March 14, 2025

AMED (Japan Agency for Medical Research and Development) Supports

International Collaboration

Implementation of wide band EEG in epilepsy care by digital EEG

No.4
One point comment:
Wide Band EEG Analysis
Now ready for clinical implementation

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Kyoto University Graduate School of Medicine
Kyoto, JAPAN

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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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28th February 2025
(Friday)

Wide-band EEG from DC shifts to HFO 3

Moderator
To be determined
(A Dr. from Regional General Hospital Dr. Soetomo, Surabaya, Indonesia)

Contents
- ✔ Mini lecture as one point comment from Prof. Akio IKEDA (Kyoto University, Japan) [15 min.]
- ✔ 1 case from Kyoto University (scalp-EEG of ictal DC shifts and ictal HFO) from Dr. Yoko TOMODA or Dr. Tomomi ADACHI (Kyoto University, Japan)
- ✔ 1 or 2 cases from different institutes
  Thai chapter: Dr. Totsapol
  Indonesia chapter: To Be Announced

Scalp EEG

Subdural EEG

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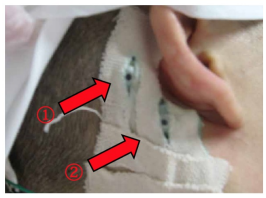
Recording condition

1) LFF is kept open for continuous monitoring.
2) System reference electrode should not be epileptically irritative and the metal should be identical to that of recording electrode, i.e., platinum scalp electrodes,
3) Scalp electrodes made by platinum are placed as the ① system reference and ② ground electrode.
Electrode impedence of the two is kept below <5kohm

(Ikeda et al., 1999; Kanazawa et al,2014)



Recording

Invasive recording
Ground electrode
System reference electrode
Platinum electrode

Scalp recording as usual
Ground electrode
System reference electrode
Ag/AgCL electrode

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Application of LFF and HFF

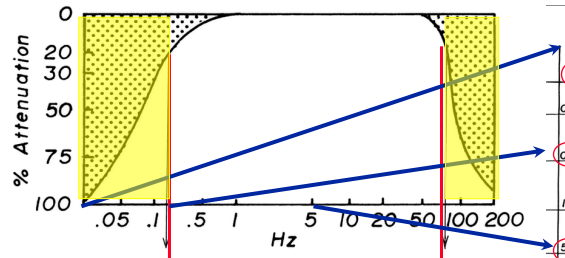


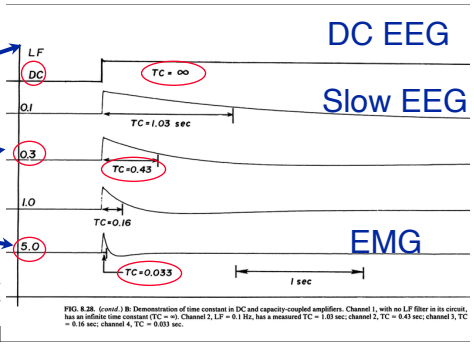
FIG. 8.32. Window based on LF filter 0.3 Hz and HF filter 70 Hz. Based on frequency response curve published by Grass Instrument Company (1973), with permission.

LFF=0.5 Hz
TC=0.3 s

HFF
70 Hz

Time constant (TC)

to filter out slow components



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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Display condition

1) Referential montage is recommended as display montage
2) System reference electrode should not be epileptically irritative and the metal should be identical to that of recording electrode, i.e., platinum scalp electrodes,
3) System reference electrode and display reference electrode are initially identical in order to avoid any mis-reformating, i.e., mastoid process skin electrodes.
4) Once initial, display reference electrode was not suitable (i.e., motion artifacts, etc.), it could be changed to 1) non-irritative subdural electrode or 2) averaged electrode activity.

(Ikeda et al., 1999; Kanazawa et al, 2014)

Display of EEG

1) Invasive EEG
Referential montage is good
reference electrode
one of silent electrodes
averaged reference
Ictal DC shifts, ictal HFO

Bipolar montage
Ictal DC shifts, ictal HFO

2) Scalp EEG
Bipolar montage
It is useful even if EMG & movement artifacts are present,
~~Ictal DC shifts~~, ictal HFO

Referential montage
It is only recommended without massive EMG & movement artifacts
Ictal DC shifts, ictal HFO

If scalp EEG is good without artifacts, referential montage can be used

6

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Display of EEG

1) Referential montage
invasive, scalp

reference electrode
one of silent electrodes
averaged reference

If scalp EEG is good without artifacts, referential montage can be used

2) Bipolar montage
invasive, scalp

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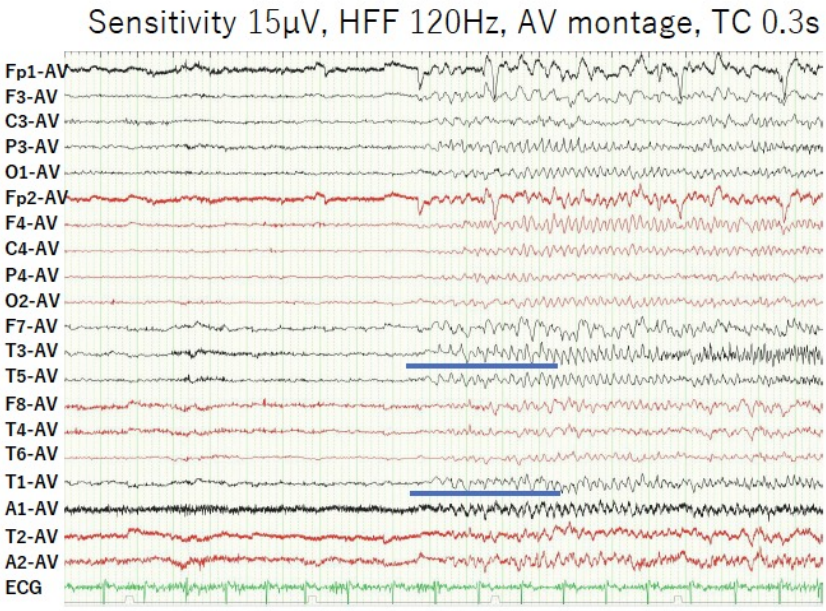

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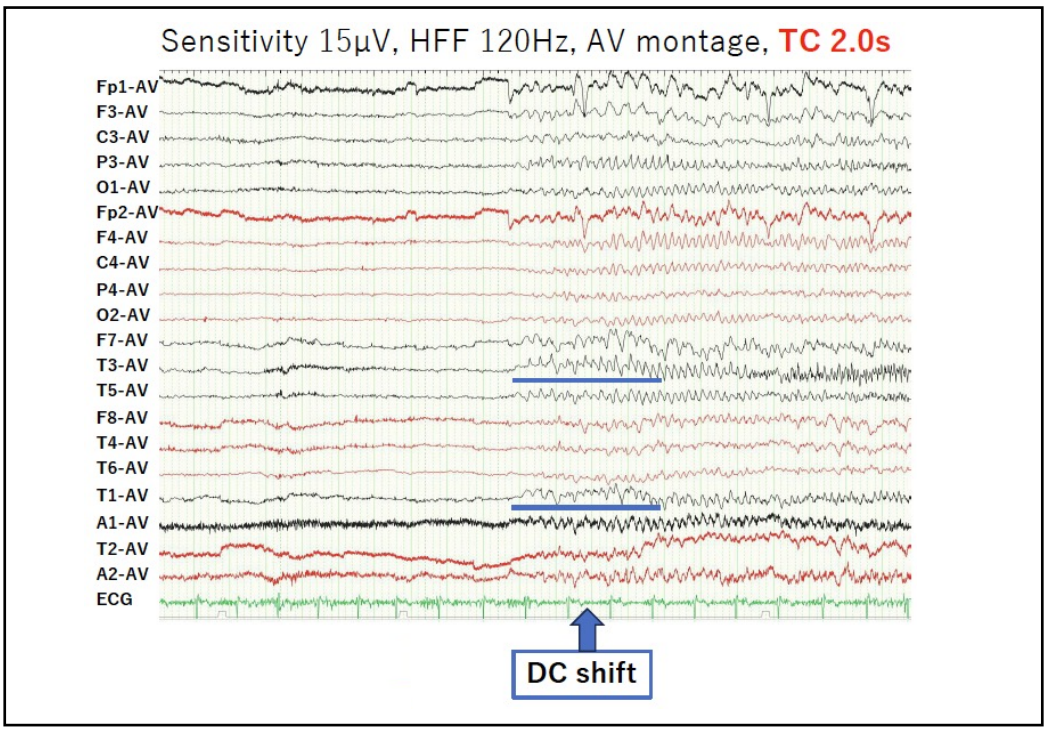
Sensitivity 15μV, HFF 120Hz, AV montage, TC 2.0s
Fp1-AV
F3-AV
C3-AV
P3-AV
O1-AV
Fp2-AV
F4-AV
C4-AV
P4-AV
O2-AV
F7-AV
T3-AV
T5-AV
F8-AV
T4-AV
T6-AV
T1-AV
A1-AV
T2-AV
A2-AV
ECG
DC shift

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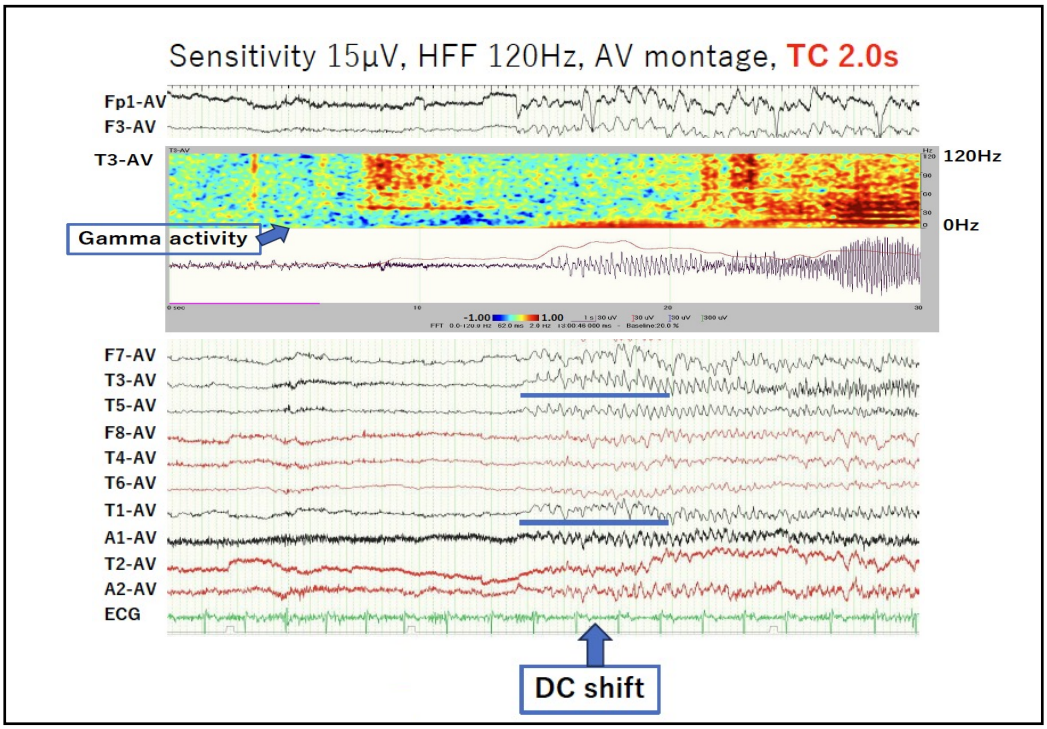
Sensitivity 15μV, HFF 120Hz, AV montage, TC 2.0s
Fp1-AV
F3-AV
T3-AV
120Hz
0Hz
Gamma activity
F7-AV
T3-AV
T5-AV
F8-AV
T4-AV
T6-AV
T1-AV
A1-AV
T2-AV
A2-AV
ECG
DC shift

10

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Ictal DC shifts, ictal HFO

If scalp EEG is good without artifacts, referential montage can be used

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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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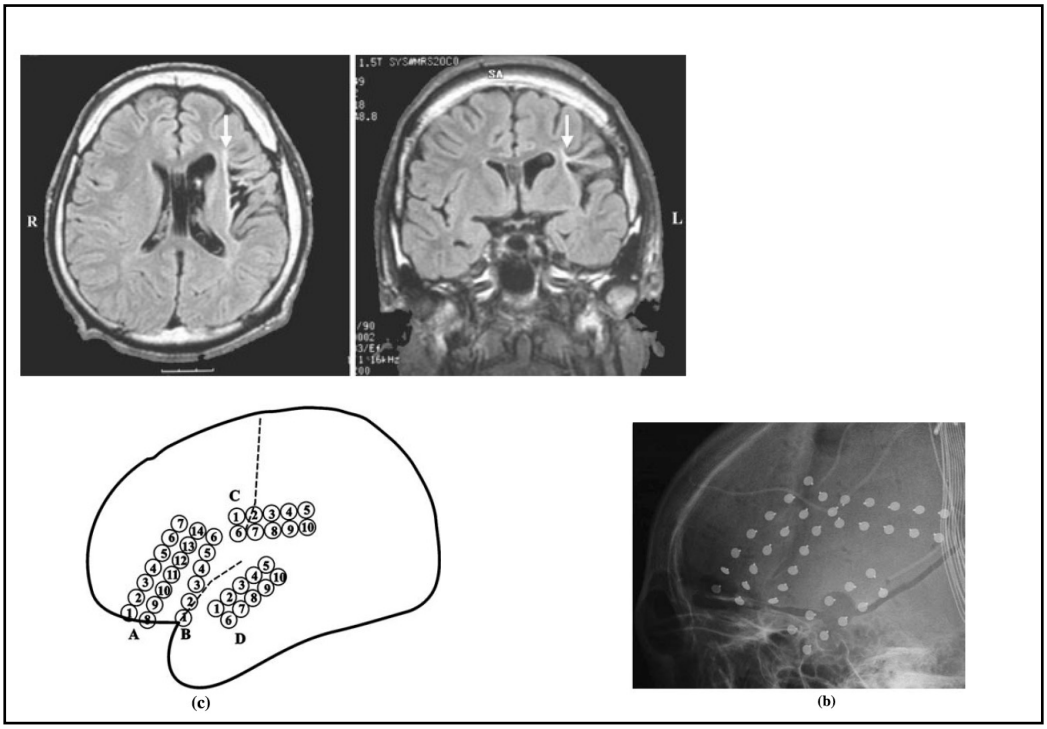

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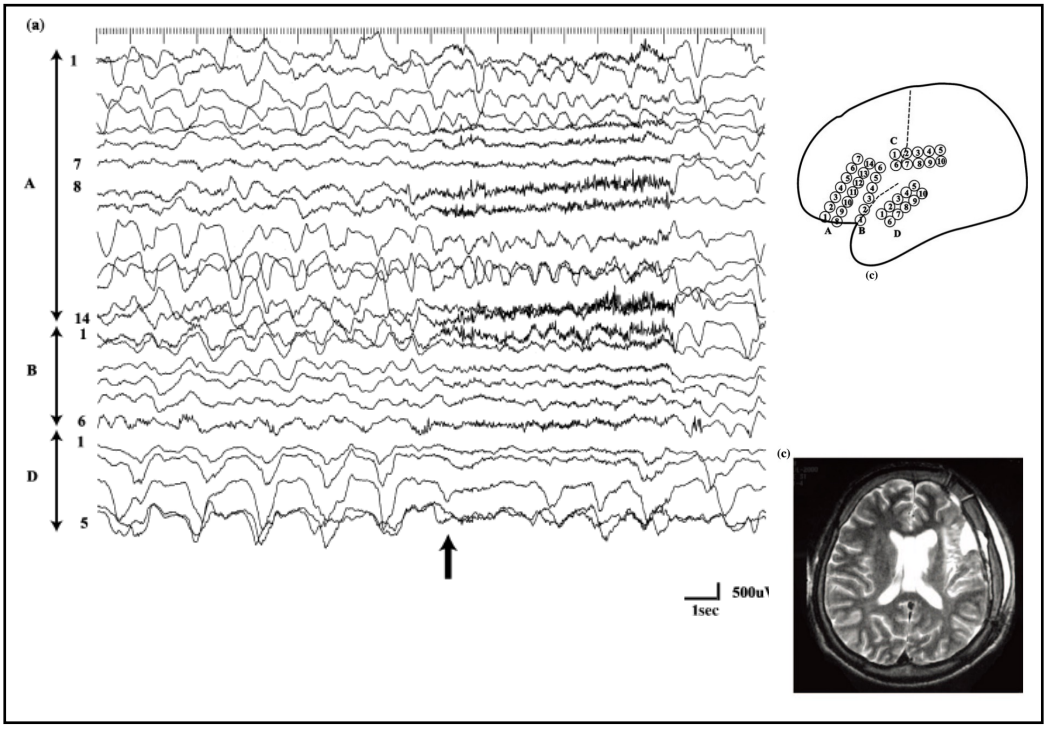

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Epiletogenic network might be present, from icDCs area to icHFOs area??

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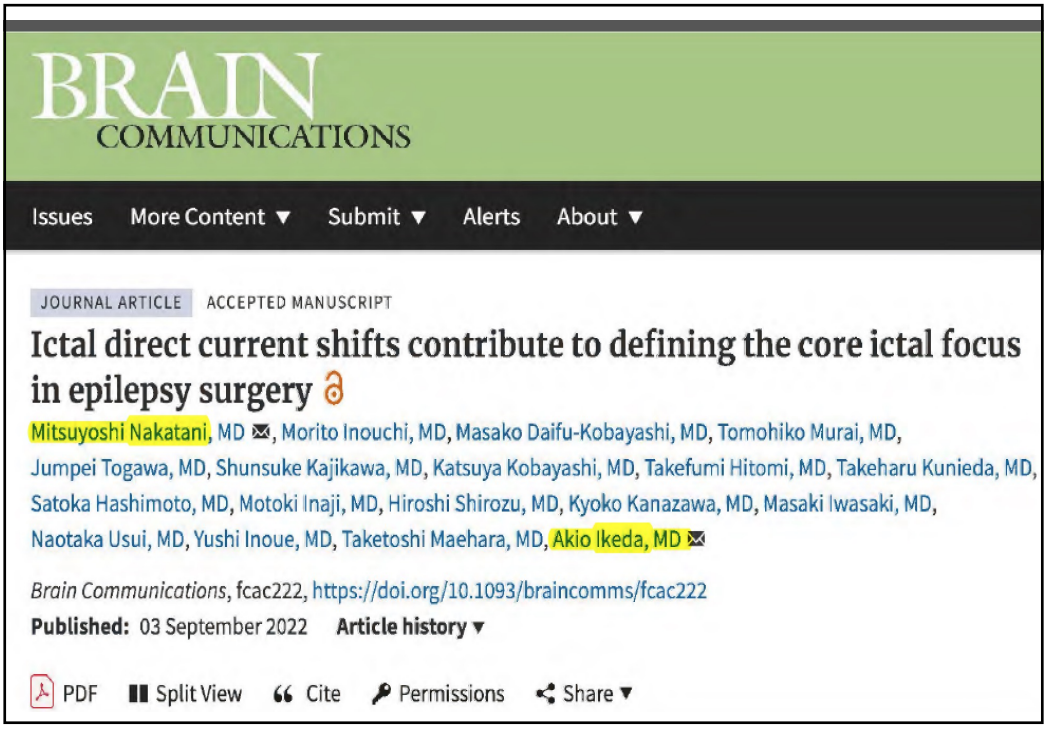

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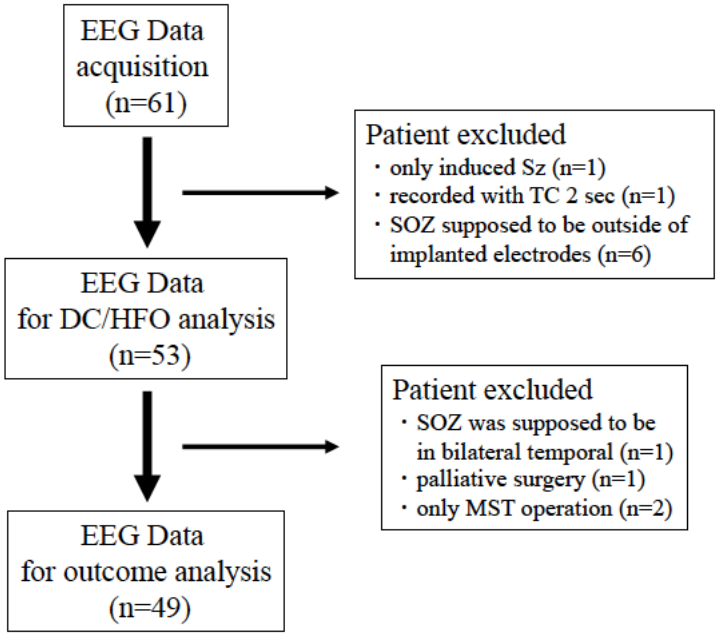
Large cohort studies on postoperative outcomes are still lacking.



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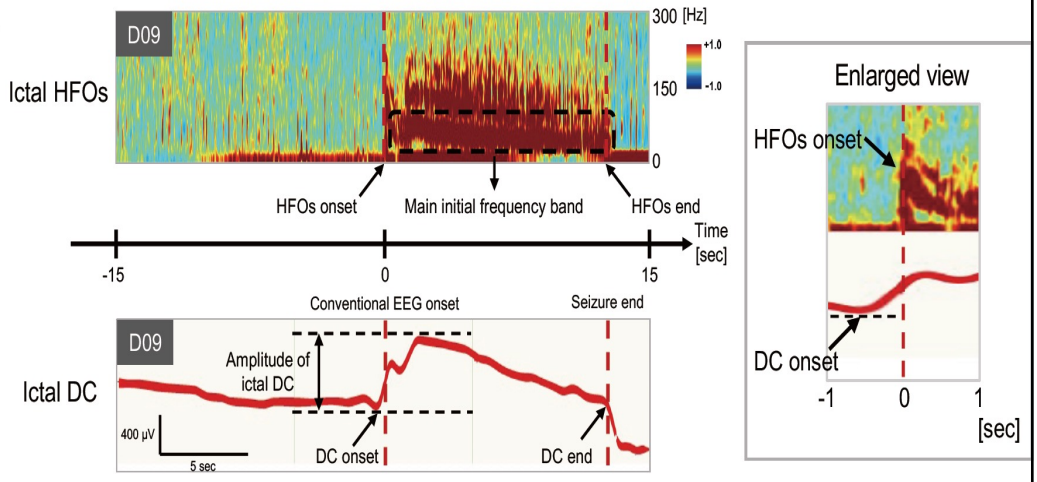
Analyzed by wide-band EEG analysis software (Nihon Kohden, Tokyo, Japan)



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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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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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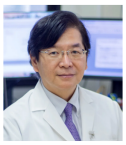
"You are invited to register for a Zoom webinar!

When: Mar 17, 2025 08:00 AM Eastern Time (US and Canada)

Topic: UH Epilepsy Grand Rounds
Register in advance for this webinar:
https://uhhospitals.zoom.us/webinar/register/WN_nIm61IAORhez6LMID4PILg
Join from an H.323/SIP room system:
H.323: 144.195.19.161 (US West) or 206.247.11.121 (US East)
Meeting ID: 975 9248 6034
Passcode: 144250
SIP: 97592486034@zoomcrc.com
Passcode: 144250

After registering, you will receive a confirmation email containing information about joining the webinar."

UH Epilepsy Grand Rounds

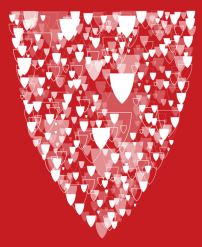


March 17th, 2025

Topic: Ictal DC shifts and ictal HFO: a mysterious wide-band EEG for astrocytes and neurons

Prof. Akio Ikeda, MD, PhD, FACNS
Professor, Department of Epilepsy, Movement Disorders & Physiology
Kyoto University Graduate School of Medicine
Shogoin, Sakyo-ku
Kyoto, Japan

University Hospitals
Neurological Institute



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