ELEKTRODEPLASSERING
DOSEBEREGNING
BEHANDLINGSMONITORERING

Obligatorisk emnekurs ECT 15.3.2018

Per Bergsholm, overlege dr. med.
Psykiatrisk klinikk, Førde sentralsjukehus

Unilateral electrode placements

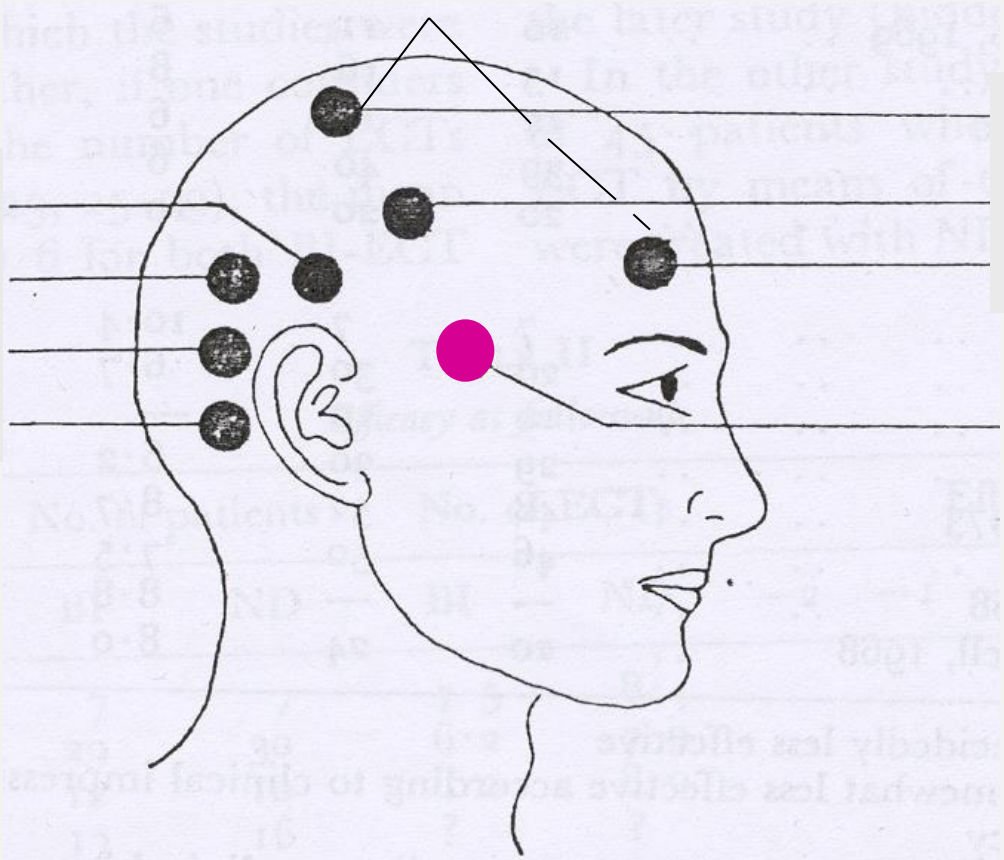
Pridmore and Rybak 1999

Zinkin and Birtchnell 1968

McAndrew et al 1967

Impastato and Karliner 1966

Halliday et al 1968



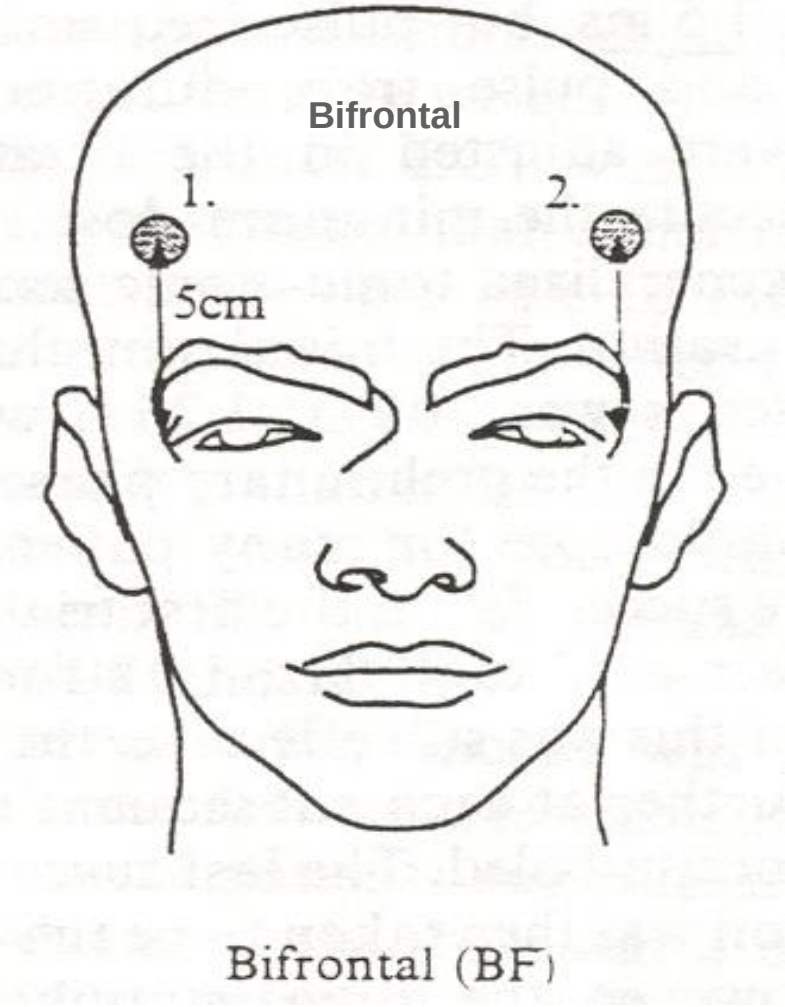
D'Elia 1970

Lancaster et al 1958

Muller 1971

Right frontotemporal position

Modified after d'Elia & Raotma. Br J Psychiatry 1975;126:83-9



Letemendia FJJ, Delva NJ et al. Therapeutic advantage of bifrontal electrode placement in ECT. Psychological Med 1993;23:349-60
Lawson et al, Ibid 1990;20:335-44

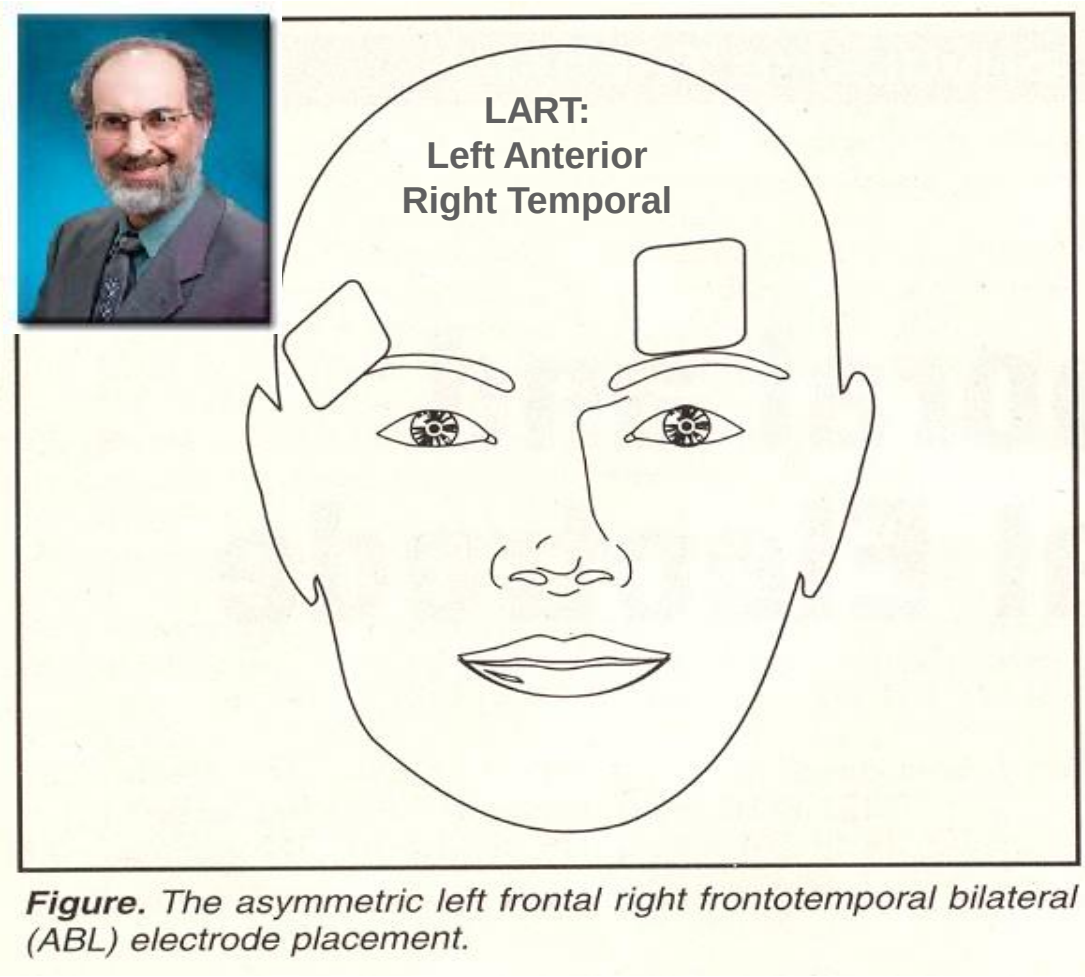
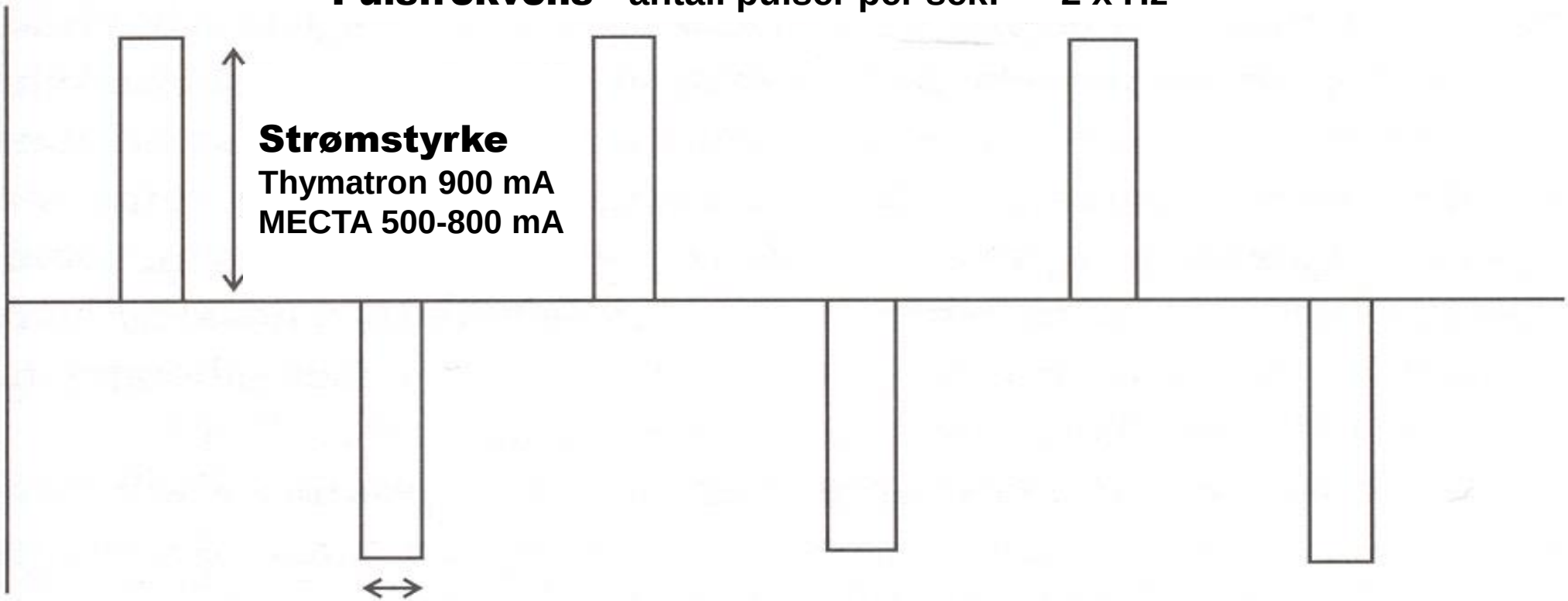


Figure. *The asymmetric left frontal right frontotemporal bilateral (ABL) electrode placement.*

Swartz CM, Evans CM. Bejond bitemporal and right unilateral electrode placements. Psychiatric Annals 1996;26:705-8

Per Bergsholm

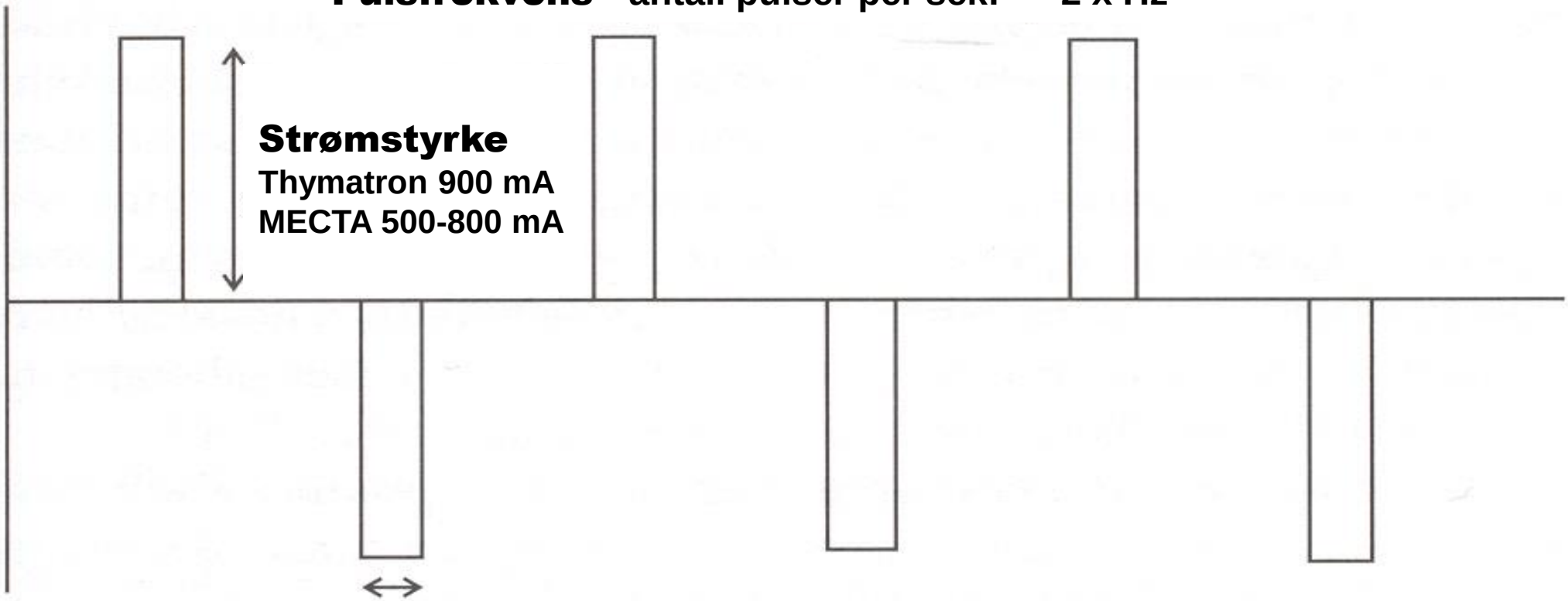
Sinusfrekvens - antall sinuser per sek: Hertz (Hz)
Pulsfrekvens - antall pulser per sek: 2 x Hz



Pulsbredde, ms: korte 0,5-2,0; ultrakorte <0,5 (oftest 0,25-0,30)

Pulstog-varighet, s

Sinusfrekvens - antall sinuser per sek: Hertz (Hz)
Pulsfrekvens - antall pulser per sek: 2 x Hz



Pulsbredde, ms: korte 0,5-2,0; ultrakorte <0,5 (oftest 0,25-0,30)

Pulstog-varighet, s

Ladning, mAs=mC: strømstyrke x strømvarighet (samlet varighet av alle pulsene)
Thymatron: 504 mC = 100%, 1008 mC = 200%

Strømvarighet, s: pulsbredde x pulsfrekvens (Hz x 2) x pulstog-varighet
= ladning / strømstyrke, maks ved 200% 1008/900=1,12 s

Per Bergsholm

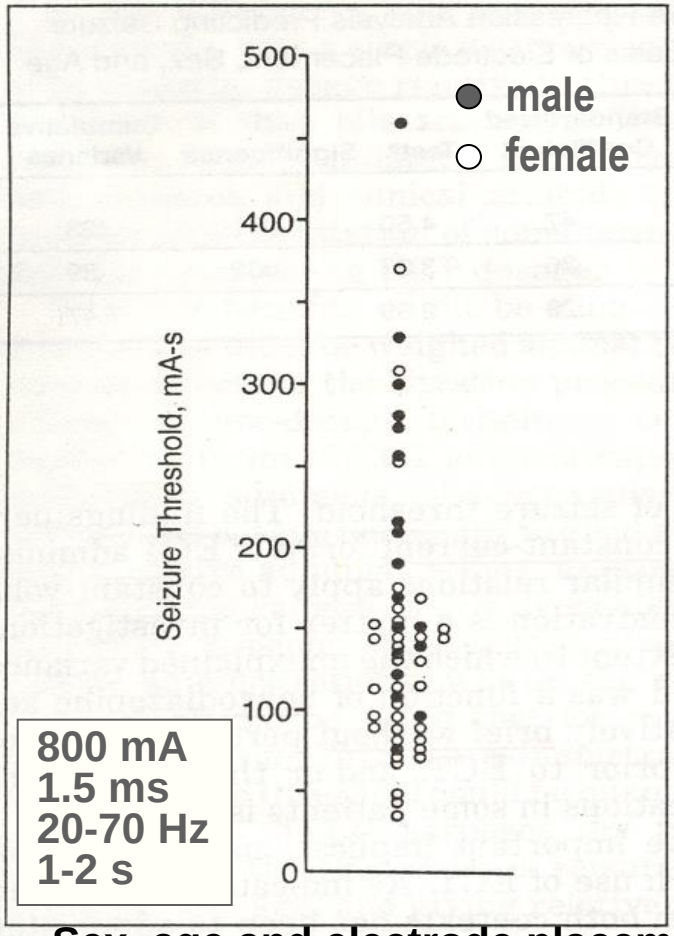
Seizure Threshold in Electroconvulsive Therapy

Effects of Sex, Age, Electrode Placement, and Number of Treatments

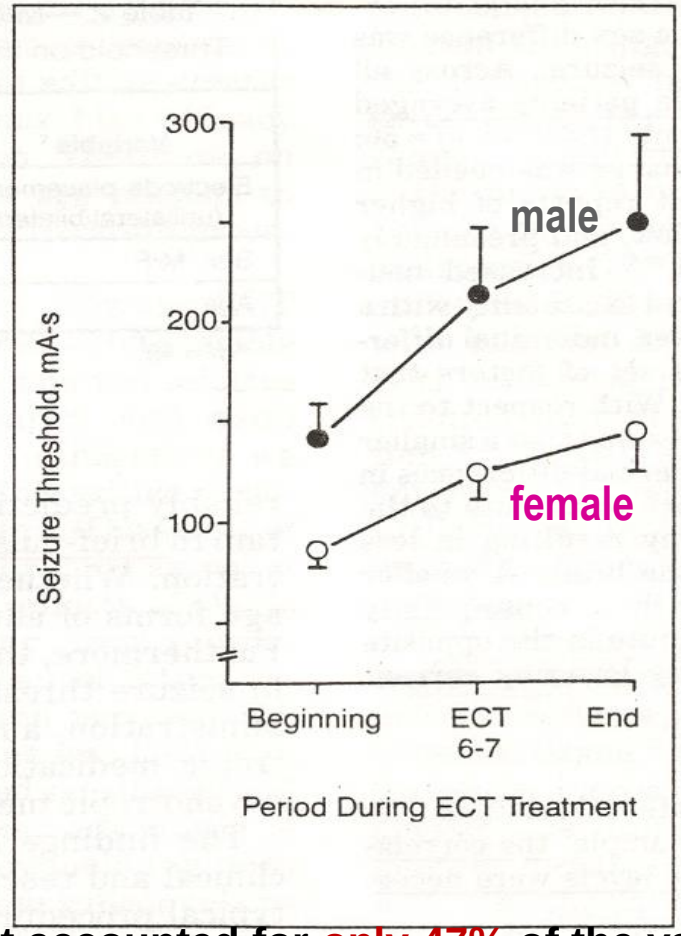
Sackeim H, Decina P, Prohovnik I, Malitz S

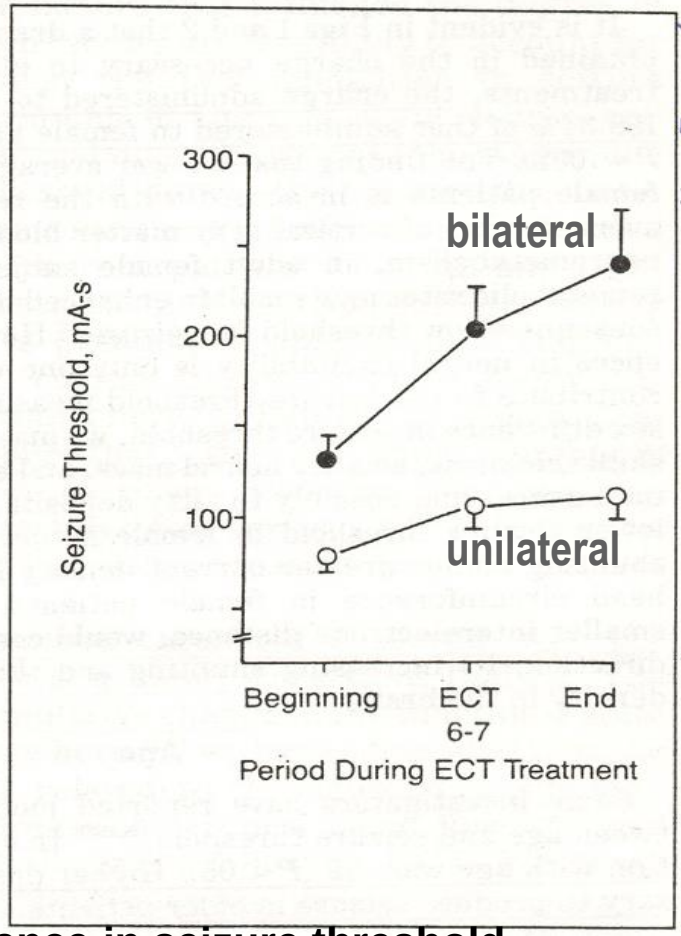
Arch Gen Psychiatry 1987;44:355-60

Age/threshold correlation .32



Male threshold 158% of woman





Sex, age and electrode placement accounted for only 47% of the variance in seizure threshold

DOSEBEREGNING

1. **Skandinavisk liminal titrering** til tonisk plantarekstensjon i stortær, særlig ved høyresidig plassering d'Elia, Ottosson & Strömgren 1983; Lamy, Bergsholm & d'Elia 1994
2. **Halv alders-% og alders-%** ved henholdsvis bitemporal Petrides & Fink 1996 og høyresidig plassering Abrams & Schwartz 1985
3. **Høydose 70-100 %,** særlig ved høyresidig plassering Abrams, Swartz & Vedak 1991
4. **Halv alders-%, alders-% og 100 %** ved henholdsvis bitemporal, bifrontal og høyresidig plassering Abrams 2002
5. **Anfallsterskel x1,5-2,5 og x2,5-6 (-10)** ved henholdsvis bitemporal Sackeim et al 1993, 2000 og høyresidig plassering Sackeim et al 2000, McCall et al 2000,2002
6. **Monitorerings/benchmark-basert** dosering Swartz 2002,2014; Mankad et al 2010 som også brukes sammen med de andre metodene
7. **Kjønnsjustering** Kessler et al 2010

Anfallsterskelen

The seizure threshold is defined as the minimum charge required to induce unequivocal ictal EEG activity (i.e. polyspike followed by 3 Hz spike-wave activity). By convention this should last at least 15 s so that a generalised seizure can be clearly documented.

Waite & Easton, red. The ECT Handbook, 3rd ed
The Royal College of Psychiatrists 2013

Restimulering

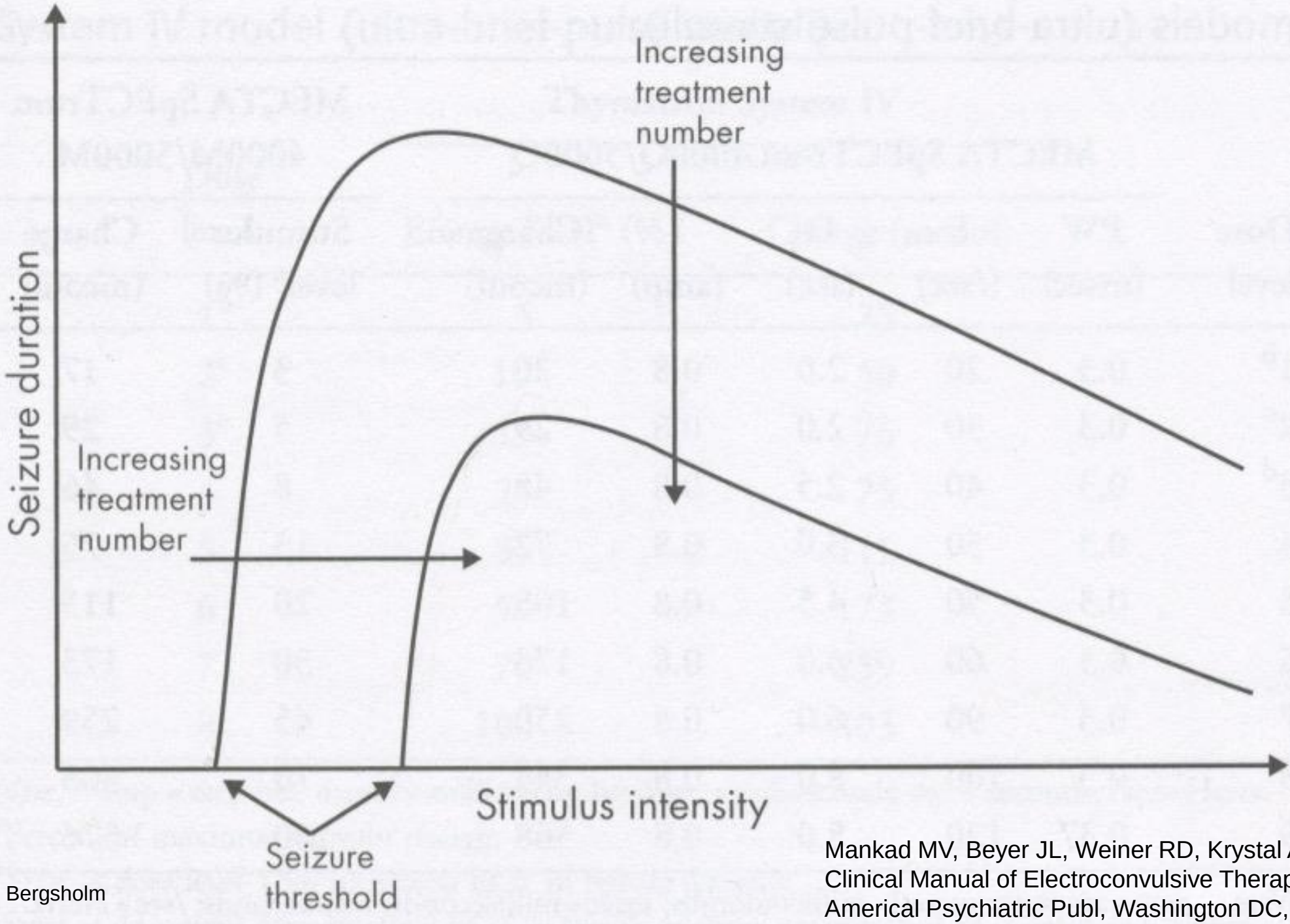
- **Stimulering uten anfall kan gi redusert terskel de nærmeste sekundene. Rask restimulering kan derfor gi summasjonseffekt (APA 2001).**
- **Anfallsterskelen stiger deretter raskt få sekunder etter stimuleringen.**
- **Hvis stimuleringen ikke ga noe anfall: Vent 20 s (APA 2001) til 40 s (Sackeim 1987) for at terskelen skal normaliseres.**
- **Hvis stimuleringen ga et abortivt/for kort anfall: Vent 45 s (APA 2001) til 90 s (Sackeim 1987) for at terskelen skal normaliseres.**

PASS OPP FOR UNDERDOSERING VED HØYRESIDIG ECT

BEHANDLINGSMONITORERING

1. **Klinisk bedring** objektivt og subjektivt samme dag, neste dag, over tid
2. EEG anfallsvarighet (sekunder)
3. EEG anfallsaktivitet (god, moderat, dårlig)
4. Postiktal EEG suppresjon / anfallsavslutning (god, moderat, dårlig)
5. Maksimal hjerteaktivitet under ECT-anfallet (peak HR)
6. Postiktal reorienteringstid (PRT)

IKKE SLAPP AV –
ØK KLINISK OPPFØLGING !



Mankad MV, Beyer JL, Weiner RD, Krystal AD
Clinical Manual of Electroconvulsive Therapy
Americal Psychiatric Publ, Washington DC, 2010

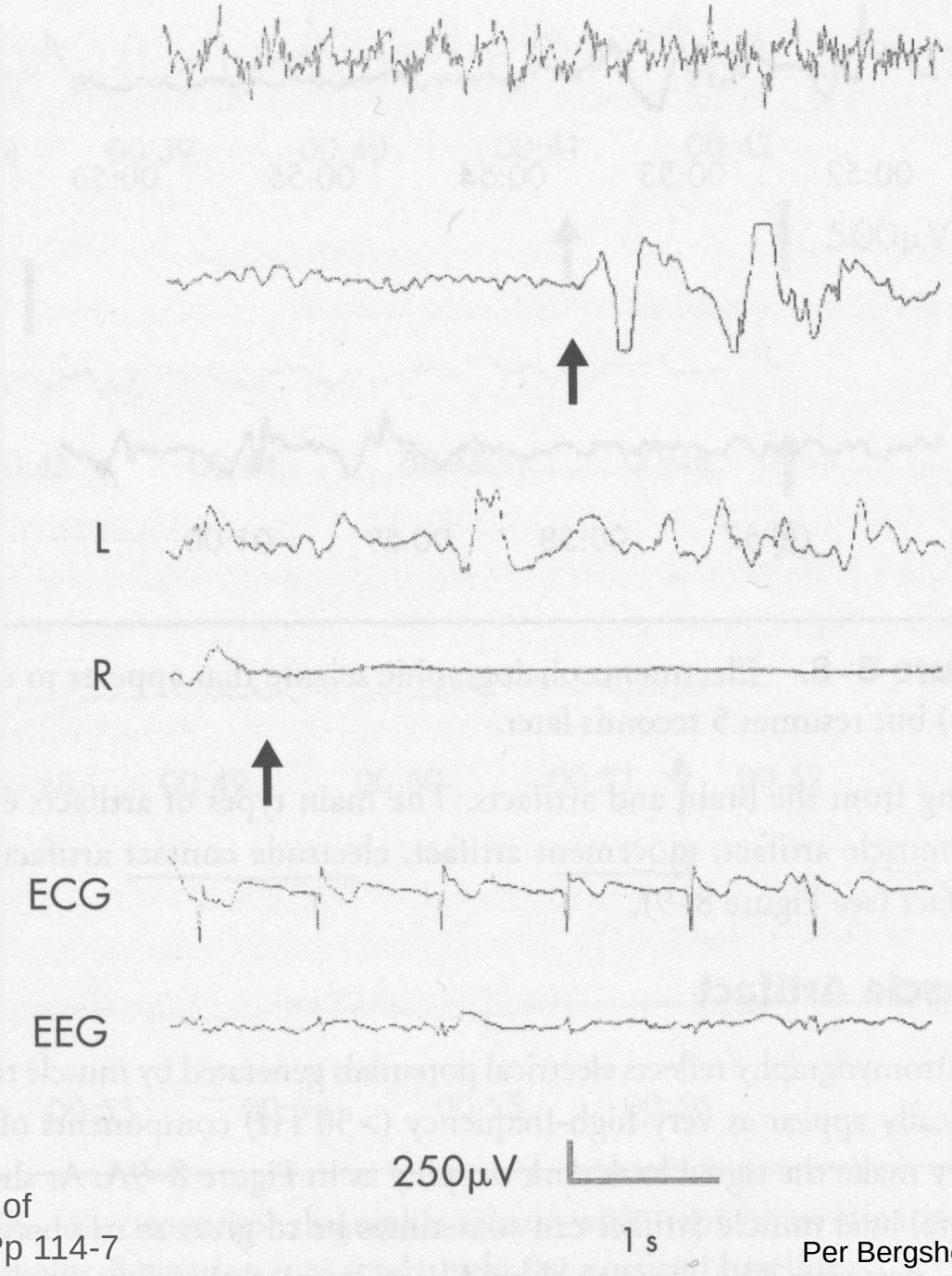
Per Bergsholm

Muscle Artifact

Movement Artifact

Electrode Contact Artifact

Electrocardiographic Artifact

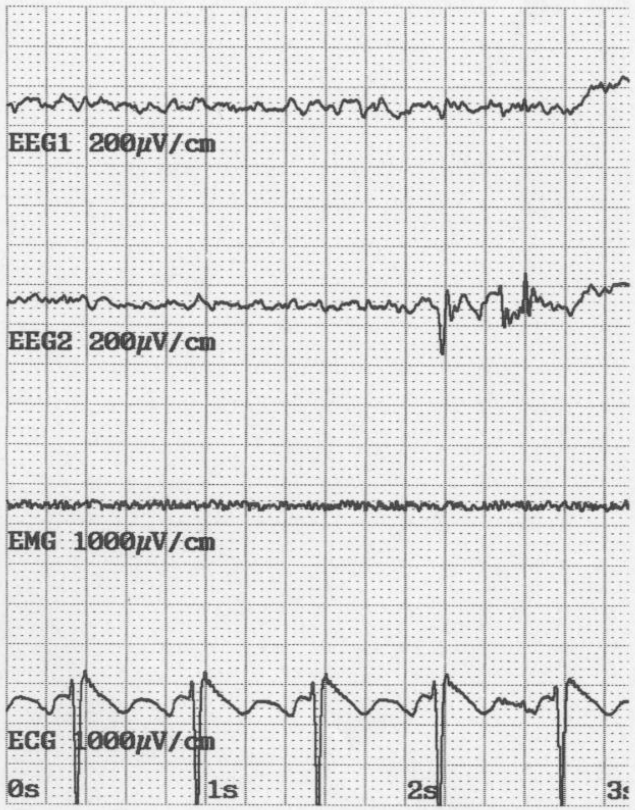


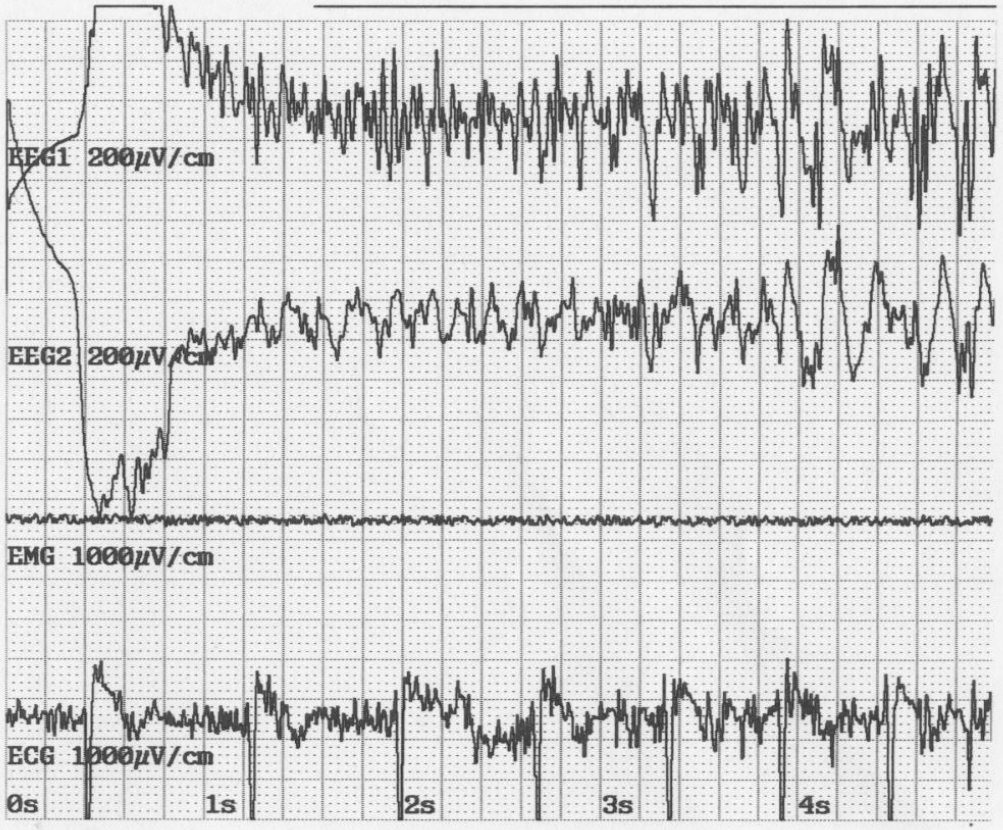
EEG Artifacts. Mankad, Beyer, Weiner, Krystal. Clinical Manual of Electroconvulsive Therapy. Washington DC, APA Press 2010. Pp 114-7

Per Bergsholm

Ideelt EEG-anfall

Kvinne 30 år med postpartum depresjon uten effekt av 4 måneder med høydose venlafaxin.
Remisjon etter 5 RUL ECT med dose 25% (125 mC), pulsvidde 0,5 ms og pulstog 7,0 s (Program: 2X Dose).

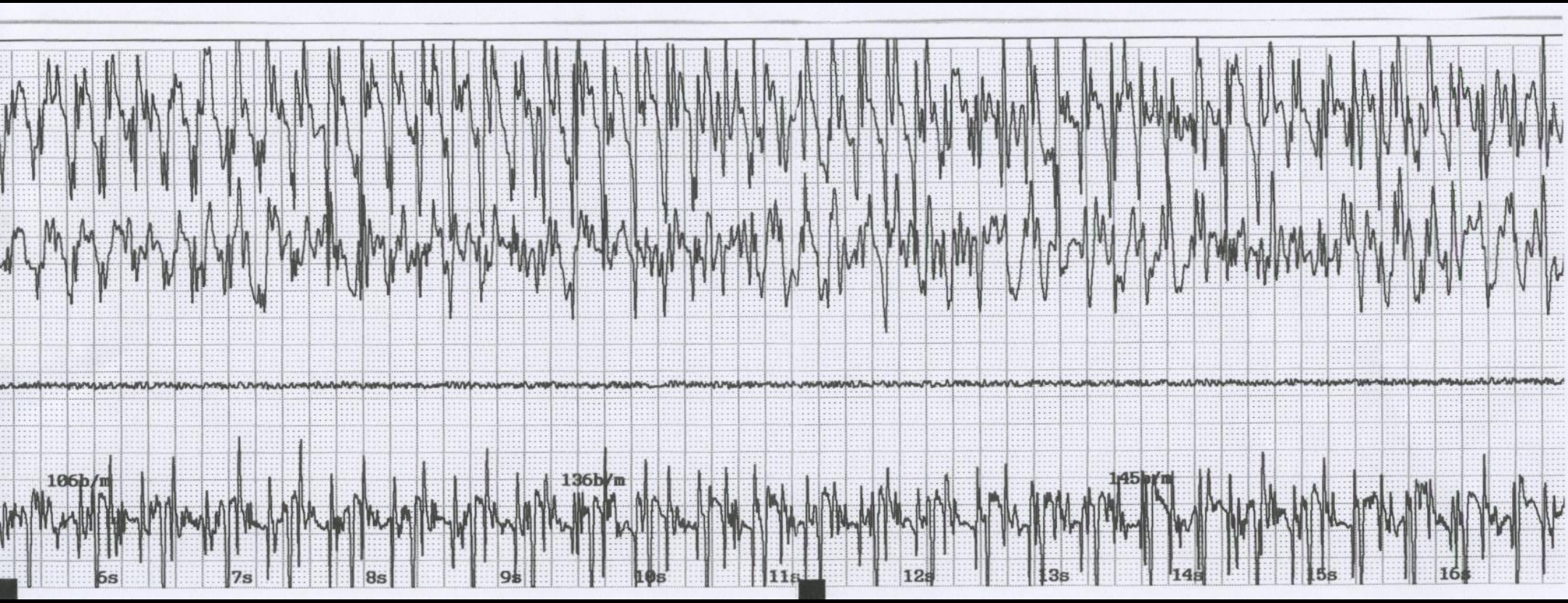




ECT nr 3 ark 1 – 18.11.15

Ideelt EEG-anfall

Kvinne 30 år med postpartum depresjon uten effekt av 4 måneder med høydose venlafaxin.
Remisjon etter 5 RUL ECT med dose 25% (125 mC), pulsvidde 0,5 ms og pulstog 7,0 s (Program: 2X Dose).



ECT nr 3 ark 2 – 18.11.15

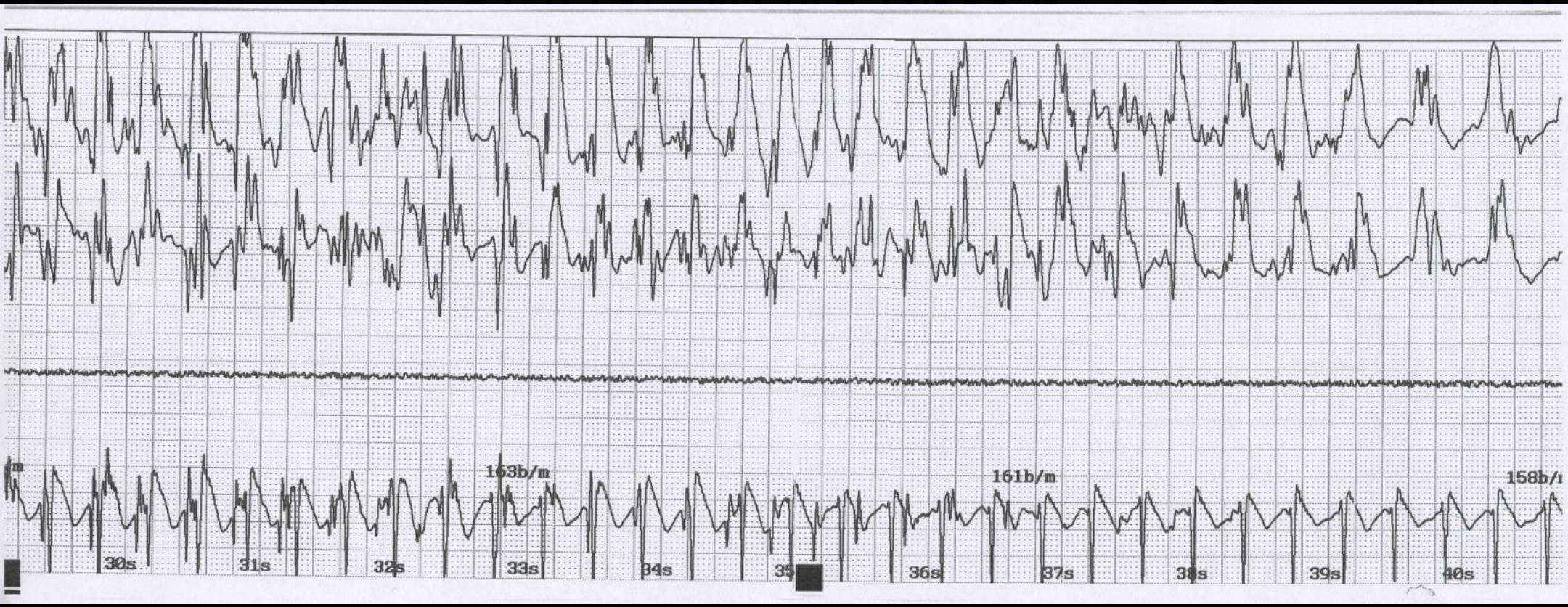
Ideelt EEG-anfall

Kvinne 30 år med postpartum depresjon uten effekt av 4 måneder med høydose venlafaxin.
Remisjon etter 5 RUL ECT med dose 25% (125 mC), pulsvidde 0,5 ms og pulstog 7,0 s (Program: 2X Dose).

ECT nr 3 ark 3 – 18.11.15

Ideelt EEG-anfall

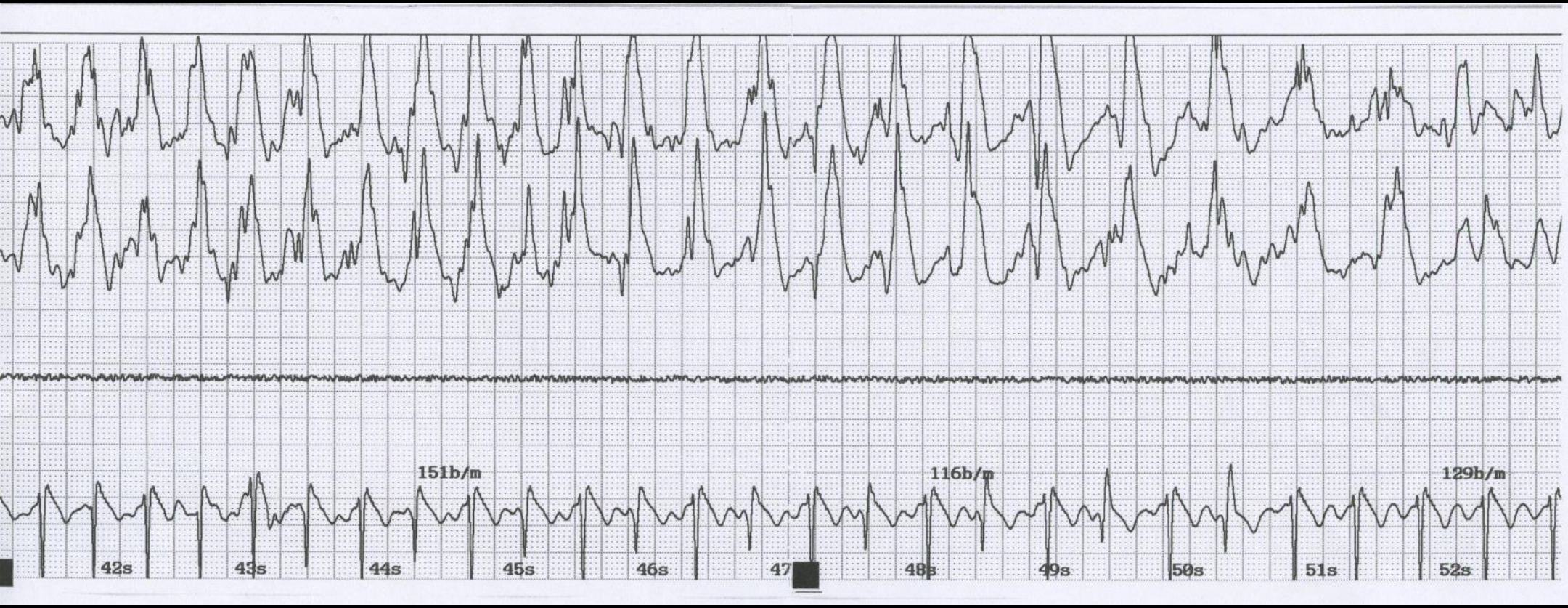
Kvinne 30 år med postpartum depresjon uten effekt av 4 måneder med høydose venlafaxin.
Remisjon etter 5 RUL ECT med dose 25% (125 mC), pulsvidde 0,5 ms og pulstog 7,0 s (Program: 2X Dose).



ECT nr 3 ark 4 – 18.11.15

Ideelt EEG-anfall

Kvinne 30 år med postpartum depresjon uten effekt av 4 måneder med høydose venlafaxin.
Remisjon etter 5 RUL ECT med dose 25% (125 mC), pulsvidde 0,5 ms og pulstog 7,0 s (Program: 2X Dose).



ECT nr 3 ark 5 – 18.11.15

Ideelt EEG-anfall

Kvinne 30 år med postpartum depresjon uten effekt av 4 måneder med høydose venlafaxin.
Remisjon etter 5 RUL ECT med dose 25% (125 mC), pulsvidde 0,5 ms og pulstog 7,0 s (Program: 2X Dose).

Thymatron System IV S/N: 42559
18/11/15 11:34:38

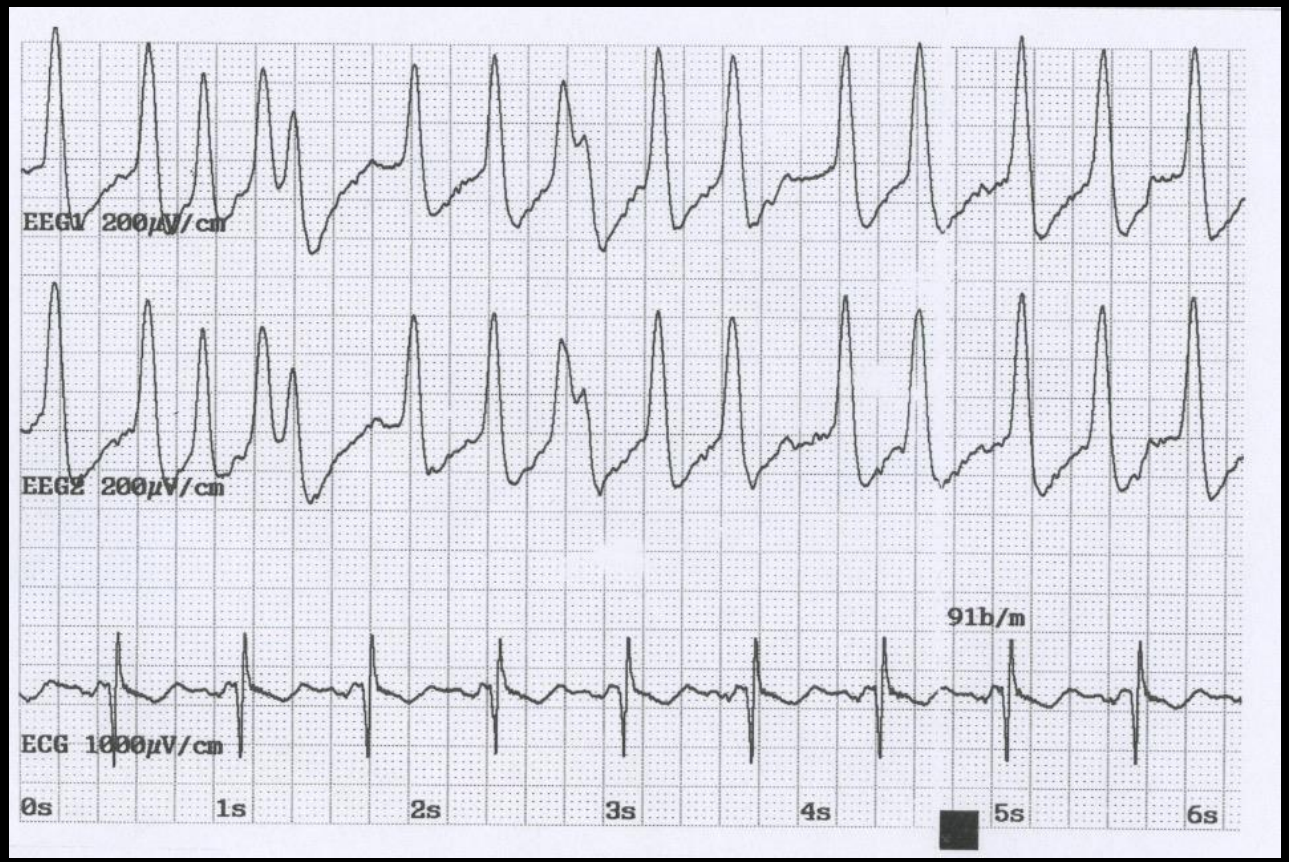
% Energy Set	25 %
Charge Delivered	124.2 mC
Current	0.89 A
Stimulus Duration	7.0 Sec
Frequency	20 Hz
Pulse Width	0.50 mSec
Static Impedance	2260 Ohm
Dynamic Impedance	310 Ohm
EEG Endpoint is not detected	
EMG Endpoint	N/A
Base Heart Rate	110 b/m
Peak Heart Rate	164 b/m
Average Seizure Energy Index	17795.2 µV2
Postictal Suppression Index	N/A
Maximum Sustained Power	23766.2 µV2
Time to Peak Power	31 Sec
Maximum Sustained Coherence	92.6 %
Time to Peak Coherence	46 Sec

Program Selected: 2X DOSE

ECT nr 3 ark 6 – 18.11.15

Bra EEG-anfall – gradvis slutt

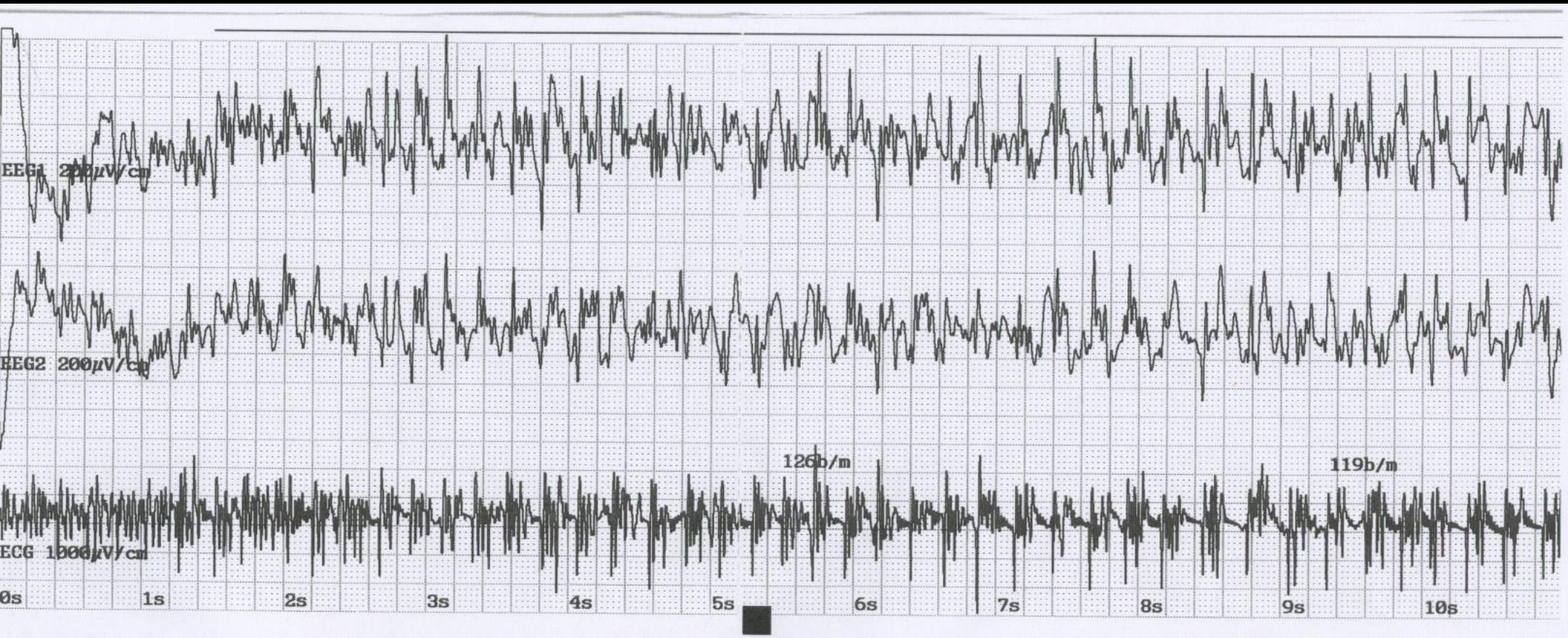
Mann 65 år med bipolar depresjon. Veldig mye bedre etter 7 ECT, men litt hypoman.
Dose 70% (350 mC), pulsvidde 0,5 ms og pulstog 7.8 s (Program: 2X Dose).



ECT nr 1 ark 1 – 12.06.15

Bra EEG-anfall – gradvis slutt

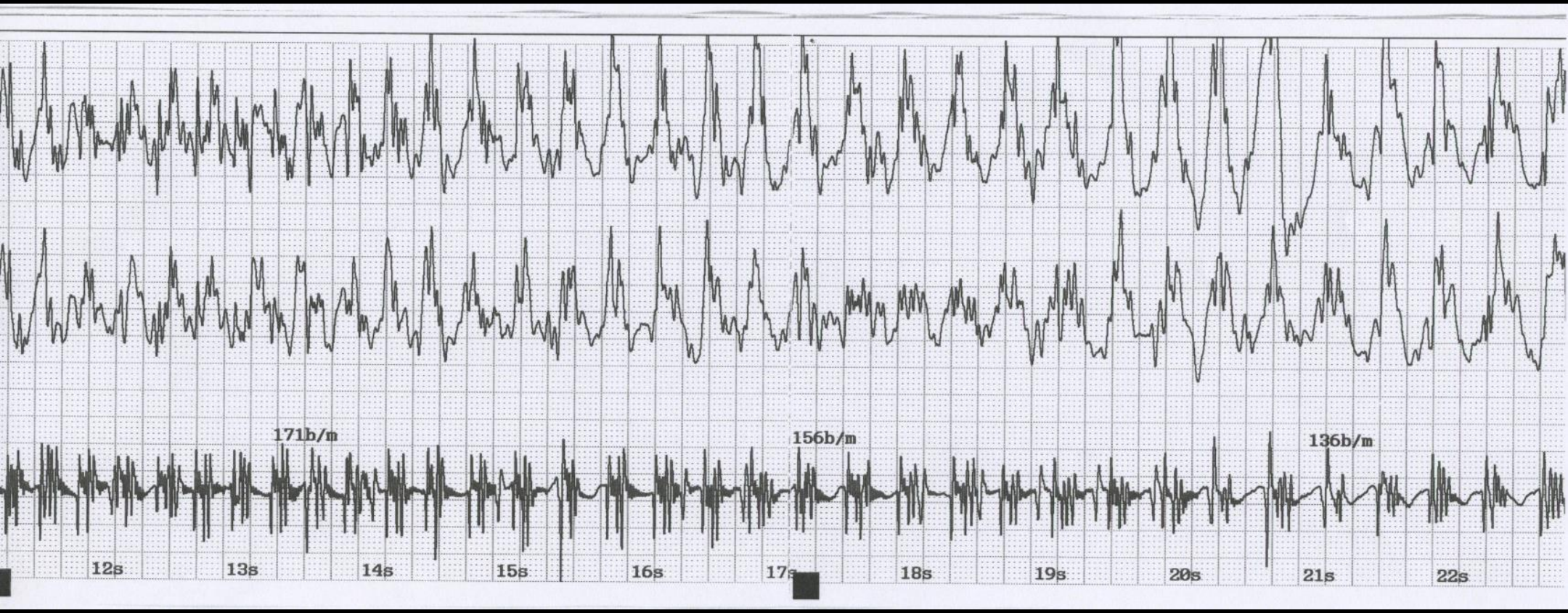
Mann 65 år med bipolar depresjon. Veldig mye bedre etter 7 ECT, men litt hypoman.
Dose 70% (350 mC), pulsvidde 0,5 ms og pulstog 7.8 s (Program: 2X Dose).



ECT nr 1 ark 2 – 12.06.15

Bra EEG-anfall – gradvis slutt

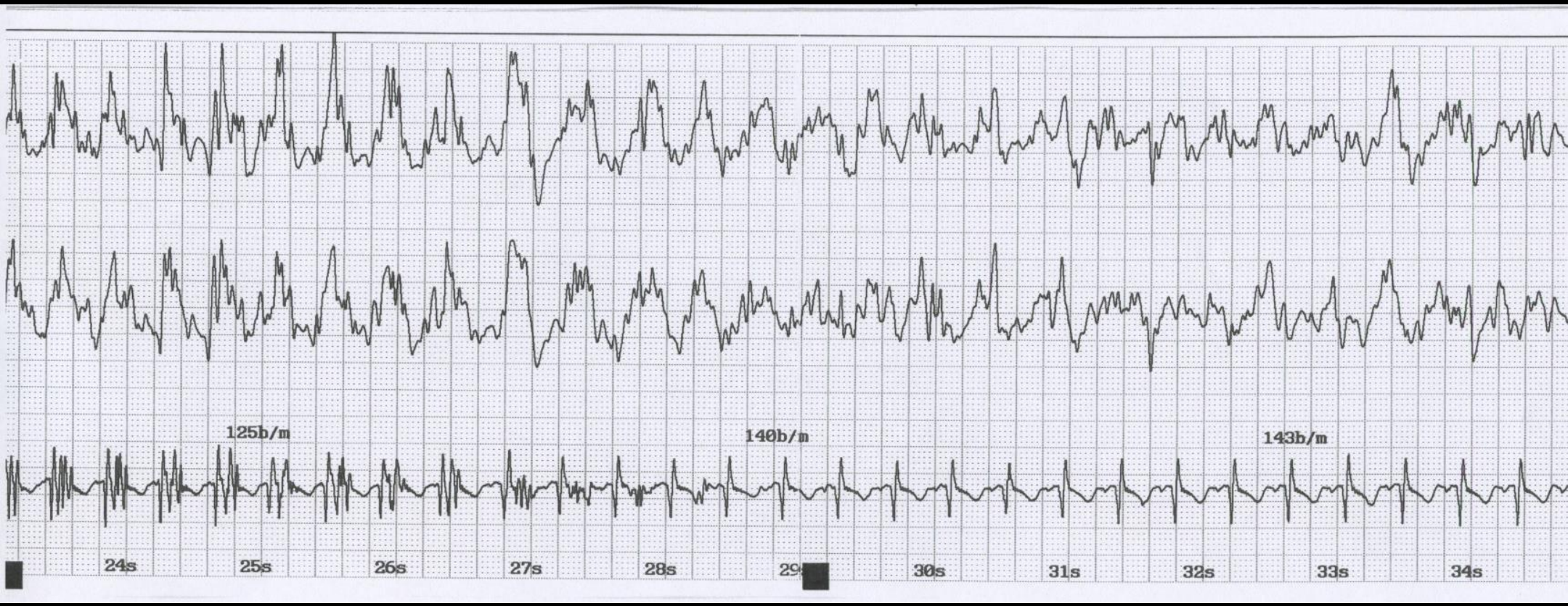
Mann 65 år med bipolar depresjon. Veldig mye bedre etter 7 ECT, men litt hypoman.
Dose 70% (350 mC), pulsvidde 0,5 ms og pulstog 7.8 s (Program: 2X Dose).



ECT nr 1 ark 3 – 12.06.15

Bra EEG-anfall – gradvis slutt

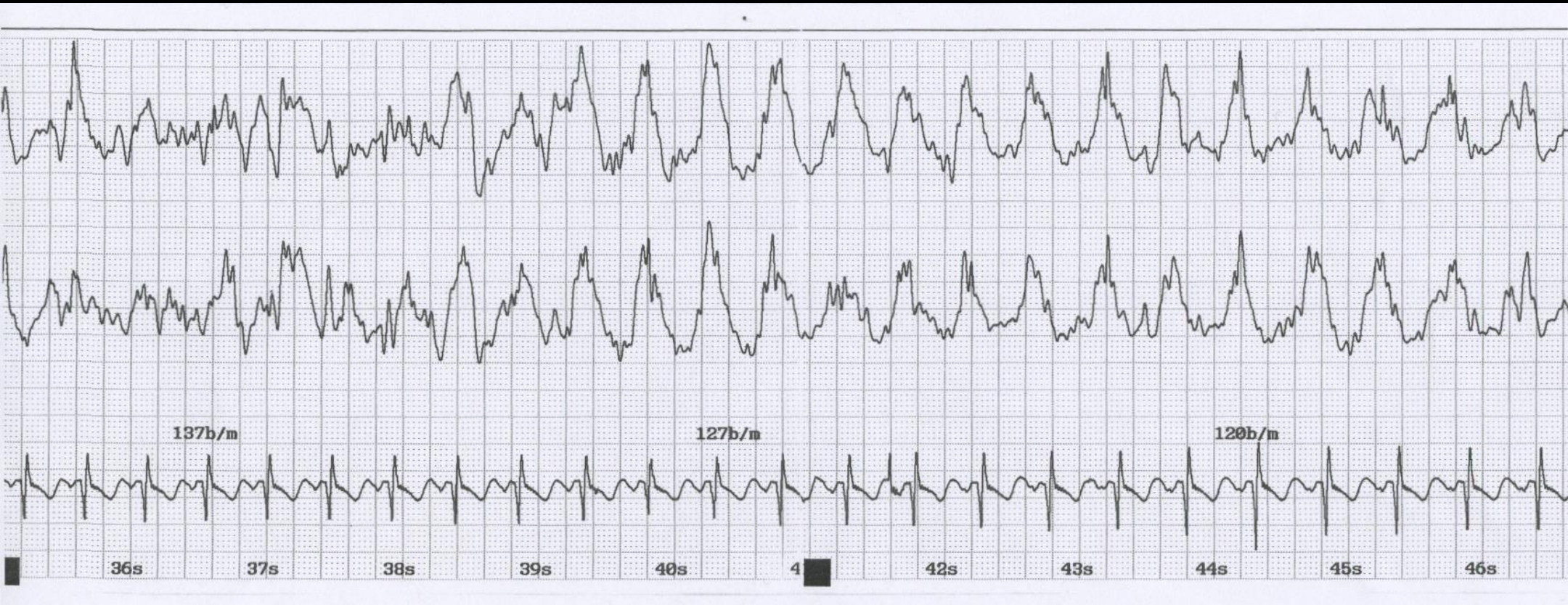
Mann 65 år med bipolar depresjon. Veldig mye bedre etter 7 ECT, men litt hypoman.
Dose 70% (350 mC), pulsvidde 0,5 ms og pulstog 7.8 s (Program: 2X Dose).



ECT nr 1 ark 4 – 12.06.15

Bra EEG-anfall – gradvis slutt

Mann 65 år med bipolar depresjon. Veldig mye bedre etter 7 ECT, men litt hypoman.
Dose 70% (350 mC), pulsvidde 0,5 ms og pulstog 7.8 s (Program: 2X Dose).



ECT nr 1 ark 5 – 12.06.15

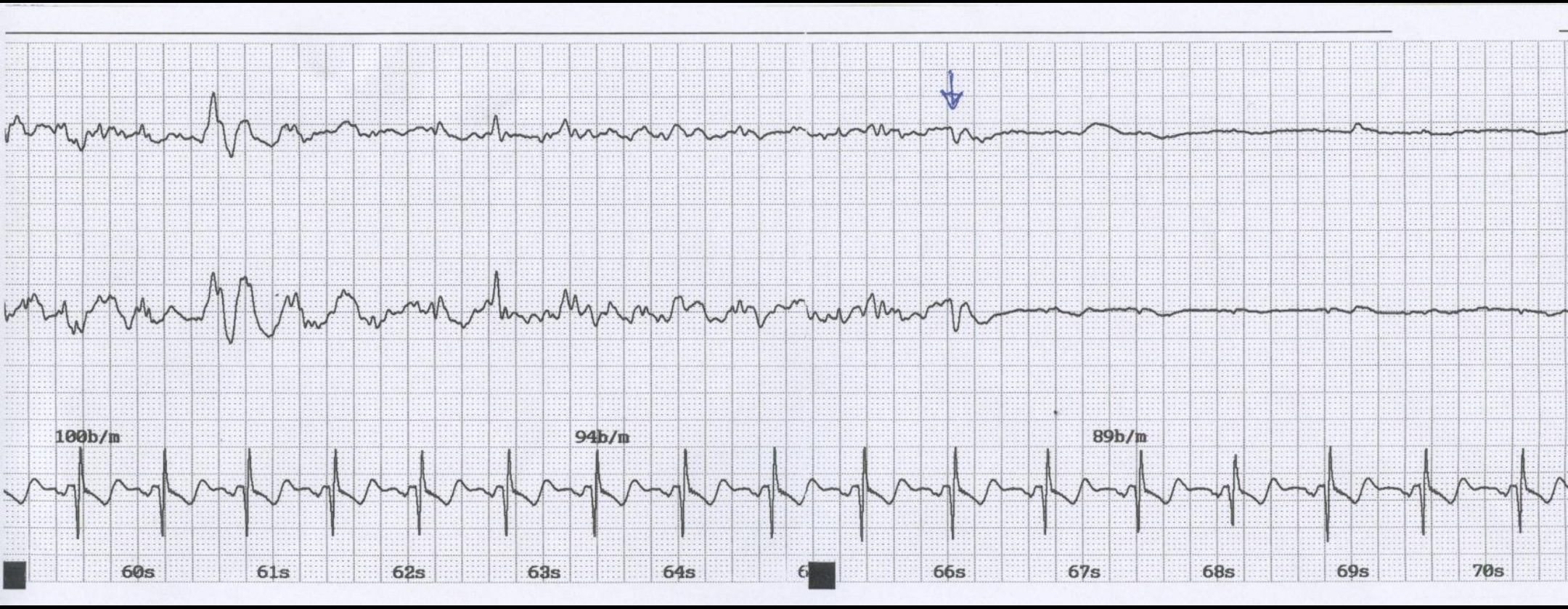
Bra EEG-anfall – gradvis slutt

Mann 65 år med bipolar depresjon. Veldig mye bedre etter 7 ECT, men litt hypoman.
Dose 70% (350 mC), pulsvidde 0,5 ms og pulstog 7.8 s (Program: 2X Dose).

ECT nr 1 ark 6 – 12.06.15

Bra EEG-anfall – gradvis slutt

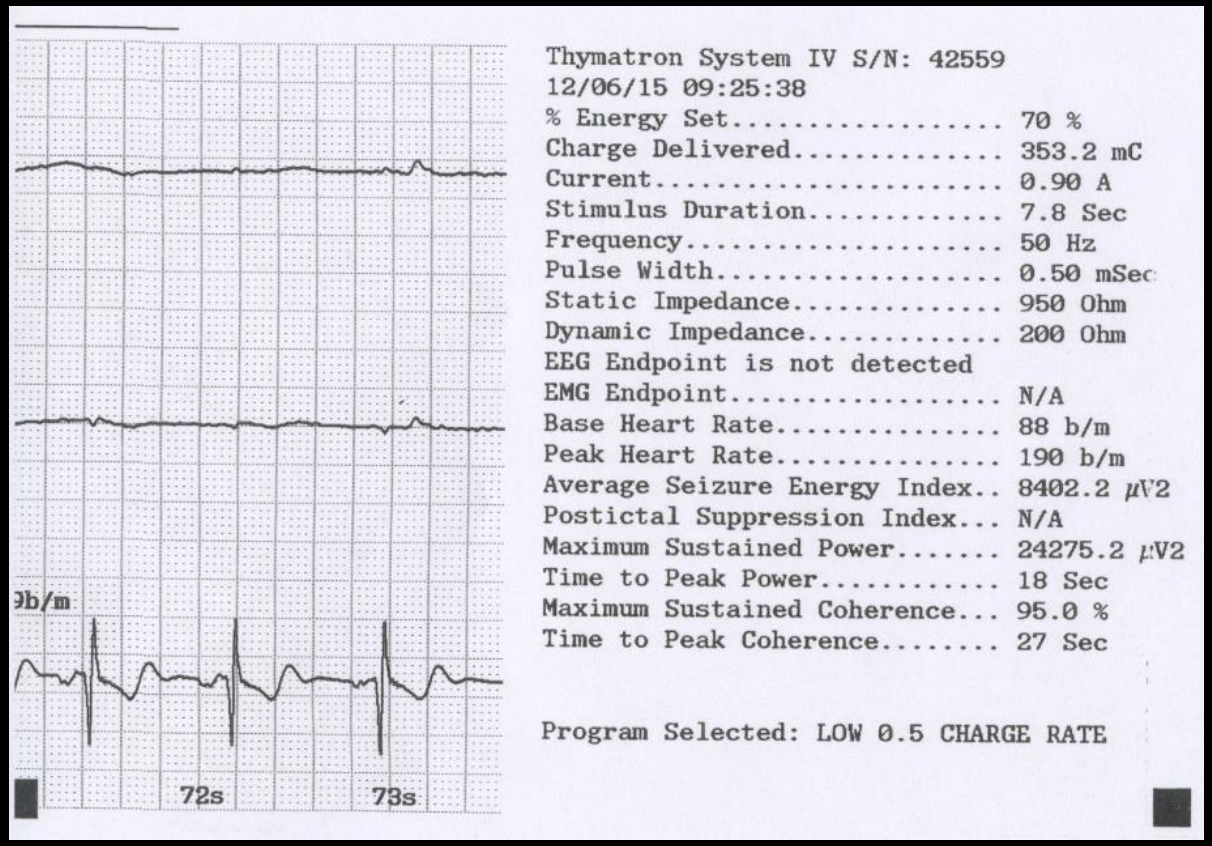
Mann 65 år med bipolar depresjon. Veldig mye bedre etter 7 ECT, men litt hypoman.
Dose 70% (350 mC), pulsvidde 0,5 ms og pulstog 7.8 s (Program: 2X Dose).



ECT nr 1 ark 7 – 12.06.15

Bra EEG-anfall – gradvis slutt

Mann 65 år med bipolar depresjon. Veldig mye bedre etter 7 ECT, men litt hypoman.
Dose 70% (350 mC), pulsvidde 0,5 ms og pulstog 7.8 s (Program: 2X Dose).



ECT nr 1 ark 8 – 12.06.15

Fig. 3. Types of EEG curves during ECT. Type 0; a mixture of β and θ activity of low amplitude, type 1; occasional spike activity on the background of low β and θ activity, type 2; spike epileptic activity of low amplitude, slow frequency; type 3; spike epileptic activity of medium amplitude, medium frequency; and type 4; spike epileptic activity of high amplitude, high frequency. EEG1 and 2: electroencephalogram in the right and left channel, respectively. EMG: electromyogram, ECG: electrocardiogram.

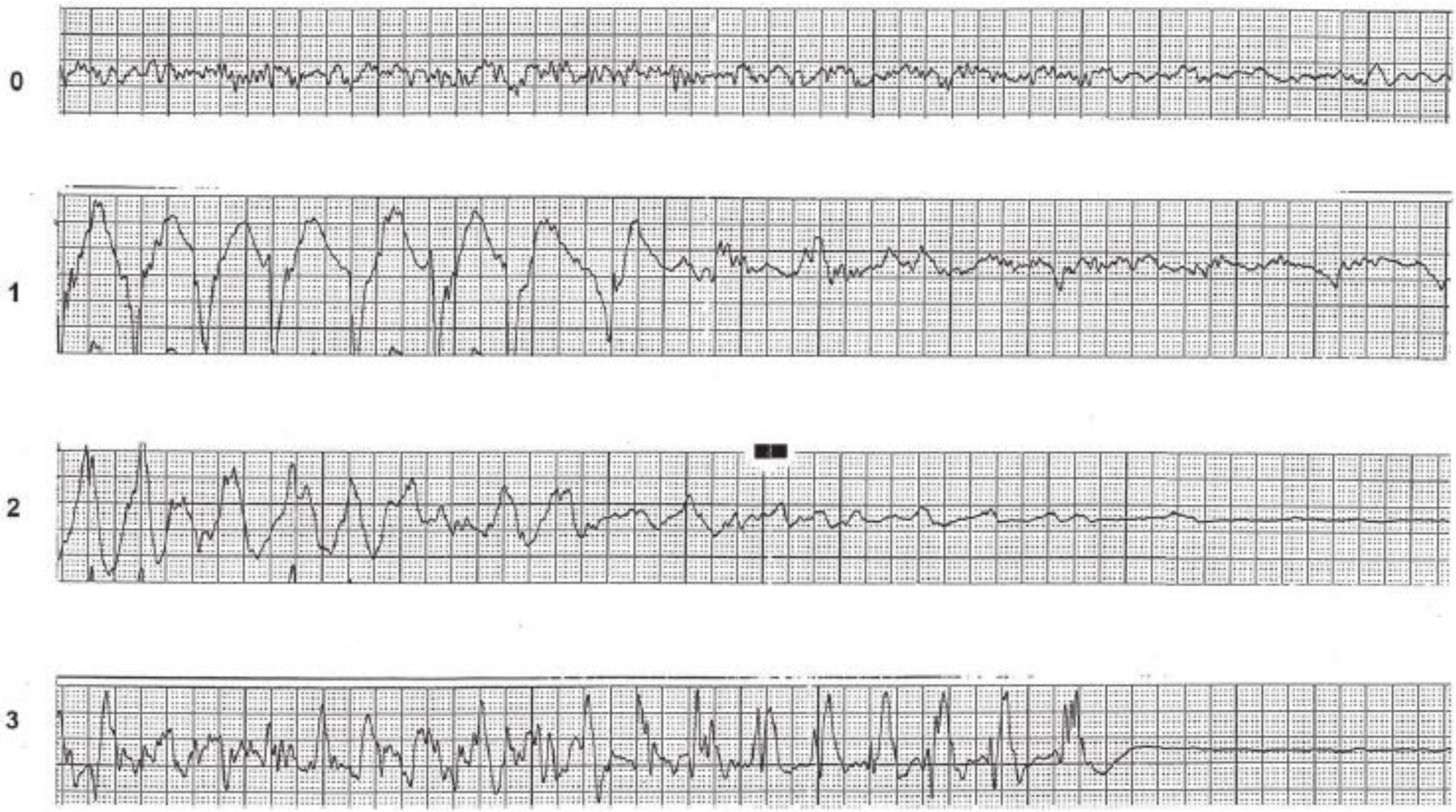
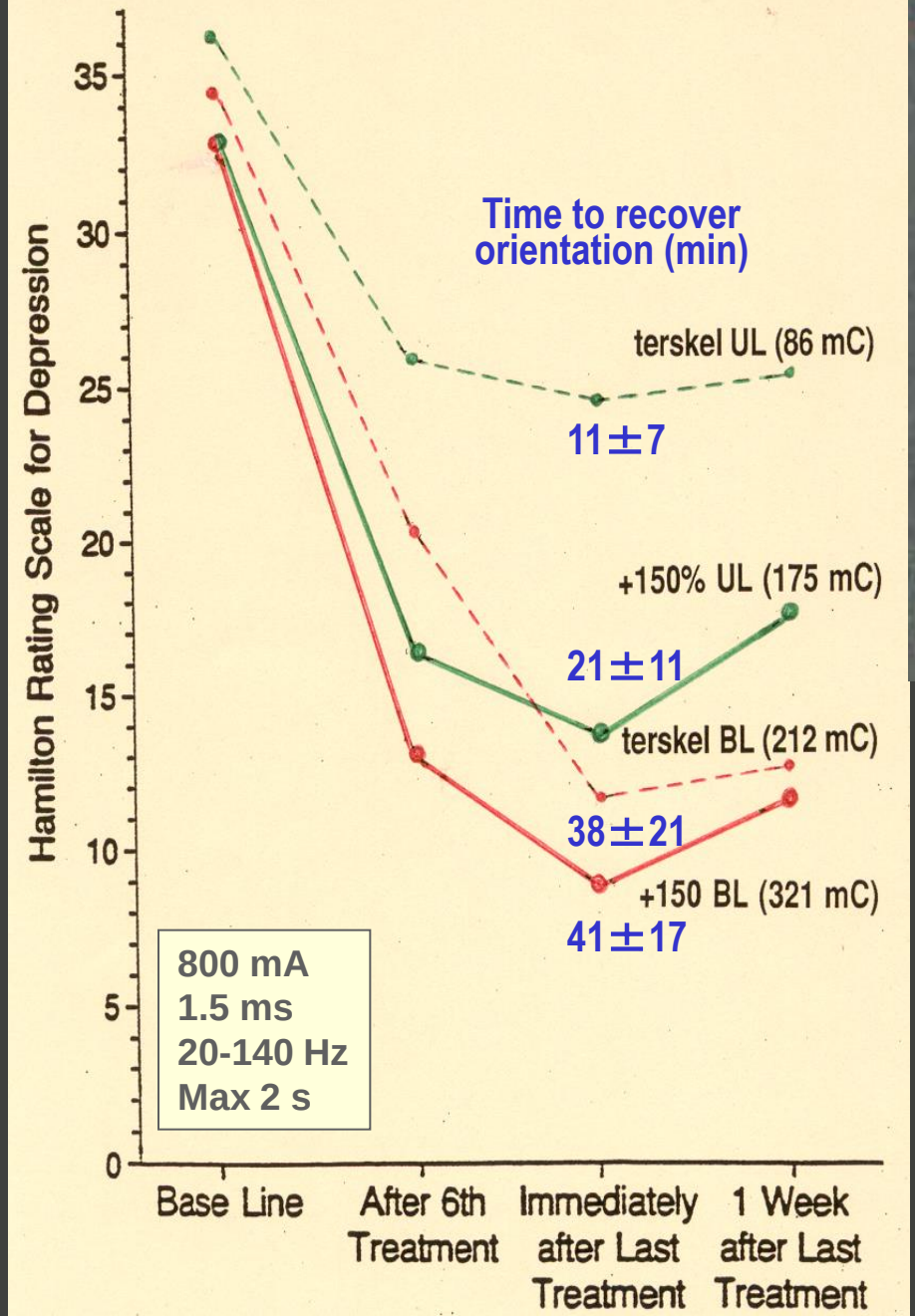


Fig. 4. Types of postictal EEG suppression. Type 0; cannot tell where the seizure ends, type 1; seizure termination is clear, but suppression is poor (not flat), type 2; good seizure suppression (very flat), but transition to flat is gradual, and type 3; good seizure suppression (very flat), and transition is abrupt.

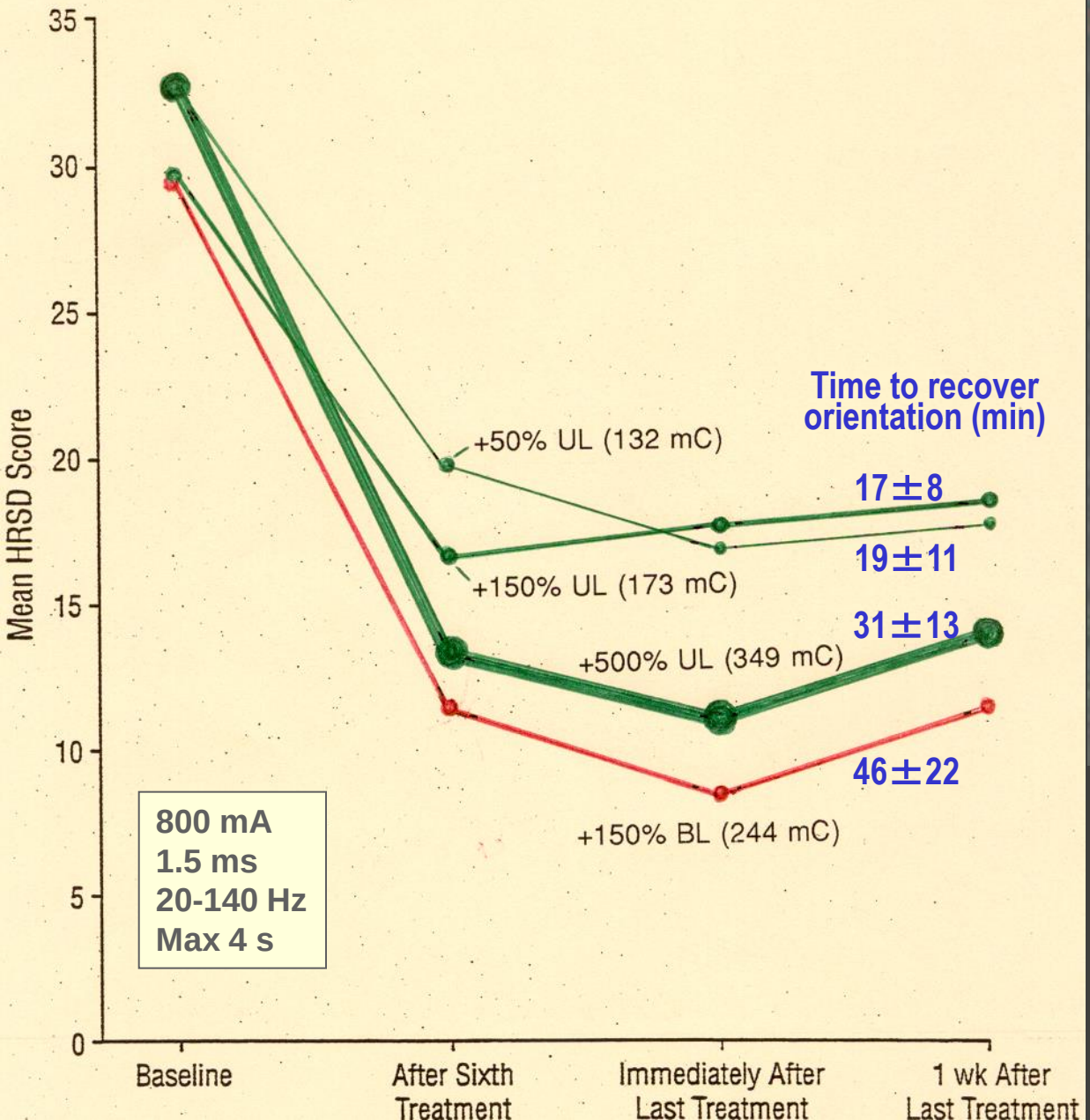
Kursorisk!

EFFECTS OF STIMULUS INTENSITY AND ELECTRODE PLACEMENT ON THE EFFICACY AND COGNITIVE EFFECTS OF ELECTROCONVULSIVE THERAPY. Sackeim HA et al. N Engl J Med 1993;328:839-46.



Per Bergsholm

A PROSPECTIVE, RANDOMIZED, DOUBLE-BLIND COMPARISON OF BILATERAL AND RIGHT UNILATERAL ELECTROCONVULSIVE THERAPY AT DIFFERENT STIMULUS INTENSITIES. Sackeim HA et al. Arch Gen Psychiatry 2000;57:425-34.

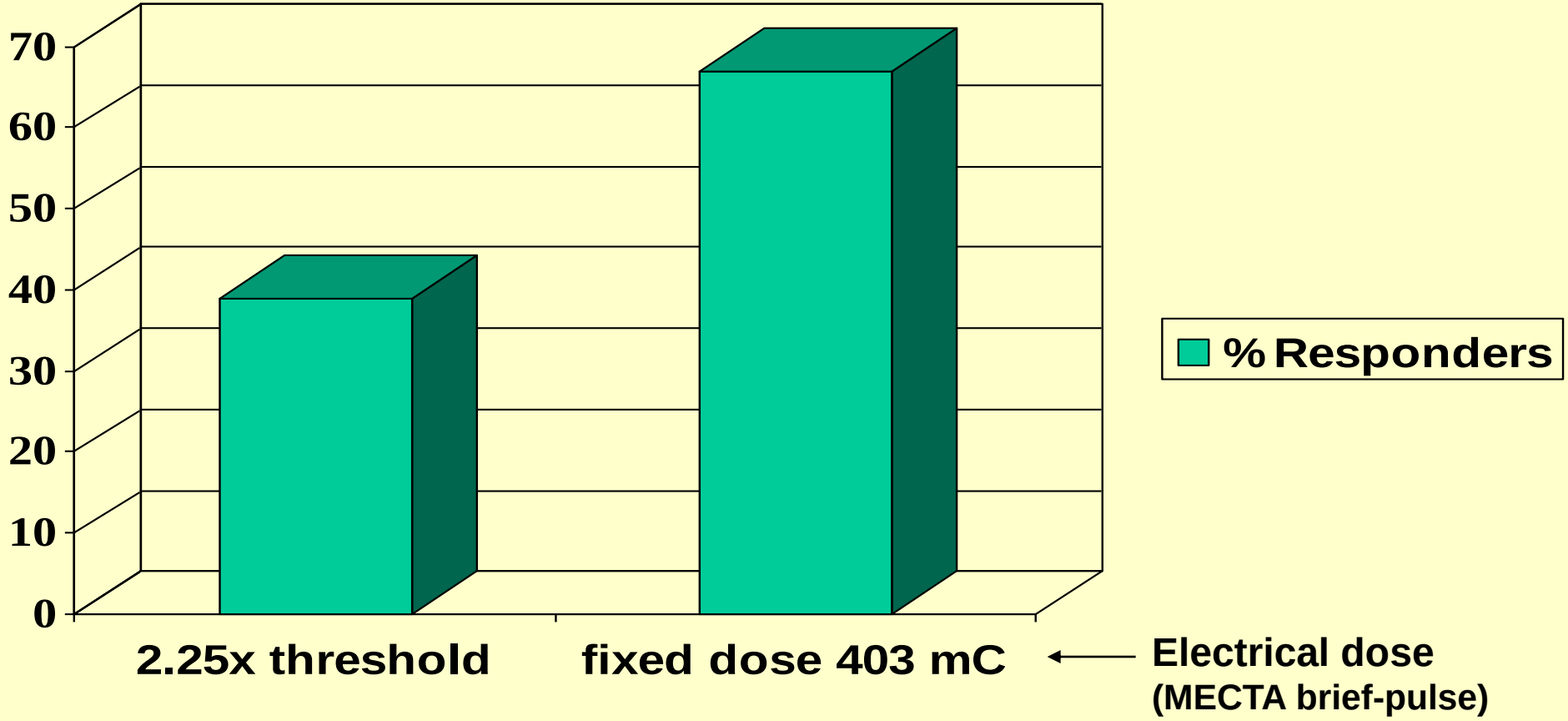


Kursorisk!

Per Bergsholm

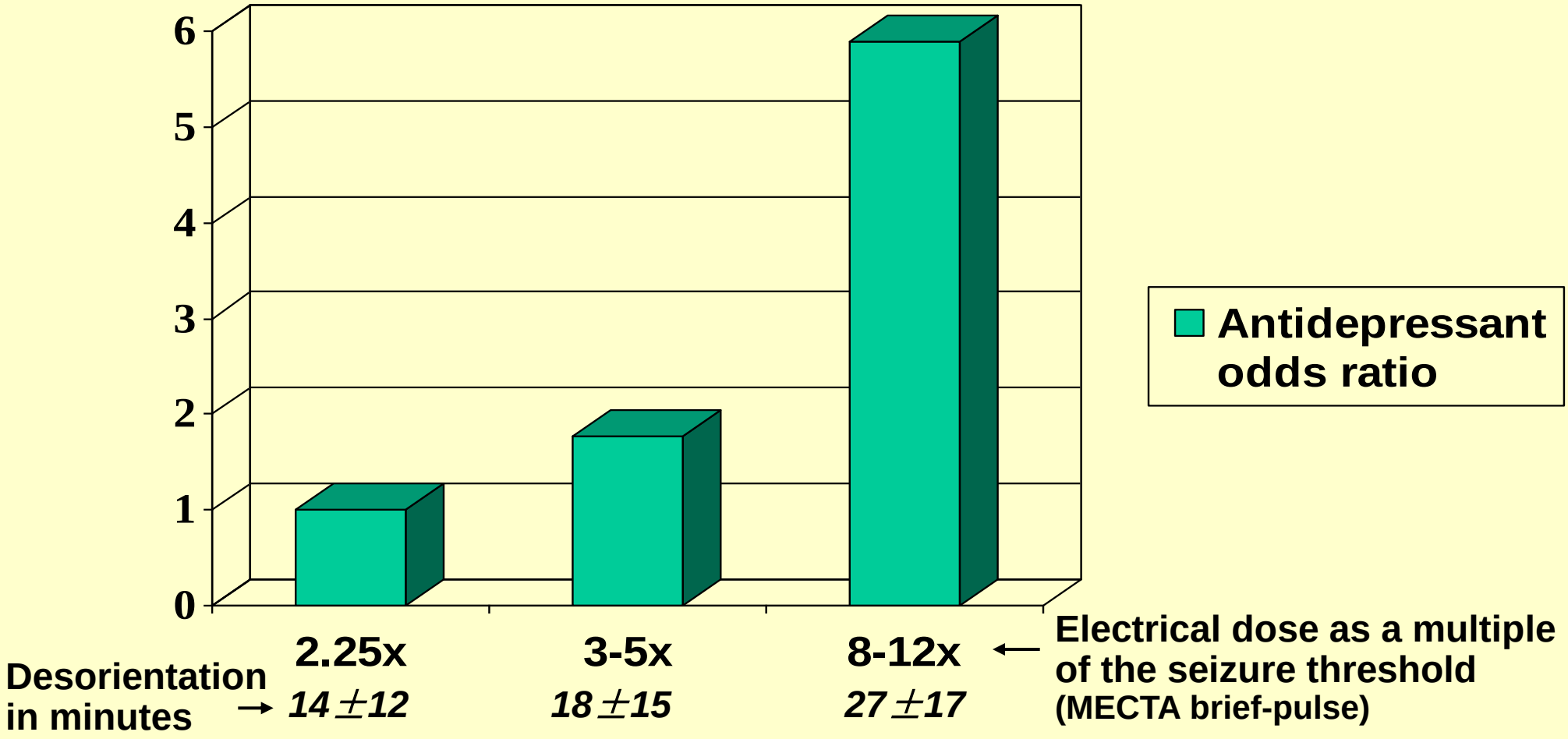
TITRATED MODERATELY SUPRATHRESHOLD VS FIXED HIGH-DOSE RIGHT UNILATERAL ELECTROCONVULSIVE THERAPY

McCall WV, Reboussin DM, Weiner RD, Sackeim HA. Arch Gen Psychiatry 2000;57:438-44



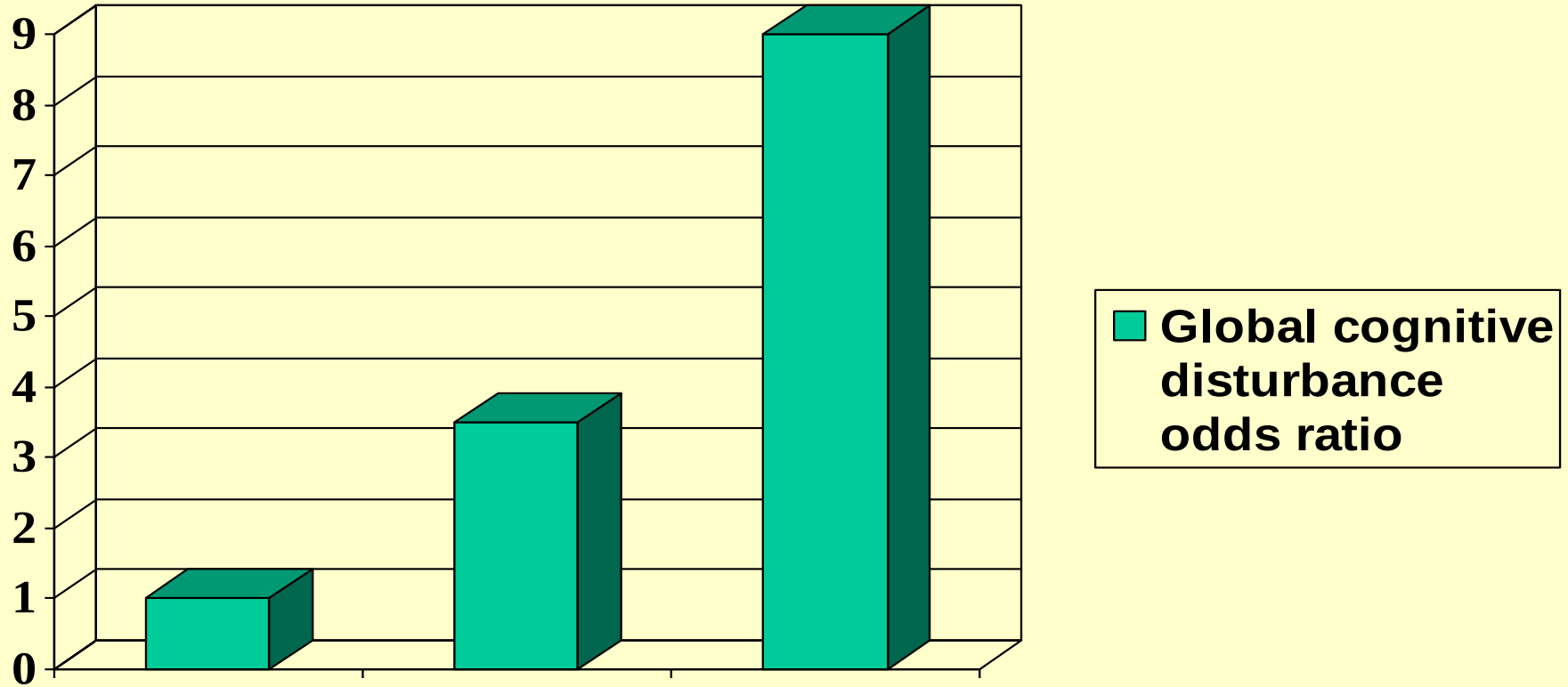
TITRATED MODERATELY SUPRATHRESHOLD VS FIXED HIGH-DOSE RIGHT UNILATERAL ELECTROCONVULSIVE THERAPY

McCall WV, Reboussin DM, Weiner RD, Sackeim HA. Arch Gen Psychiatry 2000;57:438-44



TITRATED MODERATELY SUPRATHRESHOLD VS FIXED HIGH-DOSE RIGHT UNILATERAL ELECTROCONVULSIVE THERAPY

McCall WV, Reboussin DM, Weiner RD, Sackeim HA. Arch Gen Psychiatry 2000;57:438-44



Kursorisk!

A randomized comparison of high-charge right unilateral electroconvulsive therapy and bilateral electroconvulsive therapy in older depressed patients who failed to respond to 5 to 8 moderate-charge right unilateral treatments

	Høyresidig +450% (n=13)	Bitemporal +150% (n=11)	p
Reduksjon i HAM-D, %	68	60	0,707
Remisjon, %	46 (6/13)	18 (2/11)	0,211
Respons, %	62 (8/13)	64 (7/11)	0,999
MMSE endring	1,5	- 3,6	0,048

… older patients who fail to respond to moderate-charge RUL ECT may benefit from a switch to high-charge RUL ECT rather than BL ECT.

Tew JD Jr et al. J Clin Psychiatry 2002;63:1102-5

Bitemporal versus high-dose unilateral twice-weekly electroconvulsive therapy for depression (EFFECT-Dep): A pragmatic, randomized, non-inferiority trial

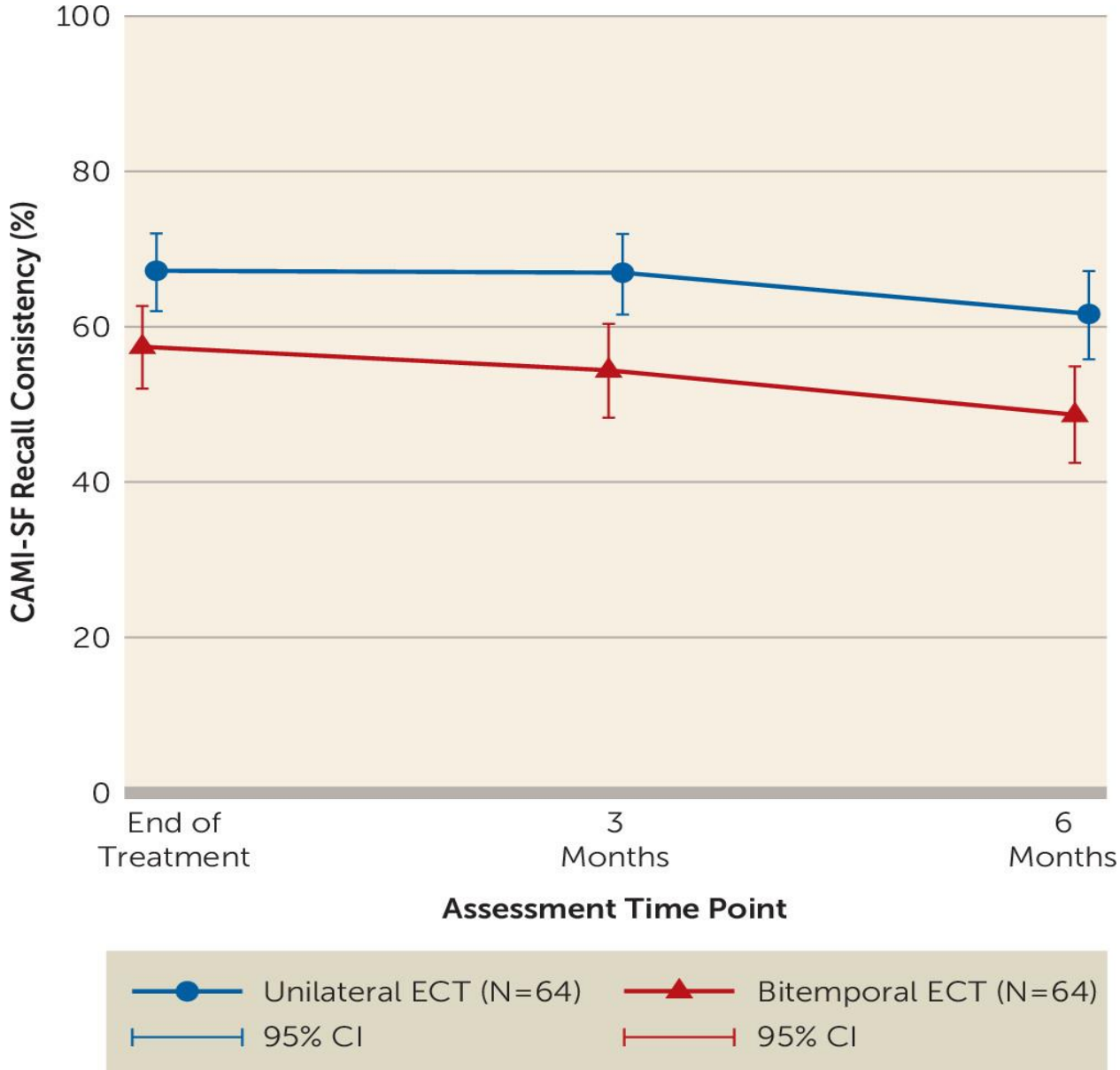
Maria Semkovska et al. Am J Psychiatry 2016;173:408-17

	Høyresidig ECT	Bitemporal ECT
N	69	69
Alder	57	57
Anfallsterskel, mC	75	150
Mean dose, mC	740	400
Anfallsvarighet, s	42	40
PRT, min	19	26
Respons, %	61	51
Remisjon, %	46	42

Bitemporal versus high-dose unilateral twice-weekly electroconvulsive therapy for depression (EFFECT-Dep): A pragmatic, randomized, non-inferiority trial

Maria Semkovska et al. Am J Psychiatry 2016;173:408-17

Kursorisk!



Per Bergsholm

Høyresidig ECT med høy dose er like effektiv som bitemporal og gir mindre kognitive bivirkninger

D'Elia G. Acta Psychiatr Scand Suppl 1970;215:1-98

Sand Strömgren L. Acta Psychiatr Scand 1984;69:484-90

Ottosson J-O. Convulsive Ther 1991;7:190-200

Sackeim et al. Arch Gen Psychiatry 2000;57:425-34

Tew JD Jr et al. J Clin Psychiatry 2002;63:1102-5

Semkovska M et al. Am J Psychiatry 2016;173:408-17