



CEREBRAL LOCALIZATION

PRESENTED BY:
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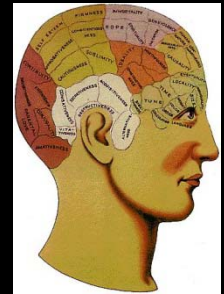
Definition

1. The diagnosis of the location in the cerebrum of a brain lesion, made either from the signs and symptoms manifested by the patient or from an investigation modality.
2. The mapping of the cerebral cortex into areas, and the correlation of these areas with cerebral function.

Functional Localization of Cerebral Cortex --- HISTORY

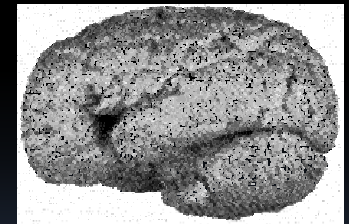
❖ Phrenology of Gall (1781) and Spurzheim

Phrenology: Analysis of the shapes and lumps of the skull would reveal a person's personality and intellect.
Identified 27 basic faculties like imitation, spirituality



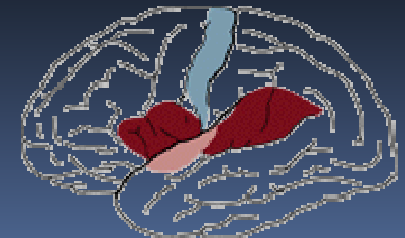
❖ Paul Broca (1861): Convincing evidence of speech laterality

“Tan” : Aphasic patient



❖ Carl Wernicke (1874):

- Temporal lesion disturbs comprehension.
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- Connectionism model of language
- Predicated conduction aphasia



❖ Experimental evidences

Fritsch and Hitzig (1870) --- motor cortex

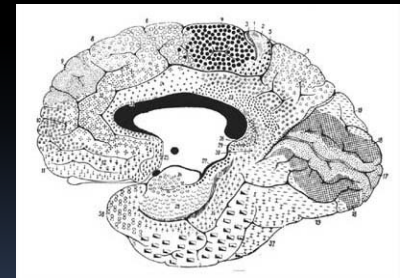
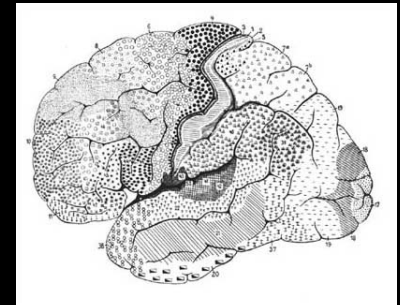
von Gudden (1870) ---- visual cortex

Ferrier (1873) ---- auditory cortex

BASED ON CYTOARCHITECTONIC STUDIES



❖ **Korbinian Brodmann (1868-1918):**

- Established the basis for comparative cytoarchitectonics of the mammalian cortex.
- 47 areas
- most popular

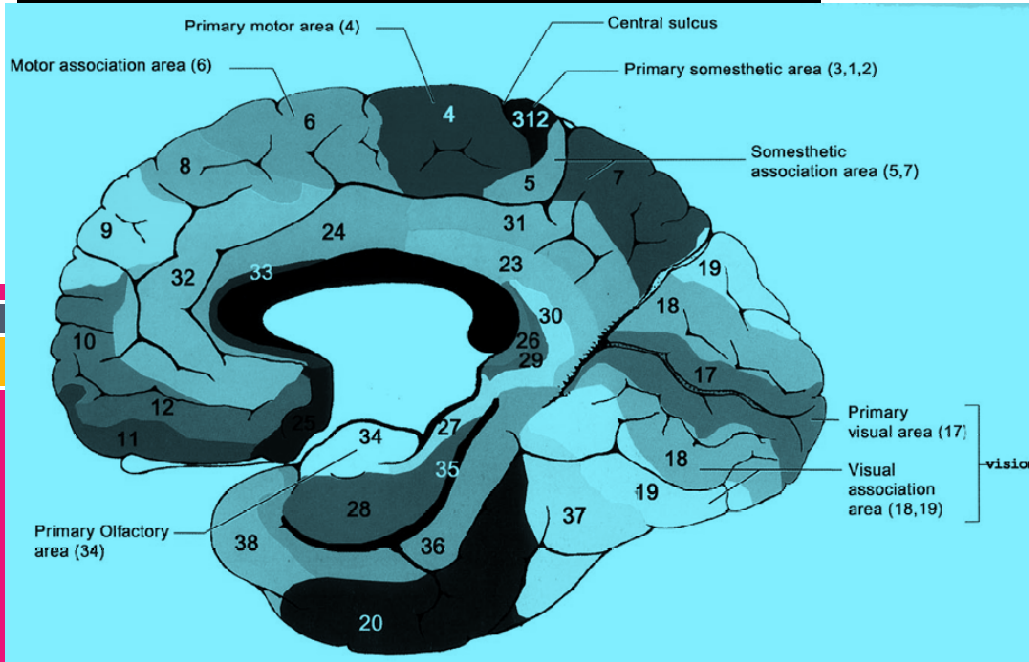
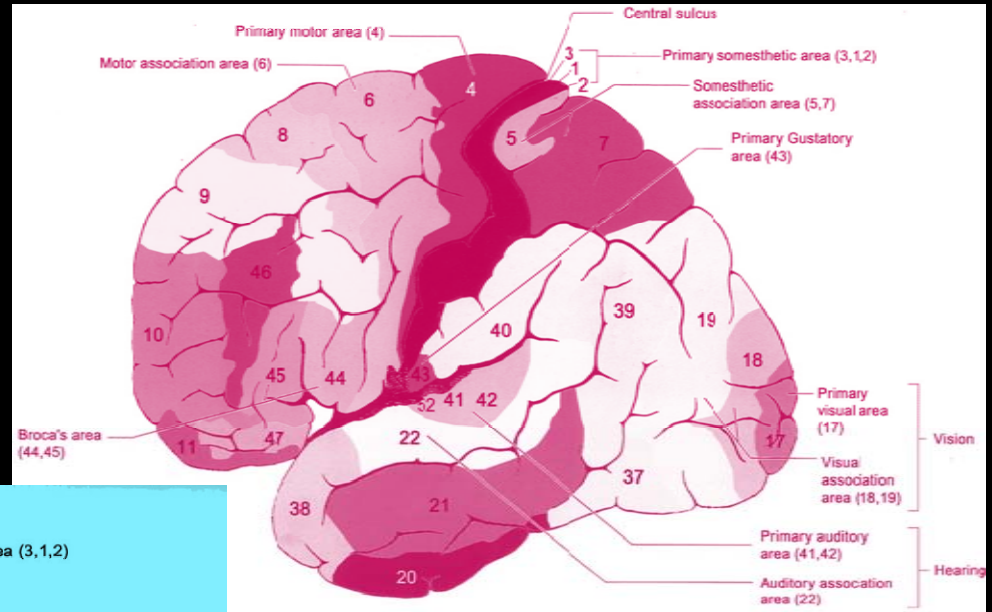


❖ Vogt and Vogt (1919) - over 200 areas

❖ von Economo (1929) -- 109 areas

- 
- ❖ HARVEY CUSHING:- Mapped the human cerebral cortex with faradic electrical stimulation in the conscious patient.
 - ❖ PENFIELD & RASMUSSEN:- Outlined the motor & sensory Homunculus.
- 

Brodmann's Classification



Cerebral Dominance (Lateralization, Asymmetry)

Dominant Hemisphere (LEFT)

Language

– speech, writing

Analytical and mathematical skills

Temporal sequencing of stimuli

Non-dominant Hemisphere (RIGHT)

Spatial Perception (3D subject)

Singing

Playing musical instrument

METHODS

- I. CLINICAL
- II. ELECTROPHYSIOLOGICAL
- III. RADIOLOGICAL
- IV. INTRA-OPERATIVE
- V. EXPERIMENTAL

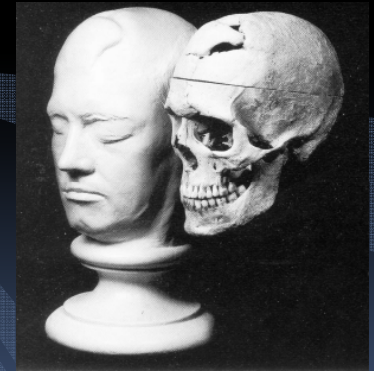
CLINICAL

- Lobar signs
- Clinical syndromes
- Aphasia
- Apraxia
- Agnosia
- Anopia

Frontal Lobe Signs

- Impaired memory
 - Recent
- Procedural defects
- Emotional lability
- Senseless joking
- Abulia

□ *Pathologic Laughter And Crying:* (Lesions of bilateral internal capsule+ basal ganglia; *substantia nigra, cerebral peduncles, and hypothalamus;* corticobulbar fibers,)



Mr. Phineas Gage

Frontal Lobe Signs

□ Alien Hand Syndrome

- Hand contra lateral to lesion performs purposeful movements against will of patient
- Lesion in Dominant Frontal Lobe (SMA, anterior cingulate gyrus and medial prefrontal cortex)

□ Magnetic Gait

- Mesial Frontal lesion

□ Salutatory Seizure

- Origin in SMA

□ Akinetic Mutism

- B/L Mesial Frontal Lesion

□ Paratonia

□ Primitive Reflexes

Frontal Lobe Signs

□ Pseudobulbar Palsy

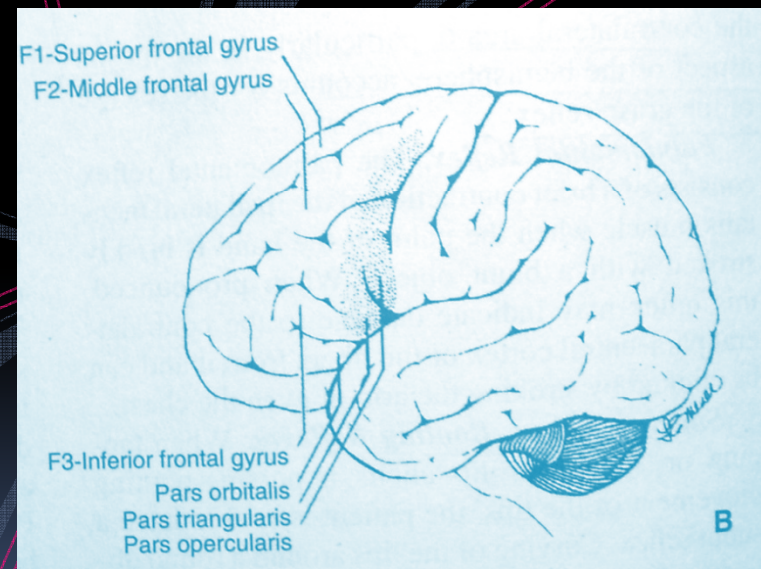
- Opercular Syndrome

□ Broca's Aphasia

- Lesions in Left frontoparietal opercular region
- Speech and writing are impaired
- Telegraphic speech

□ Pure Agraphia

- Affection of the posterior part of the
- Left second frontal gyrus
- (Exner's area)



Frontal Lobe Signs

- Executive Function Loss

- I. **Orbitofrontal syndrome**

- ✓ Disinhibited
 - ✓ Impulsive
 - ✓ Poor judgment and insight

- II. **Frontal convexity syndrome**

- ✓ Apathetic
 - ✓ Aggressive
 - ✓ Poor word list generation

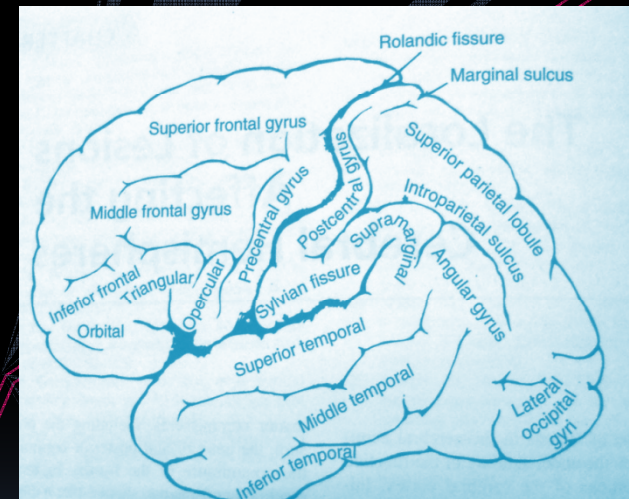
- III. **Medial frontal syndrome**

- ✓ Akinetic
 - ✓ Incontinent

Parietal Lobe

Elemental Somatosensory Disturbances

- ***Pseudothalamic sensory syndrome***
 - Lesion of parietal operculum, posterior insula
 - Impairment of elementary sensation
- ***Cortical sensory syndrome***
 - Astereognosis,
 - Graphesthesia, position sense impaired



Parietal Lobe

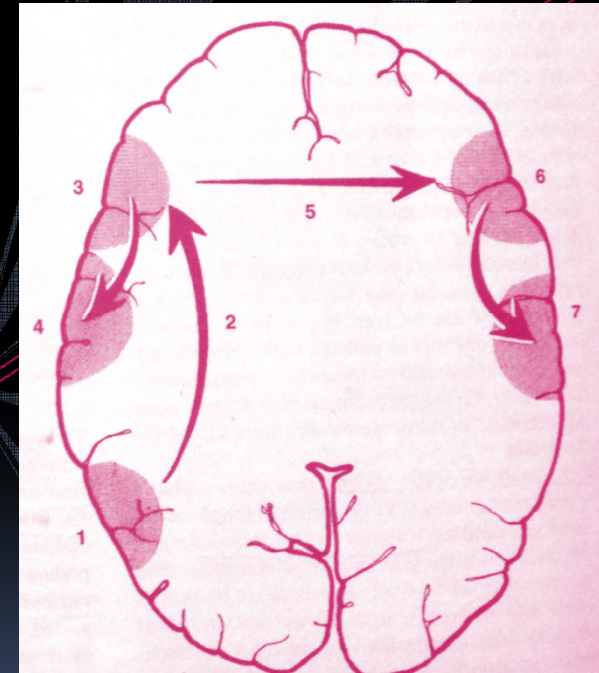
Disturbances of Body Schema[?] and Spatial Relationships

- **Common with Right Hemisphere Lesions**
- Anosognosia
- Phantom limb
- Constructional apraxia
- Geographical apraxia
- Dressing apraxia
- Hemineglect

Dressing apraxia

Disturbances of Sensorimotor Integration and Movement Execution

- Ideomotor apraxia
 - Failure to perform a *pantomime*
 - Most severe with lesions in the region of **Left intraparietal sulcus**
 -
 - Left frontal lesions
 - buccofacial apraxia, right hemiparesis, and left limb apraxia
 -
 - Left parietal lesions
 - buccofacial apraxia and bilateral limb apraxia



Temporal lobe

Hearing loss

- Auditory agnosia
 - Hearing intact
 - Sounds not recognized
 - Temporal lobe damage U/L or B/L
- Pure word deafness
 - B/L Temporal Cortical Lesion
- **Left** Hemispheric Damage Impaired
Discrimination of **Words, lyrics**
- **Right** Hemispheric Damage Impaired
Discrimination of **Musical sounds**

Temporal lobe

❖ **Complex hallucinations**

- Otoscope phenomena
- Illusory phenomena (micropsia, metamorphopsia)

❖ ***Uncinate fits***

- Olfactory hallucinations

❖ **Gustatory Hallucinations**

- Temporo - Parietal Seizures

❖ ***Déjà vu, jamais vu, Déjà vecu, jamais vecu***

- Neocortex of temporal lobe

❖ **CPS**

Aphasias

Sensory Language Area (Wernike's area) ----22, 39, 40

Receptive Aphasia - area 22

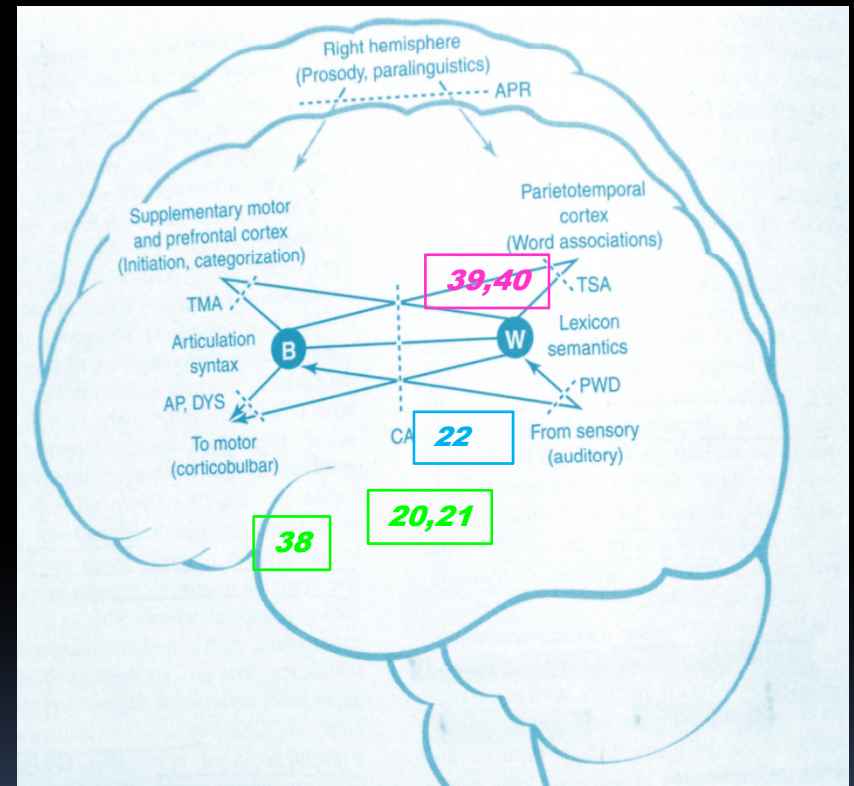
- defect in comprehension
- good spontaneous speech

Anomic Aphasia - area 38, 20, 21

- word finding difficulty

Jargon aphasia

- fluent, but unintelligible jargon
- 39 (supramarginal gyrus), 40 (angular gyrus)



Aphasias

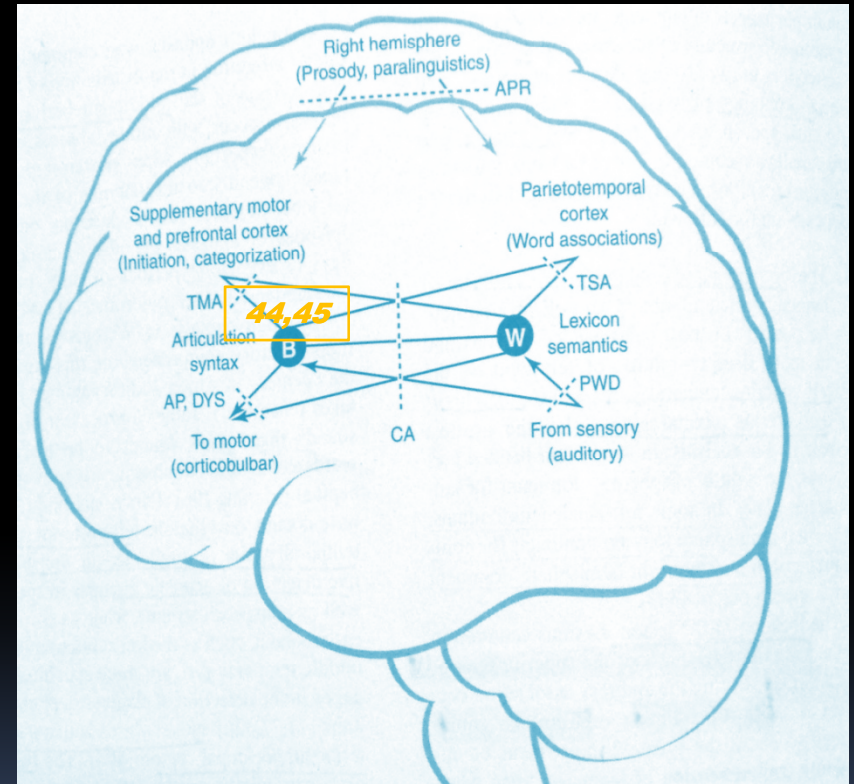
Superior Longitudinal Fasciculus

- Conduction Aphasia
 - good comprehension, good spontaneous speech
 - poor repetition, poor response

Motor Language Area (Broca's area) --- 44, 45

Motor Aphasia

- good comprehension, no speech



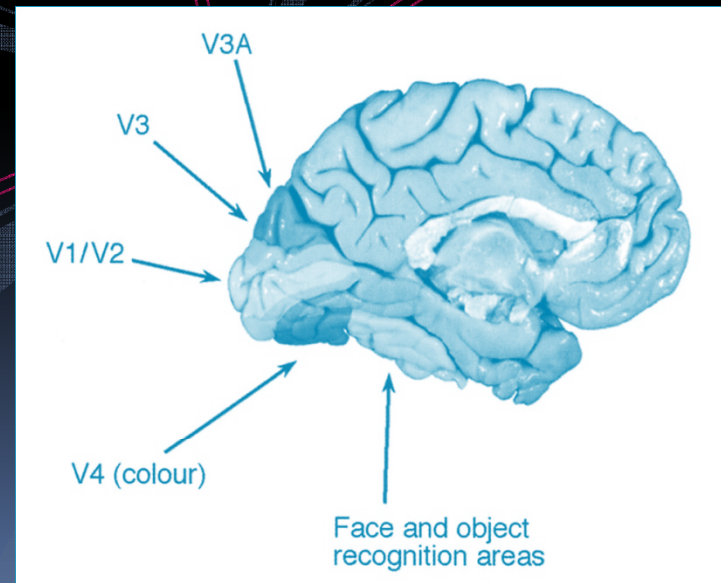
Occipital Lobe

❖ Simple Hallucinations

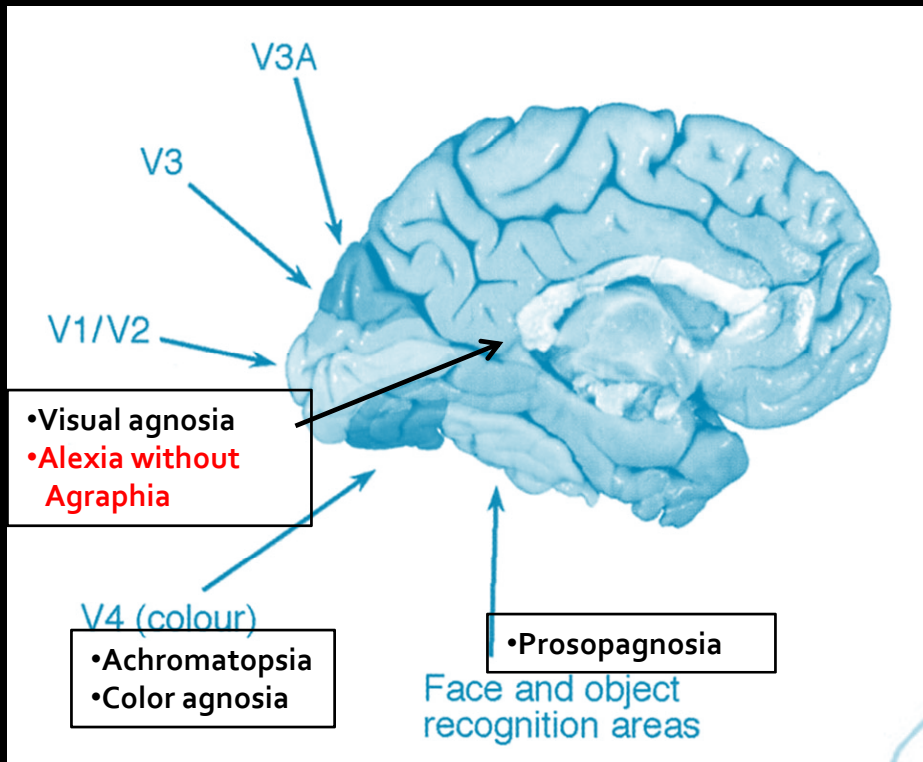
- **Infero Medial Occipital Disease**
- Migraine (fortification)
- Seizures (multicolored)

❖ Hemianopia with/without Macular Sparing

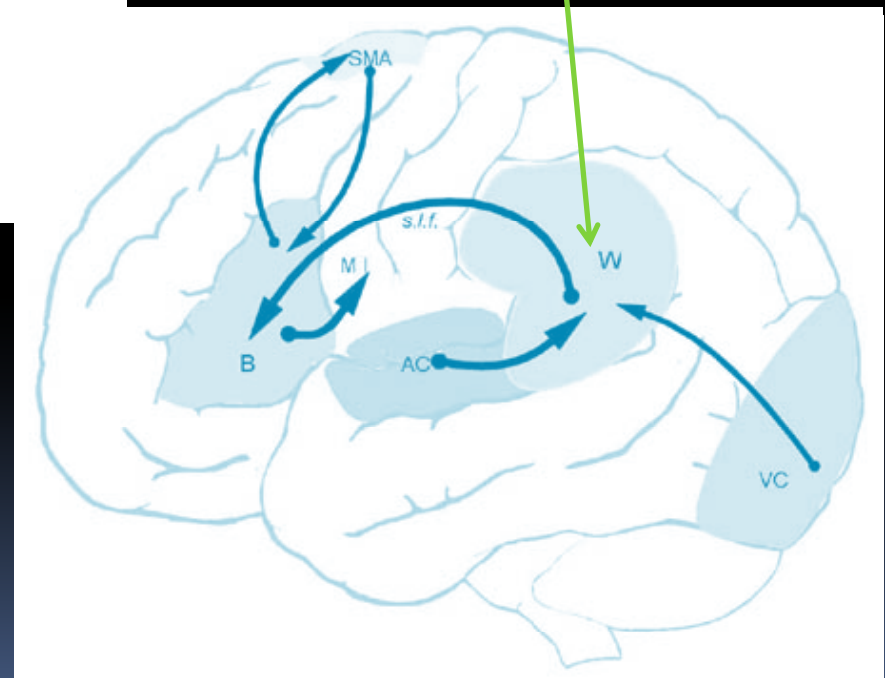
- Congruent



Visual Agnosias



•Alexia with agraphia
•GERSTMAN SYNDROME



Gerstmann Syndrome:

- Agraphia
- Right-Left confusion
- Acalculia
- Finger agnosia

ELECTRPHYSIOLOGICAL

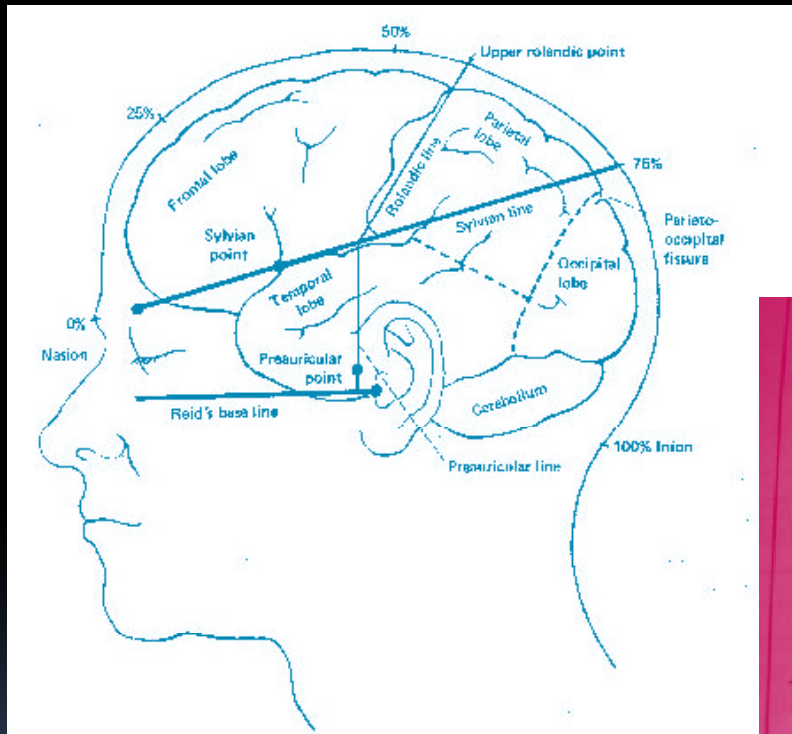
ELECTROENCEPHALOGRAPHY
(EEG)

ELECTROCORICOGRAPHY
(ECoG)

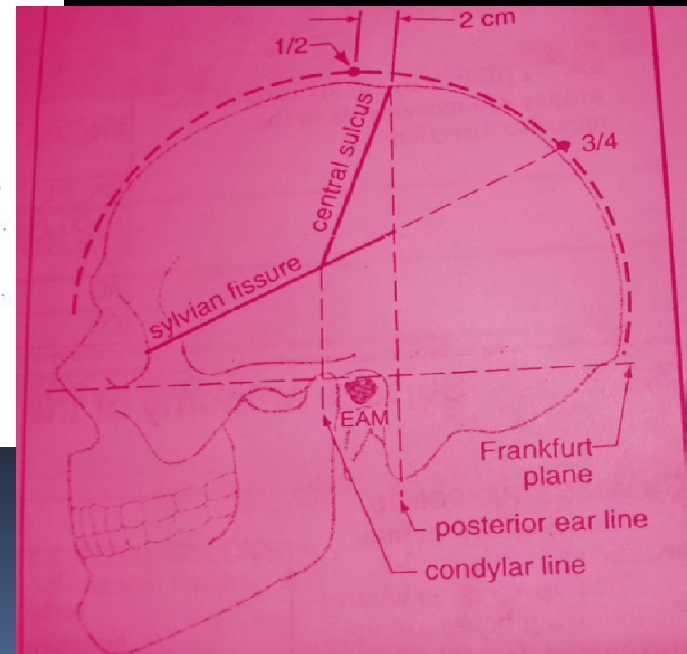


RADIOLOGICAL

➤ Plain radiograph

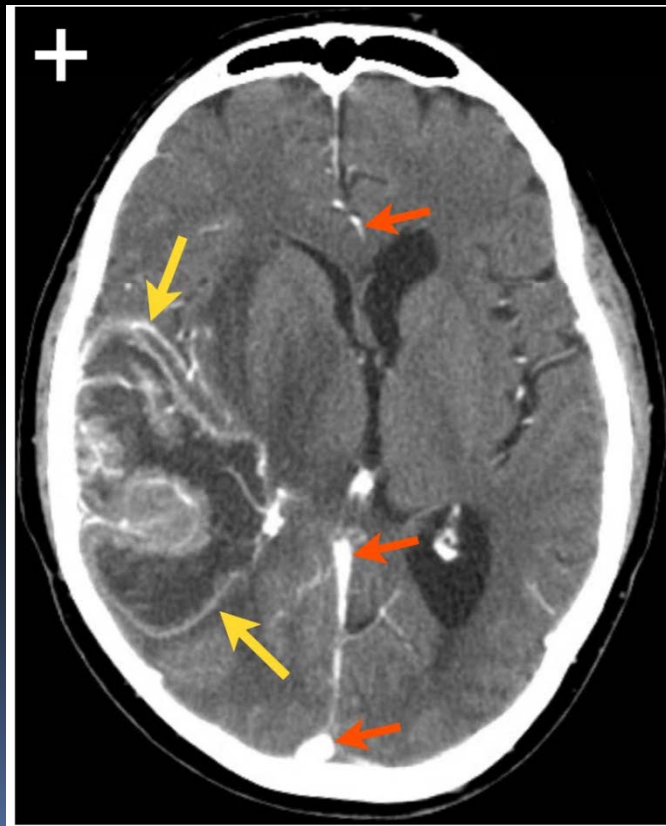


TAYLOR HAUGHTON LINES



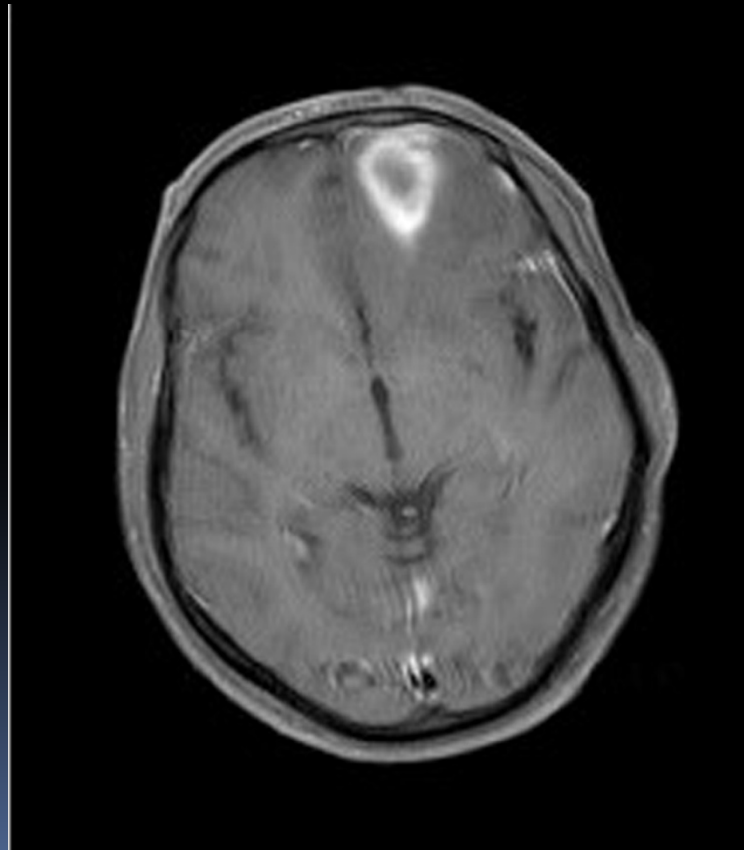
RADIOLOGICAL

CT SCAN

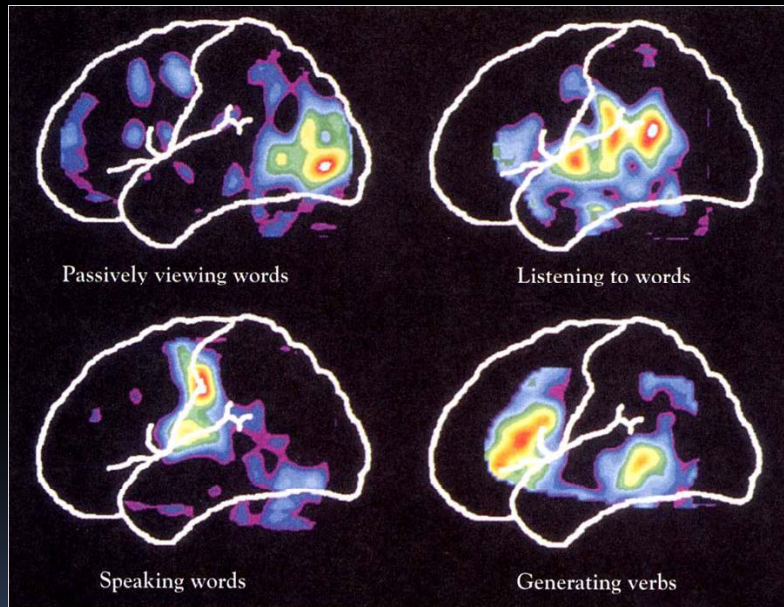


RADIOLOGICAL

MRI



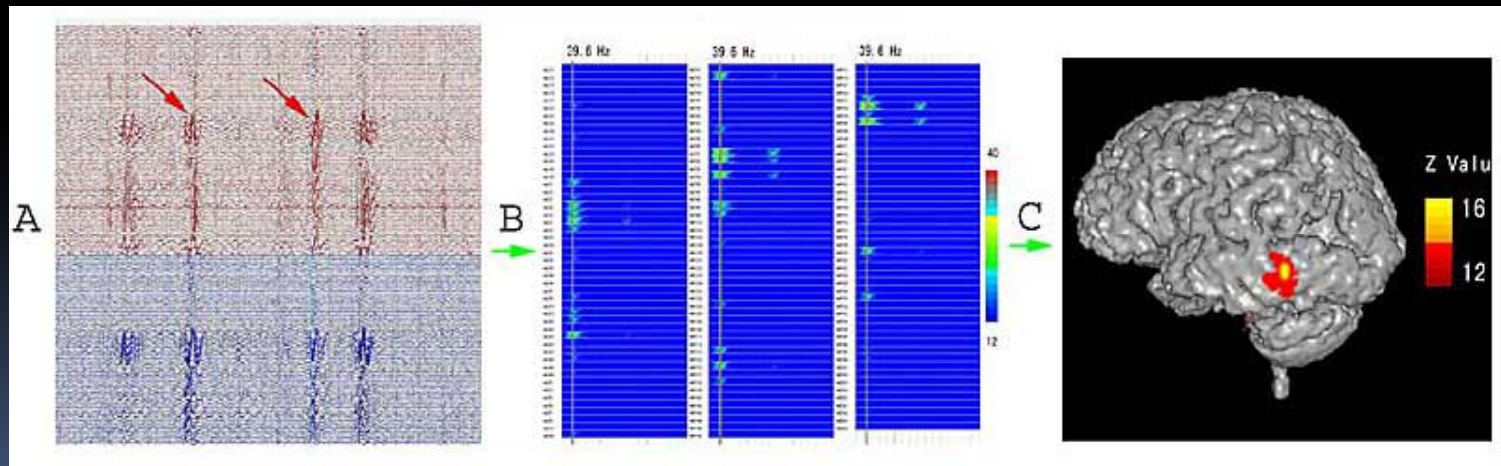
Positron Emission Tomography (PET)



- $H_2^{15}O$ PET
 - Hemodynamic changes
- FDG PET
 - Cerebral Metabolism

MAGNETOENCEPHALOGRAPHY (MEG)

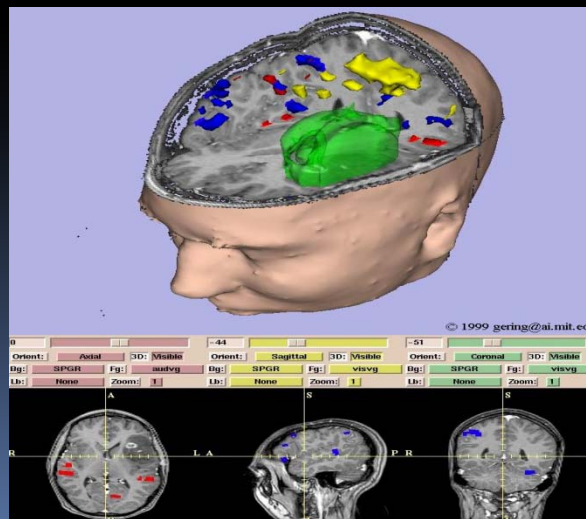
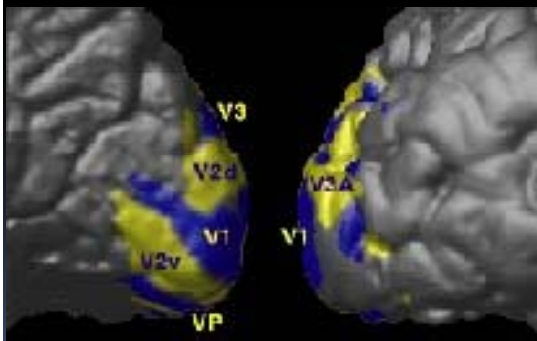
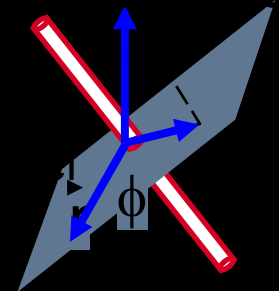
- Noninvasive
- Records Magnetic field changes due to neuronal activity



Functional MAGNETIC RESONANCE IMAGING (fMRI)

Based on the concept of **Blood Oxygenation Level-dependent Contrast (BOLD)**

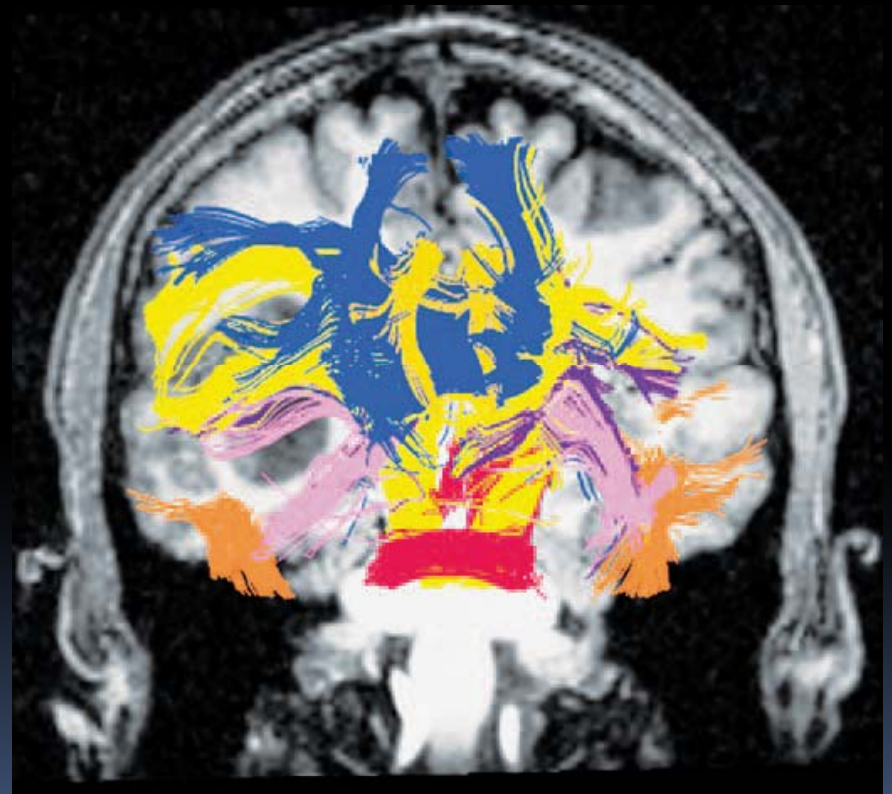
- Oxyhemoglobin is diamagnetic (like biological tissue).
- **Deoxyhemoglobin (dHb) is paramagnetic** induce susceptibility effect around dHb



Anisotropic Diffusion Tensor Imaging (Tractography)

Direction of maximum diffusivity of water corresponds to **axis** of White Matter tracts

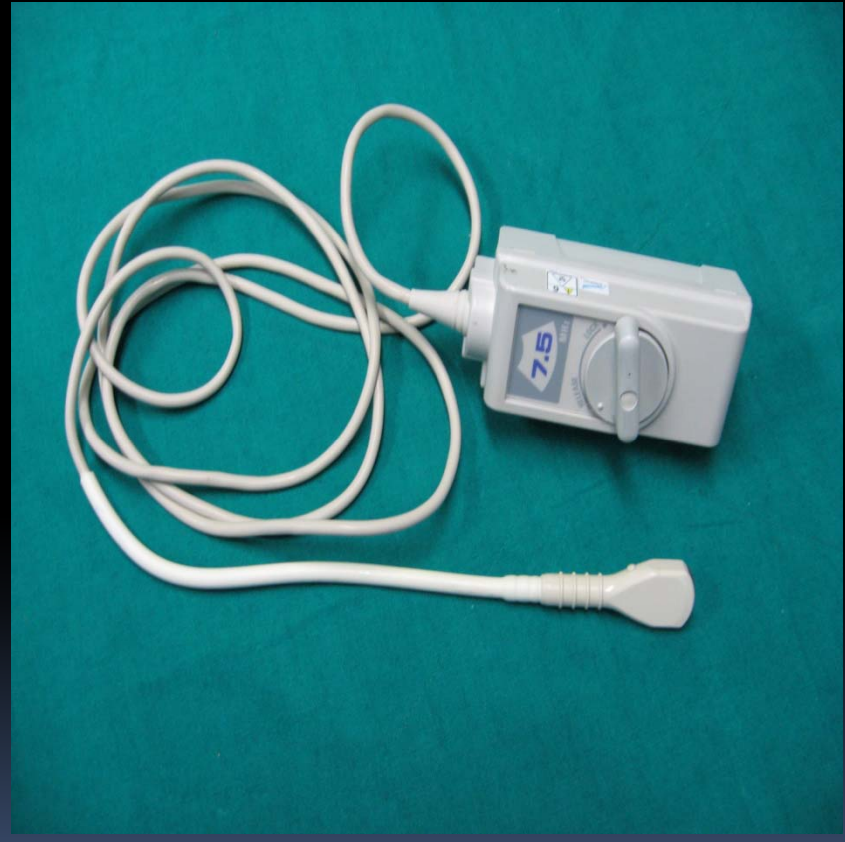
- Displacement
- Edema
- Infiltration
- Destruction

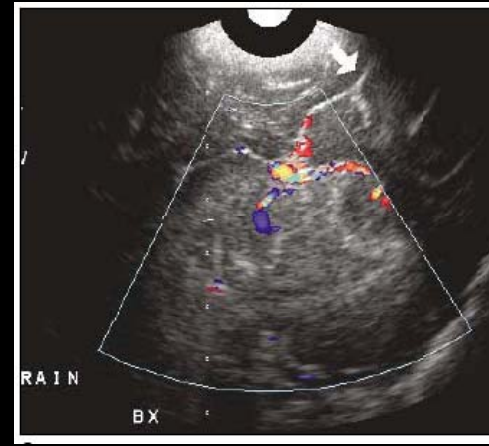




INTRAOPERATIVE LOCALIZATION IN NEUROSURGERY

INTRAOPERATIVE ULTRASOUND (IOUS)





- ❖ Sonographically Guided Procedures in the Brain
- ❖ Intraoperative Doppler Ultrasound
- ❖ 3-D Transcranial Ultrasound
- ❖ Contrast Enhanced Transcranial Ultrasonography

STEREOTACTIC LOCALIZATION :

□ FRAME BASED



□ FRAMELESS



Intraoperative / Mobile Ct Scan :



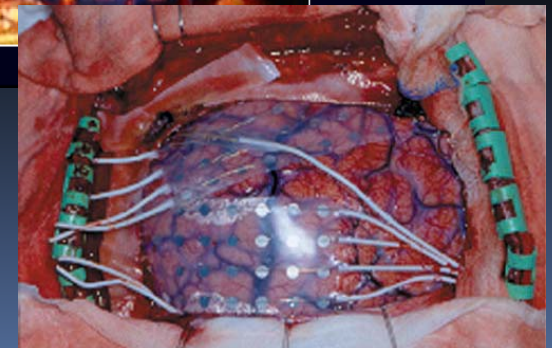
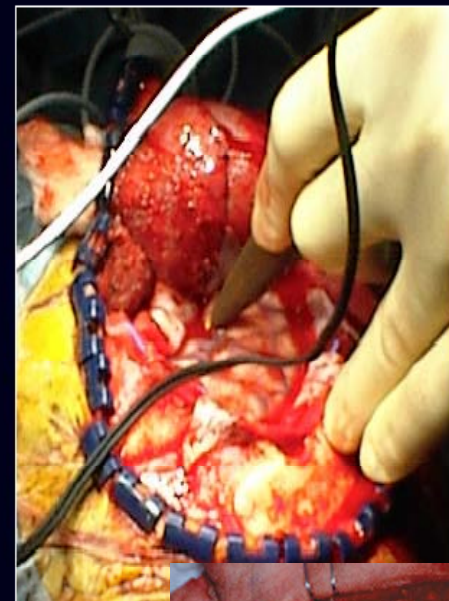
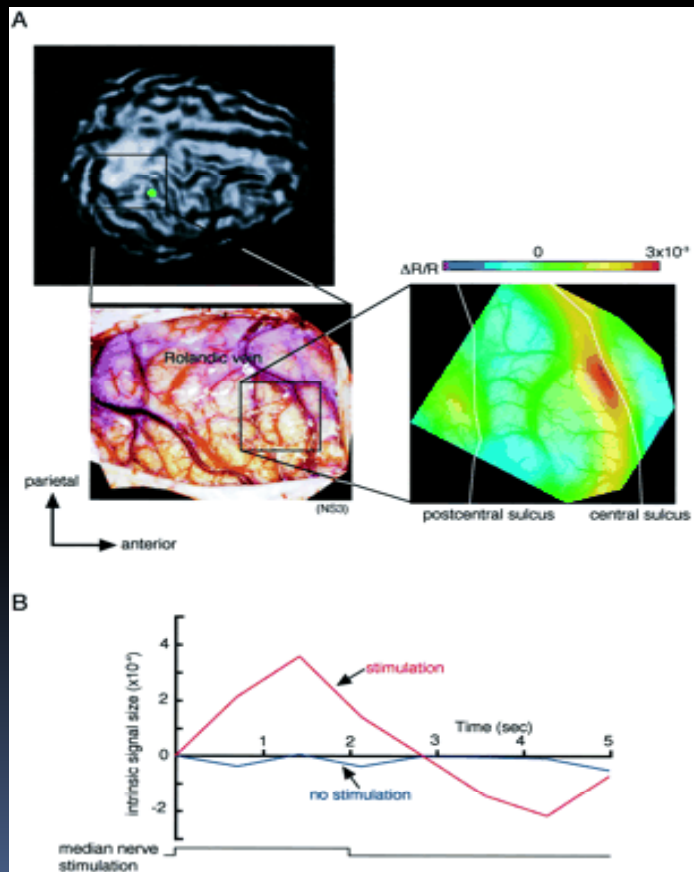
Intraoperative MRI :



- Also k /a "BRAINSUITE"

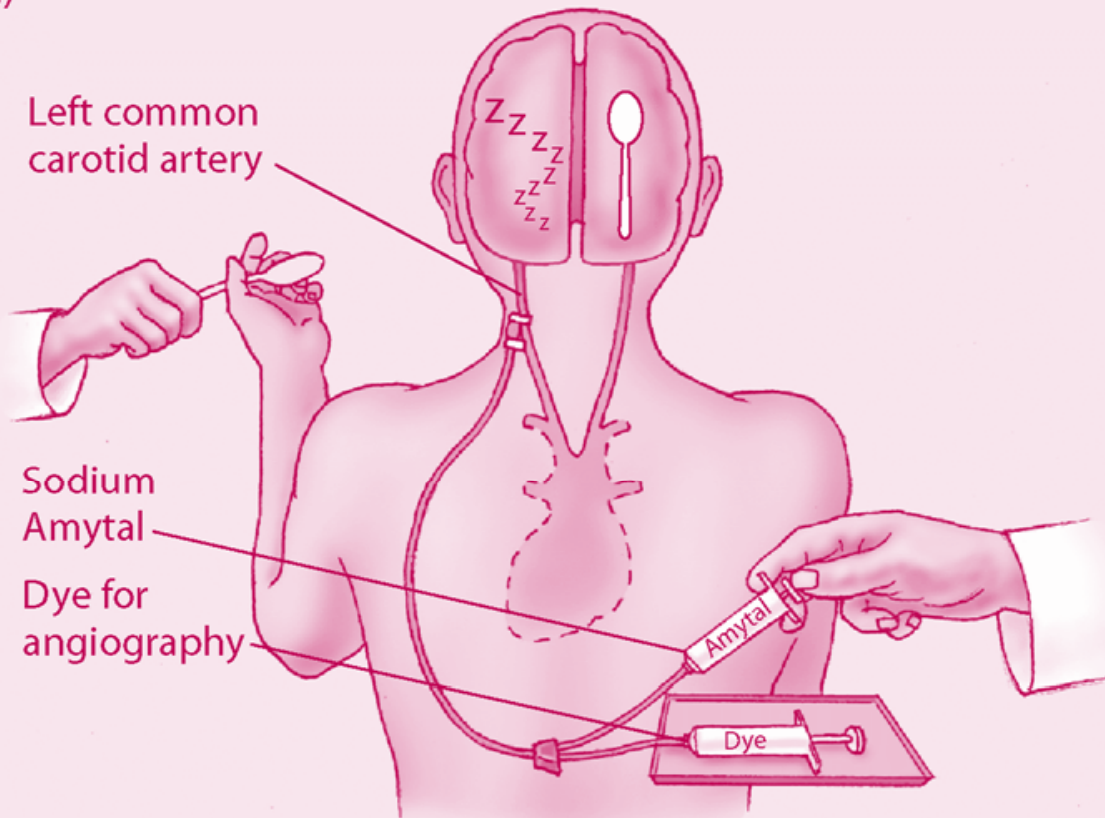
CORTICAL MAPPING :

Cortical Surface Mapping



WADA Procedure

(a)



EXPERIMENTAL

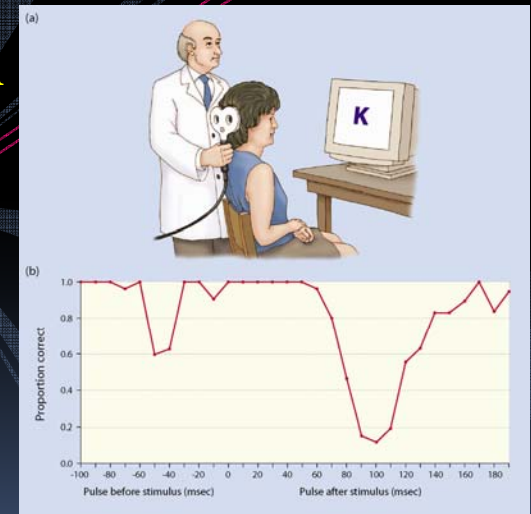
➤ Single Unit Recording

- › Animal studies
- › Advantage : great spatial and temporal resolution
- › Disadvantage : sampling only a very small fraction of a functional neural system

➤ Transcranial Magnetic Stimulation

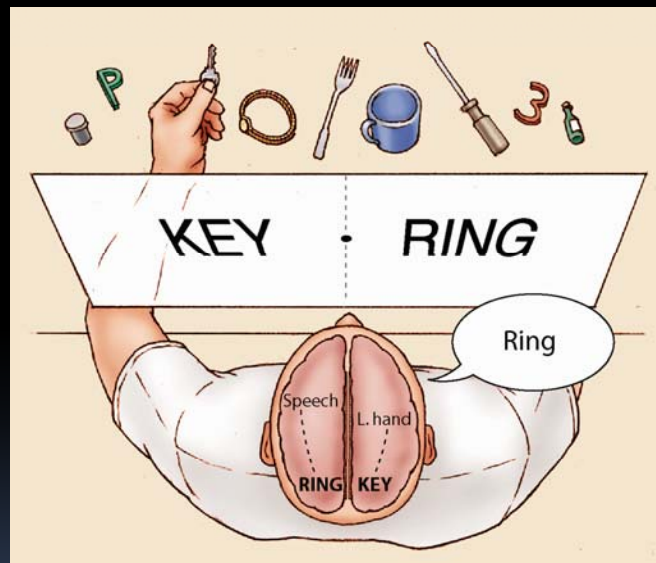
- › Coil placed over target brain region
- › Lesion : strong field
- › Excitation : mild field
- › Cognitive failures recorded

➤ Optical imaging



Split-brain

— Corpus callosotomy



Utility of Cerebral Localization

1. Pre-operative Planning
2. Create a Road Map of Brain Depicting Eloquent "No-Go" areas as well as potential functional targets
3. Increasing precision of resection
4. Development of Minimally invasive techniques
5. Recognition of concept of plasticity of brain

THANK YOU