Focal Epileptic Seizures

Amir Arain, M.D.
Focal seizures

• Seizures originating within networks limited to one hemisphere. These may be discretely localized or widely distributed.
Focal seizures

• Without impairment of awareness
  – With observable motor or autonomic components
  – Involving subjective sensory or psychic phenomena only, corresponding to aura
• With impairment of awareness dyscognitive
• Evolving to a bilateral, convulsive seizure (tonic, clonic or both)
# Semiologic Classification of Seizures (Luders et al)

<table>
<thead>
<tr>
<th>Auras</th>
<th>Motor seizures*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somatosensory auras*</td>
<td>Simple motor seizures*</td>
</tr>
<tr>
<td>Auditory auras</td>
<td>Myoclonic seizures*</td>
</tr>
<tr>
<td>Olfactory auras</td>
<td>Epileptic spasms*</td>
</tr>
<tr>
<td>Abdominal auras</td>
<td>Tonic-clonic seizures</td>
</tr>
<tr>
<td>Visual auras*</td>
<td>Tonic seizures*</td>
</tr>
<tr>
<td>Gustatory auras</td>
<td>Clonic seizures*</td>
</tr>
<tr>
<td>Autonomic auras*</td>
<td>Versive seizures*</td>
</tr>
<tr>
<td>Psychic auras</td>
<td>Complex motor seizures</td>
</tr>
<tr>
<td>Autonomic seizures*</td>
<td>Hypermotor seizures</td>
</tr>
<tr>
<td>Dialectic seizures</td>
<td>Automotor seizures</td>
</tr>
<tr>
<td>Typical dialectic seizures</td>
<td>Gelastic seizures</td>
</tr>
<tr>
<td>(typical absence seizure in ILAE† classification)</td>
<td></td>
</tr>
</tbody>
</table>

* Indicates the seizure has a somatotopic distribution
# Semiologic Classification of Seizures (Luders et al)

## Table 2: Motor Activity and Consciousness During Auras, Autonomic Seizures, Dialectic Seizures, Motor Seizures, and Special Seizures

<table>
<thead>
<tr>
<th>Seizure Type</th>
<th>Motor Activity</th>
<th>Consciousness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aura</td>
<td>Unchanged</td>
<td>Normal</td>
</tr>
<tr>
<td>Autonomic seizure</td>
<td>Unchanged</td>
<td>Normal</td>
</tr>
<tr>
<td>Dialectic seizure</td>
<td>Not present/minimal</td>
<td>Disturbed</td>
</tr>
<tr>
<td>Motor seizure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple motor seizure</td>
<td>Clonic</td>
<td>Normal or disturbed</td>
</tr>
<tr>
<td>Tonic seizure</td>
<td>Tonic</td>
<td></td>
</tr>
<tr>
<td>Tonic-clonic seizure</td>
<td>Tonic-clonic</td>
<td></td>
</tr>
<tr>
<td>Myoclonic seizure</td>
<td>Myoclonic</td>
<td></td>
</tr>
<tr>
<td>Versive seizure</td>
<td>Versive</td>
<td></td>
</tr>
<tr>
<td>Epileptic spasm</td>
<td>Spasm</td>
<td></td>
</tr>
<tr>
<td>Complex motor seizure</td>
<td>Automotor seizure</td>
<td>Normal or disturbed</td>
</tr>
<tr>
<td></td>
<td>Distal automatisms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypermotor seizure</td>
<td>Pronounced, proximal musculature</td>
</tr>
<tr>
<td>Gelastic seizure</td>
<td>Laughing</td>
<td></td>
</tr>
<tr>
<td>Special seizures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atonic seizure</td>
<td>Reduction of tone</td>
<td>Normal or disturbed</td>
</tr>
<tr>
<td>Astatic seizure</td>
<td>Patient falls down</td>
<td>Normal or disturbed</td>
</tr>
<tr>
<td>Hypomotor seizure</td>
<td>Motor activity decreased</td>
<td>Consciousness cannot be assessed</td>
</tr>
<tr>
<td>Akinetic seizure</td>
<td>Motor activity decreased</td>
<td>Preserved</td>
</tr>
<tr>
<td>Negative myoclonic seizure</td>
<td>Short, sudden loss of muscle tone</td>
<td>Preserved</td>
</tr>
</tbody>
</table>
Focal Seizures With impairment of awareness

- This is usually due to bilateral hippocampal or hemispheric involvement.
Focal Seizures With impairment of awareness

1- of Temporal origin

2- of Extratemporal origin
Temporal lobe seizures

1-MTLE
2-NCTLE
Temporal lobe seizures

- The distinction between seizure that arise from MT structures vs. LT cortex, is clinically important
  - MT seizures will often have their seizures eliminated by standard temporal lobectomy
  - Patients with neocortical disease may need invasive monitoring to tailor a resection.
Clinical Features of Medial TLE

- Early age of onset
- Early risk factor (i.e. h/o complex febrile seizure).
- Well controlled seizures in early childhood.
- Re-emergence of refractory epilepsy in adolescence or early adulthood.
- Infrequent or rare GTC Sz.
Lateralizing Features of Temporal Lobe Seizures

- Unilateral dystonic posturing
- Ictal language
- Post-ictal nose wiping
- Ictal vomiting or retching behavior
- Head version immediately prior to $2^\circ$ GTC Sz
Temporal lobe seizure features

• Rising epigastric discomfort
• Autonomic signs like pallor, flushing, mydriasis, irregular respiration or respiratory arrest, abdominal borborygmi, eructation
• fearful, olfactory and gustatory auras.
Clinical Features of Neocortical TLE

- Early motor involvement of the contralateral hand.
- Late age of onset
- No early risk factors
- No hippocampal atrophy on MRI
- Minimal automatisms
- Auditory aura or seeing faces
Neocortical Temporal seizure

• Symptoms of lateral temporal seizures
  – Auditory
  – Visual sensory experience
  – Psychic dreamy states
  – Dysphasias if the speech areas in the dominant
Localizing Value of Auras

- Psychic, autonomic
- Auditory, vertigo, seeing faces
- Absence of aura
- Olfactory

- Medial temporal
- Neocortical temporal
- Neocortical, or bilateral temporal
- Medial temporal
Frontal lobe seizures
Frontal lobe complex partial seizures

- Stereotyped pattern
- Frequent seizures, often in clusters
- Brief seizures, under 1 minute
- Bizarre attacks that appear hysterical
- Prominent motor automatisms, usually complex
- Aggressive sexual automatisms
- Vocalizations, with variable complexity
- Short postictal period, rapid clearing
- Complex partial status epilepticus common

Clinical features of frontal lobe seizures

- **Supplementary motor cortex**: postural or focal motor signs.
- **Cingulate region**: changes in mood and elaborate gestural automatism.
- **Orbitofrontal cortex**: complex gestural automatism and prominent autonomic features.
- **Dorsolateral convexity**: simple partial seizures, versive head and eye movements.
Hypermotor seizures

- Cingulate
- Orbitofrontal
- Anterior insula
- Temporal tip
- Hypothalamic Hemartoma
## Value and Limitations of Seizure Semiology in Localizing Seizure Onset.

So, Elson

DOI: 10.1097/01.wnp.0000228498.71365.7b

### Table 1. Value of Positive and Negative Motor Signs in Lateralizing Seizure Onset to the Right or the Left Hemisphere

<table>
<thead>
<tr>
<th>Sign</th>
<th>Hemisphere of Seizure Onset</th>
<th>Observed Rate</th>
<th>Positive Predictive Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive motor signs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early nonforced head turn</td>
<td>Ipsilateral</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>Late contraversive forced head turn</td>
<td>Contralateral</td>
<td>25%–50%</td>
<td></td>
</tr>
<tr>
<td>Late ipsiversive forced head turn</td>
<td>Ipsilateral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye deviation</td>
<td>Contralateral</td>
<td>Rarely solitary</td>
<td>High if occipital</td>
</tr>
<tr>
<td>Focal clonic</td>
<td>Contralateral</td>
<td>30%</td>
<td>&gt;95%</td>
</tr>
<tr>
<td>Asymmetric clonic ending</td>
<td>Ipsilateral</td>
<td>70% of secondary generalized seizures</td>
<td>83%</td>
</tr>
<tr>
<td>Dystonic limb</td>
<td>Contralateral</td>
<td>67%</td>
<td>93%</td>
</tr>
<tr>
<td>Tonic limb</td>
<td>Contralateral</td>
<td>13%</td>
<td>85%</td>
</tr>
<tr>
<td>Complex postures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2E and fencing</td>
<td>Contralateral</td>
<td>3% of temporal, 25% of frontal patients</td>
<td>90%</td>
</tr>
<tr>
<td>&quot;Figure 4&quot; sign</td>
<td>Contralateral to extended limb</td>
<td>70% of seizures generalizing from temporal lobe; 31% of extratemporal</td>
<td>89%</td>
</tr>
<tr>
<td>Negative motor signs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ictal paresis or immobile limb</td>
<td>Contralateral</td>
<td>5% of complex partial seizure patients</td>
<td>100%</td>
</tr>
<tr>
<td>Todd paresis</td>
<td>Contralateral</td>
<td>13% of partial seizure patients</td>
<td>80%–100%</td>
</tr>
</tbody>
</table>

*The positive predictive value is the number of true positives divided by the sum of true positives and false positives.

## Table 2

### Importance of Automatisms, Autonomic Signs, and Peri-ictal Speech Signs in Hemispheric Lateralization or Lobar Localization of Partial Seizures

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Location*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Automatisms</strong></td>
<td></td>
</tr>
<tr>
<td>Unilateral limb automatism</td>
<td>Ipsilateral to seizure focus; 90% PPV</td>
</tr>
<tr>
<td>Unilateral eye blinks</td>
<td>Ipsilateral to focus; 83% PPV</td>
</tr>
<tr>
<td>Postictal cough</td>
<td>40% of temporal lobe seizure patients, 0% of pseudoseizure or frontal lobe seizure patients</td>
</tr>
<tr>
<td>Postictal nose wiping</td>
<td>50% of temporal and 10% of frontal lobe seizures; 90% PPV</td>
</tr>
<tr>
<td><strong>Bipedal automatisms</strong></td>
<td>30% of frontal and 10% of temporal lobe seizure patients</td>
</tr>
<tr>
<td><em>Ictal spitting or drinking</em></td>
<td>Rare, but high association with right temporal seizures</td>
</tr>
<tr>
<td><strong>Autism with preserved responsiveness</strong></td>
<td>Nondominant (usually right) temporal or extratemporal on either side</td>
</tr>
<tr>
<td>Gelastic seizure</td>
<td>Hypothalamic; sometimes mesial temporal or frontal cingulate origin</td>
</tr>
<tr>
<td><strong>Autonomic signs</strong></td>
<td></td>
</tr>
<tr>
<td>lietus emeticus</td>
<td>Rare, but usually right temporal</td>
</tr>
<tr>
<td>lietal urinary urge</td>
<td>Rare (2%), but localizes to right temporal</td>
</tr>
<tr>
<td><strong>Piloerection (goose bumps)</strong></td>
<td>Mostly left temporal</td>
</tr>
<tr>
<td><strong>Peri-ictal speech</strong></td>
<td>Seen in 75% of temporal lobe seizure patients, but only 67% PPV for dominant hemisphere focus</td>
</tr>
<tr>
<td>lietal speech arrest</td>
<td>Seen in only 15%, but PPV of 83% for non-dominant hemisphere focus in temporal lobe seizure patients</td>
</tr>
<tr>
<td>lietal speech preservation</td>
<td>90% dominant hemisphere involvement</td>
</tr>
</tbody>
</table>

*PPV, positive predictive value.

*The PPV is the number of true positives divided by the sum of true positives and false positives.

• Most features are useful for lateralizing seizure onset to a hemisphere (hemispheric lateralization).

• Few features help in localizing seizure onset to a lobe in the hemisphere (lobar localization).
Value of Sz semiology

• Scalp EEG fails to detect seizure onset in many patients.

• About 25% of seizures in patients with unilateral mesial temporal lobe epilepsy could not be lateralized by scalp EEG
  (Pataria et al., 1998).

• This rate is higher in extratemporal lobe seizures. A 1/3 to 1/2 seizures could not be lateralized by scalp EEG
  (Walczak et al., 1992; Mosewich et al., 2000).
### Value and Limitations of Seizure Semiology in Localizing Seizure Onset.
So, Elson

*Journal of Clinical Neurophysiology. 23(4):353-357, August 2006. DOI: 10.1097/01.wnp.0000228498.71365.7b*

<table>
<thead>
<tr>
<th>Features</th>
<th>Temporal Lobe Seizures</th>
<th>Frontal Lobe Seizures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somatosensory symptoms</td>
<td>Rare</td>
<td>More common</td>
</tr>
<tr>
<td>Onset</td>
<td>Slower</td>
<td>Abrupt, explosive</td>
</tr>
<tr>
<td>Progression</td>
<td>Slower</td>
<td>Rapid</td>
</tr>
<tr>
<td>Initial motionless stare</td>
<td>Common</td>
<td>Less common</td>
</tr>
<tr>
<td>Complex postures</td>
<td>Less frequent and prominent, occurring later as seizure starts to generalize</td>
<td>More frequent, prominent, and early</td>
</tr>
<tr>
<td>Hypermotor (hyperkinetic)</td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td>Vocalization</td>
<td>Speech (nondominant temporal)</td>
<td>Loud nonspeech (grunting, screaming, moaning)</td>
</tr>
<tr>
<td>Automatisms</td>
<td>More common and longer</td>
<td>Less common</td>
</tr>
<tr>
<td>Bipedal automatism</td>
<td>Uncommon</td>
<td>Common and characteristic</td>
</tr>
<tr>
<td>Seizure duration</td>
<td>Longer</td>
<td>Brief</td>
</tr>
<tr>
<td>Postictal confusion</td>
<td>More prominent and longer</td>
<td>Absent or less prominent or shorter</td>
</tr>
<tr>
<td>Postictal dysphasia</td>
<td>More frequent (dominant temporal)</td>
<td>Uncommon (unless spreads to dominant temporal lobe)</td>
</tr>
</tbody>
</table>

Mesial Temporal lobe seizure
Unilateral dystonic posturing

- First described by Kotagal et al.
- Unilateral dystonic posturing was observed in 41 seizures in 18 patients and the dystonic posturing was always (100%) contralateral to the side of seizure onset.
- These findings have frequently been confirmed since then in patients with seizure freedom after temporal lobectomy.
Rhythmic Ictal Nonclonic Hand (RINCH) Motions: A Distinct Contralateral Sign in Temporal Lobe Epilepsy

George R. Lee, Amir Arain, Noel Lim, Andre Lagrange, Pradumna Singh, and Bassel Abou-Khalil

Department of Neurology, Vanderbilt University, Nashville, Tennessee, USA

Summary: Purpose: To describe a new ictal sign in temporal lobe seizures—rhythmic ictal nonclonic hand (RINCH) motions and to determine its lateralizing significance and other ictal manifestations associated with it.

Methods: We identified 15 patients with temporal lobe epilepsy who demonstrated RINCH motions and reviewed video-EEG recordings of all their seizures. We analyzed the epilepsy characteristics and all clinical features of recorded seizures, with particular attention to RINCH motions.

Results: RINCH motions were unilateral, rhythmic, nonclonic, nontremor hand motions. RINCH motions were usually followed by posturing, sometimes with some overlap. They involved the hand contralateral to the temporal lobe of seizure onset in 14 of 15 patients.

Conclusions: RINCH motions are a distinct ictal sign that could be considered a specific type of automatism. They appear to be a lateralizing contralateral sign and are associated with dystonic posturing in temporal lobe epilepsy.

Key Words: Seizure semiology—Automatisms—Dystonic posturing—Temporal lobe epilepsy.
Unilateral ictal eye blinking

- Wada described 5 patients with unilateral eye blinking ipsilateral to the ictal discharge.
- Benbadis et al. identified 14/914 patients with unilateral blinking unassociated with facial clonic activity.
  - Unilateral blinking was ipsilateral to the epileptogenic zone in 10 of 12 patients with a unilateral EEG focus (83%). The epileptogenic zone was identified by resection and seizure freedom.
Tujillo, D unilateral eye blinks
Version

- Wyllie et al described version during seizures.
- Version: forced involuntary turning resulting in sustained unnatural positioning.
  - Always contralateral to the seizure onset.
- Kernan et al. found that forced head deviation was contralateral in >90% seizures
  - 100% reliable if the version seen immediately prior to the GTC seizure
Association of Ipsilateral Head Turning and Dystonia in Temporal Lobe Seizures

Toufic Fakhoury and Bassel Abou-Khalil

Department of Neurology, Vanderbilt University Medical Center, Nashville, Tennessee, U.S.A.

Summary: We evaluated head turning in 239 complex partial seizures (CPS) with or without generalization in 32 patients with unilateral temporal lobe epilepsy (TLE). Head turns occurred in 187 seizures of 31 patients, more than once in 71 seizures. The first head turn was ipsilateral to the focus in 162 seizures (87%), with a mean latency of 22 s, as compared with 83 s for contralateral first head turns. Concomitant dystonic posturing of the arm occurred with 71% of all ipsilateral head turns and with 16% of all contralateral head turns. The mean difference in absolute latency between the first head turn and concomitant dystonic posturing was 6 s. Examination of all instances of concomitant head turning and dystonic posturing (160) showed them to be contralateral to each other in 154 (96%). Furthermore, the dystonia was contralateral and head turning was ipsilateral to the focus in 149 (93%). Forty-one seizures secondarily generalized, with transitional tonic head deviation contralateral to the focus in 35. Early head turning suggests an ipsilateral temporal seizure focus, particularly when associated with contralateral dystonic posturing. Similar mechanisms may account for both. Tonic head deviation preceding secondary generalization probably has a different mechanism. Key Words: Temporal lobe seizures—Head turning—Version—Dystonia—Secondarily generalized.
Ictal Speech

- Ictal speech in right temporal lobe epilepsy
- Gabr et al. observed normal speech in 12.5% of cases, and 83% of these had seizures arising from the nondominant hemisphere
- Serafetinides and Falconer suspected either the dominant hemisphere from inhibition through the nondominant hemisphere or, alternatively, overexcitement of the nondominant hemisphere
Spontaneous periictal leaving behavior: a potential lateralizing sign in mesial temporal lobe epilepsy.

- Ictal LB may indicate seizure onset in the dominant temporal lobe

- Postictal LB occurring postictally indicates nondominant side seizure onset in patients with MTLE.
SMA seizure
Cortical dysplasia
Localization value of Aura

- Elementary visual
- Unilateral somatosensory
- Pulling or throbbing
- Occipital
- Parietal
- Supplementary sensorimotor region
Parietal lobe seizures

• Common ictal clinical manifestations are
  – Paresthesia
  – Painful
  – Thermal
  – Sexual
  – Apraxic disturbances of body image
Parietal lobe seizures

• Ictal EEG may be poorly informative
• May show diffuse suppression, then sharp waves may appear, spreading
  – either anteriorly or posteriorly.
  – to frontal and parietal operculum
  – to medial frontal regions has been reported
Occipital lobe seizures

- Elementary visual hallucinations:
  - flashing or steady spots
  - simple geometric forms
  - eye blinking
  - tonic eye and head deviation, either ipsilateral or contralateral to the discharge
- vegetative phenomena (vomiting)
Ictal EEG in Occipital seizures

- May not display abnormality (in mesial or basal occipital focus)
- During the evolution of seizure, ictal discharge may become more evident appearing as a low-voltage fast activity progressively followed by a rhythmic epileptiform discharge
EEG findings in seizures
Scalp EEG In Seizures Without impairment of awareness

• These seizures often involved a limited surface area such that a scalp EEG correlate is often not seen.
  – Early reports found that a scalp EEG correlate was observed 20% of the time.
  – Another small series reported that a scalp EEG correlate is seen in 35% of these seizures without impairment of awareness.
Scalp EEG In Seizures Without impairment of awareness

- Cessation of inter-ictal activity
- Focal or regional slowing.
- Periodic sharp wave activity
- Change in heart rate
- No Scalp EEG changes
Scalp EEG in temporal lobe seizures without impairment of awareness (Sirven et al. 1996)

- 183 patients with TLE reported an aura.
- 51 (28%) showed ictal EEG changes.
- Mean duration 16 seconds range 6-24 seconds).
- Most ictal discharges consisted of rhythmic sharp waves.
Scalp EEG In Seizures Without impairment of awareness

- 19%  (Lieb et al. 1976)
- 21%  (Devinsky et al. 1988)
- 35%  (Bare et al. 1994)
- 28%  (Sirven et al. 1996)
EEG in Seizures With impairment of awareness
(Geiger and Harner 1978)

• In 17/23 patients with inter-ictal spikes, there was an abrupt decrease or cessation of inter-ictal activity at ictal onset.
• This was followed by rhythmic ictal activity that progressively decreased in frequency and increased in amplitude.
Ictal onset patterns in Seizures With impairment of awareness

- Jasper (1949) was the first to describe cessation of inter-ictal activity or attenuation of spontaneous activity as representing seizure onset.

- Klass (1975) reported attenuation in 25% of 116 partial seizures. Most complex partial seizures show a scalp EEG correlate.

- However, a deep EEG generators such as the orbito-frontal region, medial occipital region, the cingulate and the insula may not show an EEG correlate.

- In these cases, an ictal correlate may be observed only if there is propagation to the temporal lobe.
Ictal EEG in Seizures With impairment of awareness

• Focal ictal origins near the surface are more likely to show a fast frequency onset on extracranial EEG.

• Ictal origins from deep generators usually show slower frequency onset patterns.
EEG Onset Patterns of Focal Seizures
Blume at al. 1983

• Attenuation: 11%
• Sinusoidal Waves: 47%
• Repetitive Epileptiform Potentials: 39%
• Both Sinusoidal and REPss: 15%
EEG Onset Frequencies
(Blume et al. 1983)

- Delta 35%
- Theta 38%
- Alpha 9%
- Beta 13%

- Early in the seizure, the frequency was as likely to increase as to decrease.
- Later in the seizure, the frequency was more likely to decrease.
Ictal EEG Onset Morphology

• Regular or irregular delta or theta frequency that is rounded or sharply contoured.
• Periodic spikes or sharps
• Rhythmic sharp waves (delta, theta or alpha)
• Spike and wave
• Low voltage fast activity
Sinusoidal Rhythmic (Theta)
Periodic and Rhythmic 2Hz Left Temporal Sharp waves
Low Voltage Fast Activity (T3 and T5)
Ictal EEG in TLE
(Risinger et al. 1987)

**Delayed focal onset:**

Generalized or lateralized EEG change followed within 30 sec by sphenoidal maximum 5-7 Hz rhythmic theta.

**Initial focal onset:**

Focal temporal EEG change (<5Hz) followed within 30 seconds by 5-7 Hz sphenoidal maximum theta activity or

5-7 Hz sphenoidal maximum rhythmic theta at ictal onset.
Delayed Focal Onset Sphenoidal Seizure

Clinical Onset

Diffuse Attenuation
followed by Rhythmic Theta in T3, SP1
Ictal EEG in TLE (Risinger et al. 1987)

- An initial focal or delayed focal EEG onset correctly predicted the side of seizure onset in 83% and 78% patients.

- In patients with a mixture of focal and non-focal recordings, predictive accuracy was 67%.

- In patients with uniformly focal recordings, predictive accuracy was 92%
Patterns of Ictal EEG onset in TLE (MTL vs. NCTL onset)

• Rhythmic temporal alpha or theta activity within 30 seconds of onset has been reported in approximately 80% of MTLE seizures.

• An initial, regular 5-9 Hz inferotemporal rhythm was more specific for hippocampal onset seizures.

• Irregular, polymorphic 2-5 Hz lateralized or localized patterns, non-lateralized or bilateral patterns, and earlier onset of bilateral patterns has been reported in NTLE compared with MTLE.
Patterns of Ictal EEG onset in TLE (MTL vs. NCTL onset)

• A sudden generalized or lateralized suppression or attenuation of amplitude has been reported in seizures arising from the MT region.

(However, Foldvary reported in a study that suppression was observed at the onset of only 3% of MTLE seizures, in which the pattern was usually generalized).
Ebersole et al., 1996

• Reviewed scalp-recorded ictal EEGs of 93 epilepsy surgery candidates who either had intracranial-EEG monitoring (n=58) or who referred directly for temporal lobectomy (n=35).
• Initial regular 5-9 Hz Infero-mesial rhythm was most specific for hippocampal-onset Sz.
• Szs originating in temporal neocortex were most often associated with irregular, polymorphic, 2-5 Hz lateralized activity.
• Szs without a clear lateralized EEG discharges were most commonly of temporal neocortical morphology.
Ictal EEG in Patient with Bilateral IEDs (Steinhoff et al. 1995)

• Seizure onset less likely to be lateralized at onset or later (75% and 78%) than unitemporal IED patients (90% and 96%).

• Seizure onset is less likely to predict the correct side for surgery (64%) than unitemporal IED patients (98%).
EEG findings in frontal lobe epilepsy

- The frontal lobe is second most common lobe of seizure origin.

- Seizures usually occur during sleep, tends to cluster, brief, and frequently secondarily generalize.
Factors contributing to poor or lack of ictal scalp localization in FLE

• Inaccessibility of much of the frontal lobes to the surface EEG electrodes.
• Widespread anatomic connections of the Frontal lobes to other areas, causing variable propagation pathways of the ictal discharge.
• Bilateral epileptogenicity because of bifrontal injury.
• Variability in size of seizure onset zones.
Factors contributing to poor or lack of ictal scalp localization in FLE

- Short duration of ictal discharges.
- Relative absence of post ictal EEG findings.
- Contamination by muscle artifact.
• Bautisa, Spencer & Spencer tried to determine the value of scalp EEG recordings of seizures originating from different regions of the frontal lobe. Most of studies on frontal lobe seizures analyzed FLEs as a group). They included 9 patients in their study:
At ictal onset, the initial EEG changes consisted of diffuse attenuation, regardless of region of seizure onset.

- Sz began in the MF region and (did not generalize), two patterns were seen:
  - no rhythmic EEG changes were seen.
  - rhythmic EEG changes occurred after the onset of the clinical seizures.
Ictal EEG: Dorsolateral Frontal sz

• In patients with seizures of dorsolateral origin: focal EEG seizures activity that preceded the onset of clinical symptoms and was thus distinguished from seizures of MF onset. (the focal EEG activity consisted of rhythmic fast activity).
LF ictal discharge
Same ictal discharge evolved
Interictal EEG Frontal seizures

- Seizures started in MF region had either absent or multifocal (associated with hx unprovoked secondary generalization) epileptiform discharges but never localized ones.

- Seizures started in the DLF region: had focal interictal epileptiform abnormalities that localized to the area of seizure onset.