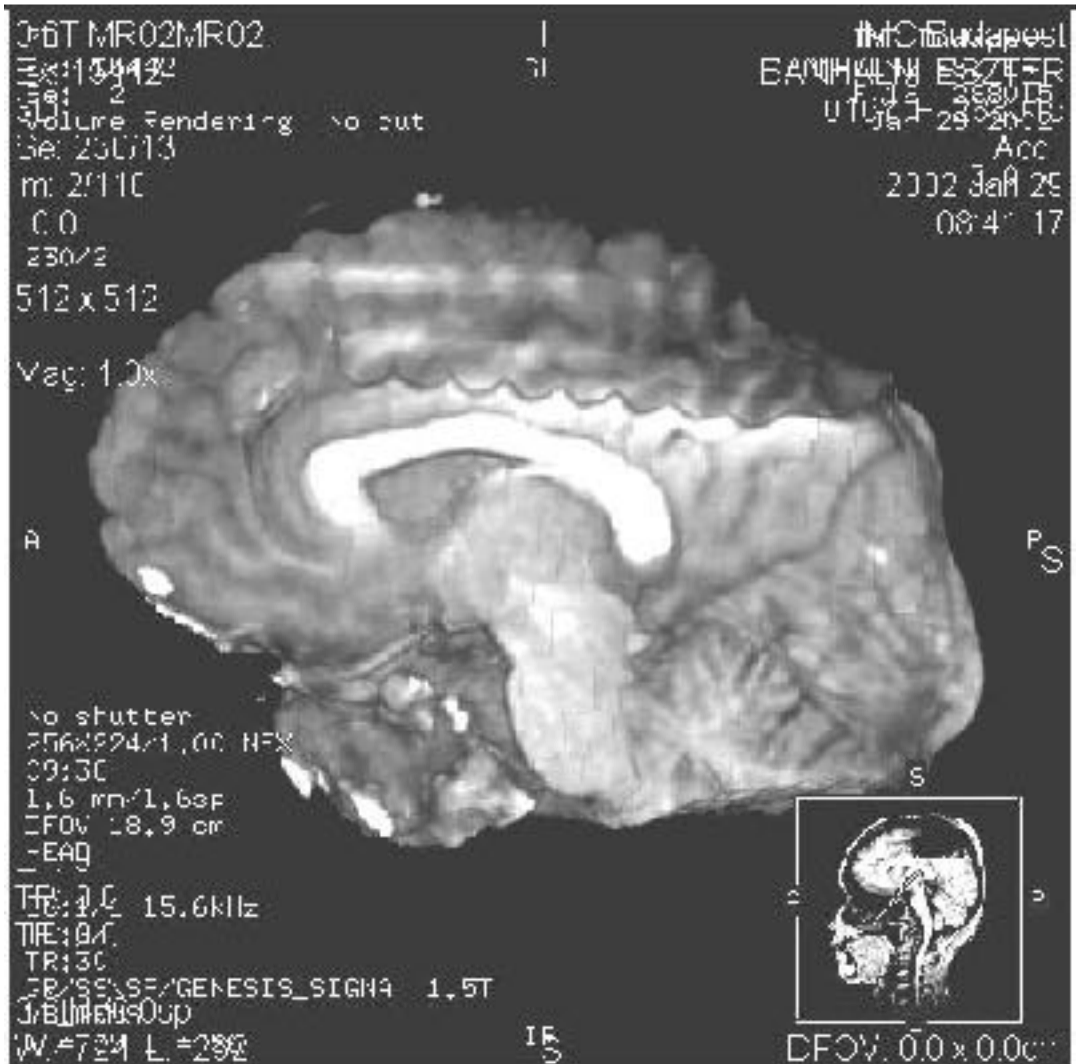


Semiology specific subdural electrode implantation protocol

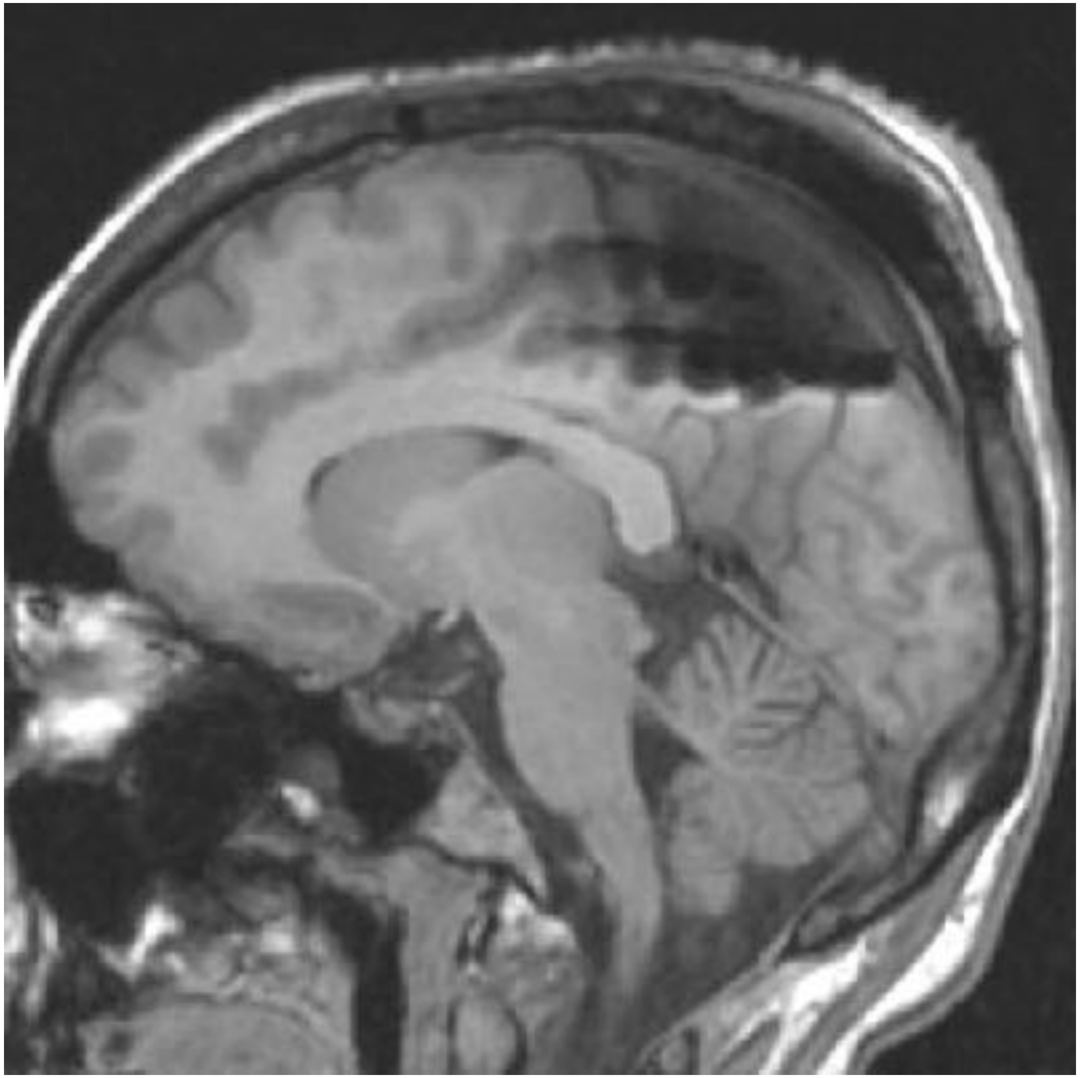


Rtg - strips

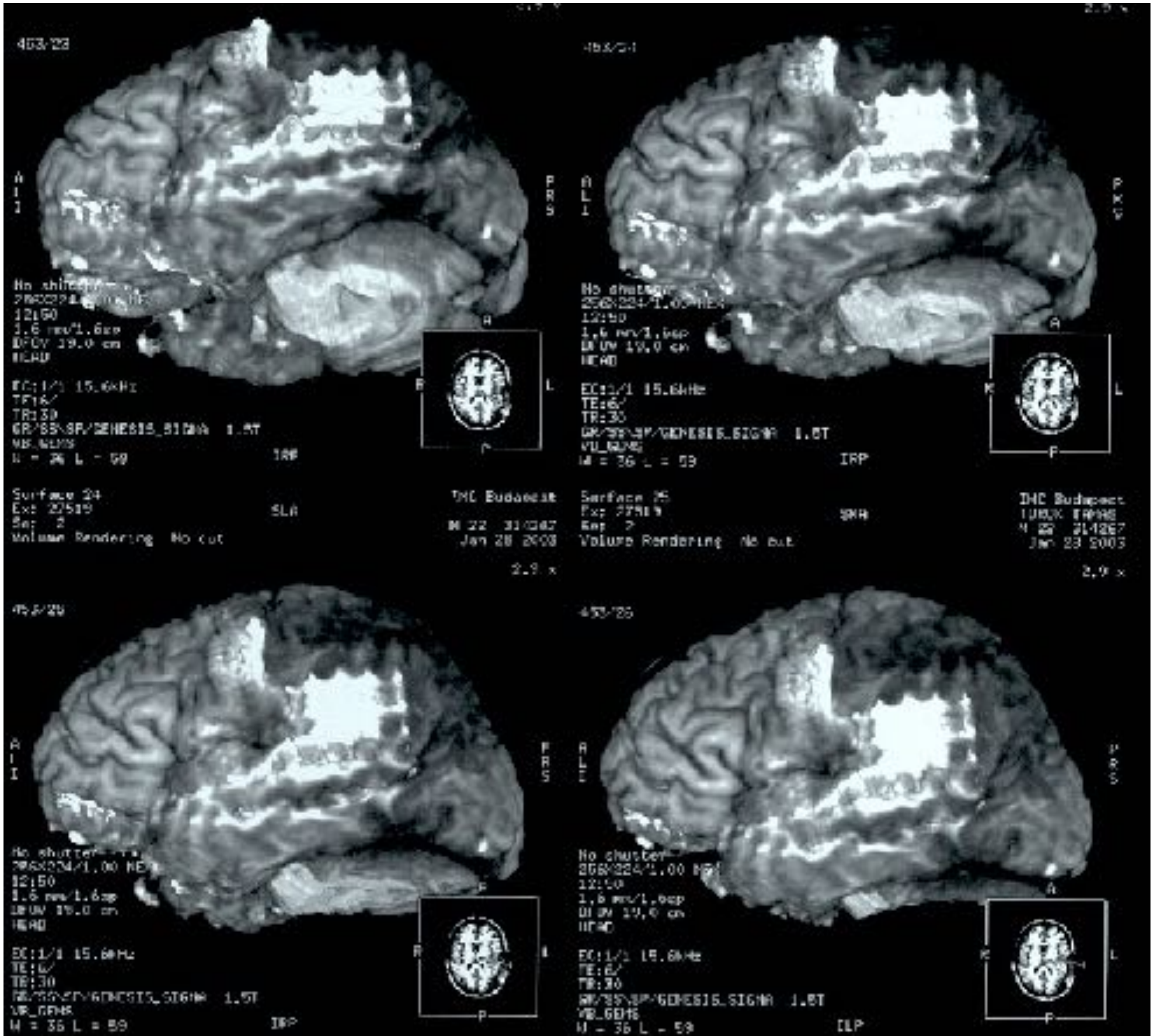
3D MRI - strips



2D - strips

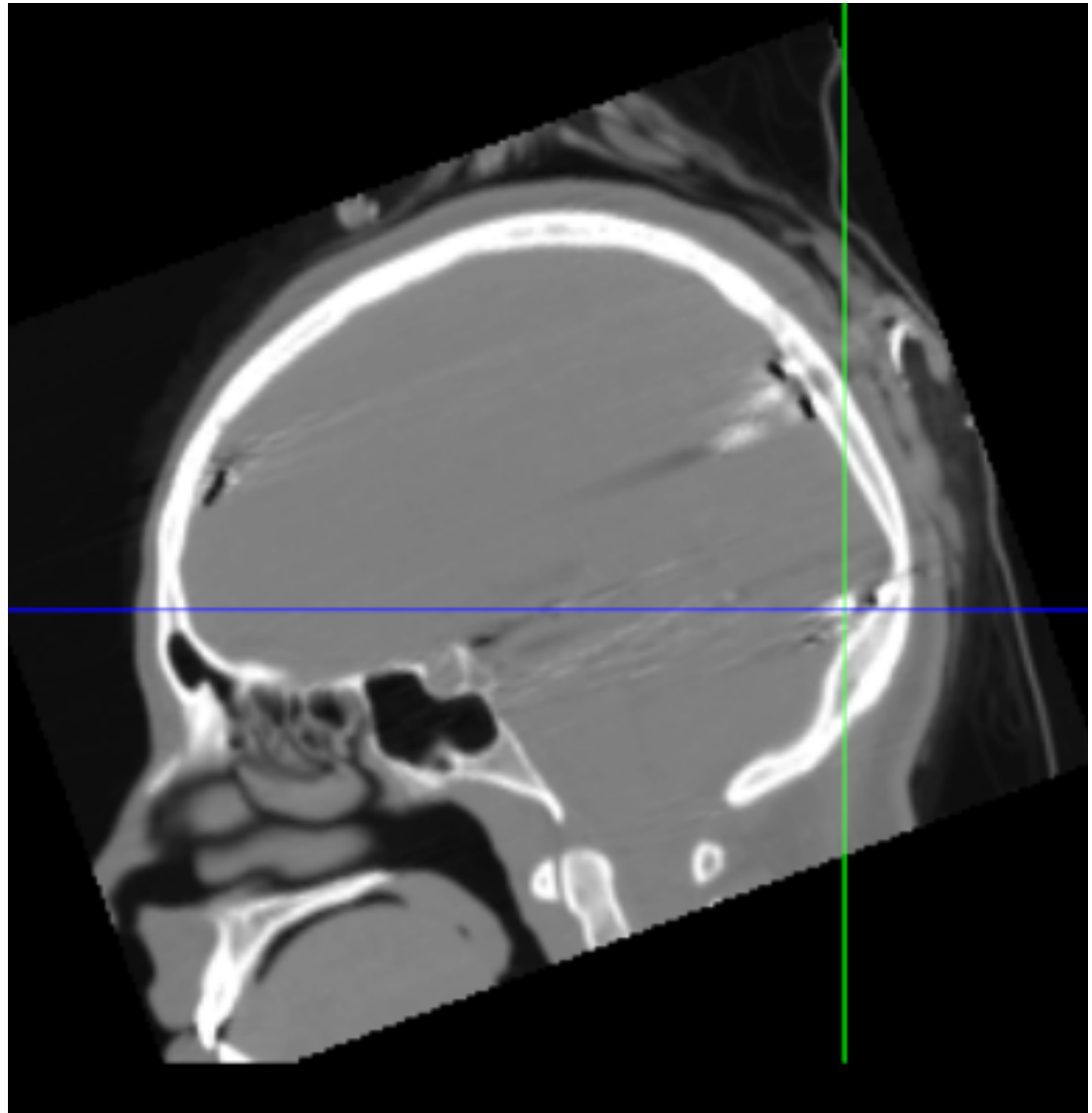


3D localisation



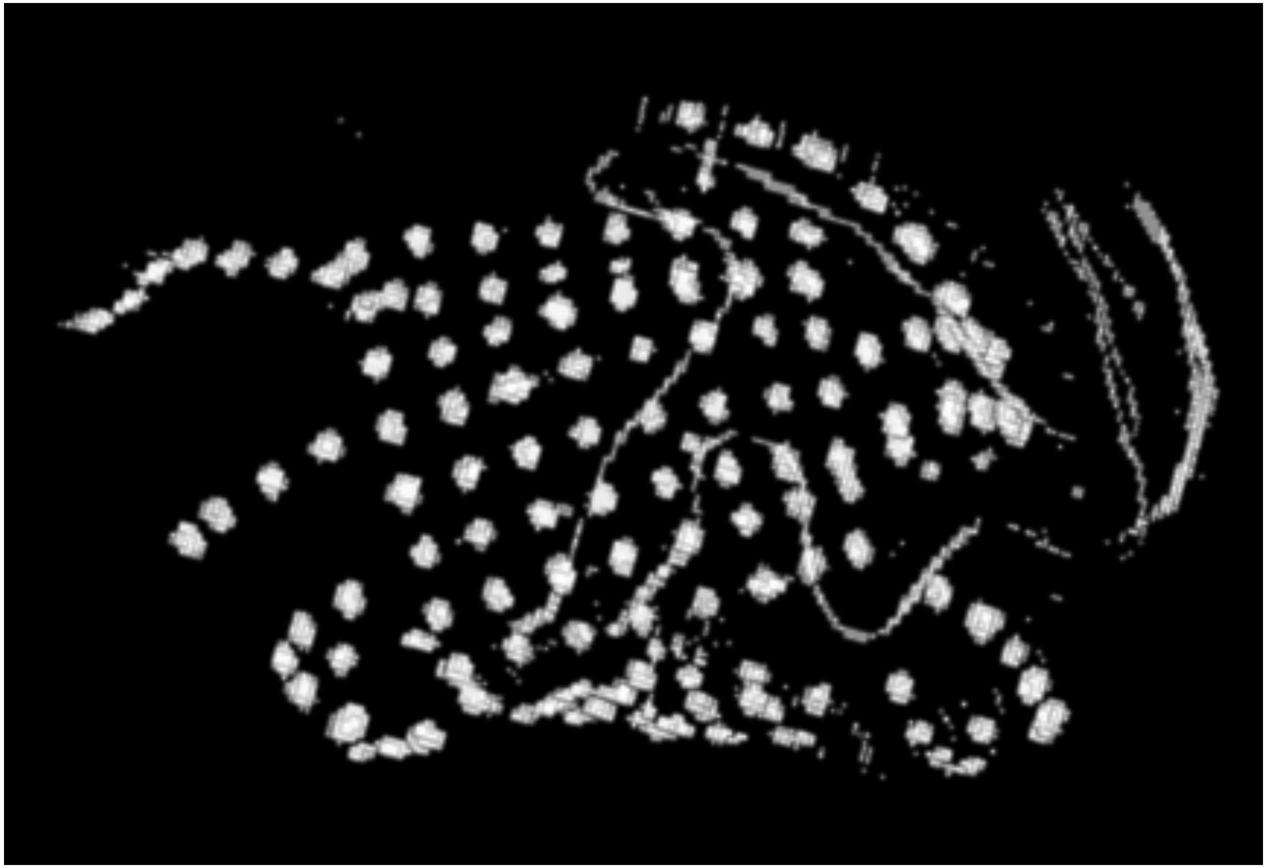
Subdural electrode localization with CT

- Sagittal CT rekonstruction



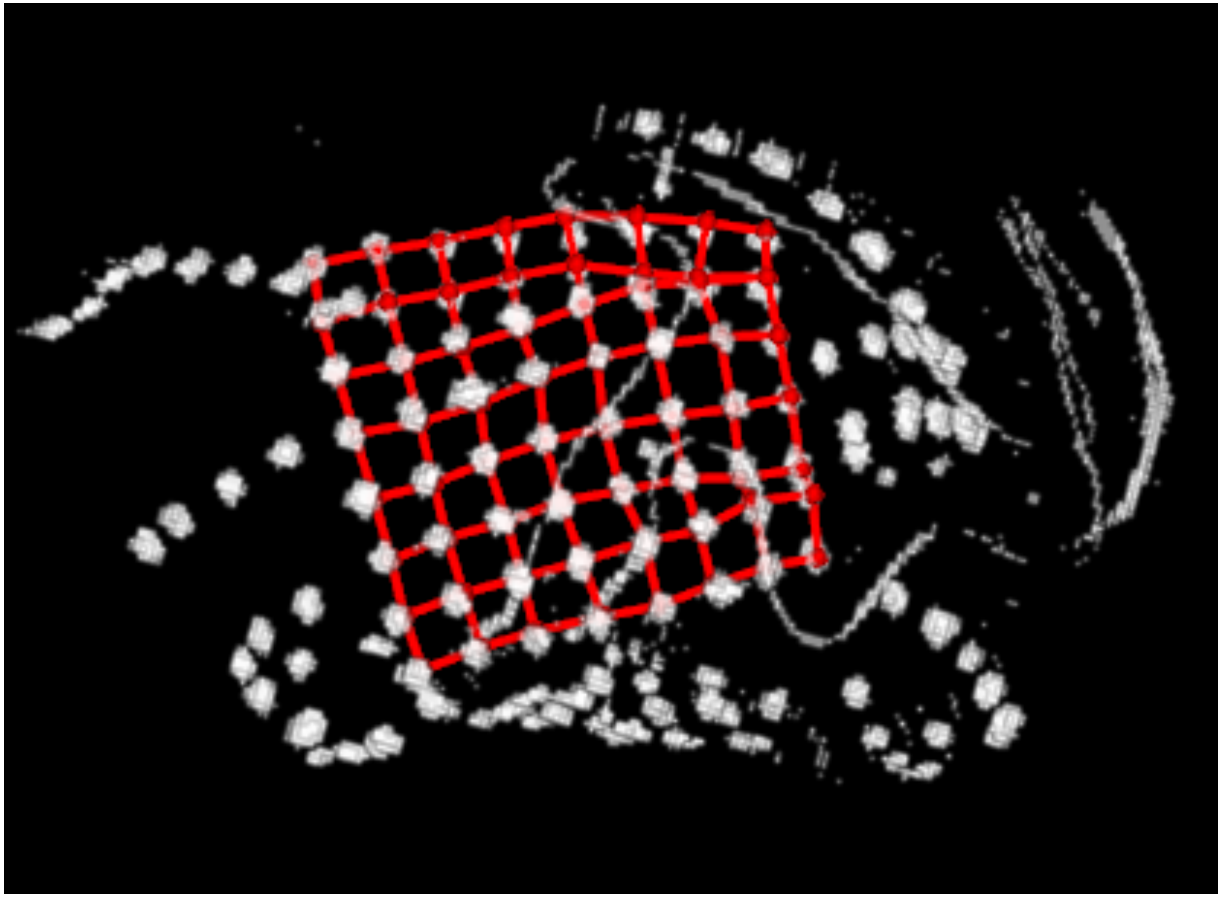
Subdural electrode localization with CT

- Electrodes are localized with appropriate windowing



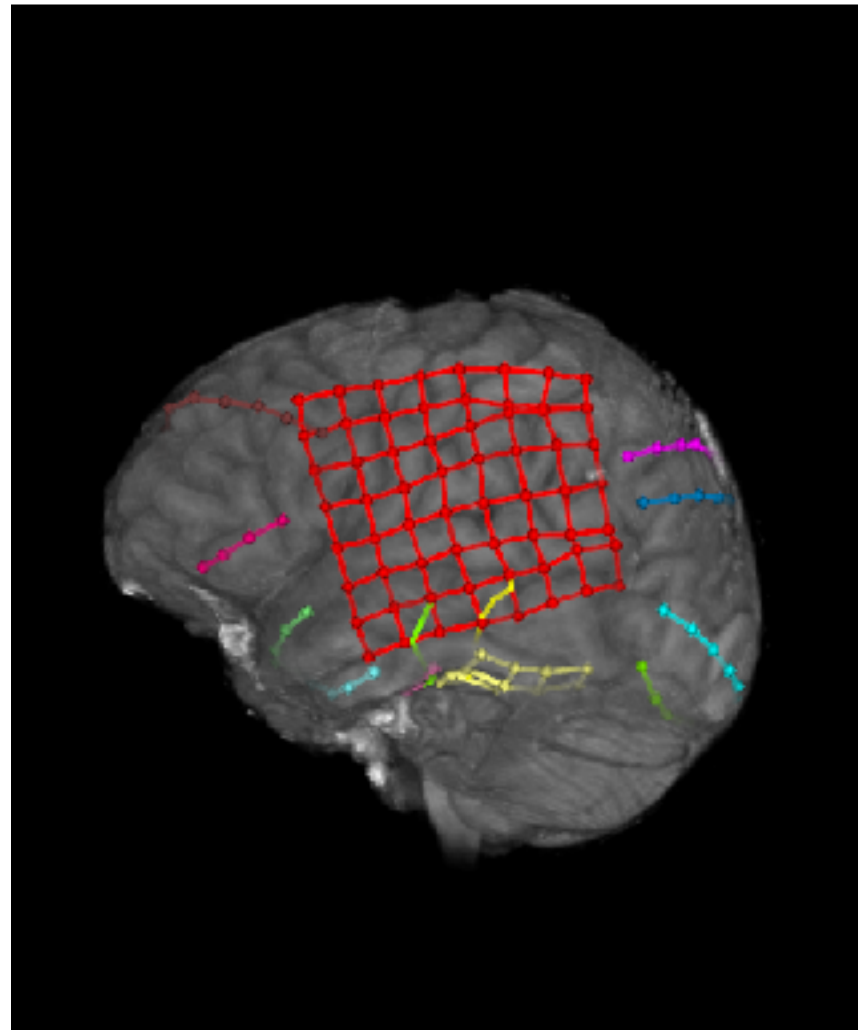
Localization of subdural electrodes with CT

- CT based definition of the coordinates of electrodes



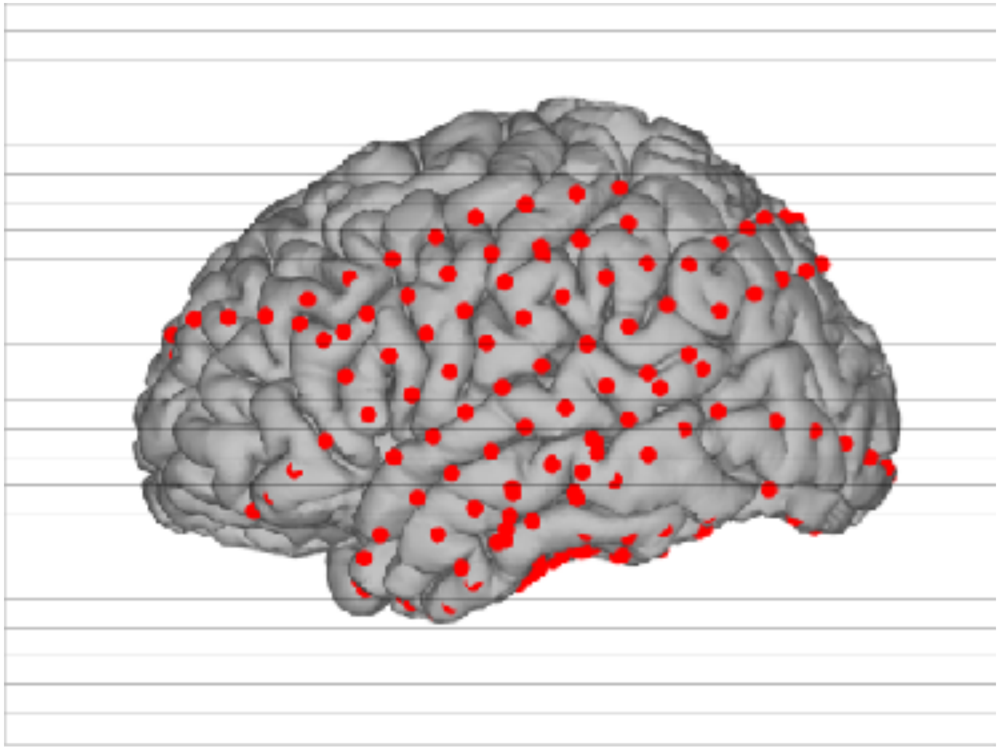
Localization of subdural electrodes with CT

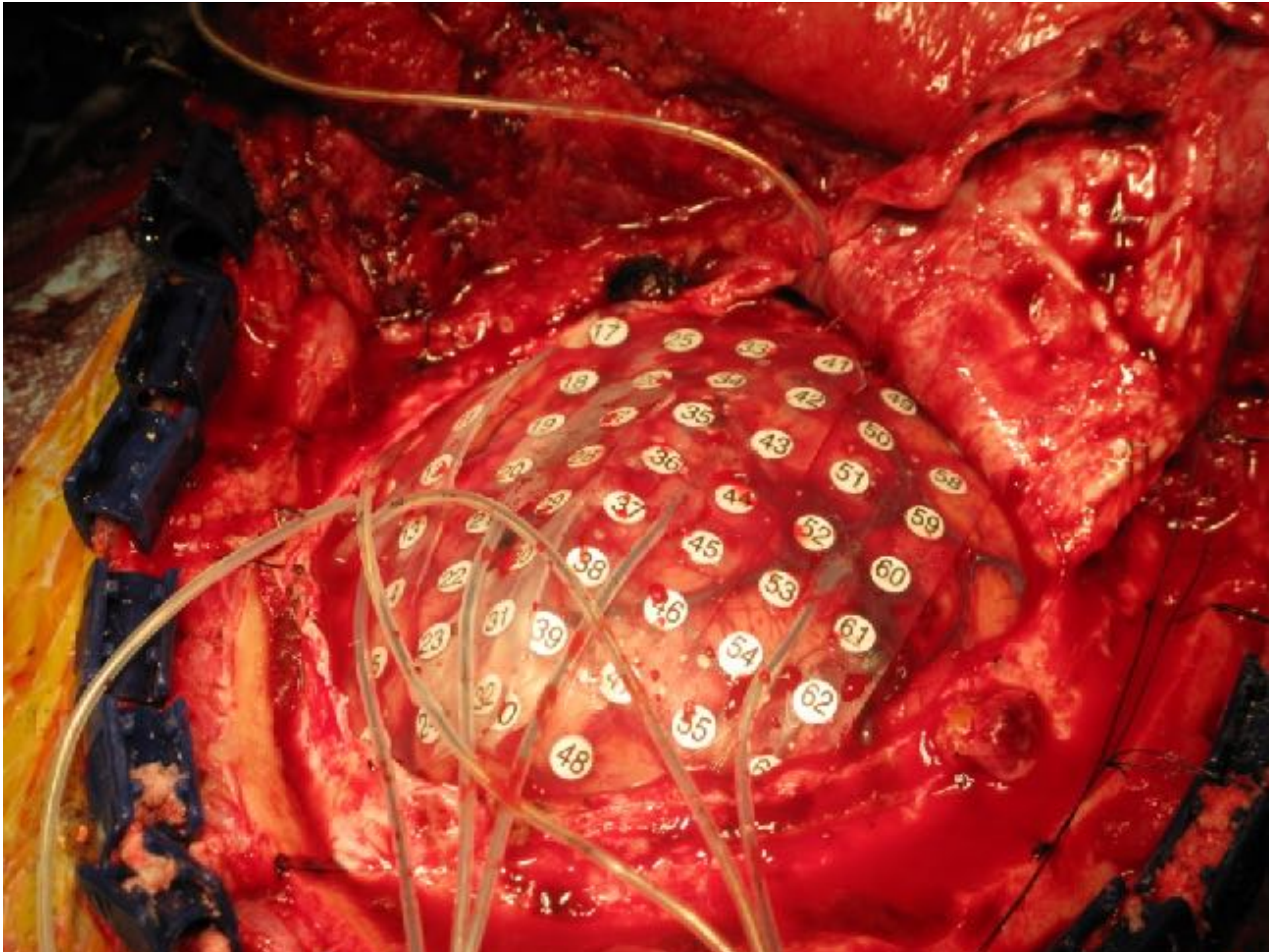
- Transformation of electrode coordinates to MRI space



Localization of subdural electrodes

- Kortikális felszin rekonstrukció külön software-el
- Az elektródák CT képének fúziója a preop és postop MR képpel

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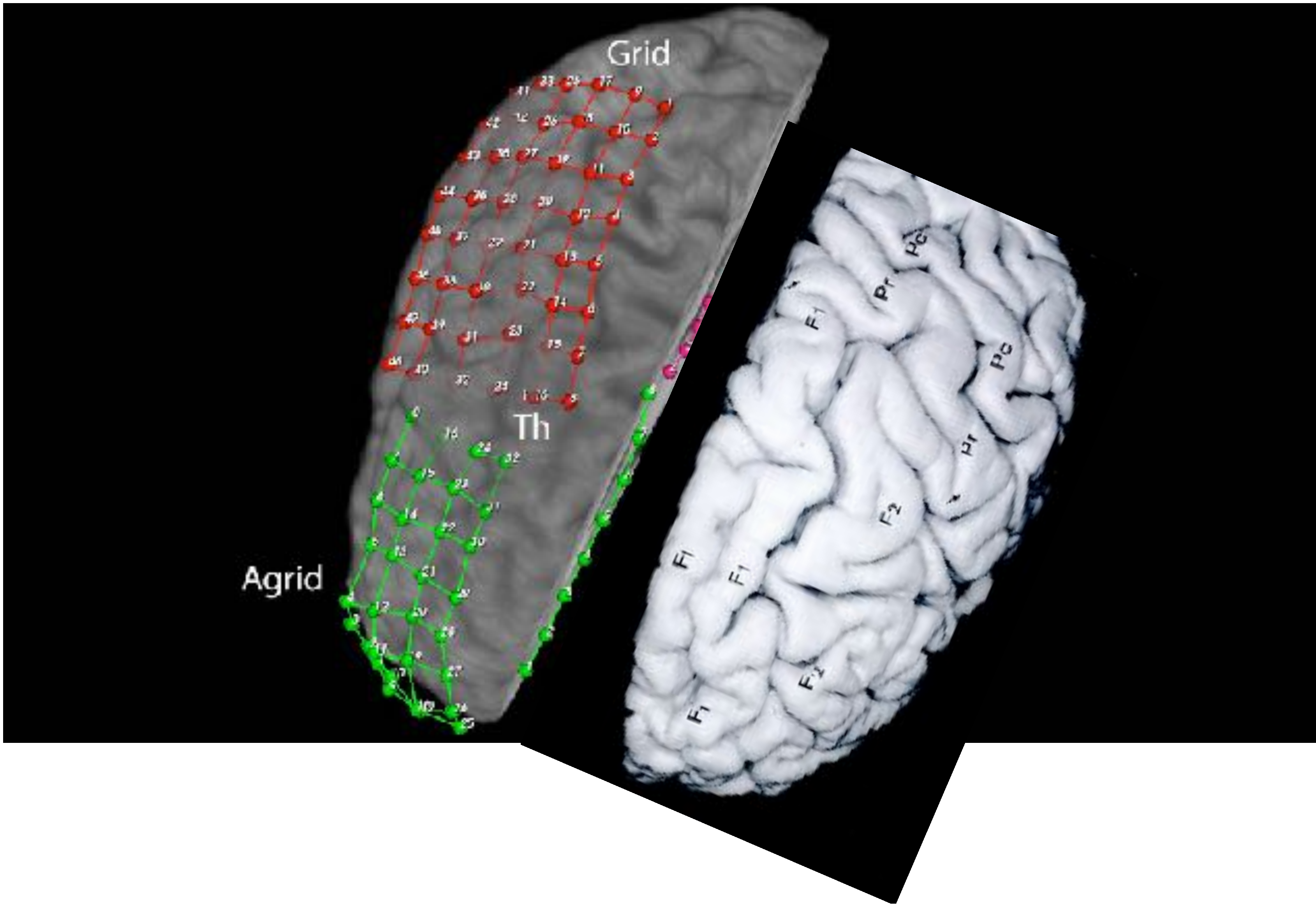
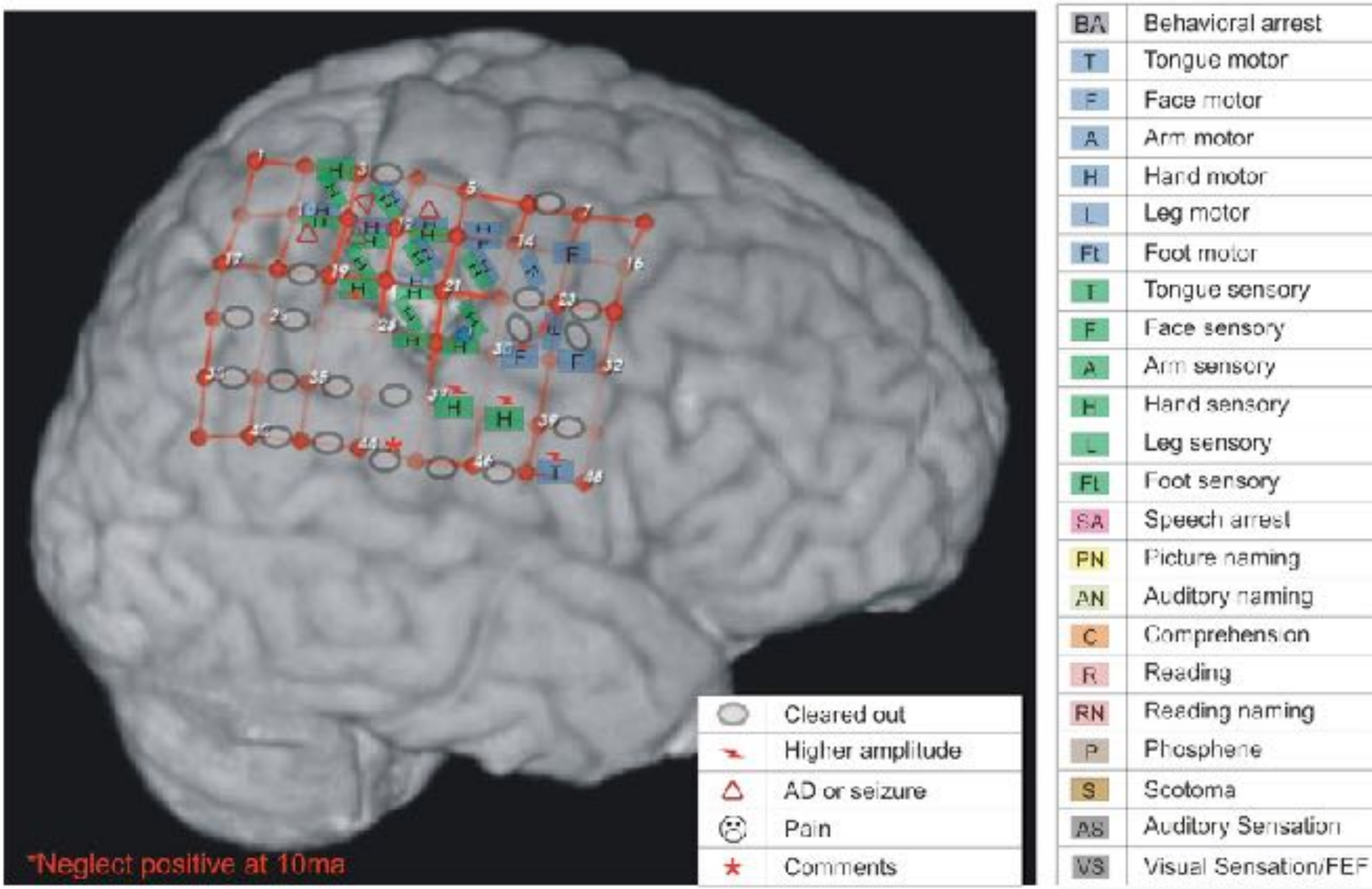

Grid
Th
Agrid
Pc
Pr
F1
F2



BA Behavioral arrest
T Tongue motor
F Face motor
A Arm motor
H Hand motor
L Leg motor
Ft Foot motor
T Tongue sensory
F Face sensory
A Arm sensory
H Hand sensory
L Leg sensory
Ft Foot sensory
SA Speech arrest
PN Picture naming
AN Auditory naming
C Comprehension
R Reading
RN Reading naming
P Phosphene
S Scotoma
AS Auditory Sensation
VS Visual Sensation/FEF
Cleared out
Higher amplitude
AD or seizure
Pain
Comments
*Neglect positive at 10ma

Surgery

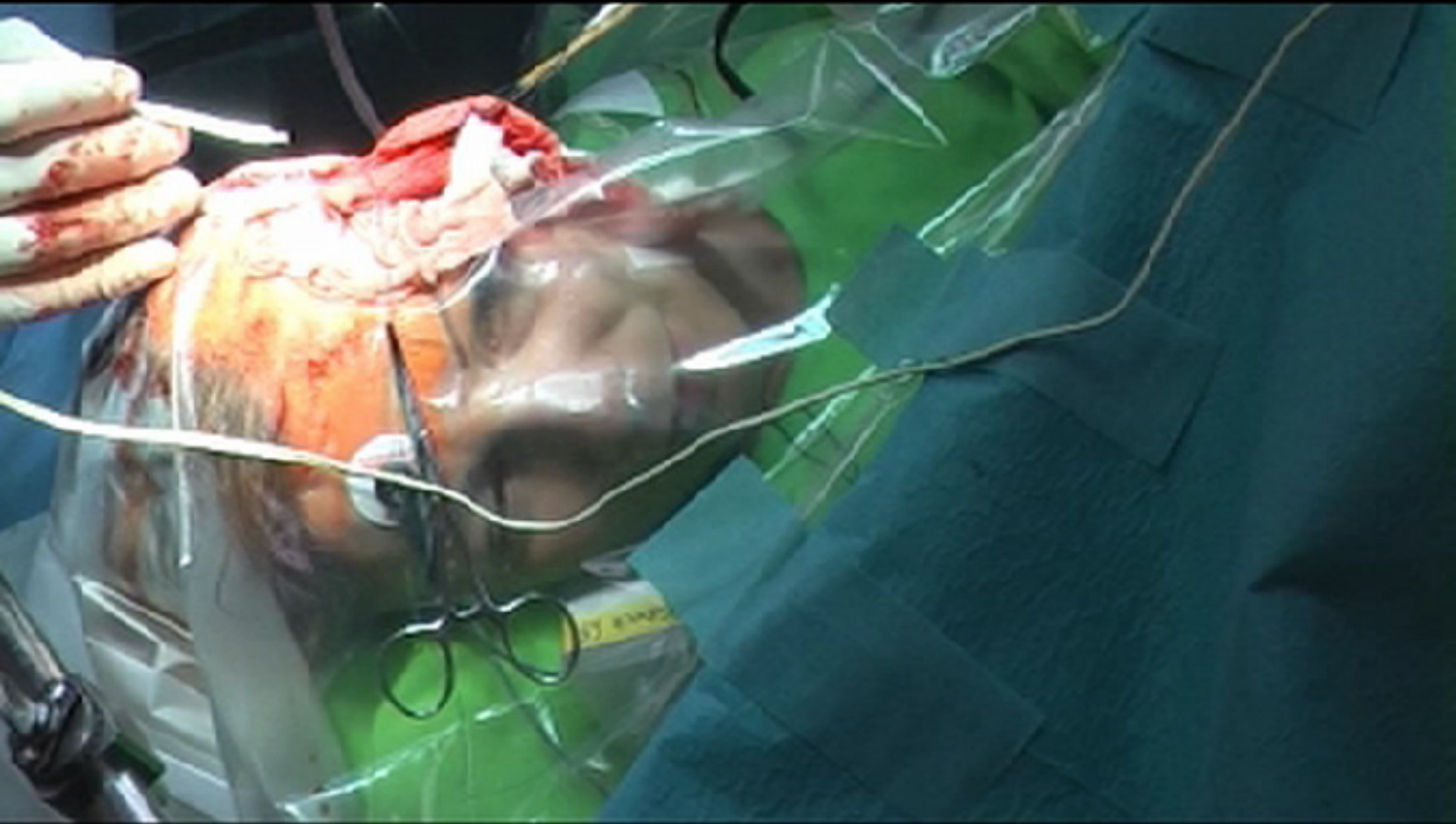
- Aim: to remove
  - the primary epileptogenic zone and/or
  - regions which involved in the early seizure propagation
  - secunder „rele stations” pl: amygdalo-hippocampal complex

  without the deficit of the eloquent areas
- „standard resection”

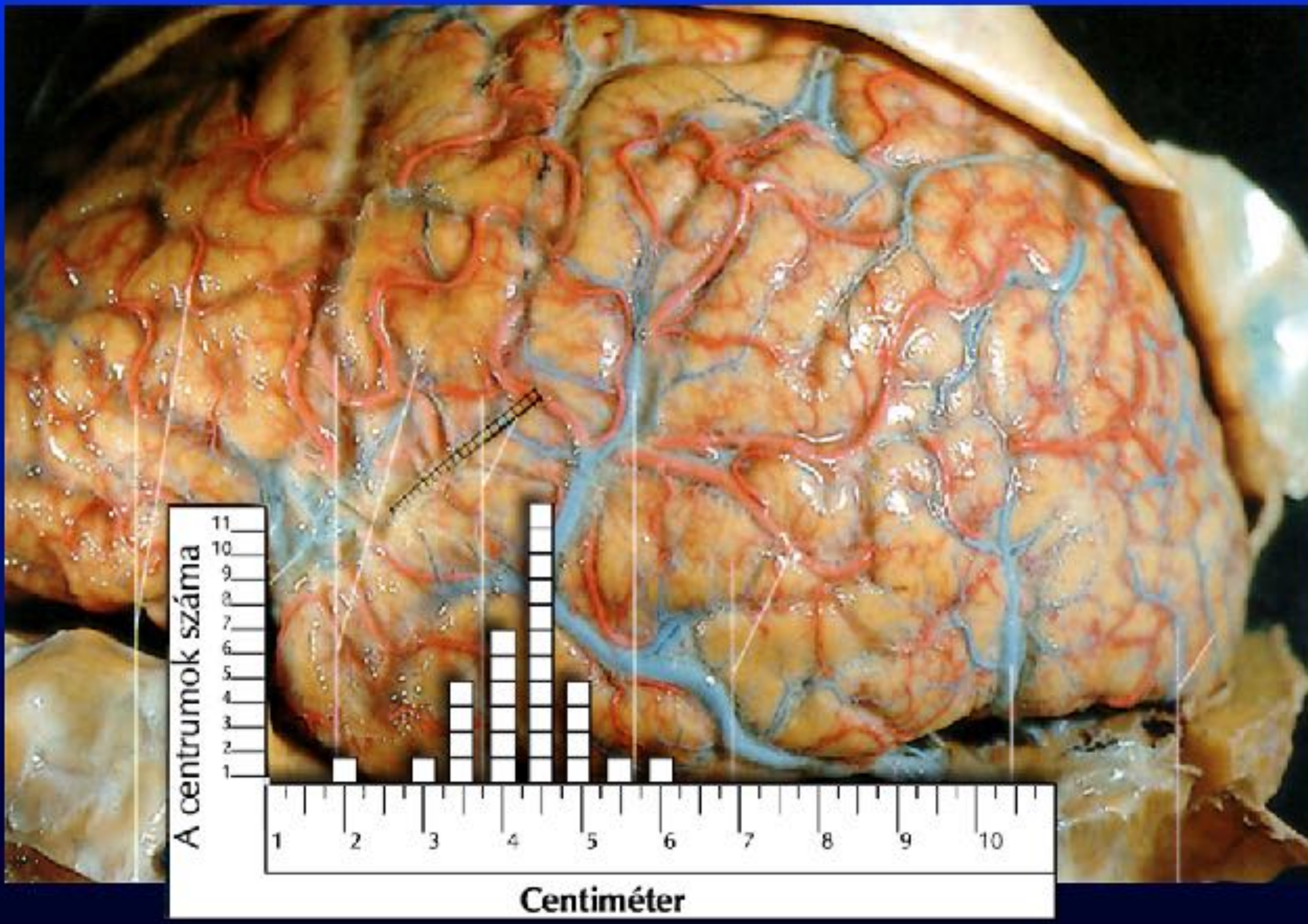
  „tailored surgery”

Surgical procedures

- Lesionectomy
- Topectomy
- Standard surgeries: lobectomies, selective amygdalohipocampectomy
- Extratemporal resections
- Hemispherotomy
- Callosocomissurotomy
- MST



The extent of dominant hemispheric temporal resect



Multiple subpial transsection in eloquent region epilepsy

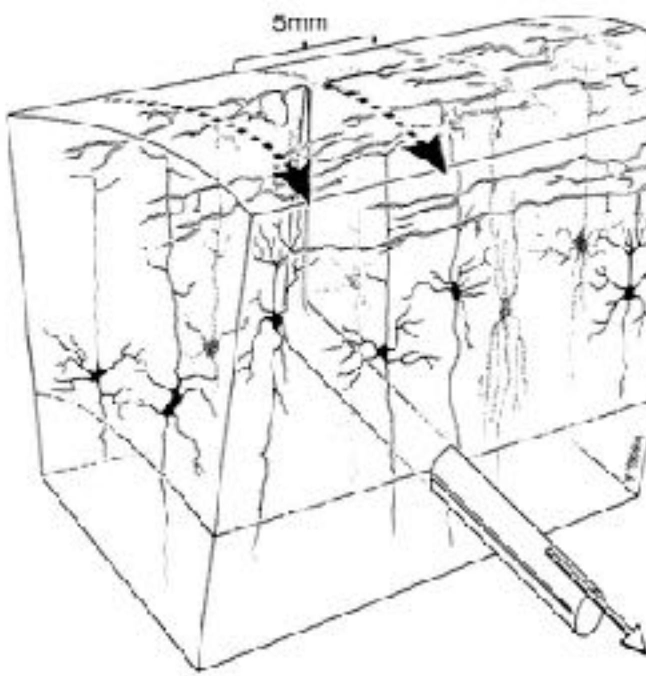


FIG. 3. Artist's drawing to illustrate the anatomical principles involved in multiple subpial transection.

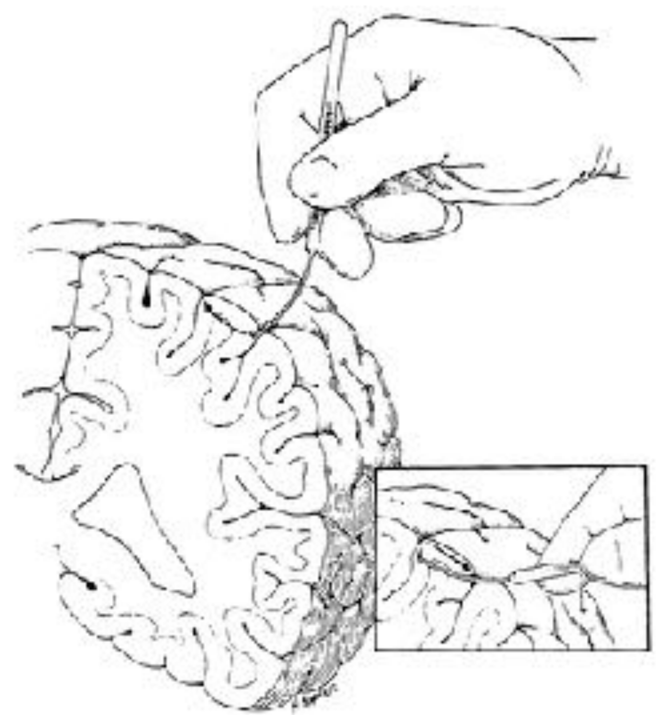


FIG. 2. Artist's drawing to illustrate the technique of insertion and movement of the subpial transector.

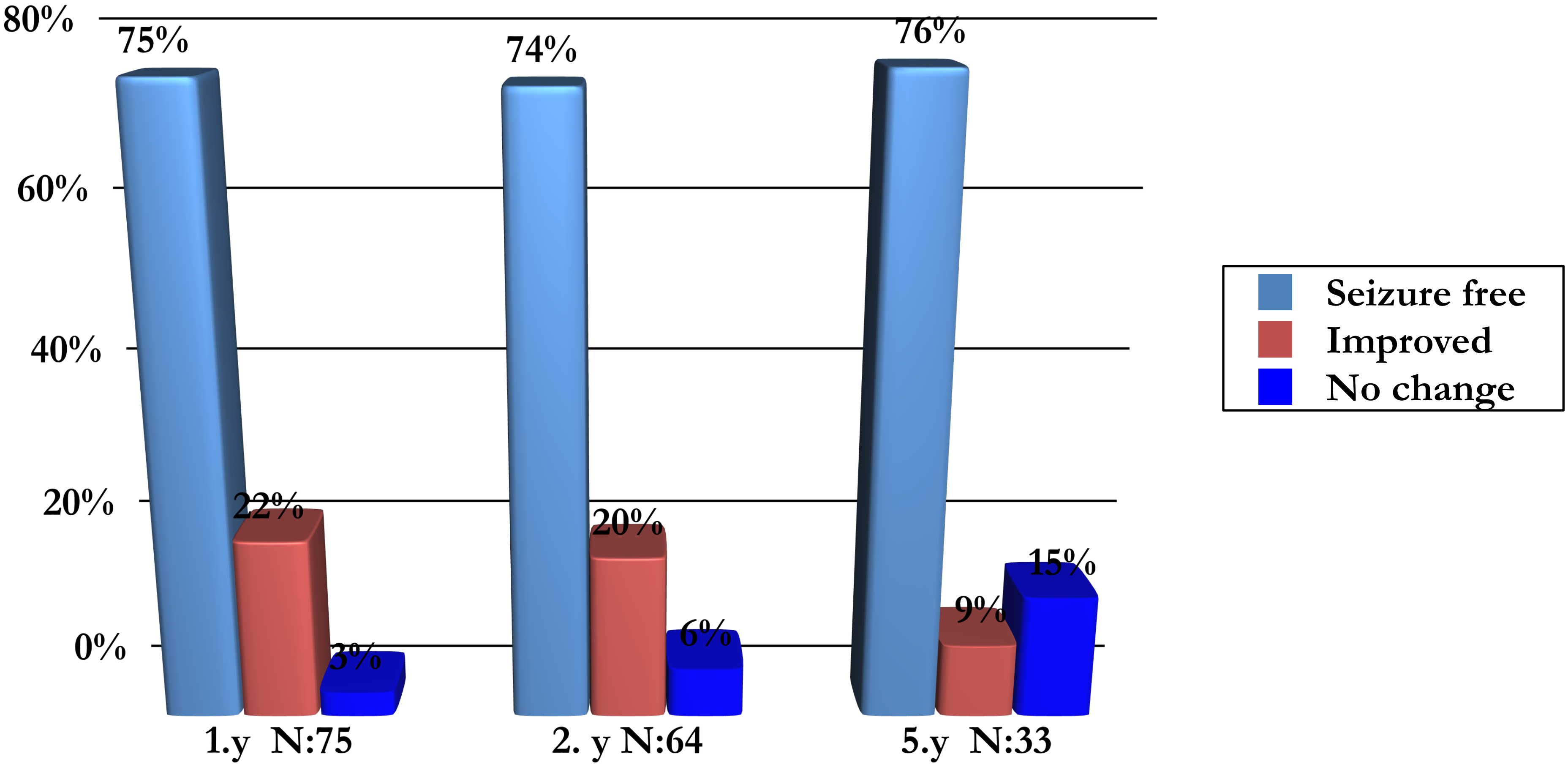
Long term results in resective epielpsy surgery (metaanalizes)

Type of procedure (lobectomy)	No of patients	Seizure free (%)
Temporal	3895	66
Hemispherectomy	169	61
Temporal and extratemporal	2334	59
Parietal	82	46
Occipital	35	46
Callosotomy	99	35
Extratemporal	169	34
Frontal	486	27
Multiple subpial transsection	74	16

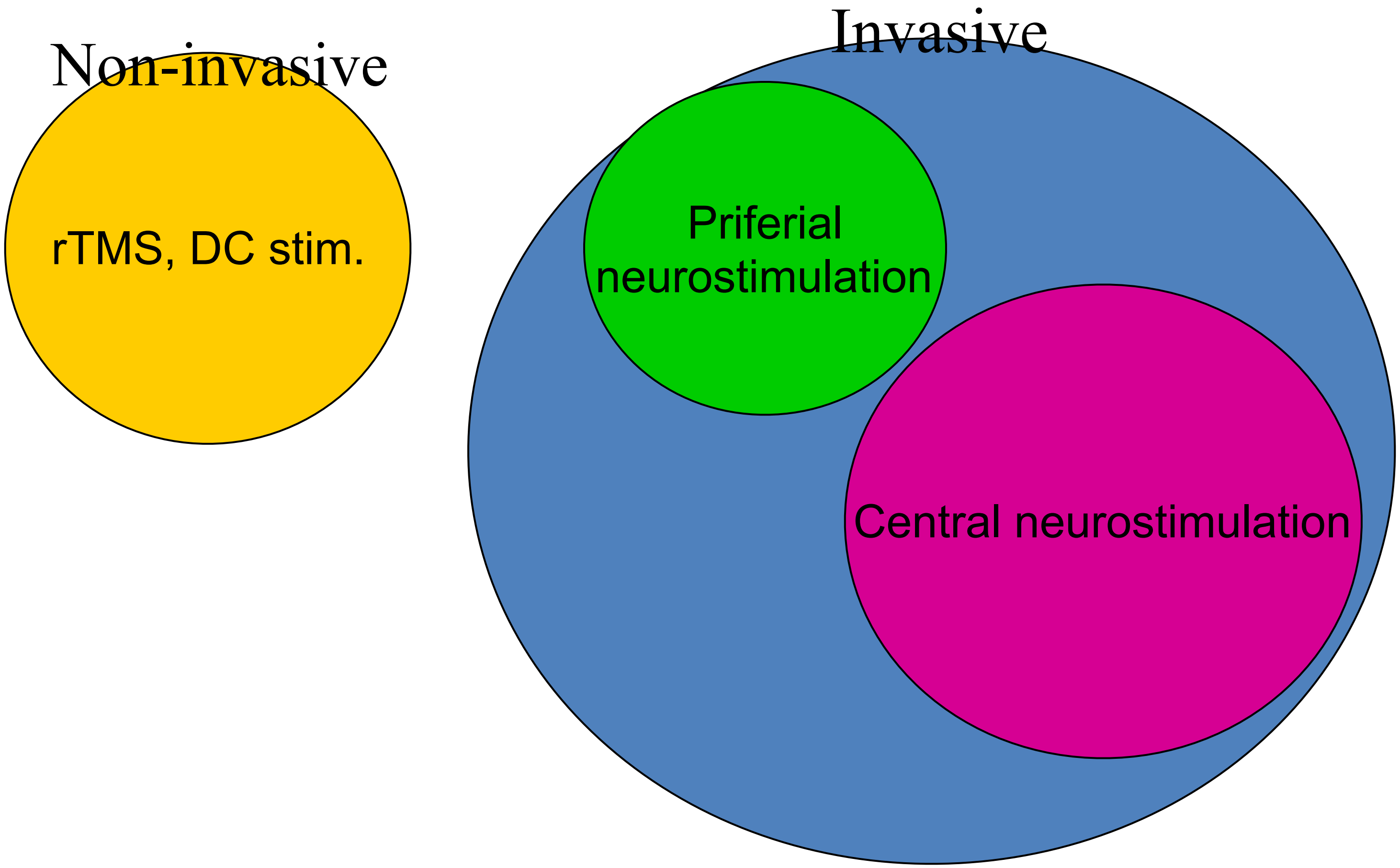
José F. Téllez-Zenteno, Raj Dhar and Samuel Wiebe: Long-term seizure outcomes following epilepsy surgery: a systematic review and meta-analysis. Brain (2005), 128, 1188–1198

Results in temporal epilepsies

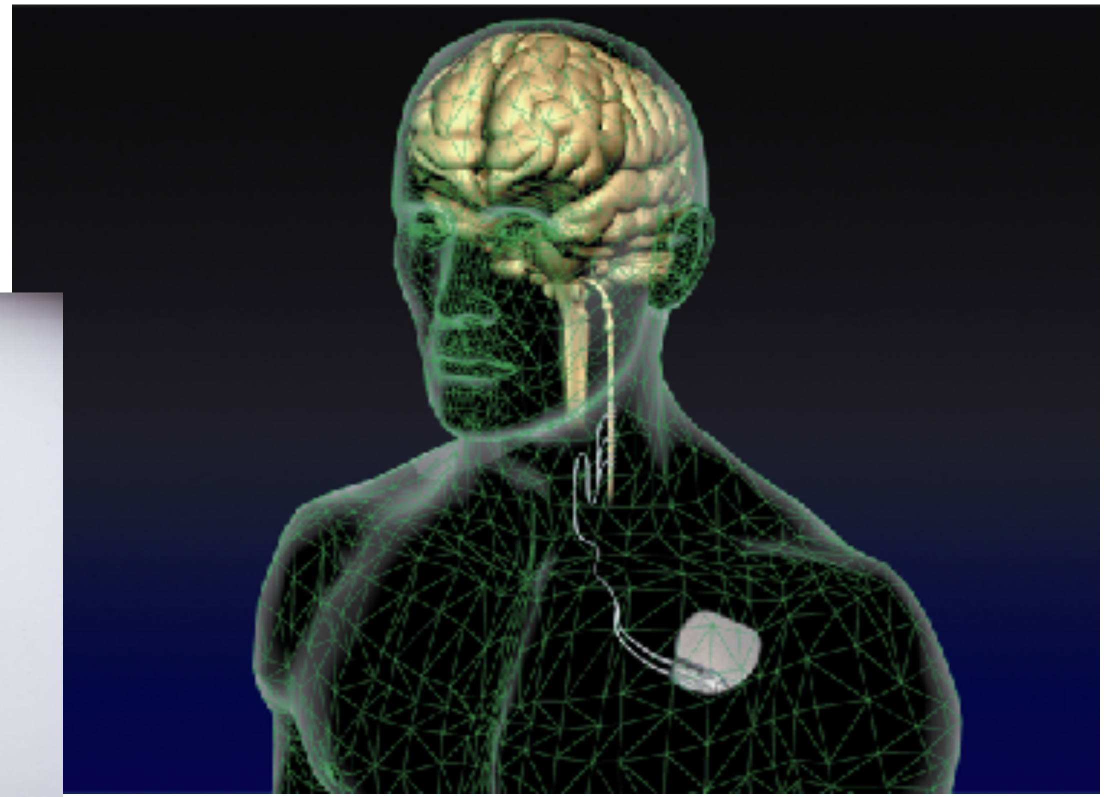
(Rásonyi, Halász et al. 2004)



Neuromodulation in epilepsy



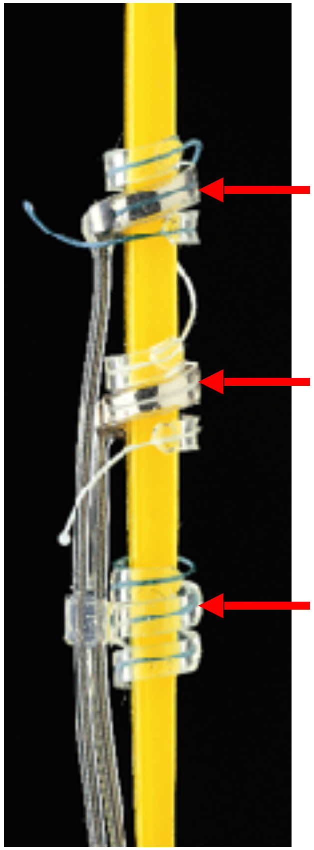
The role of VNS in the treatment of epilepsy



Electrodes

Cranial

Caudal

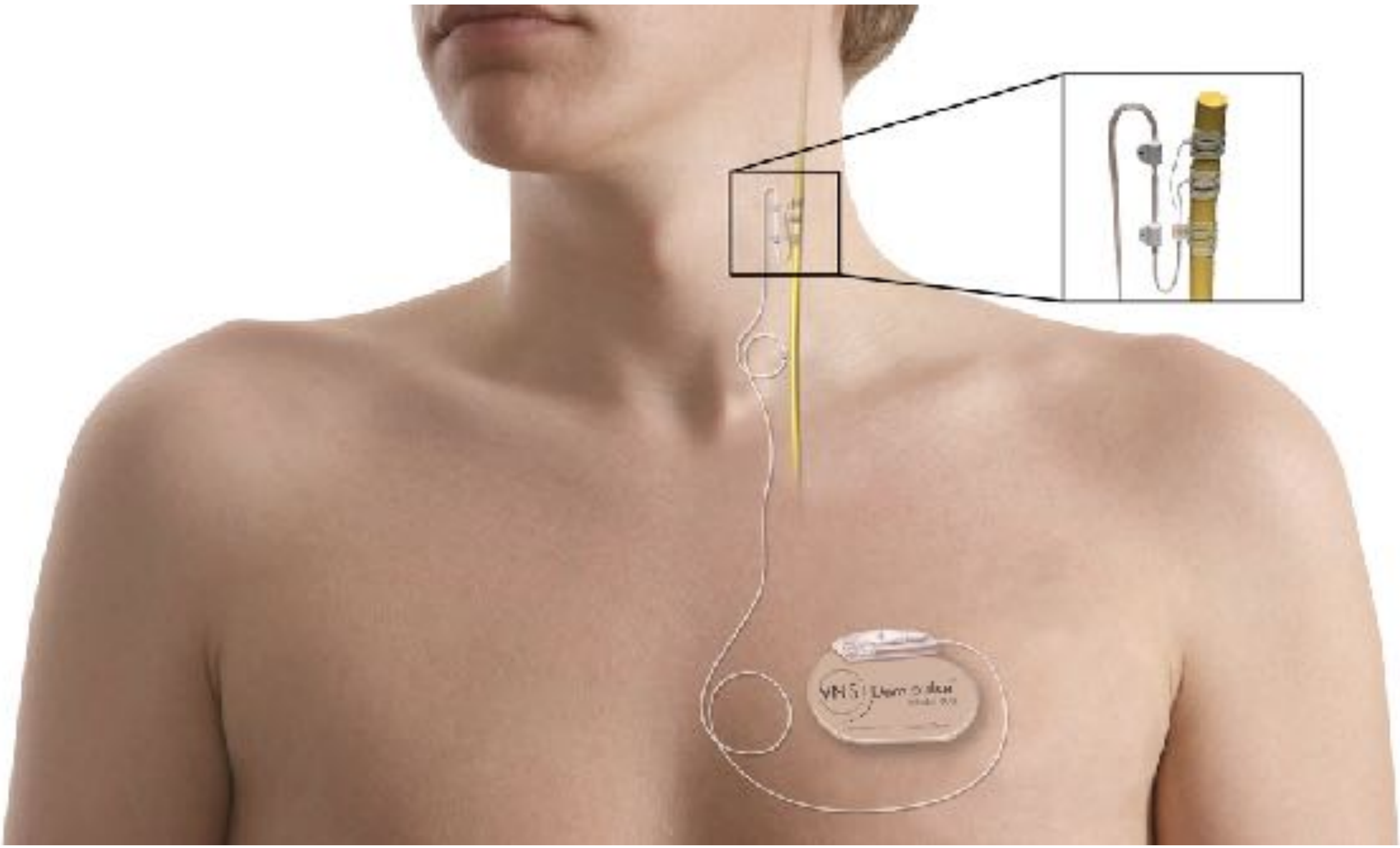


Negative Electrode

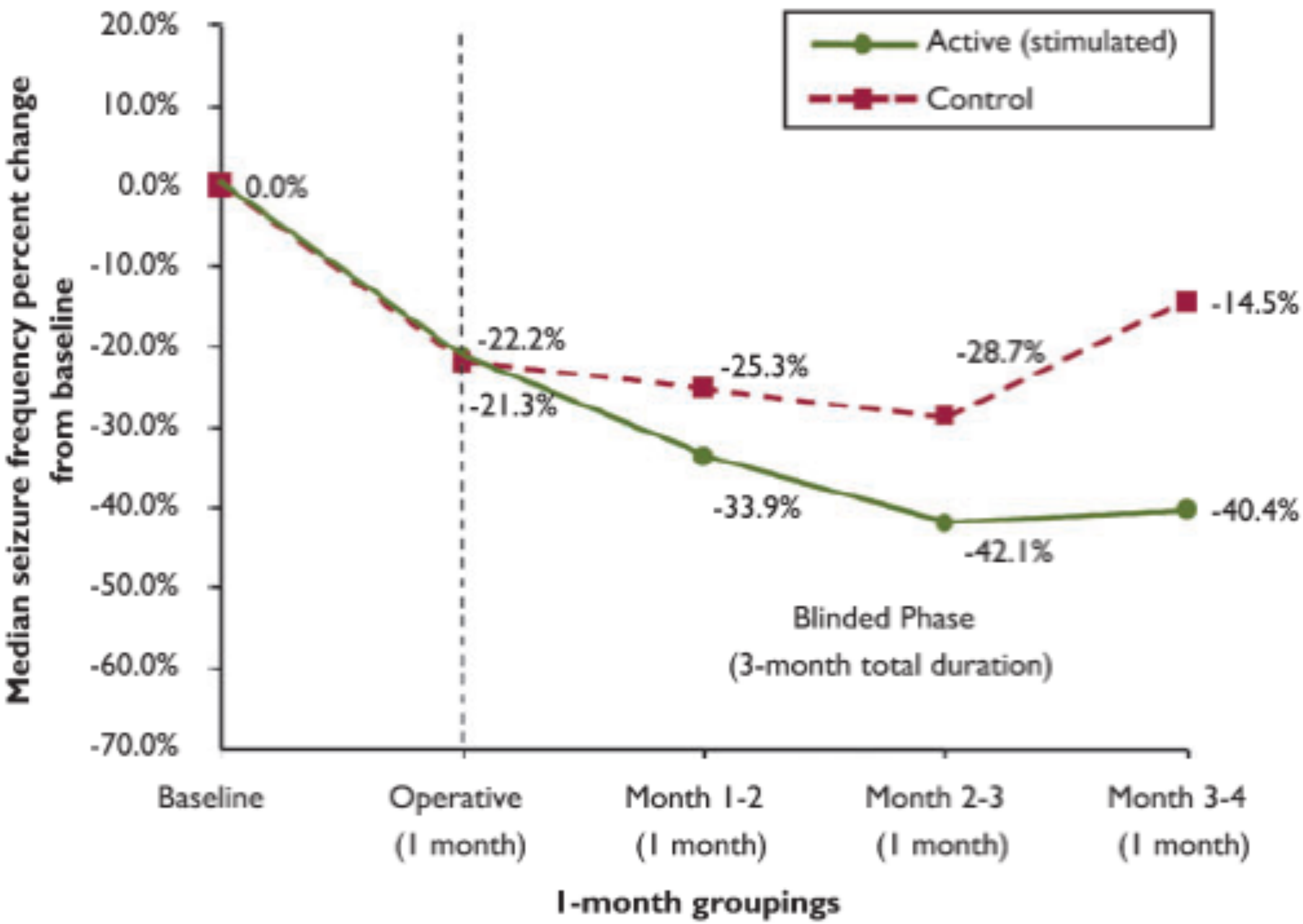
Positive Electrode

Anchor Tether

VNS Therapy – Implantation – Demipulse



Changes in seizure frequency in blinded phase of the SANTE study



2 years seizure changes in SANTE vs. VNS

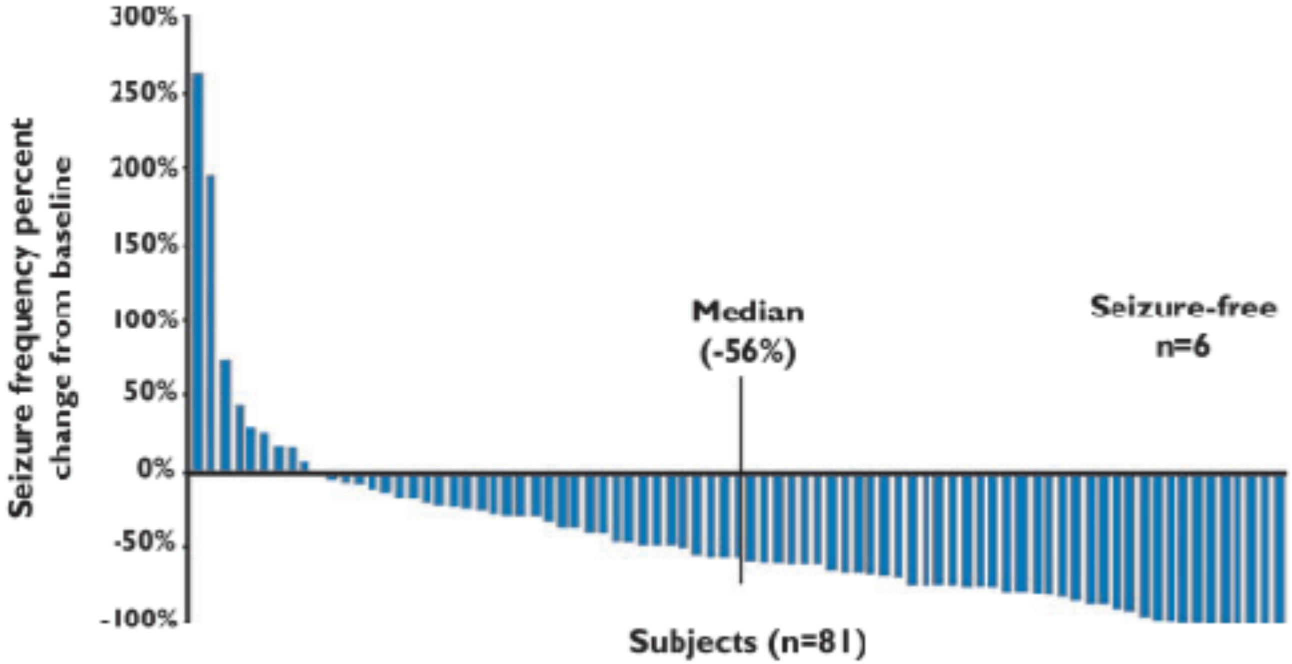
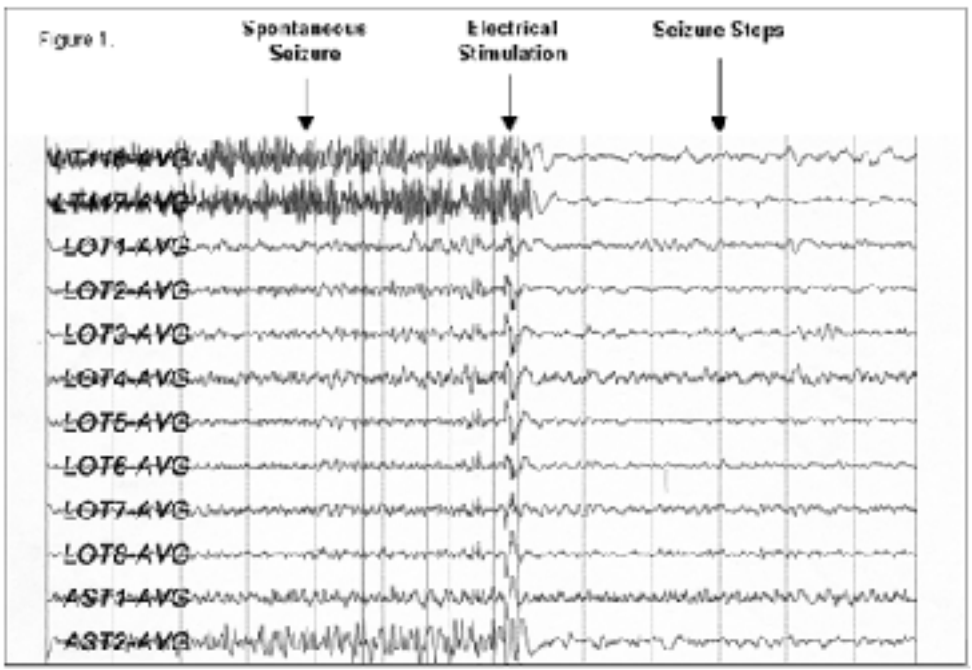


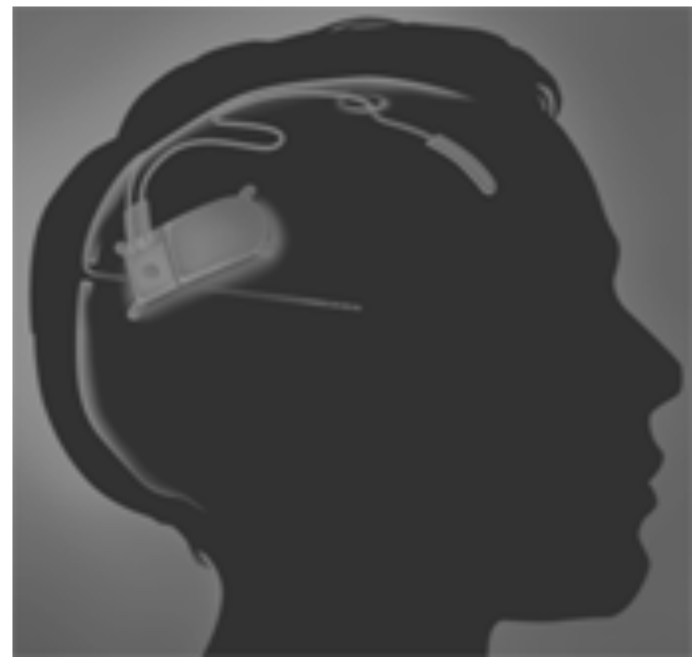
Figure 3.
Histogram of seizure frequency changes from baseline to 25 months of stimulation (2 years after randomization, n = 81) for participants with at least 70 days of diary. Negative values indicate a seizure frequency reduction compared with baseline.
Epilepsia ©ILAE

- Median Seizure freq reduction @ 13Mo: 41%
- Median Seizure freq reduction @ 25Mo: 56%
- 50% responder rate @ 13Mo: 43% (VNS: 37%)
- 50% responder rate @ 25Mo: 54% (VNS: 43%)
- 50% responder rate @ 37Mo: 67% (VNS: 43%)

Responsive neurostimulation

S/E studies 43 sites in the USA

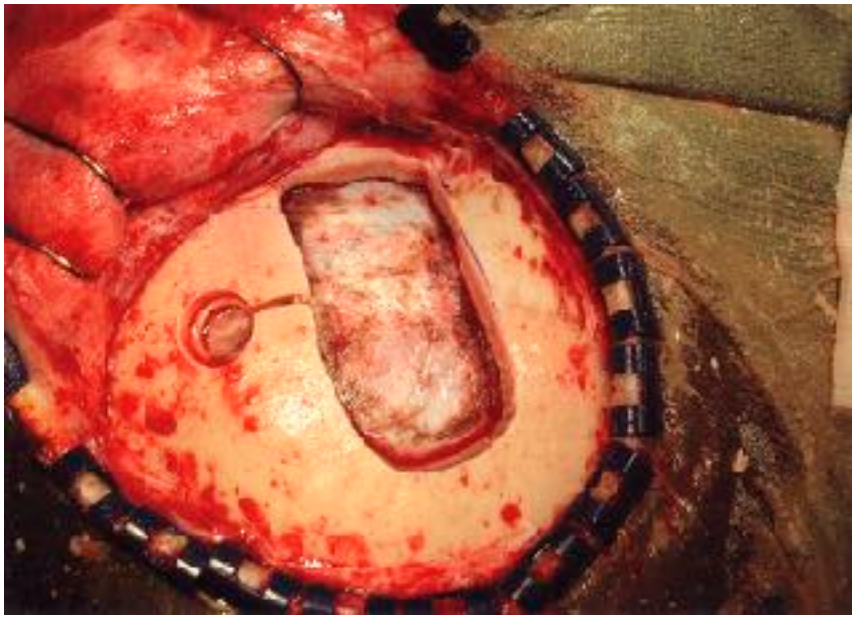


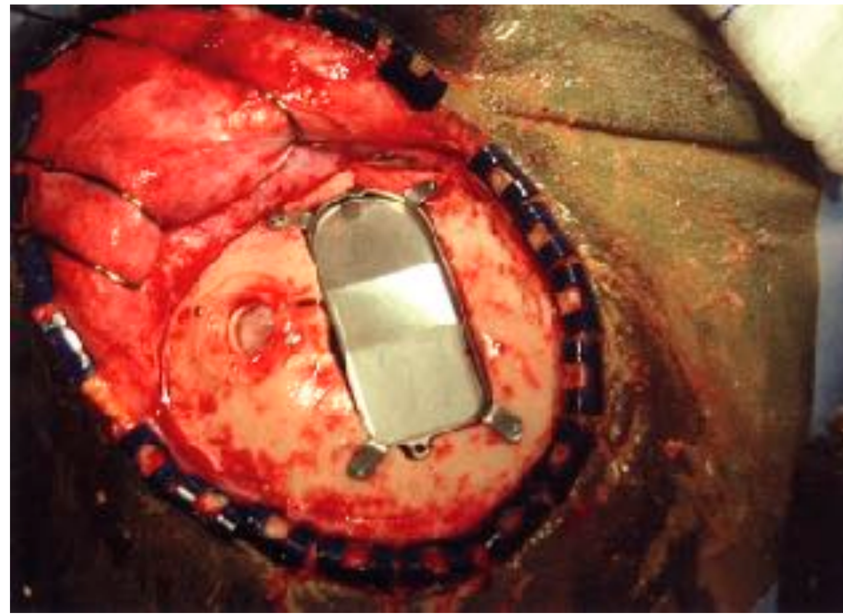


>100Hz, closed-loop

Direct stimulation of the epileptogenic focus, seizure inhibition

Responsive neurostimulation
S/E studies on 43 sites in the USA





RNS-Neuropace
- 45% seizure reduction, neaerly the same like VNS or DBS

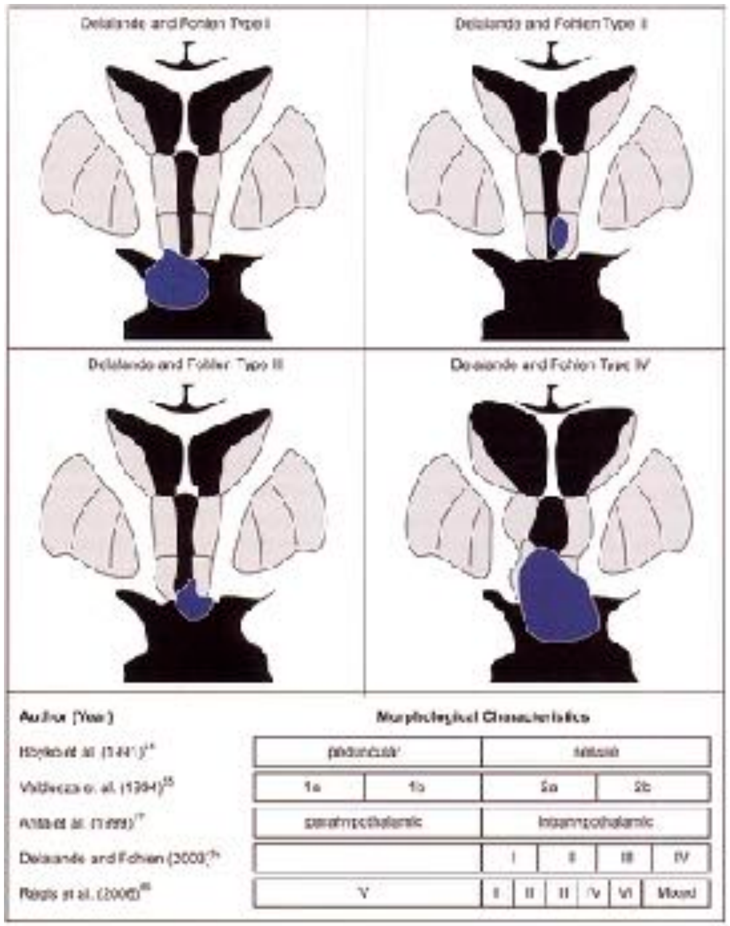
Randomized neuromodulation trials for epilepsy

Table 1 Randomized trials for direct brain stimulation as a treatment for epilepsy.

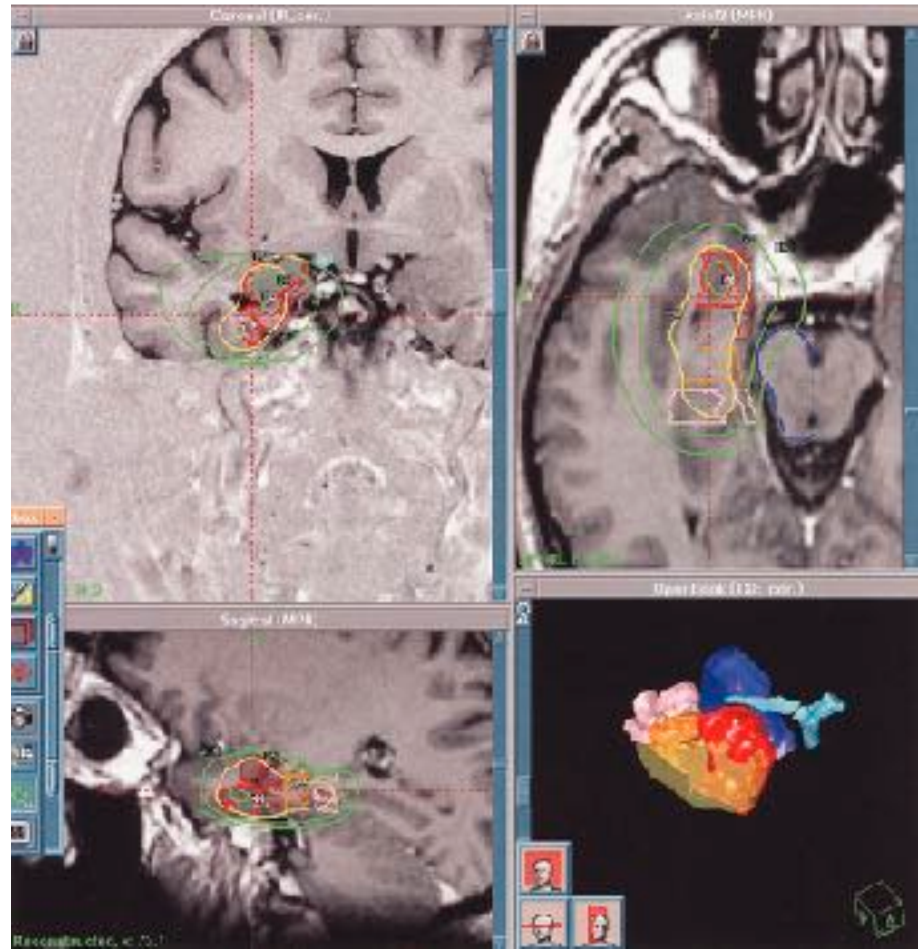
	Trial	Target	Protocol	Inclusion criteria	Status
SANTE[b]	Stimulation of the Anterior Nucleus of the Thalamus for Epilepsy	Scheduled – anterior nucleus of the thalamus	Stimulation on versus off in study period	Focal epilepsy	Completed 110 patient implanted
Neuropace™- Pivotal Trial	RNS™ System Pivotal Clinical Investigation	Responsive – seizure onset zone	Stimulation on versus off	Focal epilepsy with well identified seizure onset zone	Enrollment completed 191 patients implanted
CoRaStir	Prospective Randomized Controlled Study of Neurostimulation in the Medial Temporal Lobe for Patients With Medically RefraTactory Medial Temporal Lobe Epilepsy; Controlled Randomized Stimulation Versus Resection)	Scheduled – hippocampus	1. Stimulator on 2. Stimulator off 3. Surgery	Unilateral temporal lobe epilepsy as defined on video/EEG	Ongoing
METTLE	Randomized Controlled Trial of Hippocampal Stimulation for Temporal Lobe Epilepsy	Scheduled – hippocampus	1. Stimulator on 2. Stimulator off 3. No intervention	Mesial temporal epilepsy	Ongoing
STIMEP	Scheduled stimulation of the subthalamic nucleus/substantia nigra reticulata	Scheduled – subthalamic nucleus		Ring chromosome 20 epilepsy	Ongoing

Jobst 2009 Epilepsy Research

Gamma knife(Rejis 2010)



Hypothalamus hamartomas



MTLE

„The silent gap between epilepsy surgery evaluations and clinical practice guidelines”

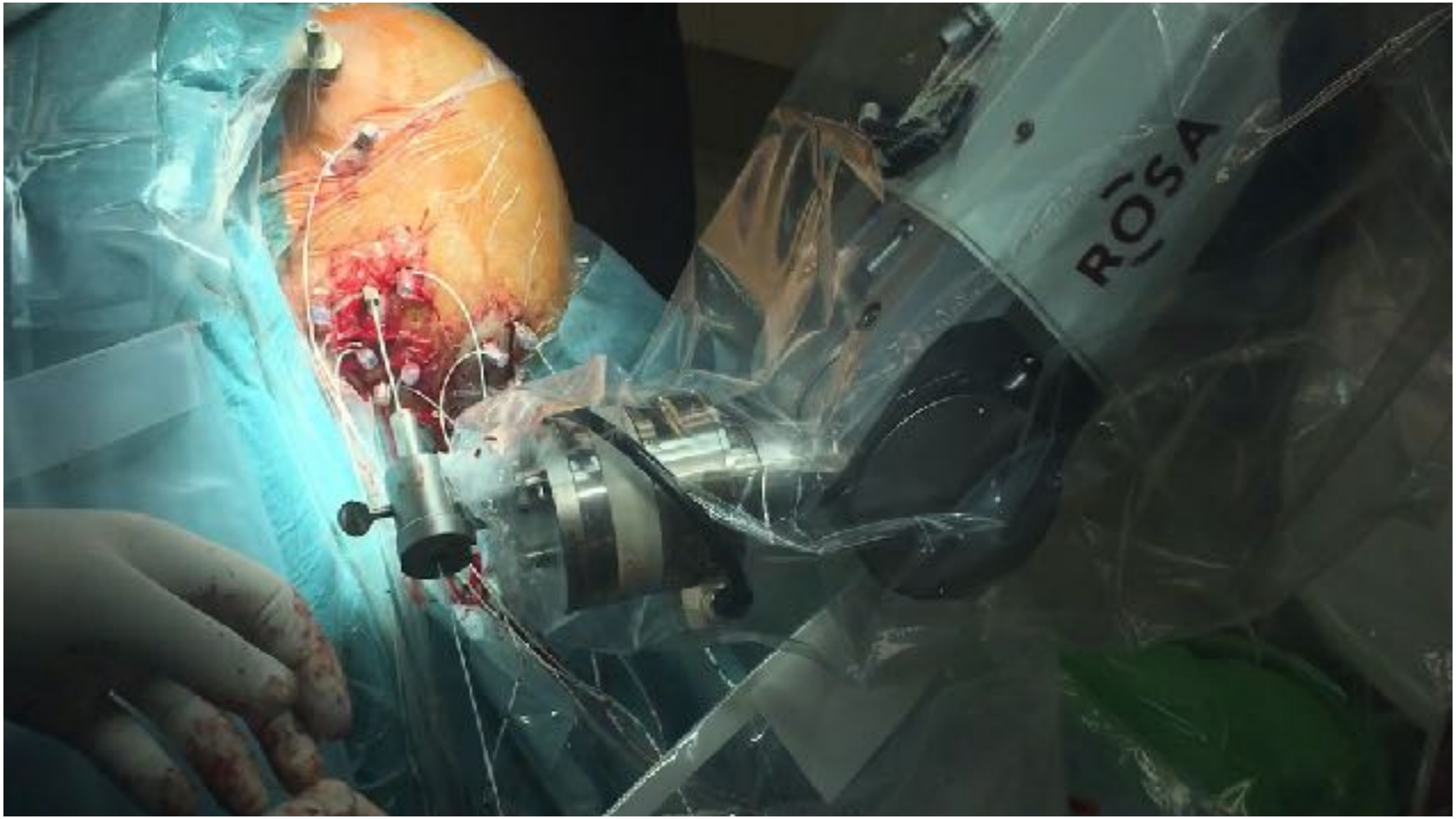
European Journal of Neurology, 2010 Apr;17(4):619-25, de Flon (Uppsala)

- Out of 48 surgical candidates 28 (58%) were not referred to the epilepsy surgery team
- Inspite of the guidelines in 45% of the patients the EEG, 33% of the patients the MRI was missing
- The prevalence of 0,54%, 100 000/60 the ratio of the non-referred epileptic patients in this swedish county

Robot assisted epilepsy surgery

Rosa: neurosurgical robot

SEEG with Rosa



Robot assisted SEEG

Summary

- The number of patients referred to epilepsy surgery is significantly lower all over the World than the criteria indicates
- Epilepsy surgery has to be done in comprehensive epilepsy centers
- The results of antiepileptic neuromodulation techniques are promising, but the outcome still much less than the outcome of resective surgeries

Thank you for your attention!