Presurgical Epilepsy Eval:
A multidisciplinary approach to intractable epilepsy

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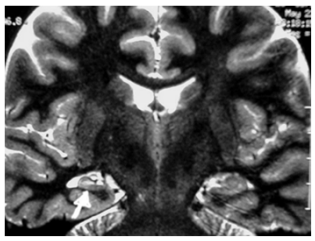
Candidates for Epilepsy Surgery

- **Persistent seizures despite appropriate pharmacological treatment (usually at least two drugs at limits of tolerability)**
- **Impairment of quality of life due to ongoing seizures**

Presurgical Evaluation

- **History and exam**
- **MRI scan**
  - **Mesial Temporal Sclerosis (MTS), tumor, vascular malformation, dysplasia**
- **Video/EEG monitoring with scalp EEG**
  - **interictal epileptiform discharges**
  - **ictal**
    - **Seizure semiology**
    - **Ictal EEG discharge**
  - **Additional electrodes**

Presurgical Evaluation



Right hippocampal sclerosis (arrow)

Figure 1a

Presurgical Evaluation

Left mesial temporal sclerosis

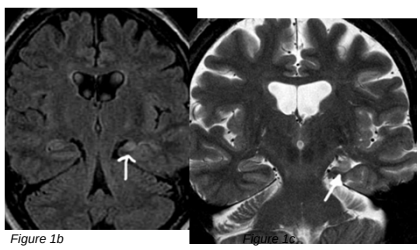
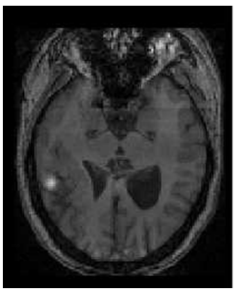


Figure 1b *Figure 1c*

Presurgical Evaluation

- **Functional Imaging**
  - **PET**
    - **hypometabolism interictally**
  - **SPECT**
    - **hypoperfusion interictally**
    - **hyperperfusion ictally**
    - **subtraction and co-registration with MRI**

Presurgical Evaluation



SISCOM Result in a patient with extratemporal epilepsy

Presurgical Evaluation

- **Neuropsychological testing**
  - **Pre-operative baseline**
  - **Aid in localization**
  - **Predicting risk of cognitive decline with surgery**
- **Wada (intracarotid amobarbital) test**
  - **language**
    - **lateralization**
  - **Memory**
    - **prediction of postoperative decline**

Presurgical Evaluation

- **Intracranial EEG when needed**
  - **Grids and strips, most commonly subdural, SEEG**
  - **Parenchymal "depth" electrodes, especially for recording from hipppocampus**
  - **Identification of ictal onset**
  - **Brain mapping**
    - **cortical stimulation**
    - **SSEPs**
    - **Functional MRI**

Types of Surgical Procedures

- **Resective Surgery: single seizure focus in non-eloquent region.**
- **Palliative Surgery:**
  - **For drop attacks: corpus callosotomy**
  - **For Rasmussen's encephalitis or hemimegalencephaly: hemispherectomy**

Surgical Treatment of Epilepsy

Figure 2

Curative ⟷ *Palliative*

Pathologies

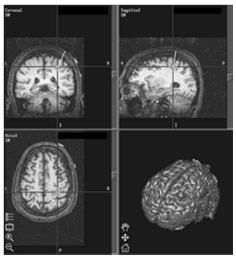
MTS TLE Lesional - Low Grade Glioma - Cav. Malformation	Non-MTS TLE Frontal Lobe epilepsy SMA/cingulate epilepsy Malformations of cortical development

Procedures

Lesionectomy Lobectomy	Hemispherectomy Topectomy MST's	Disconnection (Callosotomy)

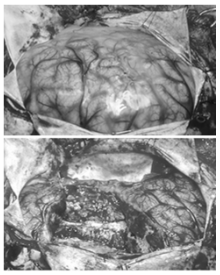
Modified from McKhann G.M. and Howard M.A.: Epilepsy Surgery: Disease Treatment and Investigative Opportunity, in Diseases of the Nervous System: Clinical Neurobiology, 2002.

Surgical Treatment of Epilepsy



- **MRI frameless stereotactic localization of focal cortical dysplasia at the base of the central sulcus (center of cross hairs).**

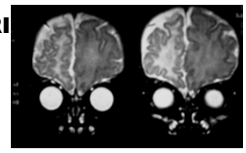
Surgical Treatment of Epilepsy



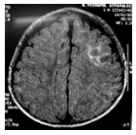
- Functional hemispherectomy: extent of cortical resections in temporal and central cortex with disconnection of residual frontal and occipital cortex by transecting white matter fibers (not shown).

Neuro Imaging: MRI

- Higher Resolution & Better Tissue Differentition than CT scan.
- Improve The sensitivity for Tuberous Sclerosis, Neuronal Migration Disorders
- Volumetric
- FLAIR
- T2 Relaxometry

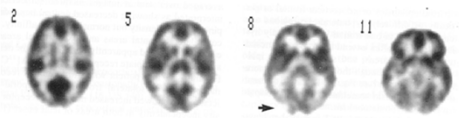


Left hemimegalencephaly



Balloon Cell FCD

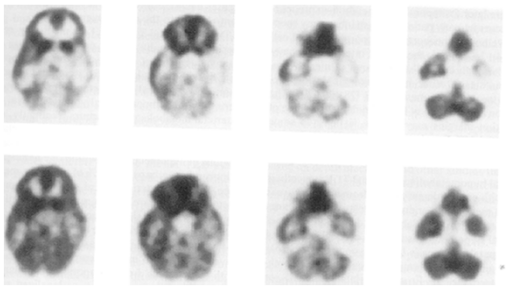
Neuro Imaging: FDG-PET



Focal Neocortical Hypometabolism

- Abnormal cortex has lower metabolic rate interictally
- Positron Emission Tomography can detect gamma ray emitted by radioactive tracer eg Fluoro-deoxy glucose which map out the hypometabolic area: temporal lobes epi. & Infantile spasms

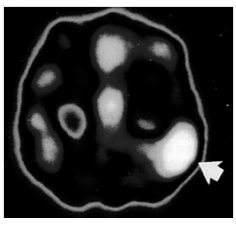
Neuro Imaging: FDG-PET

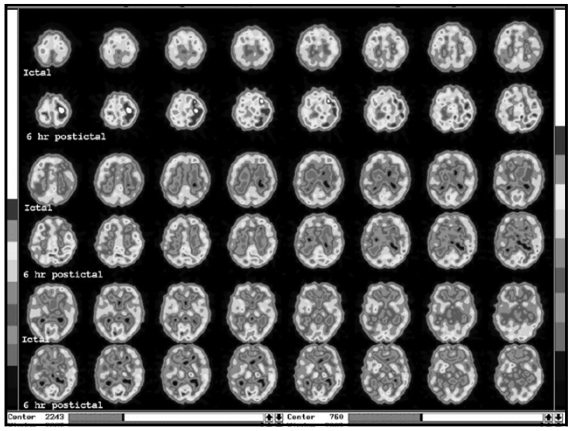


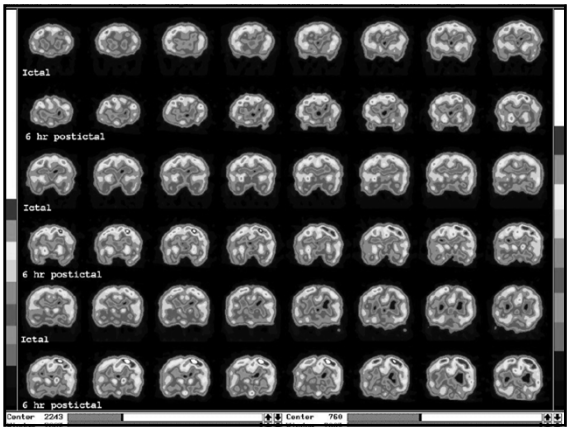
Upper: interictal, Lower: peri-ictal (Sz at 2 minutes post injection)

Neuro Imaging:Ictal SPECT

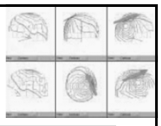
- SPECT: Single Photon Emission Tomography
- Map the increased blood flow to the brain in the abnormal cortex.
- Best when compare interictal-ictal scans



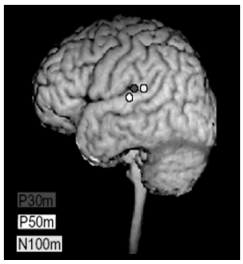




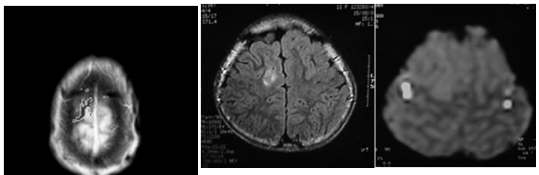
Magnetoencepalo graph



- **Measure magnetic field which runs perpedicular to the electrical field**
- **Provide additional data, can be registered with MRI**
- **Expensive, need special room and eqipment, interictal only**

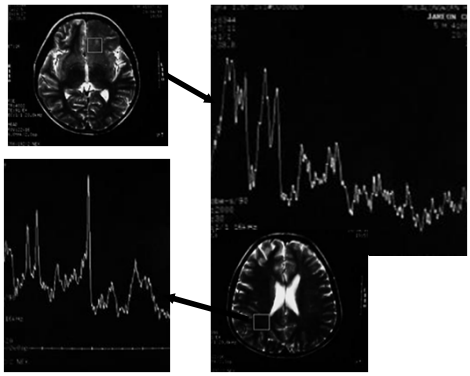


Functional MRI

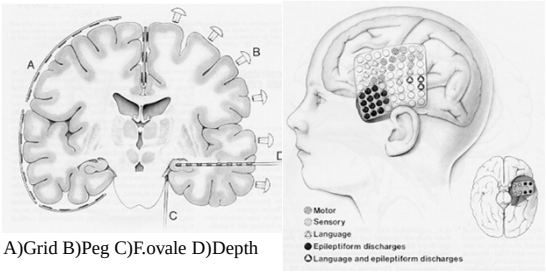


fMRI Show hand area not overlapping with the lesion, allows complete resection

Case III JJ : MRS

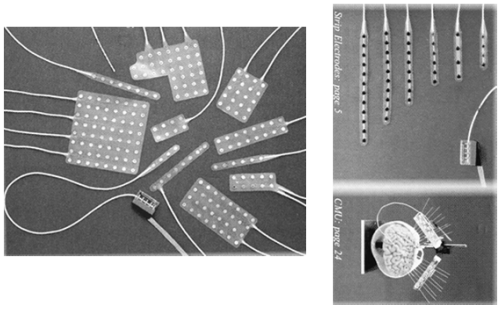


Invasive Monitoring



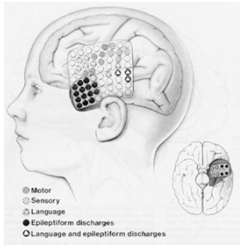
A)Grid B)Peg C)F.ovale D)Depth

Invasive Monitoring



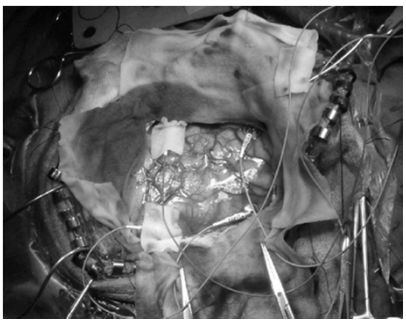
Cortical Mapping

- Penfield & other authors use electrical stimulations to avoid eloquent areas & further the understanding of the generation of Clinical Seizure Semiology

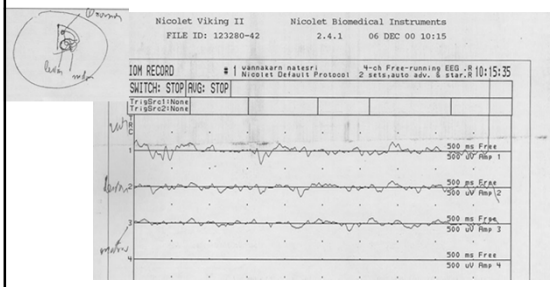


Electrical Stimulation

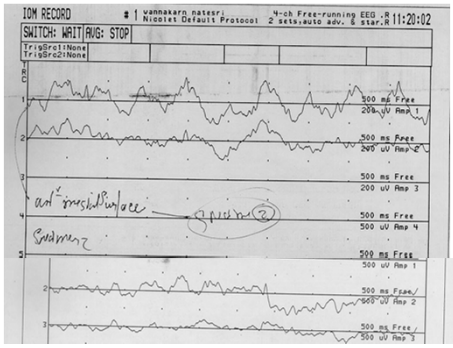
Intraoprative monitoring /Mapping/Awake Craniotomy



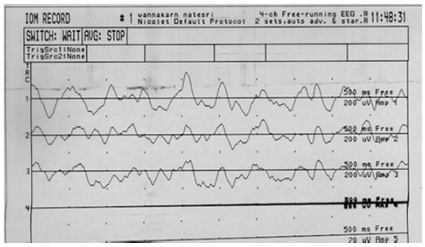
Case IV WN : EcoG : preop



Case IV WN : EcoG : during resection



Case IV WN : EcoG After resection



Convergence of the Data

- In Epilepsy Surgery, Data on History, PE, EEG, Seizure semiology, MRI, PET & Ictal SPECT + WADA & neuro-psycitric testing are compared
- The patient has the best chance of becoming seizure free with conguourous data in temporal >> extratemporal epielpsy
- Computer assisted "Co-registration" can be done on various imaging modalities & EEG source localization.

Surgically Treatble Epilepsy in Pediatrics

- Infant & Toddler : Cataltrophic Epilepsy only:
  - Infantile spasms with focal lesion or foal PET hypometaboslim (HT. Chugani) : Lesionectomy
  - Lennox-Gastaut : Corpuscallosotomy
- Children
  - Rasmussen's Encephalitis : Functional hemispherectomy
  - Temporal Lobe Epilepsy : Temporal lobectomy
  - Lesional Extratemporal Epilepsy : lesionectomy
  - Non-lesional Cases : May need Ictal SPECT, MRS, Invasive Monitoring

Benefit of Early Surgery

- Better intellectual outcome, Pts can be rehabilitated with no or low seiures frequency => Better Social Integration
- More "Plasticity" ie. surgery involve functioning areas may be performed with less disability
- May be more "Economical" when all hidden expenses are calculated eg : care taker, special educations, loss of wages.

Ped. Intractable Epilepsy is not hopeless !

Conclusion

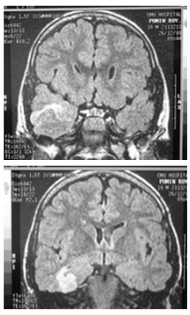
- In the rapidly evolving field of epilepsy, the improved understanding of the basic mechanisms and the avaialbility of various diagnostic technology would allow us to make a more accurate diagnosis and improve the outcome in both medical & surgical treatment of epilepsy.

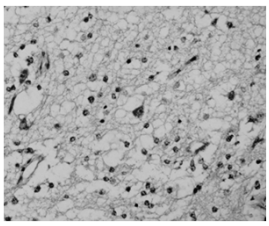
Pediatrics Epilepsy Surgery

- Resection of epileptogenic zone
  - Cortical resection e.g. cortical dysplasia
  - Lesionectomy e.g. tumor, AVM, hamartoma
  - Amygdalohippocampectomy
  - Hemispherectomy

Tumor Resection : PM DNET

- Seizure starte at age 8 year old, uncontrolled with PHT, PHENO and CBZ
- MRI : Right temporal lobe tumor with cystic component
- EEG ictal and interictal right temporal lobe origin

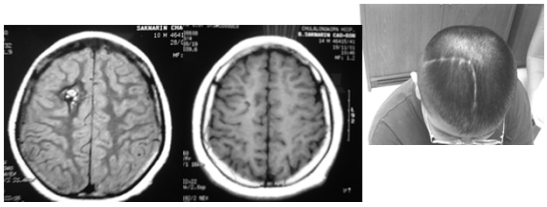





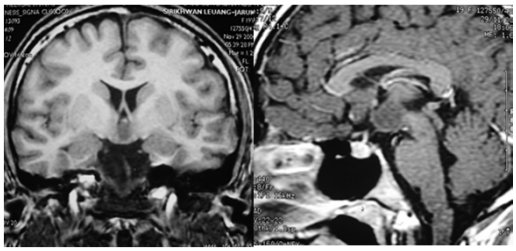
Dysembryoplastic neuroepithelial tumor (WHO 2000 grade I).

SC : AVM Lesionectomy

- An 11 year old, Sz started at age10
- Resect to remove the visible lesion & surrounding epileptic cortex

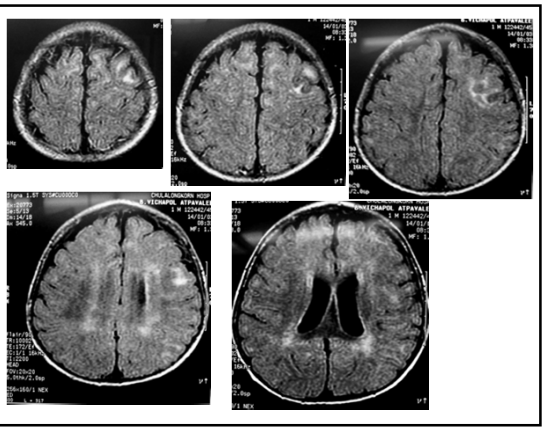


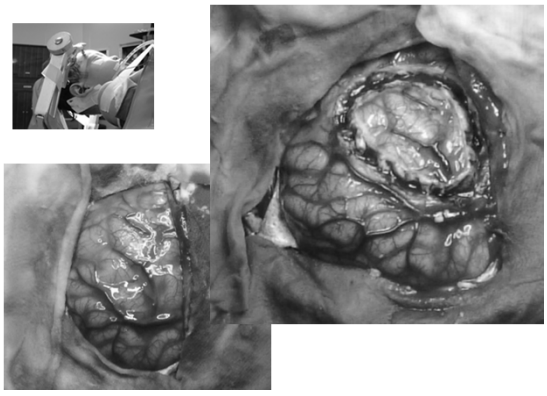
Hypothalamic Hamartoma

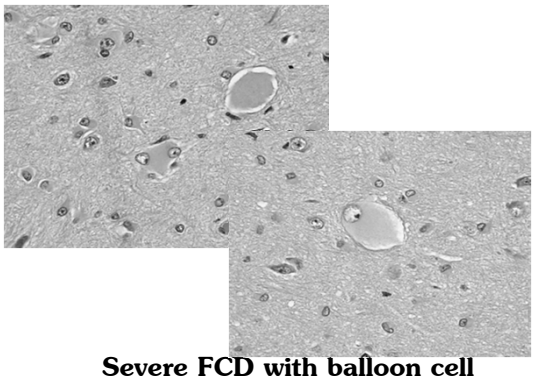


Case FCD w/ Rt Hemiparesis

- A 2 year old who had Sz since 8 months
- Intractable to PT, Peno, TPM, Kreppa, LTG
- CT scan suspected tumore of rigt frontal lobe
- MRI -> Lt FCD
- Focal resection with EcoG 2004 Nov
- Sz free **d/c TPM on PHT only**







Severe FCD with balloon cell

Epilepsy Surgery

- Disconnection
  - Corpus callosotomy
  - Hemispherotomy
  - Multiple subpial transection

Corpus Callosum

Corpus Callosum

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- Anterior (2/3) callosotomy
- Complete callosotomy
  - One stage
  - Two stages (6-12 mo. apart)

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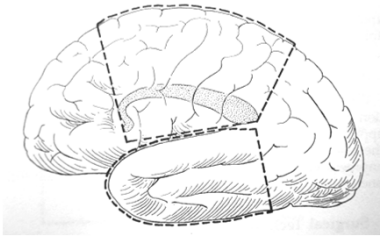
- Anterior (2/3) callosotomy
- Complete callosotomy
  - One stage
  - Two stages (6-12 mo. apart)

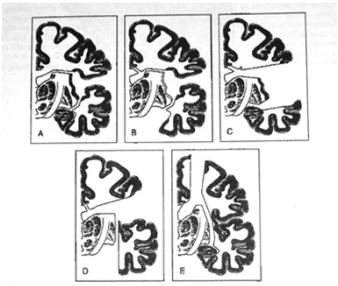
Case SH Corpus Callosotomy

- **Disconnect the two hemisphere without removal of the connection to the body**
- **Done to reduce secondary spreads esp in Lennox-Gastaut Syndrome with <u>frequent falls</u>**

Functional Hemispherectomy



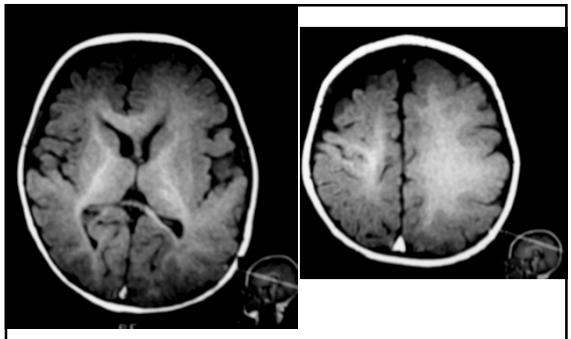
Functional Hemispherectomy

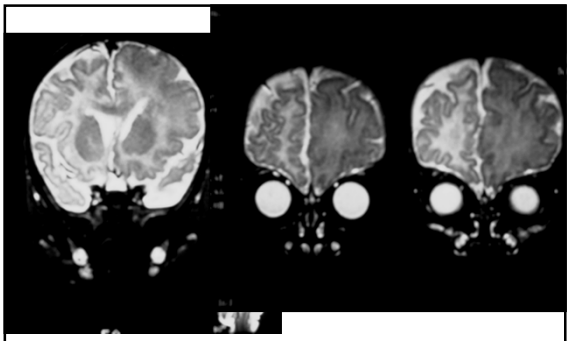


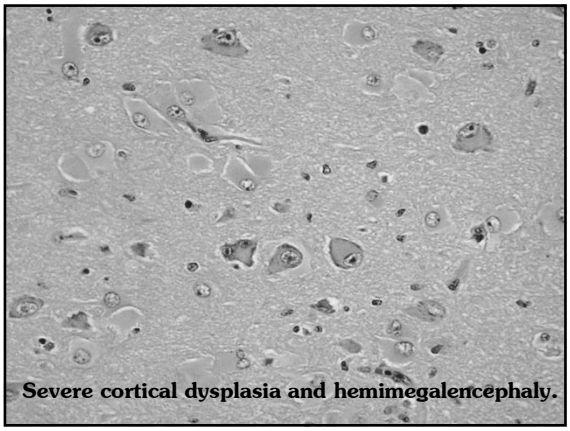
Case PP Hemispherectomy

- A five month old girl who started having clonic jerking of the right arm at age four month
- NSVD, Uneventful prenatal history
- G+D Regrad face 2 m, Follow 3 m, S[illegible] support 5 m
- The Sz frequency increased gradua[illegible] from 1-2/day to 25-45/day. Rx VPA, Phenobarbital, DZP
- All are without fever

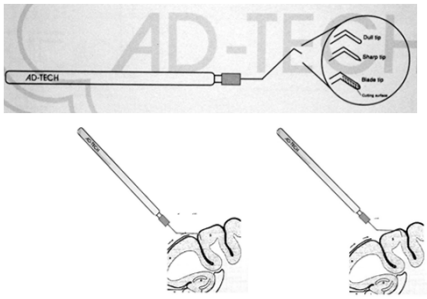
- She was lethargic, had 1-4 seziures/ hour, (+) aspiration pneumonia
- Clonic jerking Rt side with grimance of the face lasted 10-45 seconds.
- Med : Phenobarbital 20 mg/kg/day, BI level > 130 uG/ml
- PHT, CBZ, Vigabatrin, Topiramate
- B6 100 mg trial
- Video-EEG monitoring :
- Interictal > 90 % Lateralized left hemisphere 10 % Rt C4 P4
- Ictal EEG : > 90 % Lateralized Lt Hemisphere



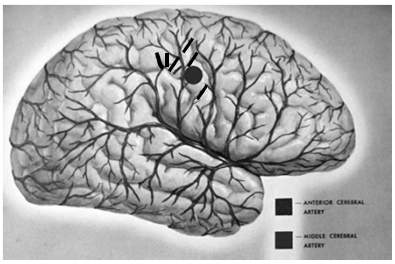




Multiple Subpial Transection

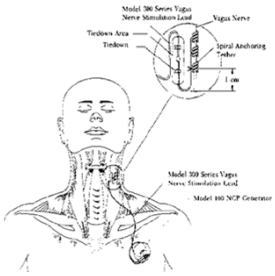


Multiple Subpial Transection



Epilepsy Surgery

- Neuroaugmentation
  - Vagal nerve stimulation (VNS)
  - Deep brain stimulation (DBS)

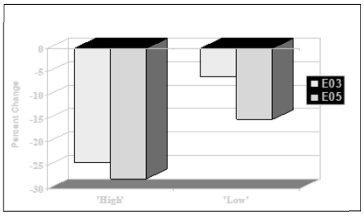


The Vagus Nerve Stimulator: NCP 101 generator (with leads attached).

Cyberonics, Webster, Texas.

Vagus Nerve Stimulation Percentage Change – All Seizures

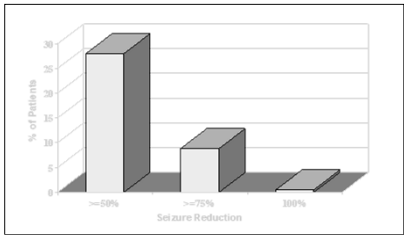
Results of two randomized, controlled trials in medically refractory partial seizures.



VNS Study Group, 1995
Handforth, et al., 1998

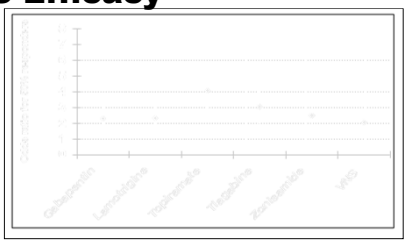
Vagus Nerve Stimulation "Responder Rates"

Responder rates from the randomized controlled trials



VNS Study Group, 1995
Handforth, et al., 1998

Metaanalysis of AEDs and VNS Efficacy



Marson et al (1997)

Ketogenic Diet

- **Main experience with children, especially with multiple seizure types**
- **Anti-seizure effect of ketosis (beta hydroxybutyrate)**
- **Low carbohydrate, low protein, high fat after fasting to initiate ketosis**
- **Long-term adverse effects unknown**