April 11, 2025

AMED (Japan Agency for Medical Research and Development) Supports

International Collaboration

Implementation of wide band EEG in epilepsy care by digital EEG

No.5
One point comment:
Wide Band EEG Analysis
Now ready for clinical implementation

Akio IKEDA, MD, PhD, FACNS
Department of Epilepsy, Movement Disorders & Physiology
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Kyoto, JAPAN

1

Disclosure Form

Company Name	Nature of Affiliation
• Sumitomo Pharma Co • Nihon-Kohden	• Industry-Academia Collaboration Courses • Collaboration study
• UCB Japan • Eli Lilly Japan • RICHO	• Collaboration study
Off-Label Product Usage	
• None	

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14th March 2025
(Friday)

Wide-band EEG from DC shifts to HFO 4

Moderator
Dr. Triana Limoa
(Haji Hospital Makasar Indonesia)

Contents
✓ Mini lecture as one point comment
from Prof. Akio IKEDA (Kyoto University, Japan) [15 min.]

✓ 2 cases from Kyoto University
Dr.Katsuya KOBAYASHI
Dr. Tomomi ADACHI

Subdural EEG
Scalp EEG

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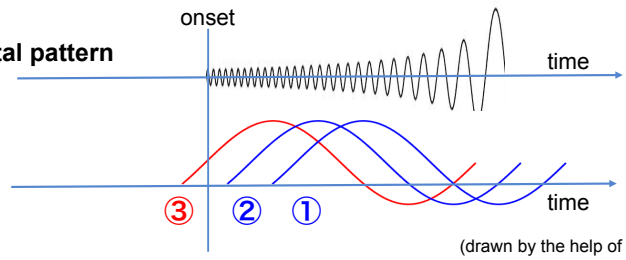
Hypothesis of active vs. passive DC shift in the ictal period

- **Conventional ictal pattern**
- **HFO**
- **DC shift**



(drawn by the help of Murai)

		③Active DC shift	② ① Passive DC shift
Clinical state		**Chronic epilepsy**	**Acute symptomatic seizure**
Clinical	patients	Habitual seizures	Non-habitual seizures
Basic	animals	Chronic model	Acute model
		Chronic pilocarpine model	Acute pilocarpine model

(by Ikeda et al) (as the working hypothesis of AMED research team of Epilepsy and Glia, chaired by Maehara, Japan, 2015-2018)

(Ikeda et al., 2020)

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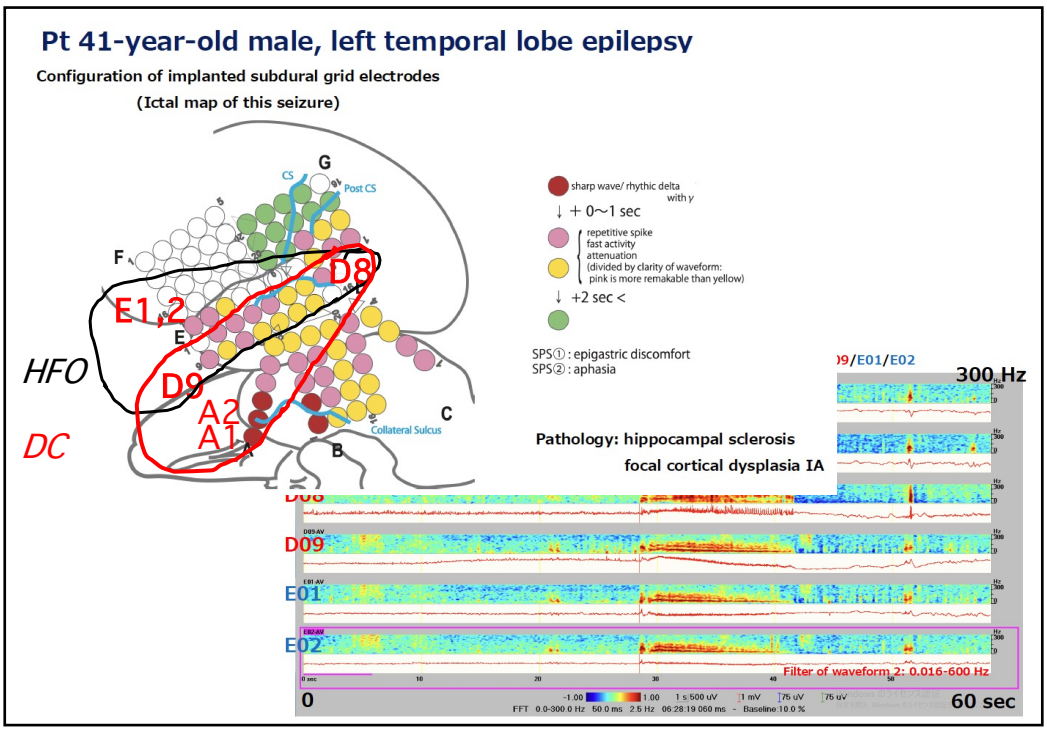
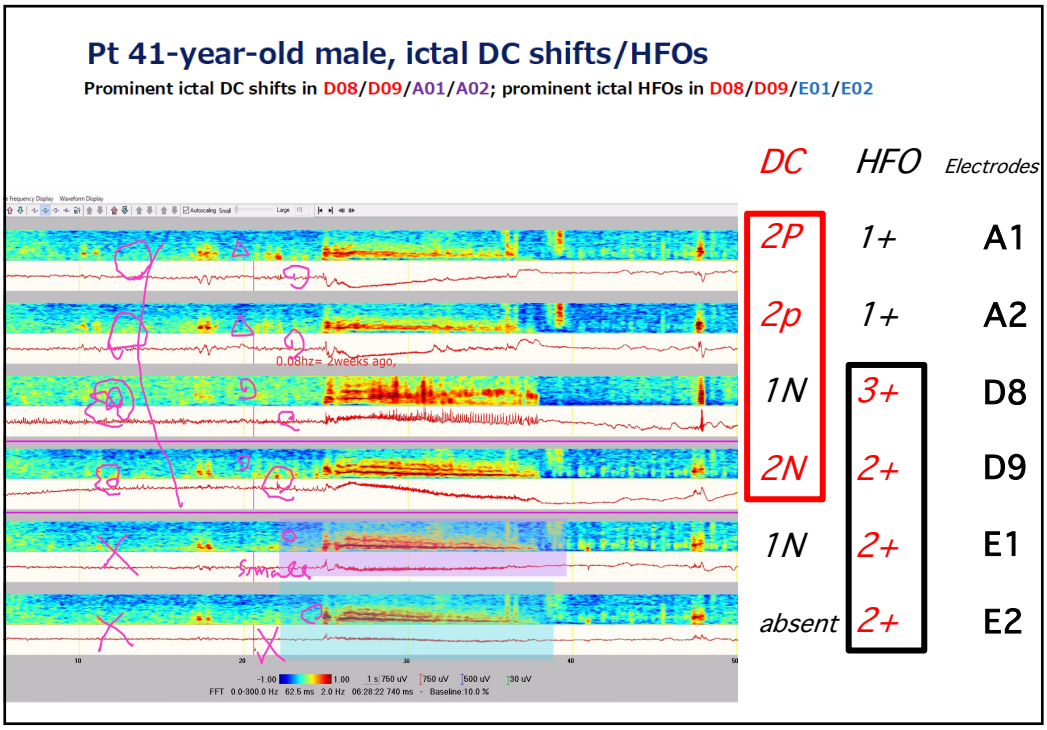
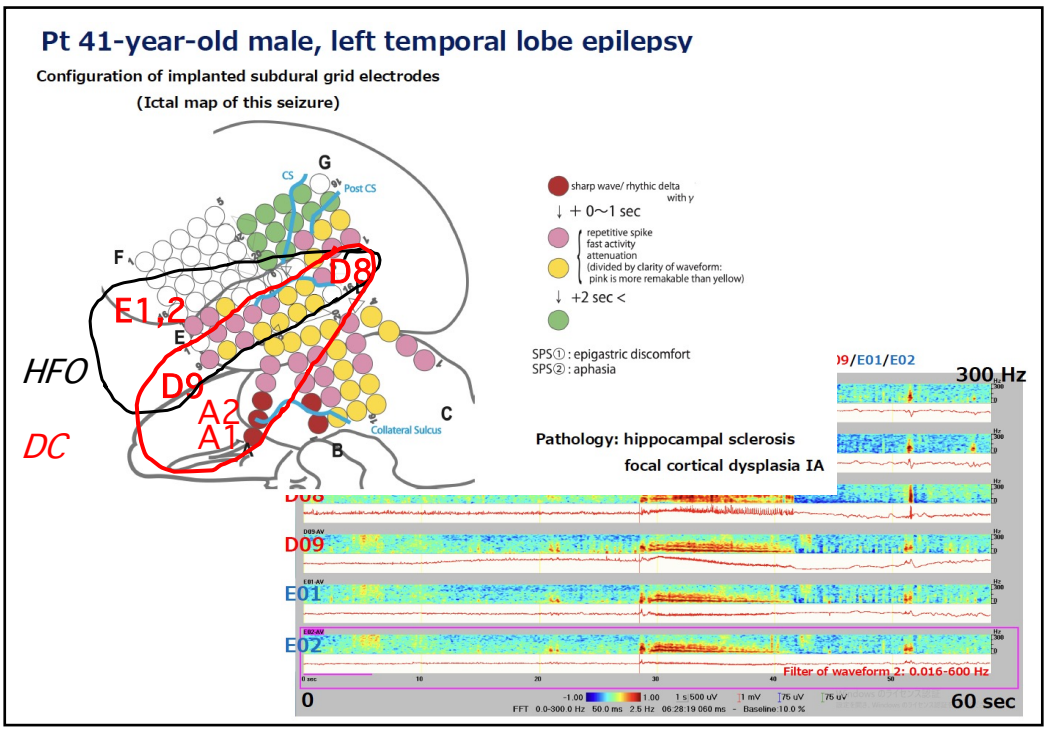

Pt 41-year-old male, left temporal lobe epilepsy
Configuration of implanted subdural grid electrodes
(Ictal map of this seizure)
G
CS
Post CS
F
D8
E1,2
E
HFO
D9
A2
A1
DC
A
B
C
Collateral Sulcus
sharp wave/ rhythic delta
with y
↓ + 0~1 sec
repetitive spike
fast activity
attenuation
(divided by clarity of waveform:
pink is more remakable than yellow)
↓ +2 sec <
SPS① : epigastric discomfort
SPS② : aphasia
Pathology: hippocampal sclerosis
focal cortical dysplasia IA
300 Hz
D09
E01
E02
Filter of waveform 2: 0.016-600 Hz
0
60 sec

5


Pt 41-year-old male, ictal DC shifts/HFOs
Prominent ictal DC shifts in D08/D09/A01/A02; prominent ictal HFOs in D08/D09/E01/E02
DC
HFO
Electrodes
2P
1+
A1
2p
1+
A2
0.08hz= 2weeks ago,
1N
3+
D8
2N
2+
D9
1N
2+
E1
absent
2+
E2

6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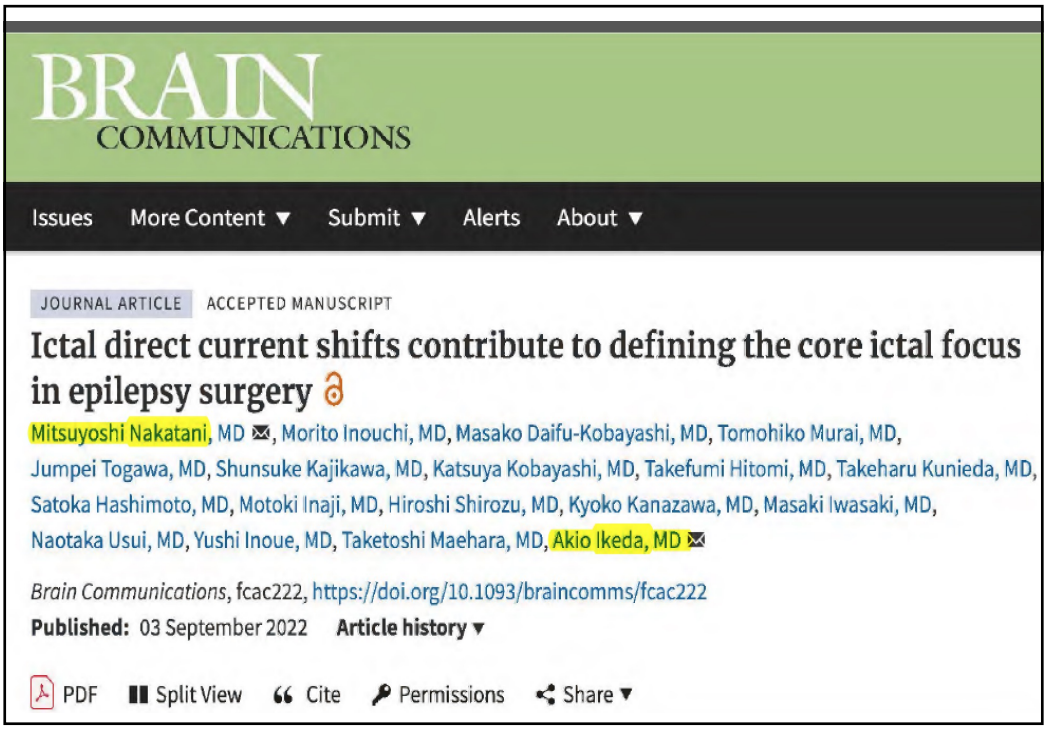
7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JOURNAL ARTICLE
ACCEPTED MANUSCRIPT
Ictal direct current shifts contribute to defining the core ictal focus in epilepsy surgery
Mitsuyoshi Nakatani, MD, Morito Inouchi, MD, Masako Daifu-Kobayashi, MD, Tomohiko Murai, MD, Jumpei Togawa, MD, Shunsuke Kajikawa, MD, Katsuya Kobayashi, MD, Takefumi Hitomi, MD, Takeharu Kunieda, MD, Satoka Hashimoto, MD, Motoki Inaji, MD, Hiroshi Shirozu, MD, Kyoko Kanazawa, MD, Masaki Iwasaki, MD, Naotaka Usui, MD, Yushi Inoue, MD, Taketoshi Maehara, MD, Akio Ikeda, MD
Brain Communications, fcac222, https://doi.org/10.1093/braincomms/fcac222
Published: 03 September 2022
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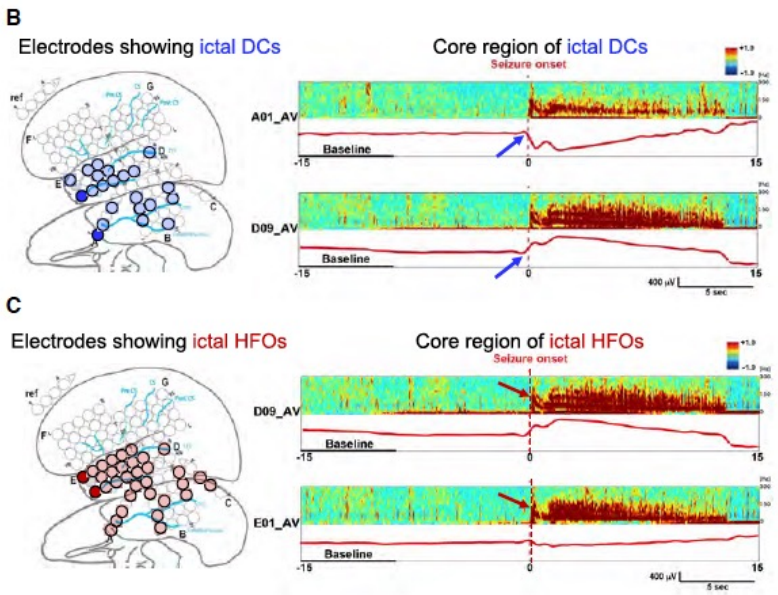

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Epiletogenic network might be present,

from icDCs area to icHFOs area??

10

Conclusion

1) It is the first large cohort multi-institutional study on wide-band EEG analysis and postoperative outcomes in Japan.

2) icDCs onset was statistically earlier than icHFOs onset in both MTLE and Neocortical epilepsy.

3) icDCs more frequently recorded than icHFOs among both patients (92% vs. 71%) and seizures (86% vs. 62%).

4) Complete resection of the core area of icDCs significantly correlated with favorable outcomes, similar to icHFOs outcomes.

5) The independent significance of icDCs and icHFOs should be considered as reliable biomarkers to achieve favorable outcomes in epilepsy surgery.

↓

Epiletogenic network might be present, from icDCs area to icHFOs area.

If so, both may be resected, and only either icDCs area or icHFOs area is not enough for the optimal surgical outcome.

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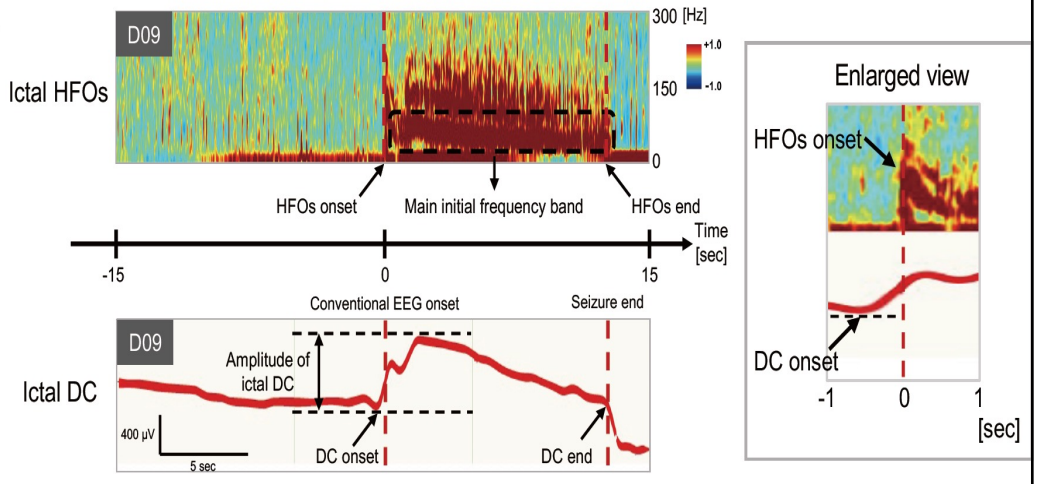
Analyzed by wide-band EEG analysis software (Nihon Kohden, Tokyo, Japan)



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	Amplifier	Occurrence rate among patients (%)		Occurrence rate among seizures (%)		Correspondence of core electrodes of ictal DC and HFOs (%)	ictal DC amplitude (μV)	ictal DC duration (sec)	ictal HFOs frequency (Hz)	ictal HFOs duration (sec)
		ictal DC	ictal HFOs	ictal DC	ictal HFOs					
Nakatani et al., 2021 (n=61)	AC	92	71	86	62	39	1037 ± 570	15.8 ± 7.8 *	R (FR)	7.0 ± 4.1 *
Ikeda et al., 1999[18] (n=9)	AC	82 (subdural) 84 (scalp)	–	85 (subdural) 23 (scalp)	–	–	200 – (subdural) 50 – (scalp)	–	–	–
Modur et al., 2009[25] (n=1)	AC	100	100	100	75	10 – 75 ? (no detail)	–	– 25	R	Sustained (no detail)
Kim et al., 2009[41] (n=11)	DC	91	–	69.5	–	–	800 – 10,000	1 – 493	–	–
Wu et al., 2014[4] (n=15)	AC	100	67	91	81	19.3	1,700 ± 910	5 – 180	R, FR	–
Kanazawa et al., 2015[5] (n=16)	AC	75	50	71.3	46.3	–	903.1 ± 462.8	35.5 ± 15.6	R, FR	10.7 ± 9.7
Thompson et al., 2016[24] (n=15)	AC	100	–	100	–	–	300 – 8,500	– over 100	–	–

*: Long-lasting icDC or icHFOs beyond 30 sec analysis time-window after the seizure onset were excluded due to the limitation of the software.

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Application of LFF and HFF

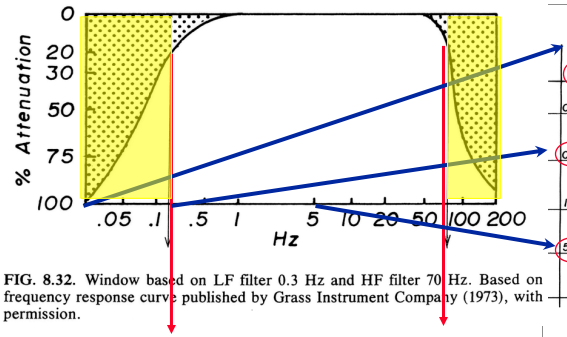

FIG. 8.32. Window based on LF filter 0.3 Hz and HF filter 70 Hz. Based on frequency response curve published by Grass Instrument Company (1973), with permission.

LFF=0.5 Hz
TC=0.3 s

HFF
70 Hz

Time constant (TC)

to filter out slow components

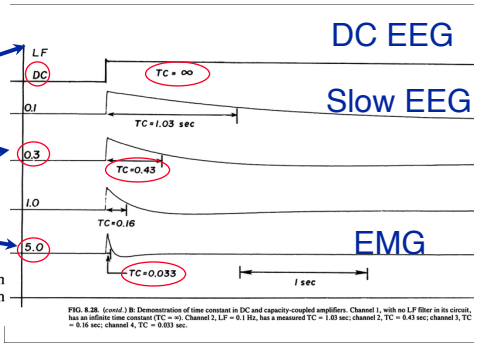

FIG. 8.28. (cont.) B: Demonstration of time constant in DC and capacity-coupled amplifiers. Channel 1, with no LF filter in its circuit, has an infinite time constant (TC = ∞). Channel 2, LF = 0.1 Hz, has a measured TC = 1.03 sec; channel 2, TC = 0.43 sec; channel 3, TC = 0.16 sec; channel 4, TC = 0.033 sec.

TC	x	LFF	=0.16(1/2π)
0.1 sec		1.6 Hz	
0.3 sec		0,5Hz	
1 sec		0.16 Hz → scalp ?	
2 sec		0.08 Hz → scalp, invasive	
10 sec		0.016 Hz → invasive ~~scalp~~	

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Todays scalp case by Dr. Adachi

Acta Neurochir (Wien) (2004) 146: 1021–1026
DOI 10.1007/s00701-004-0311-7

Case Report

Surgical treatment of seizures from the peri-Sylvian area perinatal insult: a case report of ictal hypersalivation

T. Satow[1,2], A. Ikeda[3], N. Hayashi[2], J. Yamamoto[1], M. Takayama[1,2], M. Matsuhashi[1], N. Mikuni[2], J. Takahashi[2], H. Shibasaki[1,3], S. Miyamoto[2], and N. Hashimoto[2]

[1] Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan
[2] Department of Neurosurgery, Kyoto University Graduate School of Medicine, Kyoto, Japan
[3] Department of Neurology, Kyoto University Graduate School of Medicine, Kyoto, Japan

Summary

Objectives and importance. It is important to evaluate the seizure manifestation of epilepsy before surgical planning. A patient with partial epilepsy manifesting hypersalivation who underwent resection of the epileptogenic foci with satisfactory postoperative seizure control is reported.

Clinical presentation and intervention. A 26-year-old man, with a history of perinatal asphyxia, started having medically intractable partial epilepsy at the age of 10 years. His seizure was characterized by throat discomfort followed by hypersalivation. Brain MRI showed an atrophic lesion around the peri-Sylvian area. Scalp recorded EEG did not demonstrate robust epileptiform activity localized enough to define the epileptogenic zone. The patient underwent invasive recording by multiple subdural electrode grids, which showed that the seizure arose from the left anterior frontal operculum. After resection of epileptogenic opercular cortex, the seizures disappeared with no additional neurological deficits.

Conclusion. Although the responsible sites for ictal drooling are distributed in multiple areas including insula, medial temporal area and operculum, the seizure can be successfully controlled by focus resection of the frontal opercular area in a selected patient with careful presurgical evaluation.

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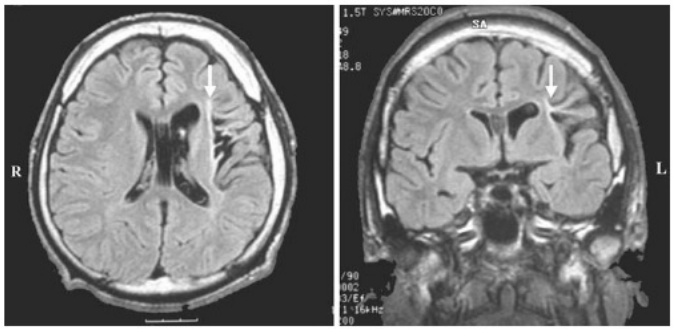
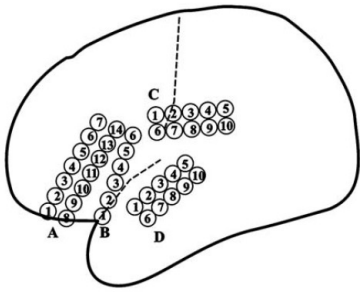
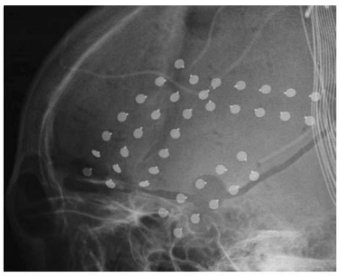




(c)



(b)

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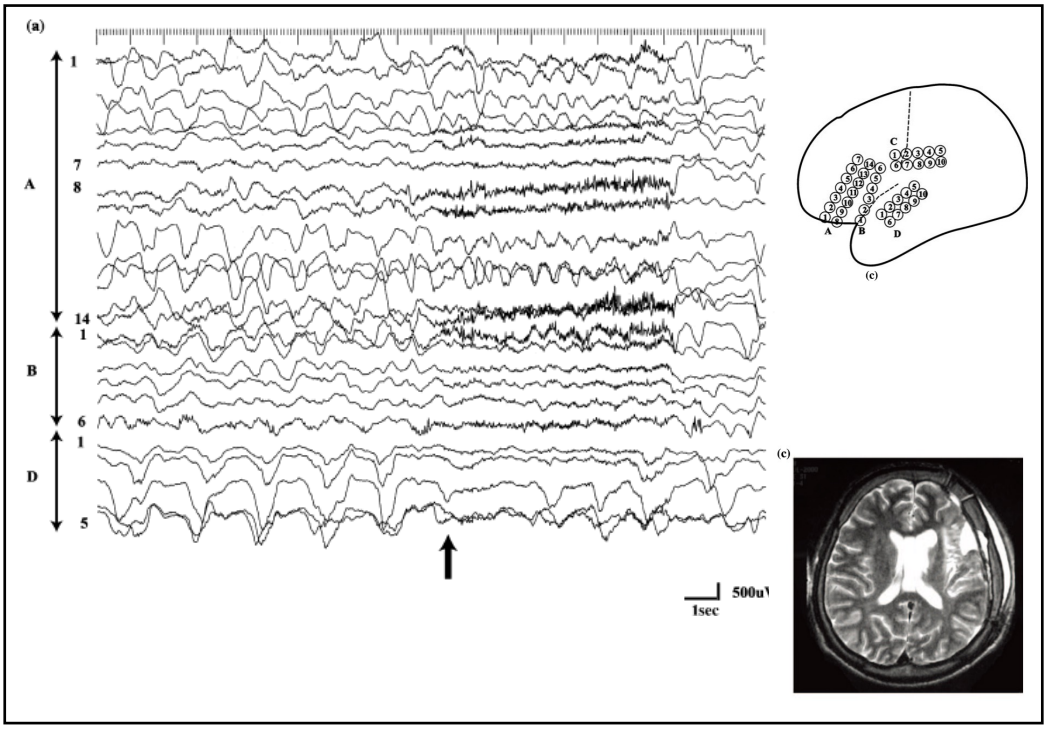

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Today's content, and highlight points

AMED (Japan Agency for Medical Research and Development)
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International Collaboration

Implementation of wide band EEG in epilepsy care by digital EEG

11th April 2025
(Friday)

Wide-band EEG from DC shifts to HFO 5

Moderator
Dr. Shenny Dianathasari Santoso
(Dr. Hasan Sadikin Central General Hospital, Indonesia)

Contents
- ✔ One point lecture
  by Prof. Akio IKEDA, Kyoto, Japan
- ✔ Case presentation
  by Dr. Katsuya KOBAYASHI, Kyoto, Japan
- ✔ Case discussion from different institutes
  To Be Announced

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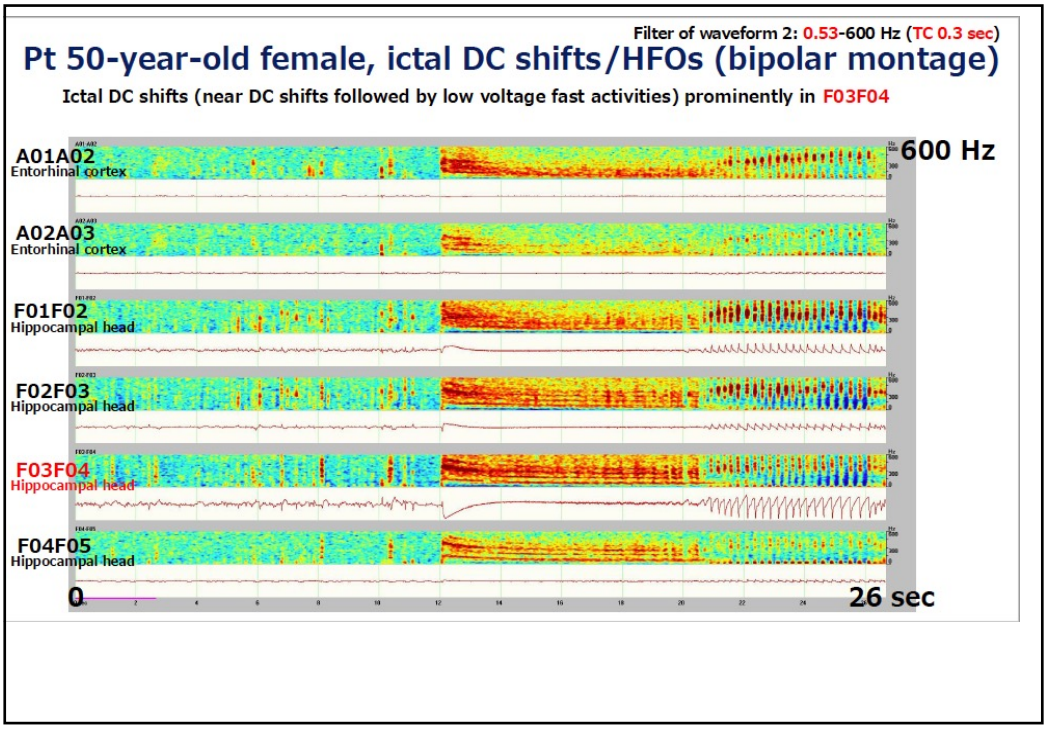

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Seizure-onset patterns in focal cortical dysplasia and neurodevelopmental tumors: Relationship with surgical prognosis and neuropathologic subtypes

*†Stanislas Lagarde, *†Francesca Bonini, *†Aileen McGonigal, *†Patrick Chauvel, *†Martine Gavaret, ‡Didier Scavarda, †§Romain Carron, †§Jean Régis, *Sandrine Aubert, *Nathalie Villeneuve, †Bernard Giusiano, ¶Dominique Figarella-Branger, *†Agnès Trebuchon, and *†Fabrice Bartolomei

Epilepsia, 57(9):1426–1435, 2016

Results: We identified six seizure-onset patterns using visual and time-frequency analysis: low-voltage fast activity (LVFA); preictal spiking followed by LVFA; burst of polyspikes followed by LVFA; slow wave/DC shift followed by LVFA; theta/alpha sharp waves; and rhythmic spikes/spike-waves. We found a high prevalence of patterns that

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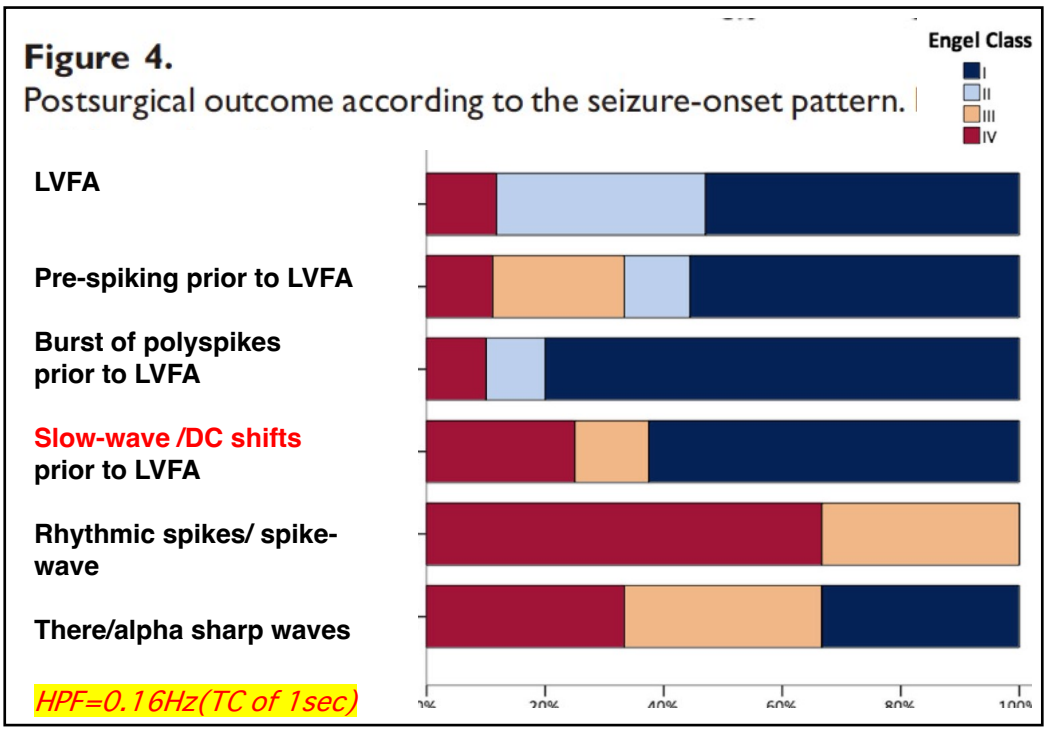

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Application of LFF and HFF

Time constant (TC)

to filter out slow components

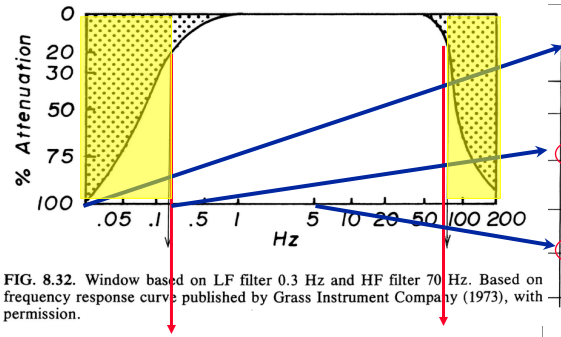
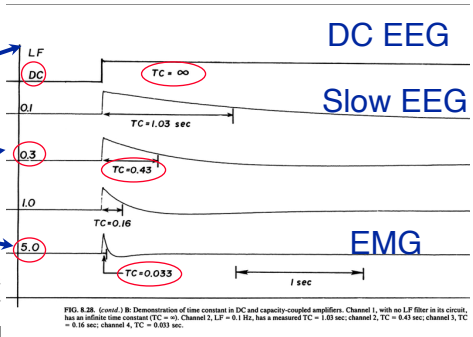


FIG. 8.32. Window based on LF filter 0.3 Hz and HF filter 70 Hz. Based on frequency response curve published by Grass Instrument Company (1973), with permission.



LFF=0.5 Hz
TC=0.3 s

HFF
70 Hz

TC	x	LFF	=0.16(1/2π)
0.1 sec		1.6 Hz	
0.3 sec		0,5Hz	
1 sec		0.16 Hz → scalp ?	
2 sec		0.08 Hz → scalp, invasive	
10 sec		0.016 Hz → invasive ~~scalp~~	

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hard disk (16 bits/ sample) using no digital filter. Two hardware filters were present in the acquisition procedure: a high-pass filter (cutoff frequency equal to 0.16 Hz at −3 dB), and an anti-aliasing low-pass filter (cutoff frequency equal to 97 Hz at 256 Hz, 170 Hz at 512 Hz, or 340 Hz at 1,024 Hz).

LFF of 0.16Hz (=TC of 1sec) was used

TC	x	LFF	=0.16(1/2π)
0.1 sec		1.6 Hz	
0.3 sec		0,5Hz	
1 sec		0.16 Hz → scalp ?	
2 sec		0.08 Hz → scalp, invasive	
10 sec		0.016 Hz → invasive ~~scalp~~	

23

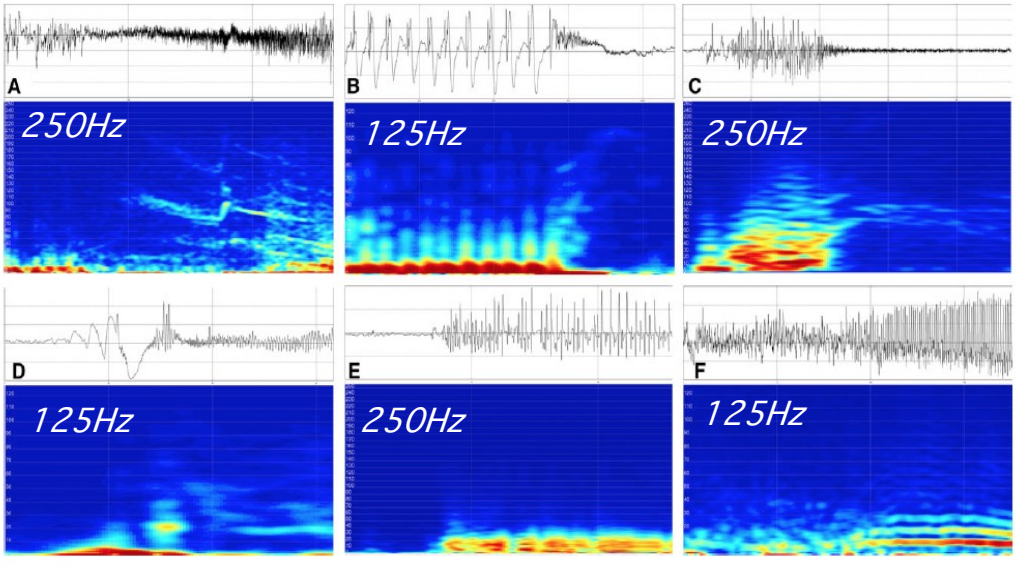

Figure 2.
The six patterns of seizure onset according to the time-frequency representation from SEEG trace. (**A**) Low-voltage fast activity (LVFA). (**B**) Preictal spiking with rhythmic spikes of low frequency followed by LVFA. (**C**) Burst of polyspikes of high frequency and amplitude followed by LVFA. (**D**) Slow wave or baseline shift followed by LVFA. (**E**) Rhythmic spikes or spike-waves, at low frequency and with high amplitude. (**F**) Theta/alpha sharp activity with progressive increasing amplitude.

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RESEARCH ARTICLE

Epilepsia

Received: 16 February 2024 | Revised: 11 July 2024 | Accepted: 17 July 2024

Investigating current clinical opinions in stereoelectroencephalography-informed epilepsy surgery

John Thomas[1,2] | Chifaou Abdallah[1] | Zhengchen Cai[1] | Kassem Jaber[1] | Jean Gotman[1] | Sandor Beniczky[3] | Birgit Frauscher[1,2,4]

Out of 14 ictal s-EEG features

Opinion from 321 experts

50.2% in each