The American Approach to Depth Electrode Insertion

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Jonathan Miller, MD
Director, Epilepsy Surgery
University Hospitals Case Medical Center/Case Western Reserve University
Cleveland, Ohio
Disclosure

None
Learning Objectives

• After this session, participants will gain an understanding of SEEG technique and indications
The Goal of SEEG

Localization of the Epileptogenic Zone
The Goal of SEEG

Localization

of the

Epileptogenic Zone

Symptomatogenic Zone

Lesion

Irritative Zone

Seizure Onset Zone

Eloquent Tissue
The Goal of SEEG

Localization of the Epileptogenic Zone

- Symptomatogenic Zone
- Lesion
- MRI
- PET
- Semiology

Irritative Zone
- Interictal EEG
- Ictal EEG
- Ictal SPECT

Seizure Onset Zone
- fMRI
- WADA
- Neuropsych.

Eloquent Tissue
The Goal of SEEG

Localization of the Epileptogenic Zone

- Symptomatogenic Zone
- Lesion
- Eloquent Tissue
- Seizure Onset Zone
- Irritative Zone

SEEG
EEG vs. SEEG
EEG vs. SEEG
EEG vs. SEEG

EEG

Subdural Grids

EZ
EEG vs. SEEG

EEG

Subdural Grids

EZ

Depth Electrodes
EEG vs. SEEG

- No activity
- Ictal/interictal activity
- Eloquent cortex
History of SEEG


Stereotaxic Approach to Epilepsy
Methodology of Anatomo-Functional Stereotaxic Investigations

J. TALAIRACH and J. BANCAUD

Service of Functional Neurosurgery, Hôpital Sainte-Anne, and INSERM Research Unit (U 97), Paris
History of SEEG

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Modern Era: MRI Targetting
SEEG Strategies

1. Multi-target SEEG
   - Identify epileptic structures

2. 3D-SEEG
   - Delineate epileptogenic & eloquent zones
SEEG Strategies

1. Multi-target SEEG
   – Identify epileptic structures

2. 3D-SEEG
   – Delineate epileptogenic & eloquent zones

Non-lesional Temporal Lobe Epilepsy:
- Hippocampus
- Amygdala
- Temporal neocortex
- Temporal pole
- Mesial frontal lobe
- Insula
- Posterior cingulate gyrus
- Posterior temporal lobe
SEEG Strategies

1. Multi-target SEEG
   – Identify epileptic structures

2. 3D-SEEG
   – Delineate epileptogenic & eloquent zones
Multi-Target SEEG

- Choose entry point to cover area of interest
- Can enter from any direction to sample tissue of interest
- Additional depth electrodes may be added in second stage
SEEG Strategies

1. Multi-target SEEG
   – Identify epileptic structures

2. 3D-SEEG
   – Delineate epileptogenic & eloquent zones
3D-SEEG

- Surround area of interest using “three-dimensional grid”

- Can enter from any direction; parallel electrodes may be easier to interpret
Framed Stereotaxy
Framed Stereotaxy
Framed Stereotaxy

Ring less limited than arc
(-30° to 210°) (30° to 150°)
Positioning

Supine (Prone) = from front (back)

Lateral = from side
Positioning

Supine (Prone) = from front (back)

Lateral = from side
Positioning

Ring perpendicular to electrode path

Supine (Prone) = from front (back)

Lateral = from side
Frame Placement

Placed low to maximize trajectory options
Simultaneous bilateral placement: tilt frame toward dependent side
Simultaneous bilateral placement: tilt frame toward dependent side
Fluoroscopy

Verify correct placement
Determine depth of placement
Implantation

- 3 mm stab incision, 2.7 mm drill
Implantation

- 3 mm stab incision, 2.7 mm drill
- Open dura with monopolar cautery
Implantation

• 3 mm stab incision, 2.7 mm drill

• Open dura with monopolar cauterity

• Advance stylet to target under x-ray
Implantation

- 3 mm stab incision, 2.7 mm drill
- Open dura with monopolar cautery
- Advance stylet to target under x-ray
- Place anchor bolt
- Place electrode
Postoperative Processing

- Postoperative volumetric CT (1 mm)
  - Fused with preoperative MRI
- Contour electrodes
  - Anatomic definition of EZ
  - Can import into frameless stereotaxy for resection
<table>
<thead>
<tr>
<th>Case Example</th>
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<tbody>
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<td><strong>Seizures:</strong> déjà vu aura, dialeptic, automotor</td>
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<td><strong>Location:</strong> left temporal (Sp1&gt;P7)</td>
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Case Example

32 year old RH man

**Seizures:** déjà vu aura, dialeptic, automotor  
**Etiology:** unknown (imaging normal)

**Location:** left temporal (Sp1>P7)  
**Related medical conditions:** bipolar disorder
Case Example

32 year old RH man

Seizures: déjà vu aura, dialeptic, automotor  Etiology: unknown (imaging normal)
Location: left temporal (Sp1>P7)  Related medical conditions: bipolar disorder

Seizure onset zone: Posterior Temporal

- No activity
- Interictal
- Ictal
- Eloquent
32 year old RH man

**Seizures:** déjà vu aura, dialeptic, automotor  
**Etiology:** unknown (imaging normal)

**Location:** left temporal (Sp1>P7)  
**Related medical conditions:** bipolar disorder

**Case Example**

Additional electrodes placed around active contacts to delineate epileptogenic zone
32 year old RH man

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**Pathology:**  
Cortical Dysplasia
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57 year old RH woman

**Seizures:** visual aura, aphasia

**Location:** left temporal (Sp1)

**Etiology:** cavernous angioma

**Related medical conditions:** migraine

Cavernous angioma
Case Example

57 year old RH woman

**Seizures:** visual aura, aphasia

**Location:** left temporal (Sp1)

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Mesial temporal structures

Anterior, Posterior, Superior, Inferior, and Lateral to Cavernous Angioma
57 year old RH woman

**Seizures:** visual aura, aphasia

**Location:** left temporal (Sp1)

**Etiology:** cavernous angioma

**Related medical conditions:** migraine

Seizure onset zone *only* in hippocampus (not perilesional)
Case Example

57 year old RH woman

**Seizures:** visual aura, aphasia

**Location:** left temporal (Sp1)

**Etiology:** cavernous angioma

**Related medical conditions:** migraine

Seizure onset zone *only* in hippocampus (not perilesional)
Conclusions

• Standard stereotactic techniques are used for implantation

• Goal is *improved* anatomic delineation of epileptogenic zone; hypothesis is important

• Provides anatomic information that can be helpful to guide surgical resection