

Clinical Magnetoencephalography in Epilepsy Diagnosis

Prof. H. Stefan

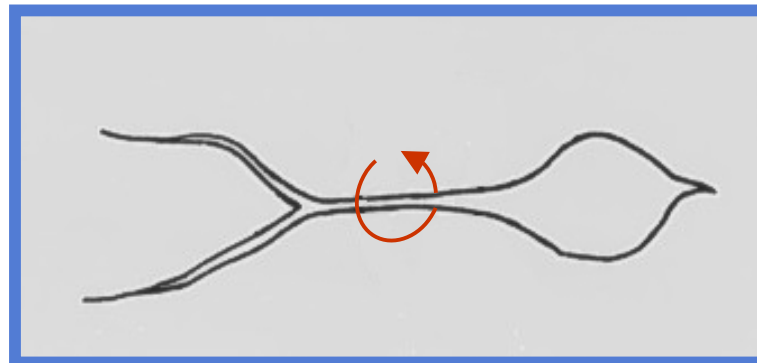
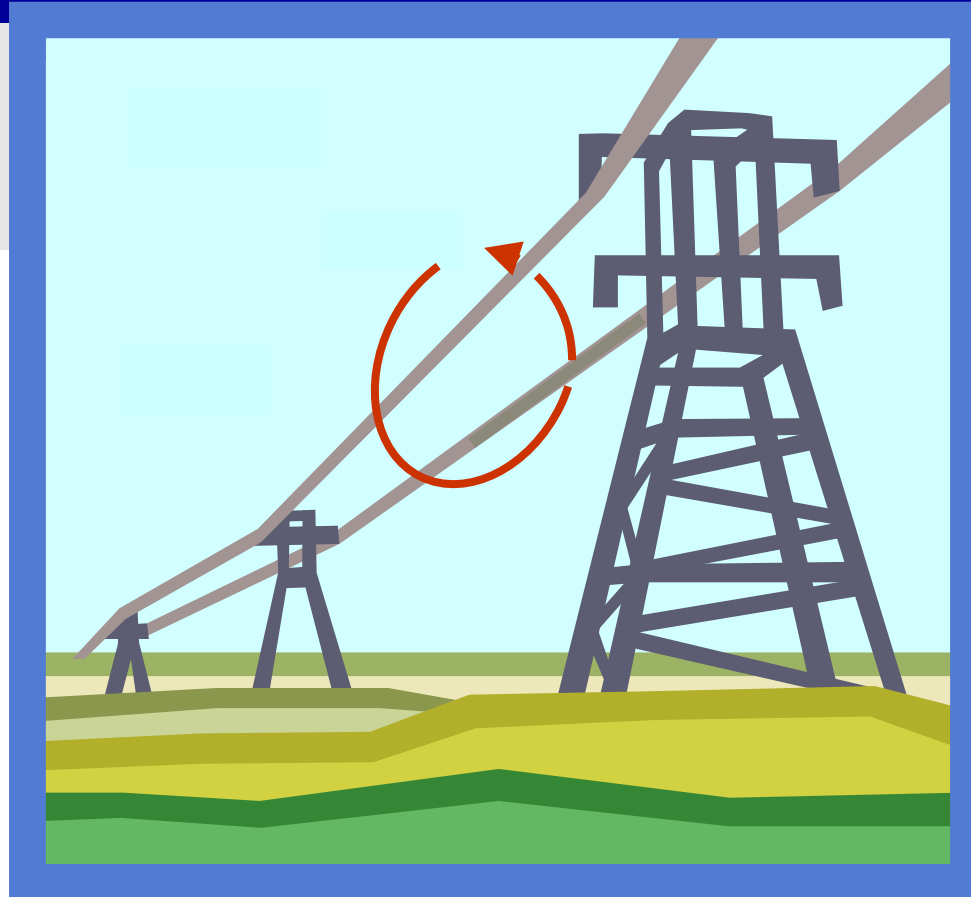
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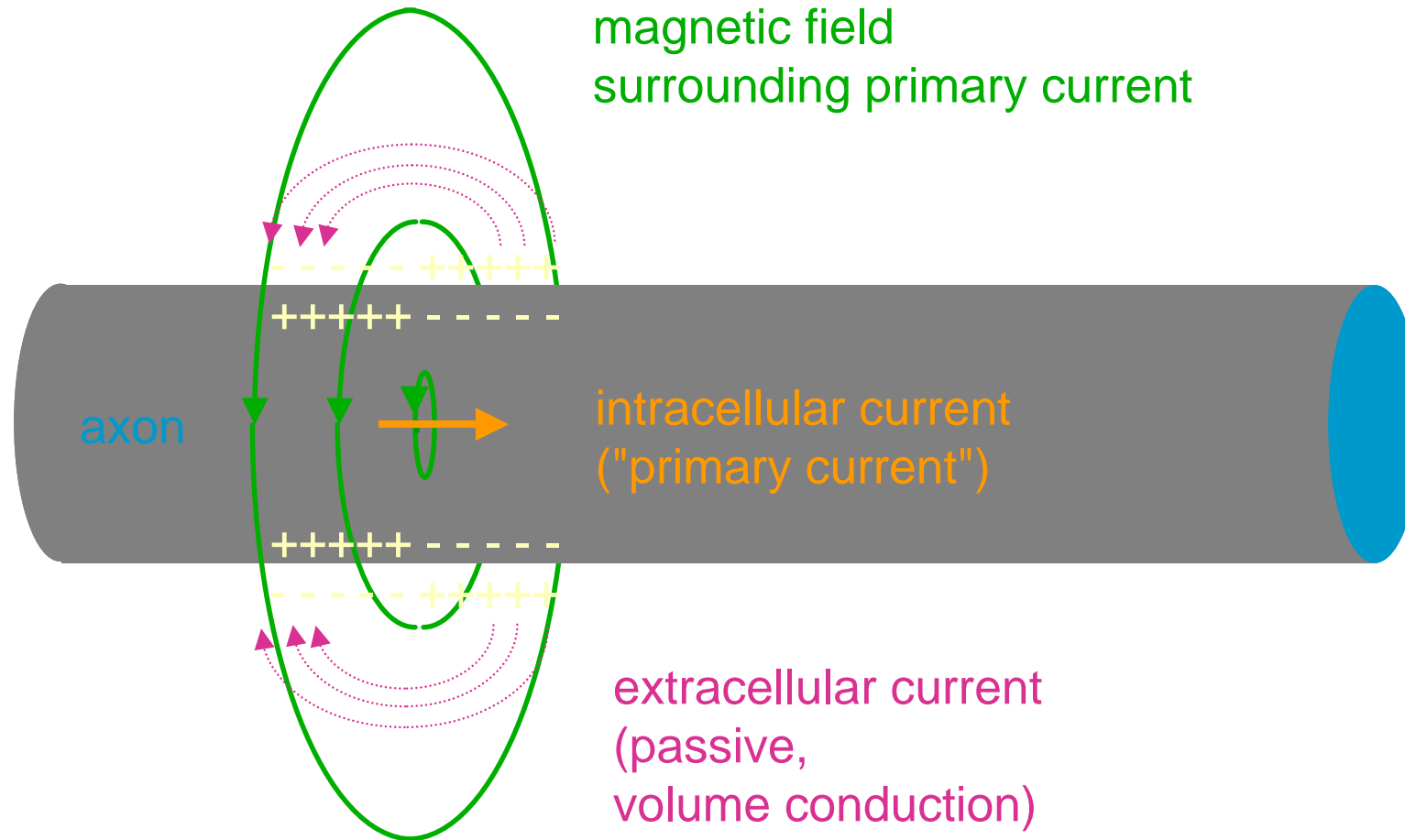




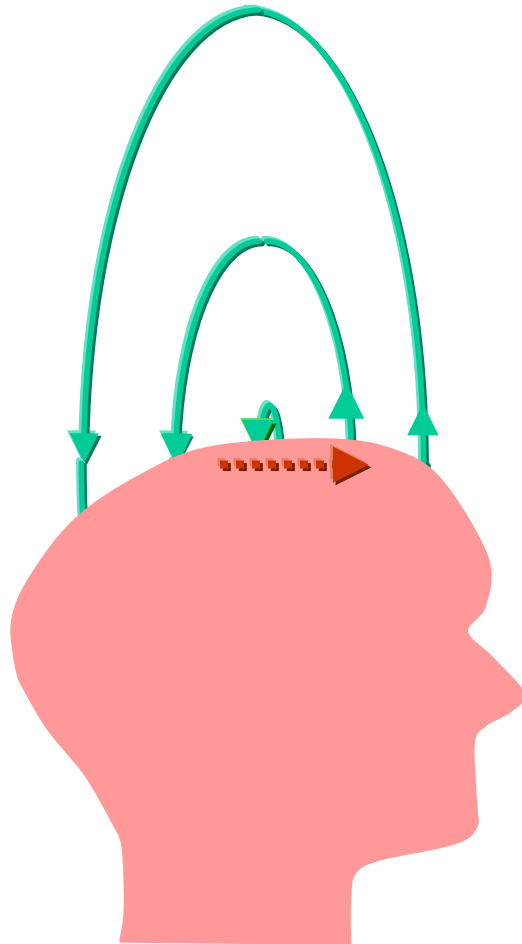
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Neuromagnetism

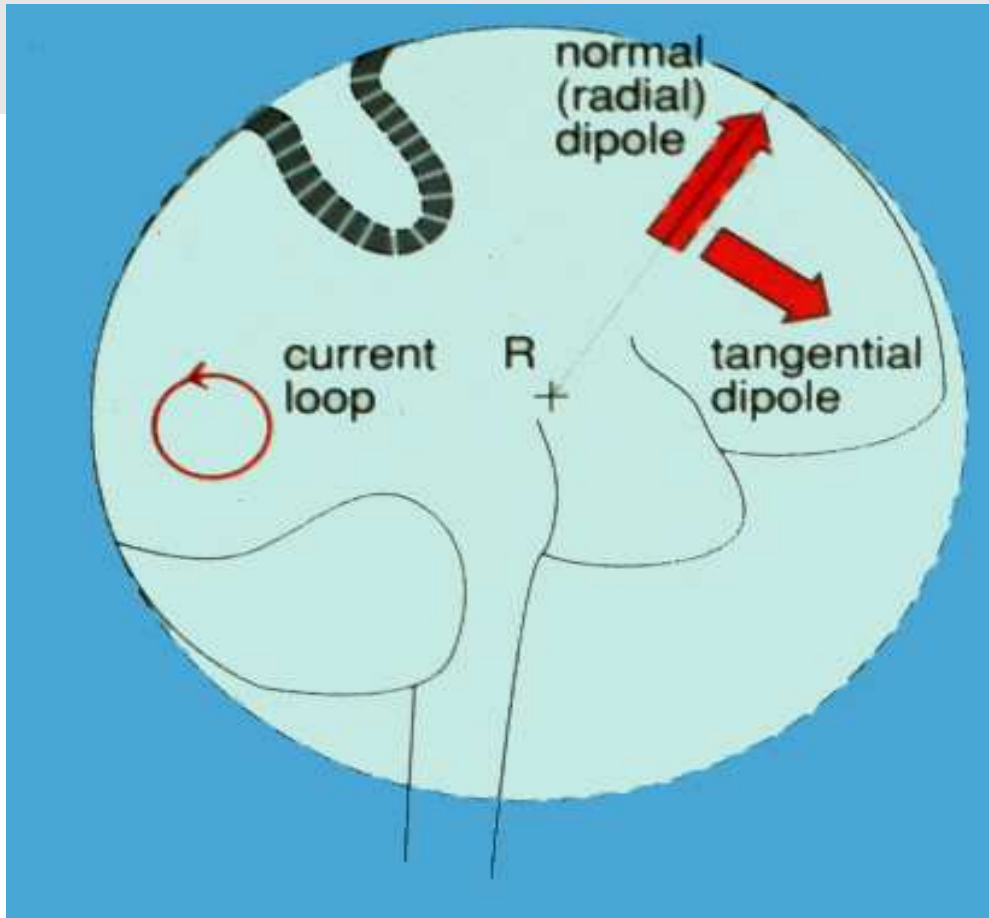


Neuromagnetism

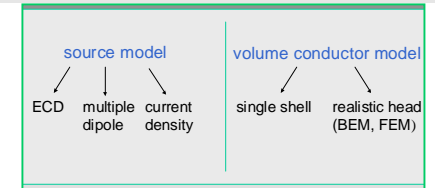


- MEG records **the magnetic field leaving and entering the head**
- it is presumed that the **primary current** of EPSP is the source of magnetic fields recorded by MEG

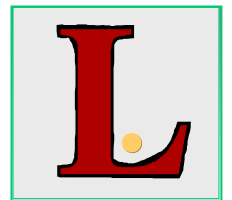




- inverse problem
- assumptions:
source localization
volume model



- no physical point,
describes center of gravity
- validation:
coregistration, correlation

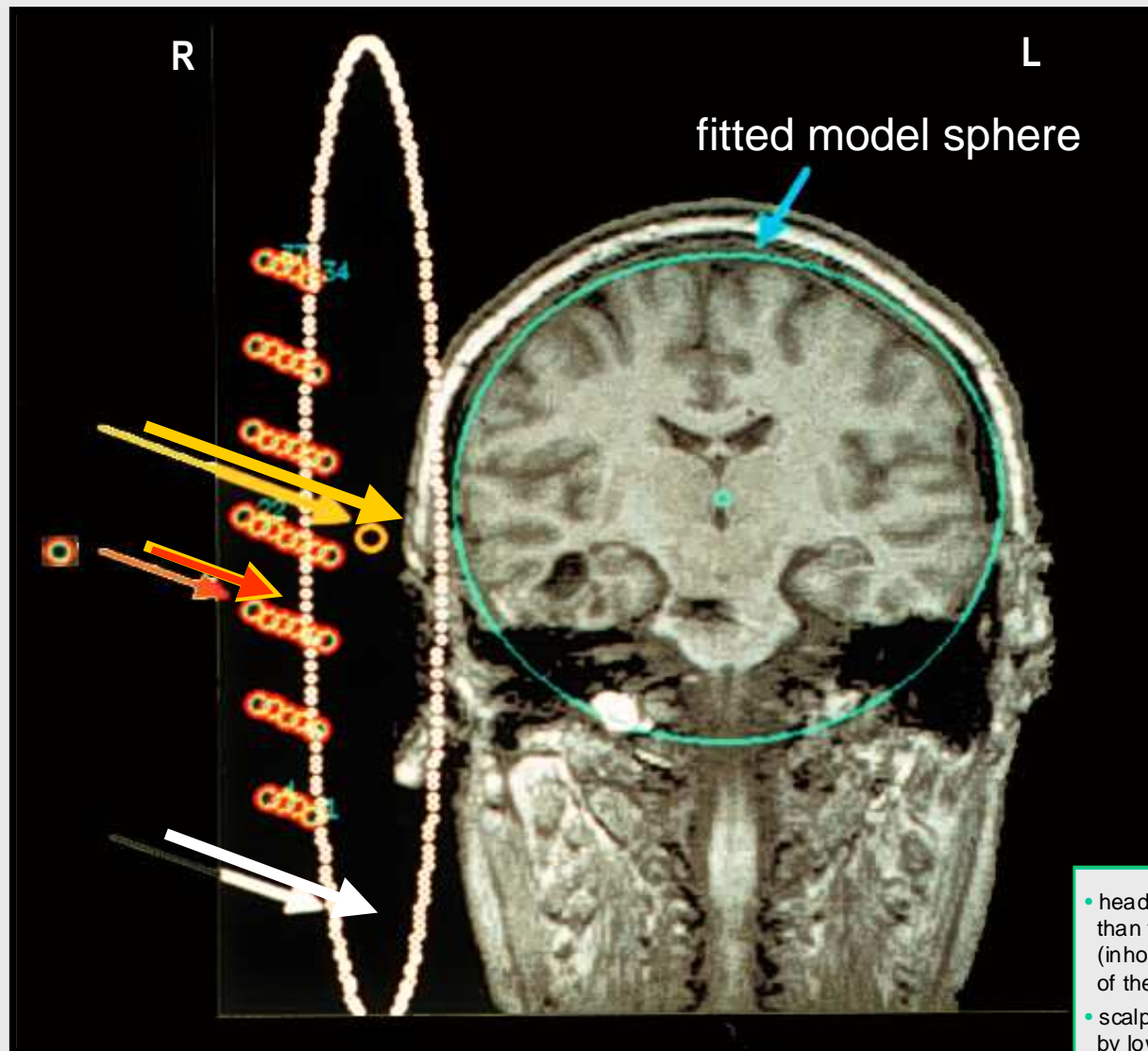


Display of Sensors and Dewar Surface in Relation to Patient's Head

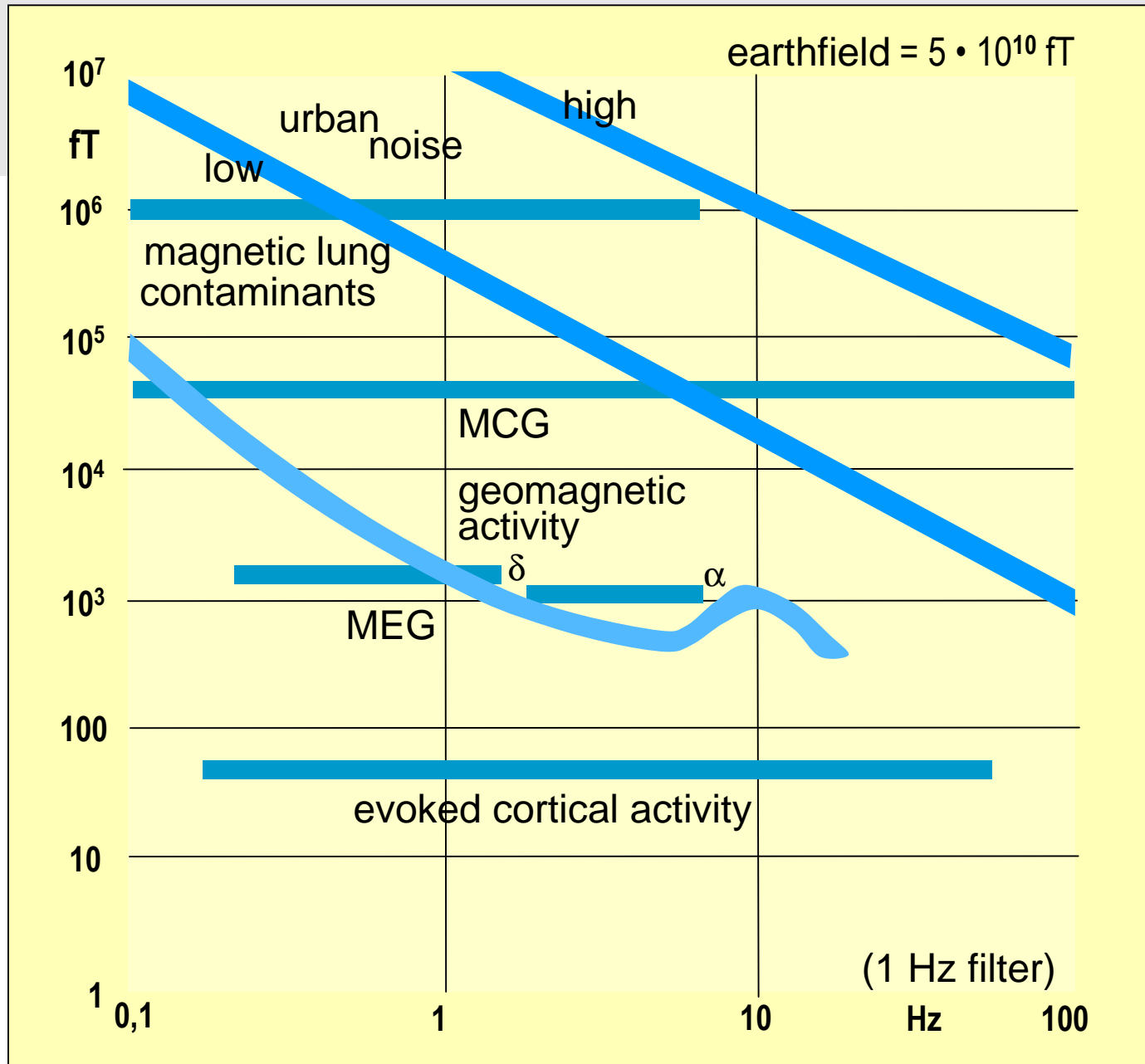
dewar center

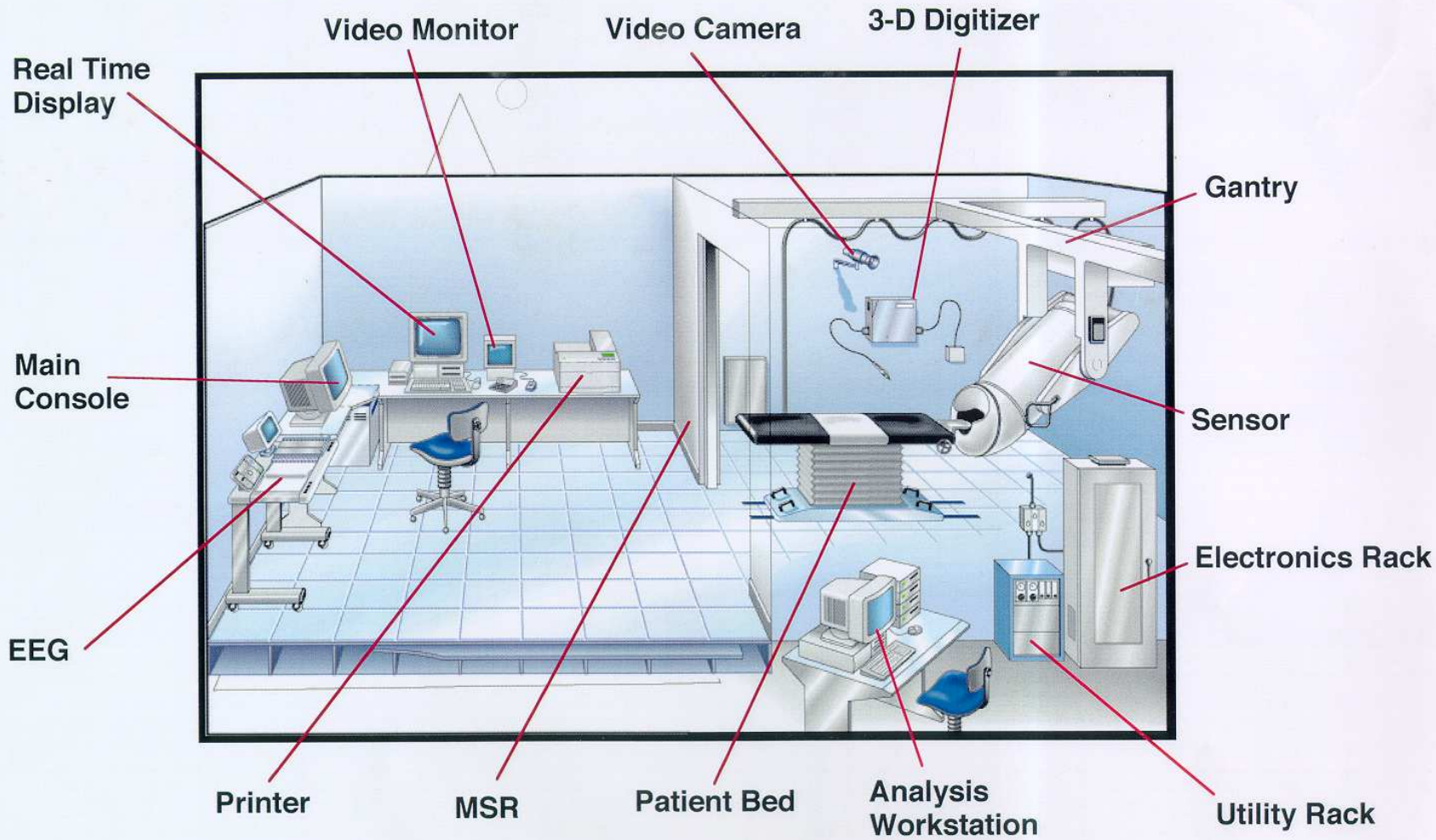
coils

dewar contour



- head shape models for MEG work better than for EEG (inhomogeneities and anisotropies of the head)
- scalp potentials are attenuated and spread by low conductivity of shell





Epidemiology of Intractable Epilepsies

- remission 60-80% (5 years seizure free)
 - 5-10 % pharmacologically intractable
Hauser et al 1996
 - intractable candidates 1,3-3-3% →
 - Europe 10-20000
Wieser H 2000 Nomos Verlag Vol 123, 51-58



Epidemiology of intractable epilepsies

- incidence 40-70/100 000 per year
- prevalence 4-8/1000 in Germany
May et al 2000 Nomos Verlag vol 123 2000 13-22
- remission 60-80% (5 years seizure free)
 - 5-10 % pharmacologically intractible
Hauser et al 1996
 - intractable candidates 1,3-3-3% → Europe 10-20000
Wieser H 2000 Nomos Verlag Vol 123 51-58



- Localisation related epilepsies: 69%

Kurtz et al 1998, British Medical Journal 316 339-342

- complex partial 64% (increase with age)

simple partial 24%

indetermined 12%

Hauser et al 1993 Epilepsia 34 453-468



Presurgical Evaluation Used for the Selection of Therapy

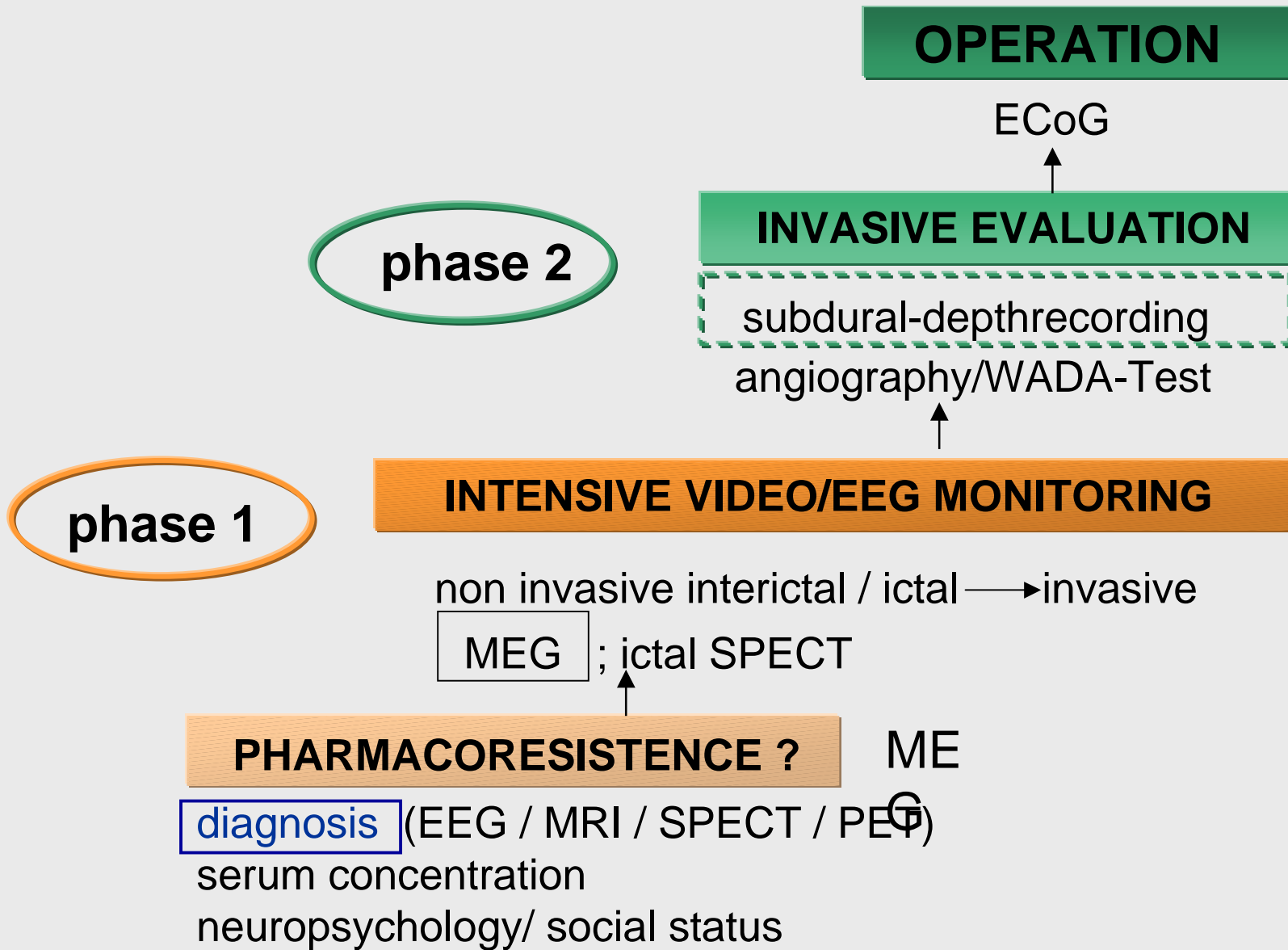
- **RESECTION**
standard, tailored
- **TRANSSECTION**
multiple subpial
- **ELECTROSTIMULATION**
N. vagus, intracerebral
- **RADIOTHERAPY/-SURGERY**
fractionated



Successful Surgery

- patient selection (PPP)
- optimal diagnosis (experienced team)
- interactive benefit / risk balance
- multimethodological approach
(coregistration imaging and electrophysiology)



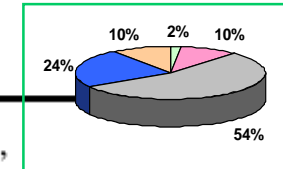


Magnetic brain source imaging of focal epileptic activity: a synopsis of 455 cases

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Summary

Epilepsy surgery is based upon the minute assessment of brain tissue generating epileptic activity. A number of diagnostic methods are employed in the process of presurgical evaluation, supplying information on various morphological and functional aspects, ultimately integrated into the general result fundamental to the final treatment decision. Magnetic source imaging (MSI), combining structural (MRI) and functional (MEG) data, has been playing an increasingly important role among the tools of presurgical epilepsy evaluation. However, in spite of a considerable number of publications, the samples used have hardly exceeded 50 cases. Therefore, we present a synopsis of 455 epilepsy patients who underwent MSI investigations. Analysis of this substantial data revealed that the average sensitiv-

ity of MEG for specific epileptic activity was 70%. Among 131 patients who underwent surgical therapy in addition to antiepileptic drug medication, MSI identified the lobe to be treated in 89%, with results for extratemporal cases being even superior to those with temporal lobe surgery. Introducing a measure to quantify the contribution of MSI to the general result of presurgical evaluation that was applied to 104 patients, the results showed that MSI supplied additional information in 35% and information crucial to final decision making in 10%. Accuracy as well as contribution findings underlined MSI appropriateness even for extratemporal epilepsies, which otherwise frequently prove difficult with respect to focus localization.

comparison patient

comparison percentage

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Comparison Scalp EEG, Invasive EEG, MEG, MRI and Zone of Resection

n=58 patients

- MEG second only to intracranial video-EEG in predicting resection zone
- prediction of good surgical outcome:
MEG 52% > ictal scalp video-EEG 33% > interictal EEG 45% indicate site of surgery

Wheless et al, Epilepsia 40(7):931-941 1999



Magnetic Source Imaging versus Intracranielles Electroencephalogram zur Epilepsie Chirurgie: eine prospektive Studie

Methode

49 Patienten mit fokaler pharmkoresistenter Epilepsie

Ergebnis

positiver prädiktiver Wert für MSI: für alle Anfallsformen 82-90%

Schlussfolgerung

klinische Evidenz: MSI kann invasive Ableitung potentiell ersetzen

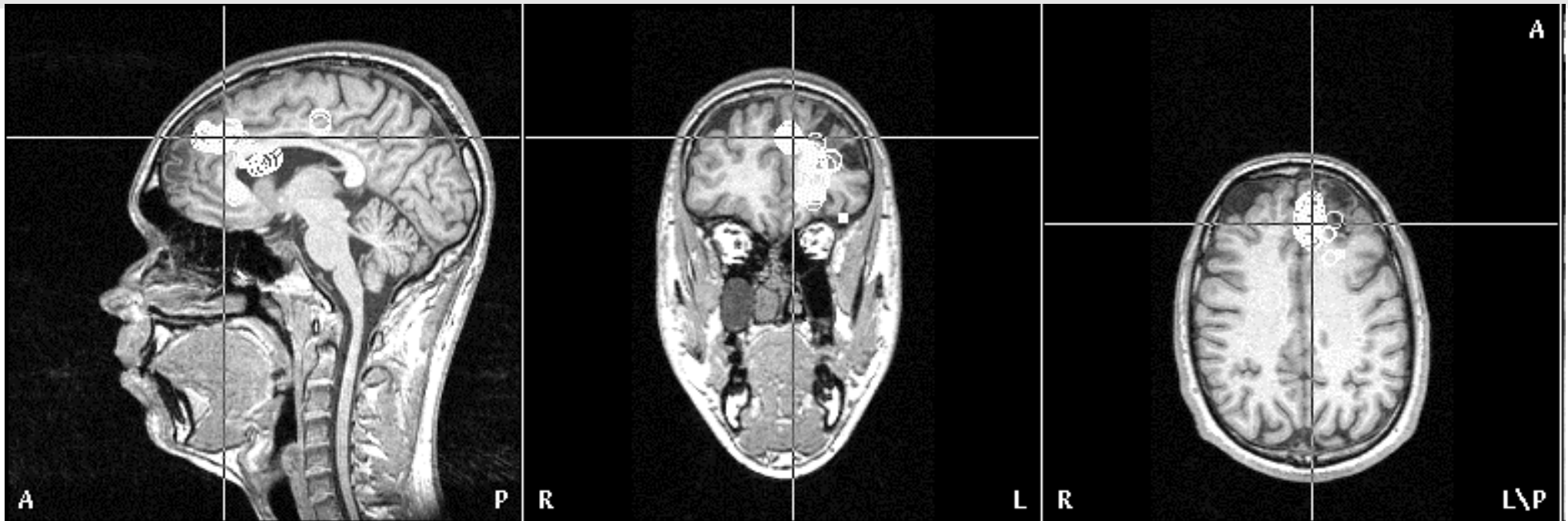
| VEEG | MSI, n | | | ICEEG, n | | |
|-------|-----------|----|-----------------------|-----------|----|-----------------------|
| | Localized | NL | Negative ^a | Localized | NL | Negative ^b |
| ExTLE | 13 | 4 | 4 | 14 | 5 | 2 |
| MTLE | 10 | 3 | 5 | 12 | 4 | 2 |
| LTLE | 6 | 0 | 0 | 5 | 1 | 0 |
| NL | 3 | 0 | 1 | 3 | 0 | 1 |
| Total | 32 | 7 | 10 | 34 | 10 | 5 |

| Measurement | Versus ICEEG | Versus Accuracy Estimate ^a |
|------------------------------|--------------|---------------------------------------|
| Sensitivity, % | 75 | 75 |
| Specificity, % | 54 | 70 |
| Positive predictive value, % | 82 | 90 |
| Negative predictive value, % | 44 | 44 |

Accuracy estimate is based on early surgical outcome over intracranial electroencephalogram (ICEEG).



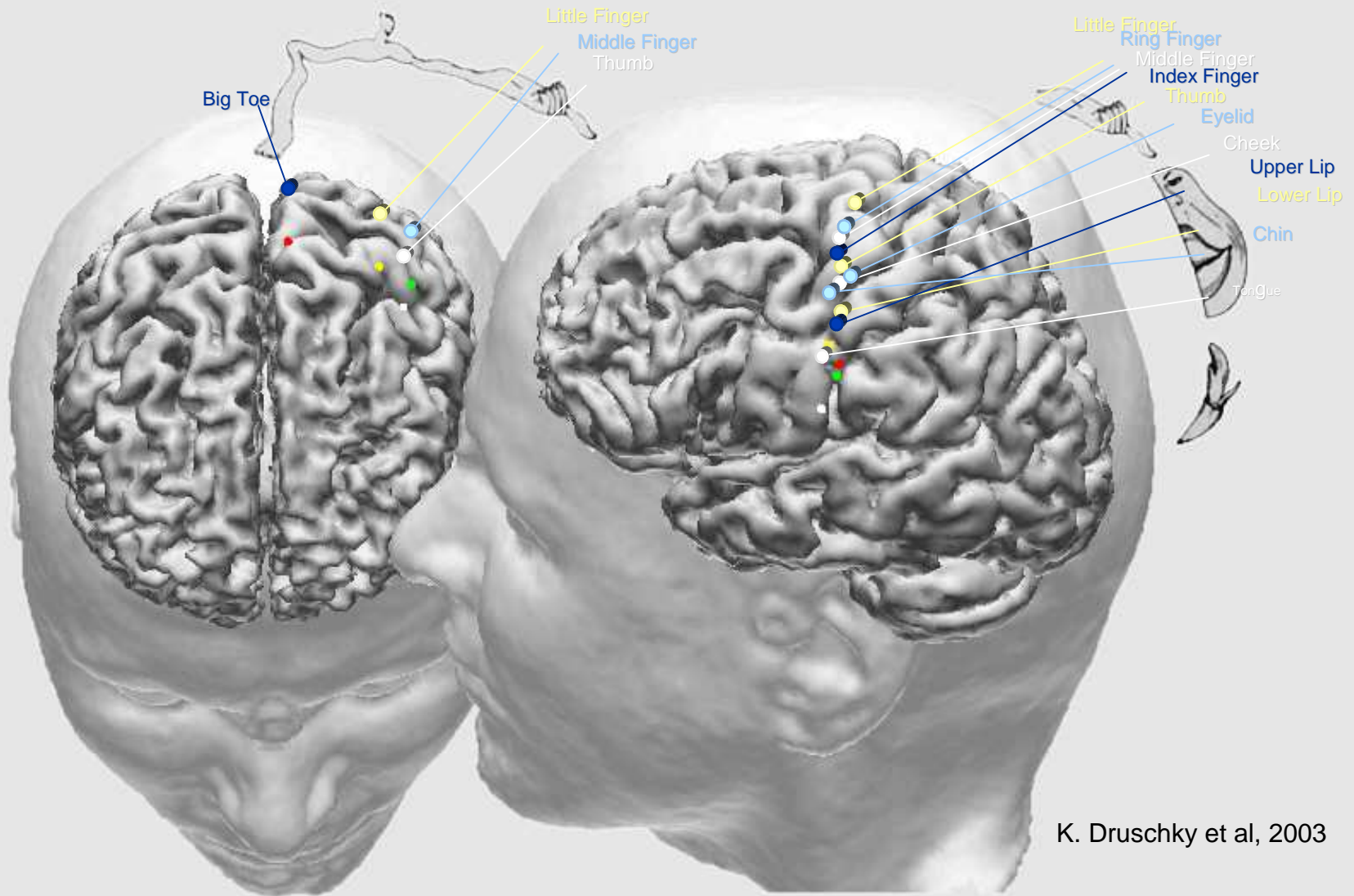
Posttraumatic frontal lobe epilepsy



Cluster of MEG localisations adjacent to the mesial posterior part of the lesion.



Homuncular Representation of the Body Surface in Human Primary Somatosensory Cortex



K. Druschky et al, 2003

