ELICITING AND ENSURING AN OPTIMIZED SEIZURE

Per Bergsholm, MD/PhD - Førde, Norway

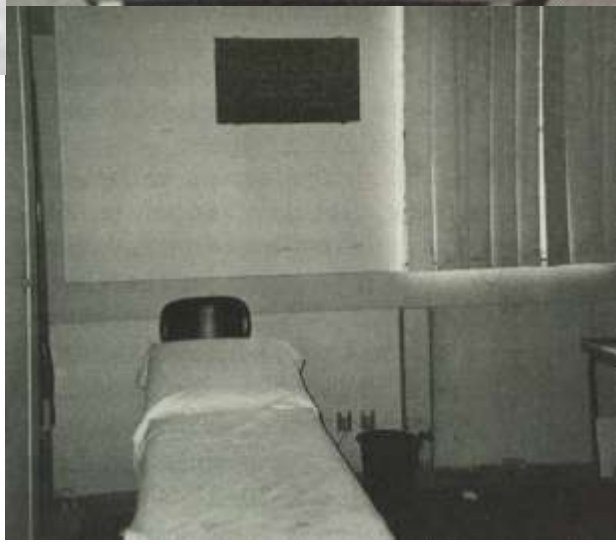
NACT, Gjøvik - May 24, 2019

The first ECT - April 1938

Rome university psychiatric clinic
Lucio Bini's notebook for Enrico X


Ugo Cerletti 1939


Lucio Bini



Titration with alternating current

April 11	11.15 h	80 volt ¼ s – no seizure
	11.25 h	80 volt ½ s – no seizure
	11.40 h	80 volt ¾ s – no seizure
April 20		92 volt ½ s – tonic-clonic seizure no breath 105 s

Total 10-11 sessions

March 1940 Readmitted to Mombello psychiatric hospital, Milano

Edward Shorter, David Healy
Shock Therapy. A History of Electroconvulsive Treatment in Mental Illness. Rutgers 2007

2 photos: Norman Endler 1985

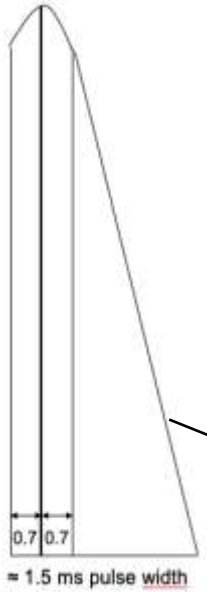
Per Bergsholm

DOSING/CHARGE

1. Tonic phase liminal stimulation
2. High-dose 75% to 100%
3. Age-dependant: Age and half-age
4. Placement-dependant percentage
5. Threshold multiplied dose

Pulse-width and pulse-train duration

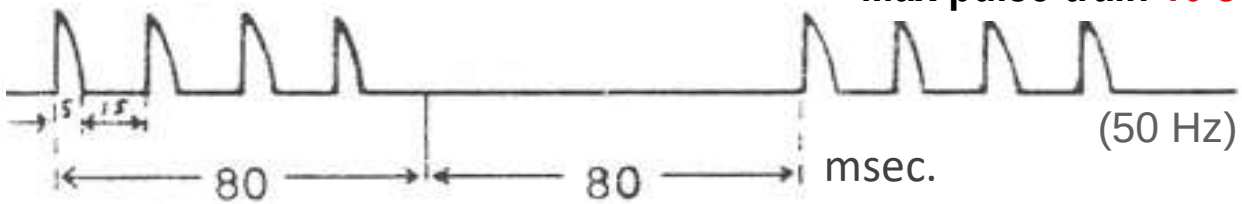
«The therapeutic efficiency with the Elther was somewhat lower ... may be due to subtotal, but grand mal-like, seizure patterns sometimes induced with ultrabrief stimulus. The influence on memory functions did not differ»



Close to brief pulse

KONVULSATOR III

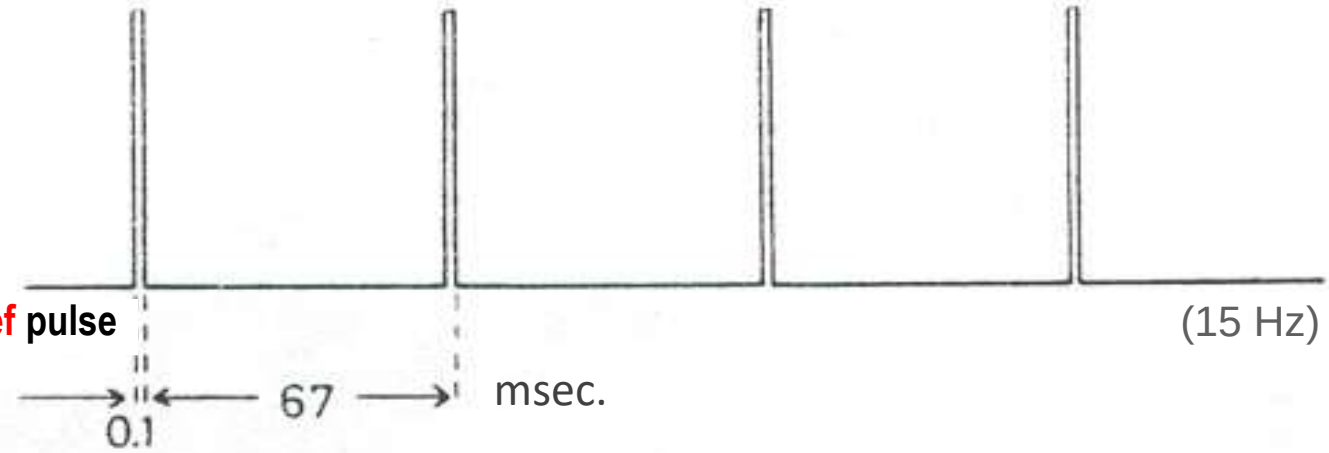
Max pulse-train 10 s



(50 Hz)

Bitemporal electrode placements

ELTHER



Ultrabrief pulse

(15 Hz)

Anyone got a picture of Börje Cronholm ? ☺

Börje Cronholm (1913-83), Jan-Otto Ottosson (1925-), Stockholm

Ultrabrief stimulus technique in electroconvulsive therapy
J Nerv Ment Dis 1963;137

I. Influence on retrograde amnesia ... 117-23

II. Comparative studies of therapeutic effects ... 268-76

Per

The Scandinavian liminal titration method

Anyone got a picture of Lizzie? ☺

Stimulation

1. Unilateral nondominant with long electrode distance
2. Stimulus duration not prefixed
3. Current interrupted as soon as the clonic contractions shift to the tonic phase, most readily observed in the plantar extension of the great toes

Observation

1. The optimal convulsion usually ends by degrees, and is succeeded by a comatose stage from which consciousness is gradually regained
2. The dissociative convulsion is followed by early awakening
3. The clonic form has no tonic phase, ends abruptly and simultaneously in the whole body, last only 10 to 20 s
   Both have lower antidepressant efficacy

Giacomo d'Elia (1934-), **Jan-Otto Ottosson** (1925-), Gothenburg, **Lizzie Sand Strömgren** (1928-2007), Aarhus
Present Practice of Electroconvulsive Therapy in Scandinavia. *Arch Gen Psychiatry 1983;40:577-81*

Per

Electrode placement

Comparisons of antidepressant efficiency according to interelectrode distance

24 studies 1962-1988

Electrode position	Interelectrode distance	Number of studies		
		Bilateral better than unilateral	Bilateral equal to unilateral	Bilateral worse than unilateral
Lancaster et al	6 – 8 cm	9	6	1
Other unilateral	12-15 cm	2	3	3

Jan-Otto Ottosson

Is unilateral nondominant ECT as efficient as bilateral ECT? A new look at the evidence

Convulsive Therapy 1991;7:190-200

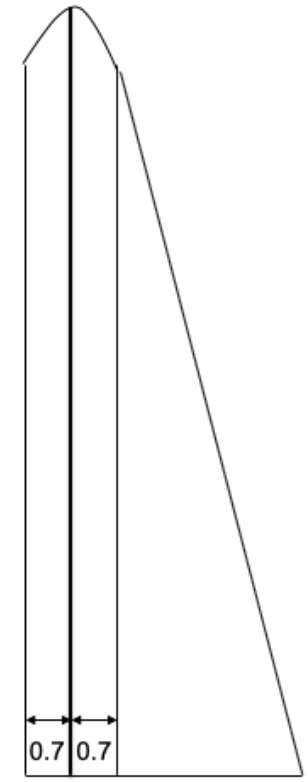
Per

Anyone got a picture of Szilvia? ☺

The Scandinavian liminal titration method - «The Last Waltz»

TABLE 2. *Treatment variables*

	U-ECT (n = 22)	equal efficiency	B-ECT (n = 20)	p
No. treatments in each ECT series				
Mean	7.7		8.0	NS
Range	4–11		6–11	
Duration of stimulus pulse train(s)				
Mean	6.3	long	6.0	NS
Range	4.1–10	pulse-train	4.6–9.5	
Stimulus charge (mC)				
Mean	403	80 %	384	NS
Range	262–640	50-130%	294–608	
Mean seizure duration(s)		«high-dose»		
Mean	37.7		36.6	NS
Range	34–91		30–86	



≈ 1.5 ms pulse width

close to brief-pulse

Sziliva Lamy, Per Bergsholm, Giacomo d'Elia. *The antidepressant efficacy of high-dose nondominant long-distance parietotemporal and bitemporal electroconvulsive therapy. Convulsive Therapy 1994;10:43-52*

Per


Current push botton on one of the electrode handles
SIEMENS
KONVULSATOR
622
O
U
J
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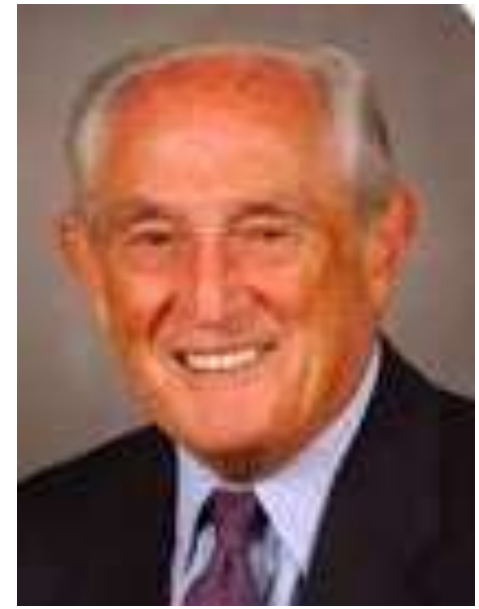
sec
Flexible stimulus duration with a long maximum of 10 s
Low frequency 25 or 50 pps. Short pulses ~1.5 ms

European v US devices

Georgios Petrides

Some traditional European devices allows the duration of the stimulus to be determined by the therapist watching for motor signs and ending the energy stream when an «adequate seizure» has been elicited.

United State devices, however, require delivery of a preset amount of energy



Max Fink

Georgios Petrides and Max Fink, New York

The «half-age» stimulation strategy for ECT dosing

Convulsive Therapy 1996;12:138-46

Per

Fixed high dose and Full age dosing

1. **Fixed** dosage at 75% of energy
2. **Full-age** dosing, **5 mC × age,** averaging about **2.5 times** threshold in bitemporal ECT

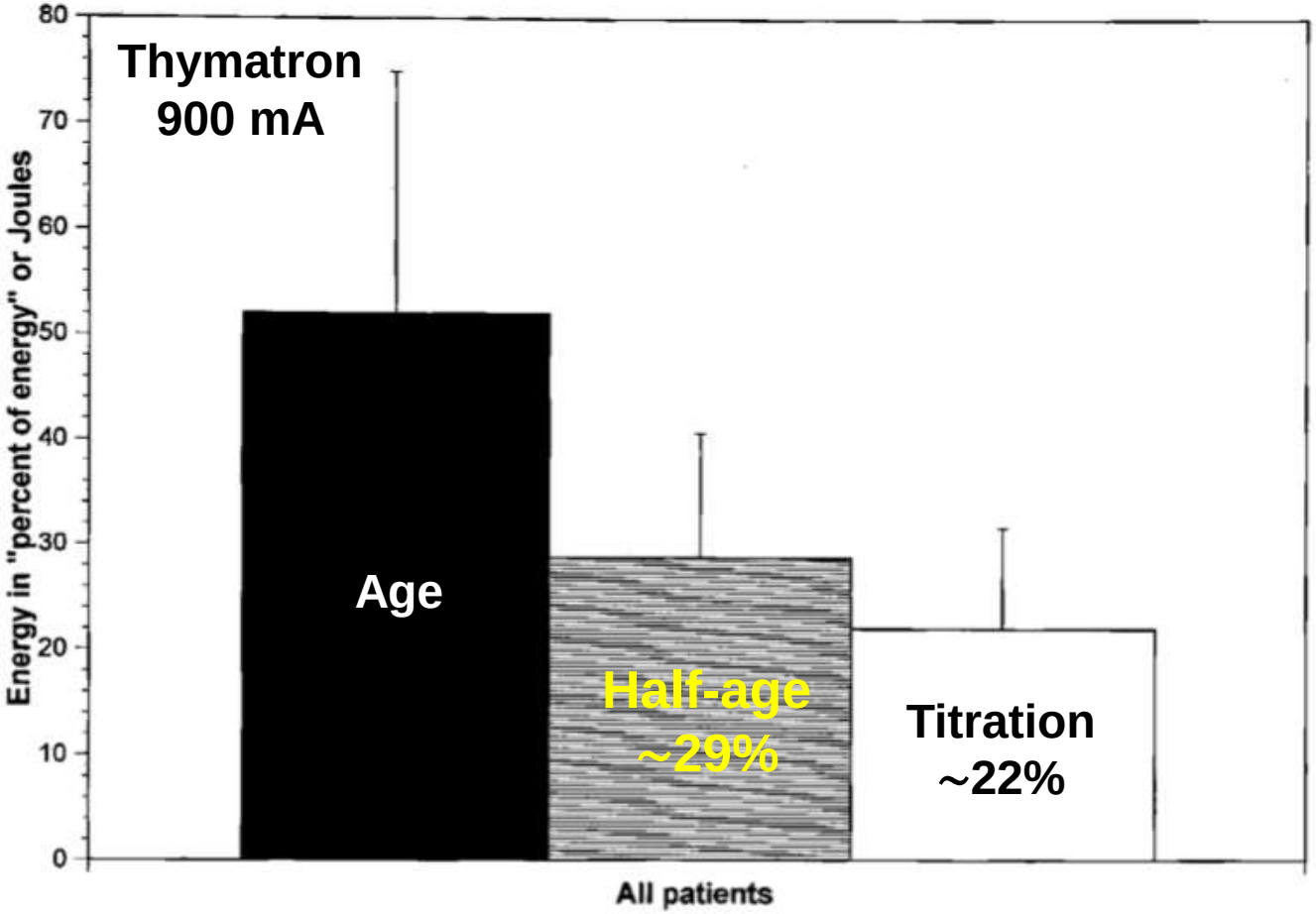
Richard Abrams and Conrad M Swartz, Illinois

- *Abrams R, Swartz CM. ECT Instruction Manual. Lake Bluff, IL: Somatics Inc., 1985*
- *Swartz CM, Abrams R. ECT Instruction Manual. 3rd ed. Lake Bluff, IL: Somatics Inc., 1989*
- *Abrams R, Swartz CM, Vedak C. Antidepressant effect of right versus left unilateral electroconvulsive therapy. Arch Gen Psychiatry 1991;48:746-8*
- *Abrams R. Electroconvulsive Therapy, 4th Ed, 2002, p 153*

Per

Half age method for bitemporal ECT

- We examined an energy estimate for bilateral ECT at **half** the patient's age
- Required **only one** stimulation
- Increments of **10%** when motor seizure duration was less than 30 sec
- All patients **recovered** (in their first group, n=35)



Petrides G, Fink M. The «half-age» stimulation strategy for ECT dosing. *Convuls Ther 1996;12:138-46*

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The unilateral-bilateral controversy

- The relative efficacy of unilateral right ECT and bilateral ECT continues to be a source of controversy
- At least 35 clinical trials. The majority failed to observe significant differences
- Traditionally, the dose has been kept the same for all patients, regardless of modality

Harold A. Sackeim, **P. Decina, M. Kanzler, B. Kerr, S. Malitz. New York**

Effects of electrode placement on the efficacy of titrated, low-dose ECT

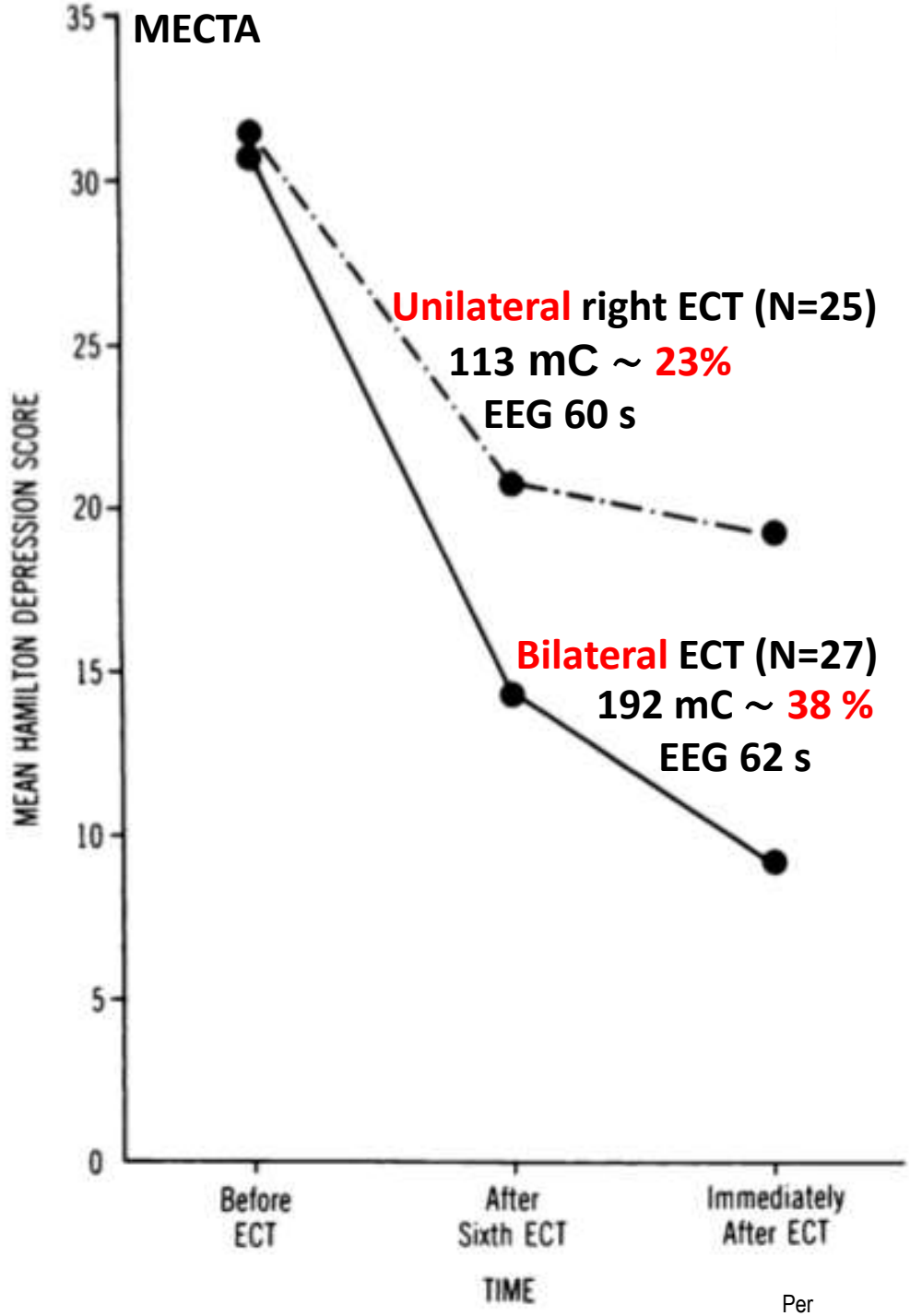
Am J Psychiatry 1987;144:1449-66

Per

Dose titration method

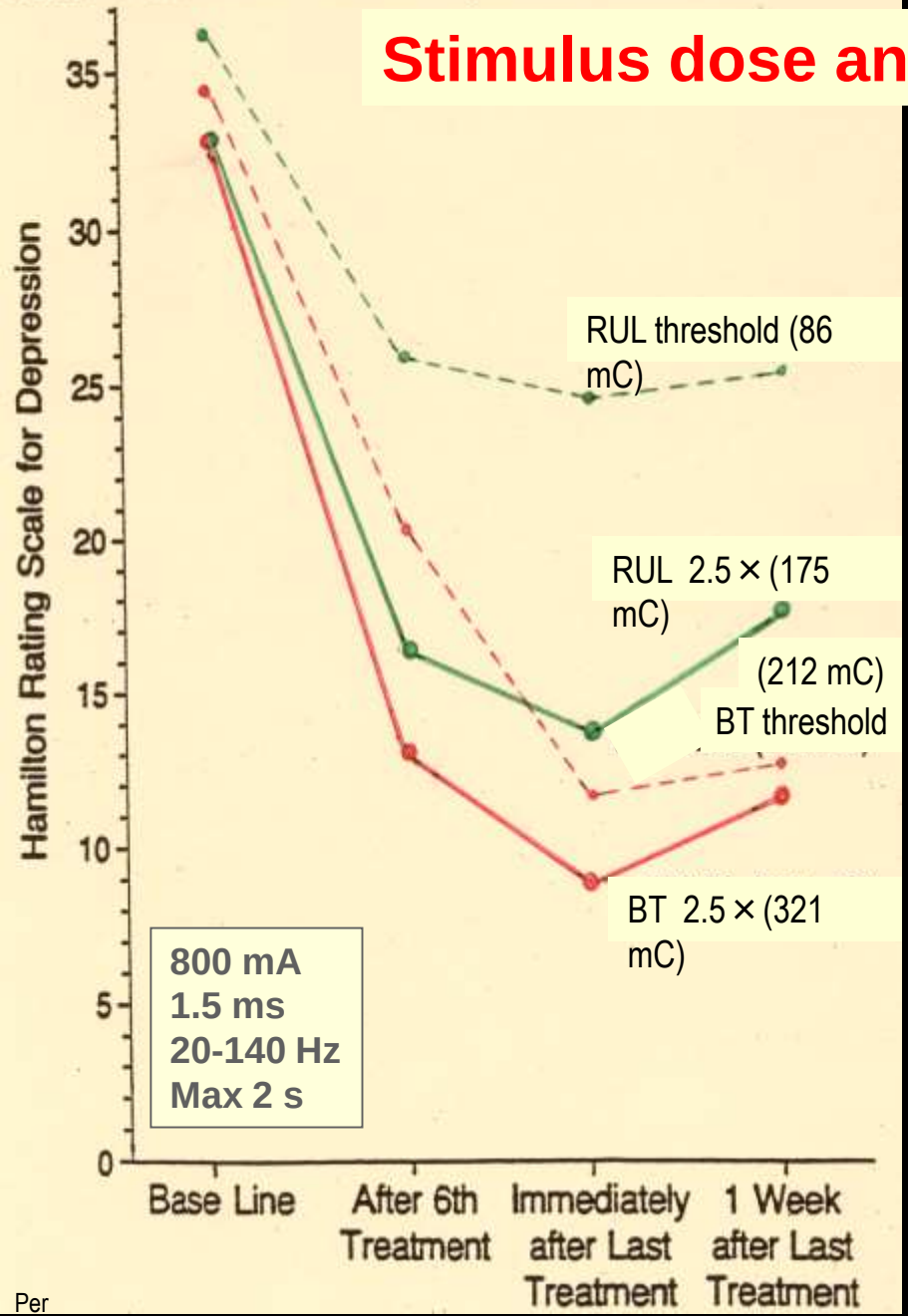
- **Low** titrated threshold dose
- **bilateral** markedly superior
- dose in excess of seizure **threshold** may contribute, particularly with **unilateral**
- the generalized **seizure** may be necessary, but not sufficient

Harold A Sackeim et al. New York
Effects of electrode placement on the efficacy of titrated, low-dose ECT
Am J Psychiatry 1987;144:1449-66

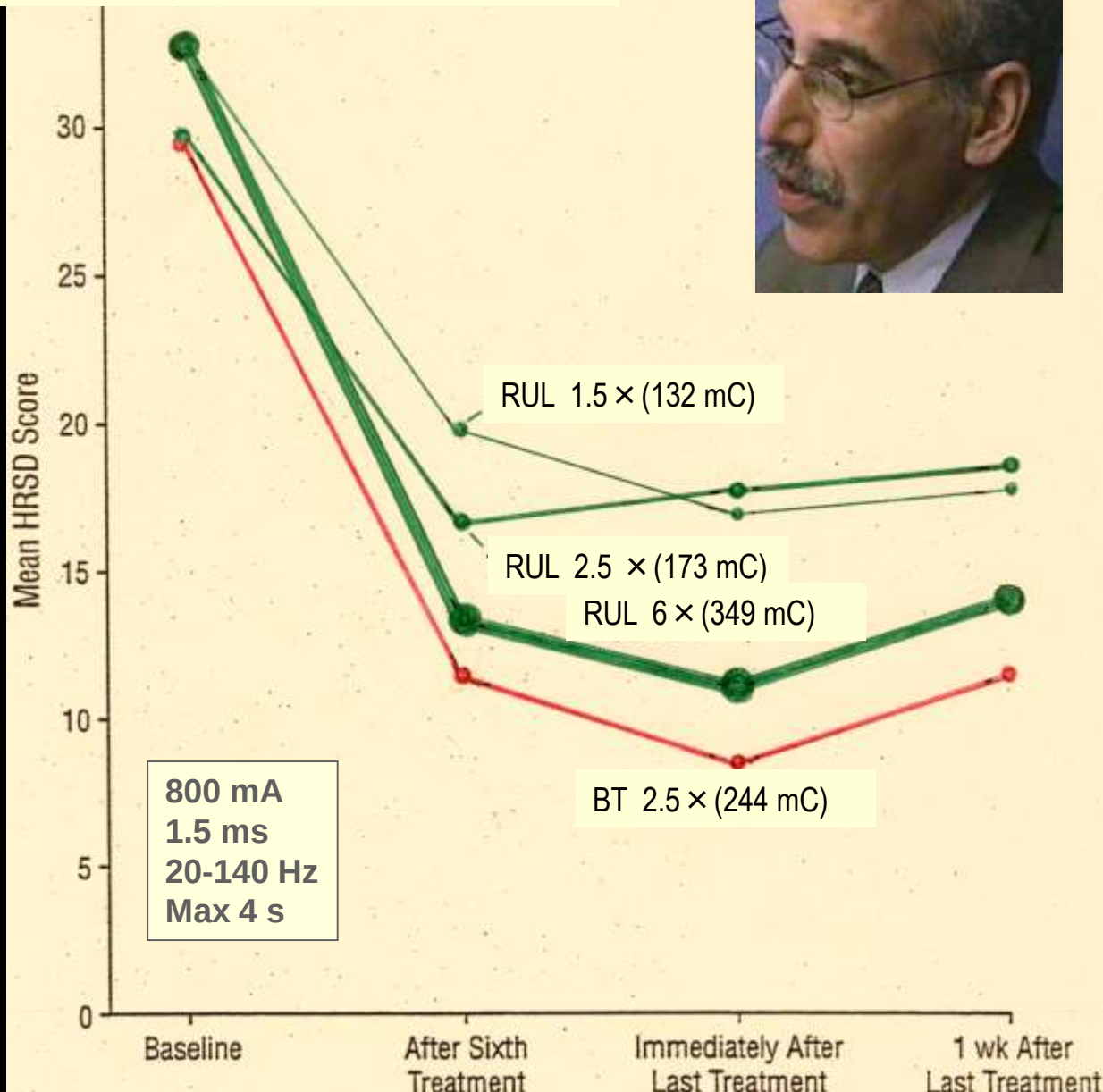


Stimulus dose and electrode placement

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.



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.



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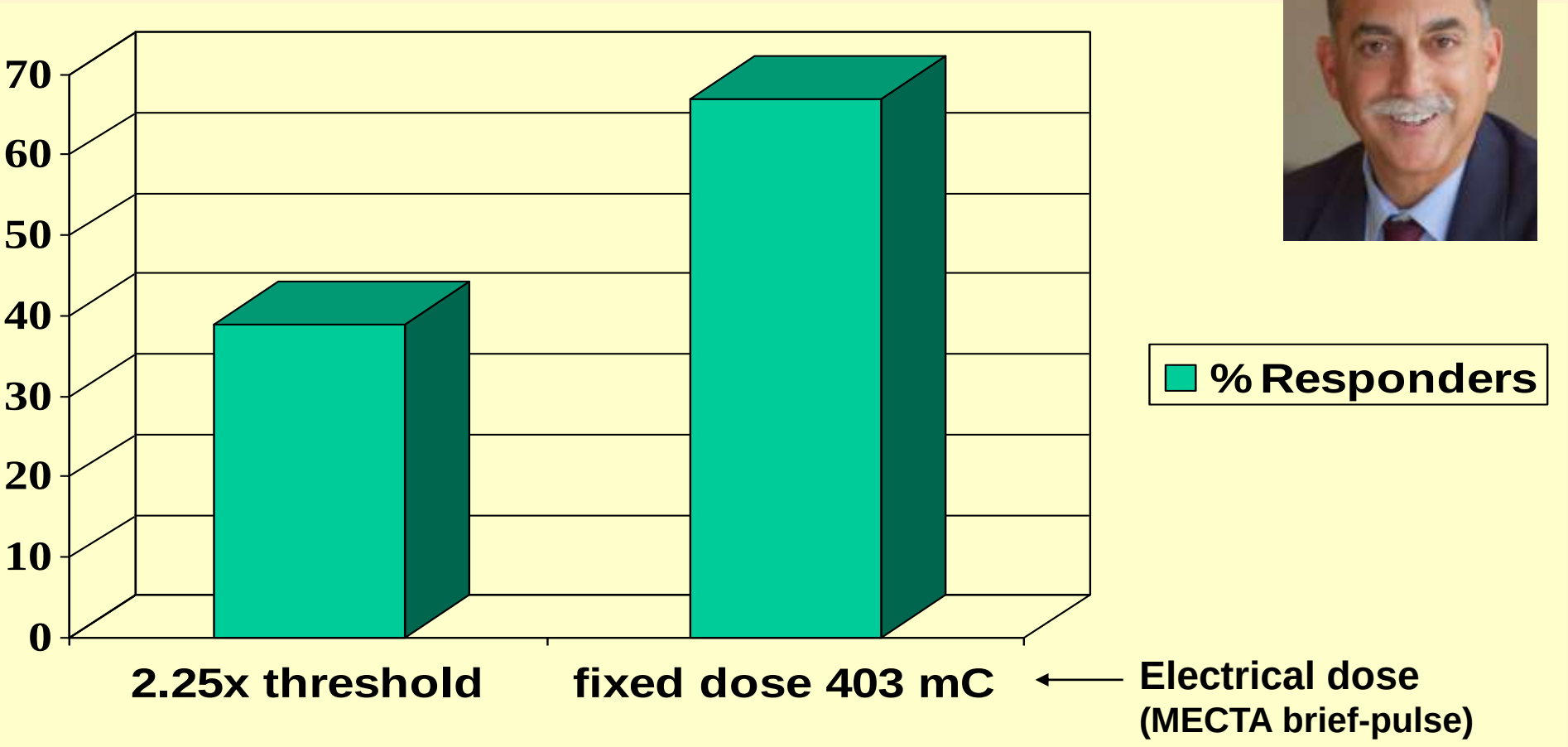
TITRATED MODERATELY SUPRATHRESHOLD VS FIXED HIGH-DOSE RIGHT UNILATERAL ELECTROCONVULSIVE THERAPY

Willian Vaughn McCall (NC) , DM Reboussin, RD Weiner, HA Sackeim

Arch Gen Psychiatry 2000;57:438-44



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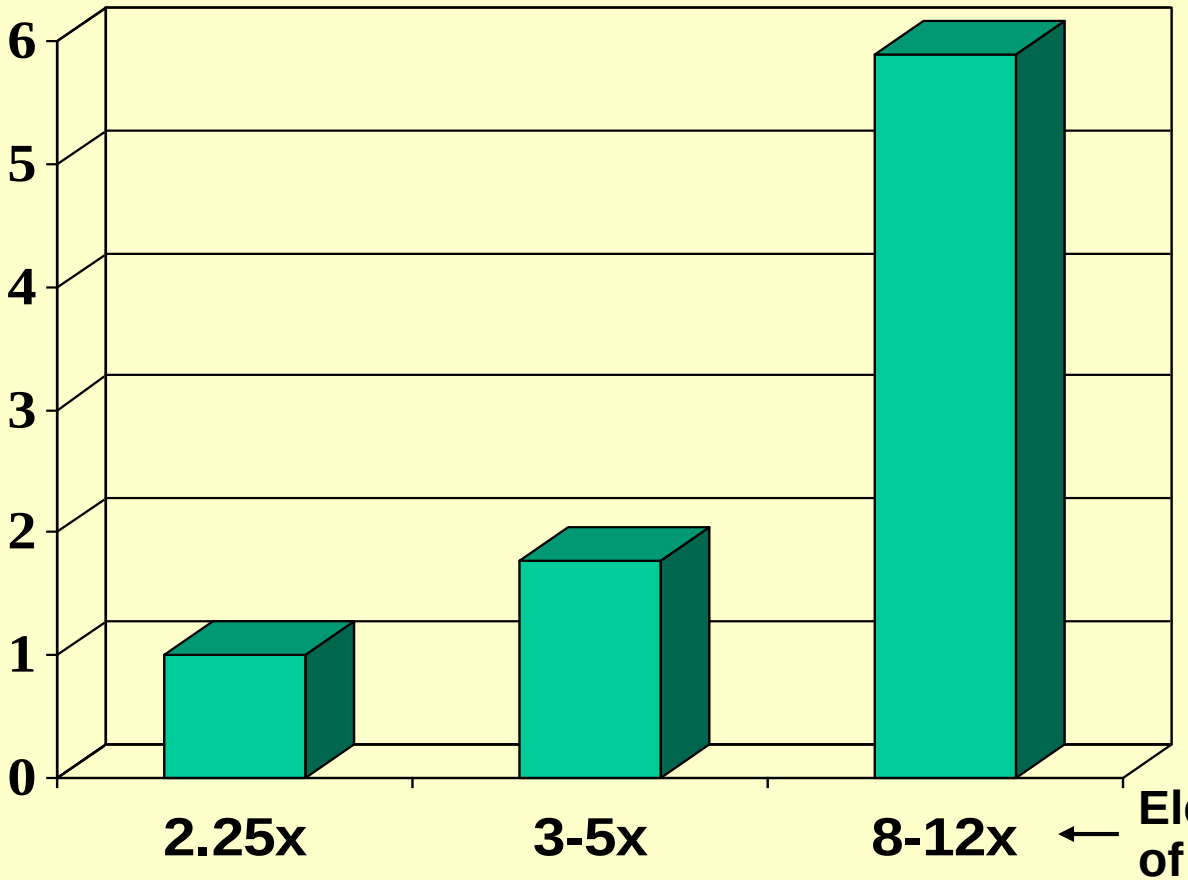

Antidepressant odds ratio

Electrical dose as a multiple of the seizure threshold (MECTA brief-pulse)

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

Willian Vaughn McCall (NC) , DM Reboussin, RD Weiner, HA Sackeim

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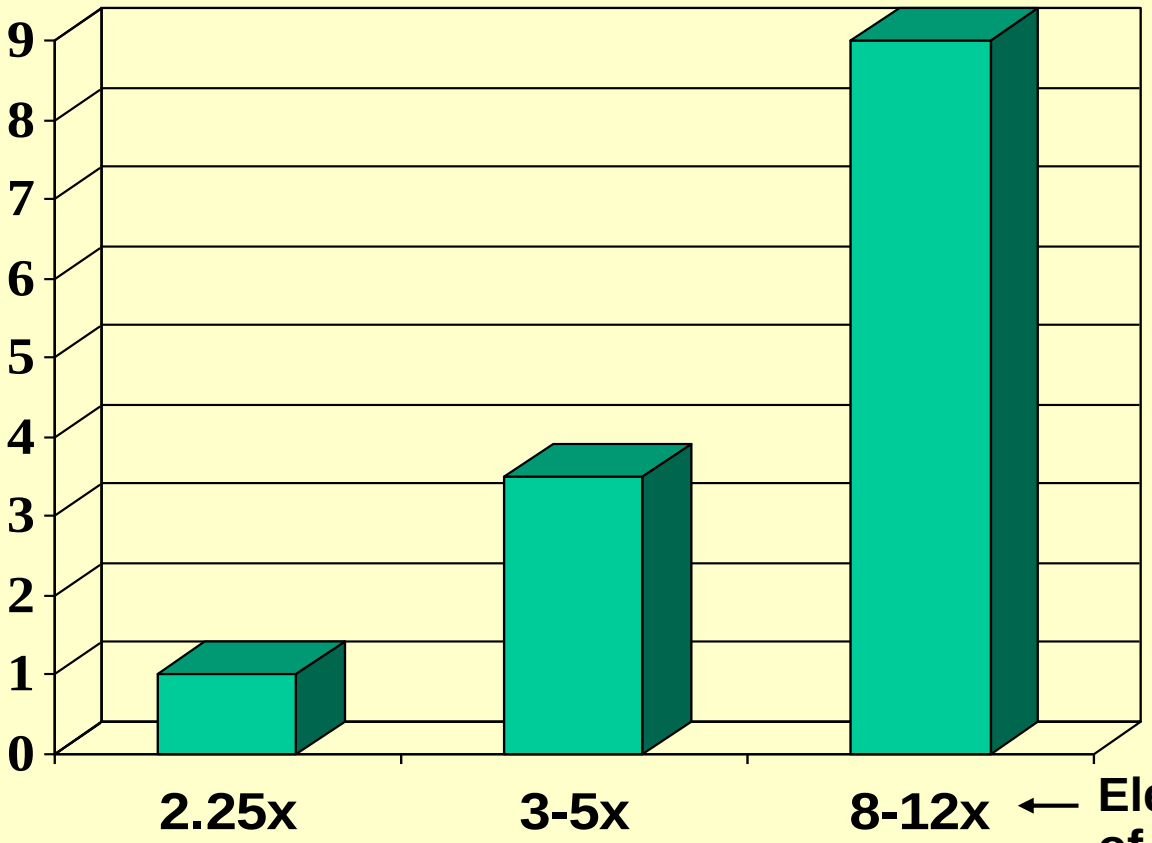

Global cognitive disturbance odds ratio

← Electrical dose as a multiple of the seizure threshold (MECTA brief-pulse)

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Right unilateral vs Bifrontal vs Bitemporal

Towards the Modal ECT Treatment

For most patients dose titration is unnecessary

- **Right unilateral ECT ≈75% of the device's maximal output**
- **Bilateral ECT in the middle third**
- **Bifrontal ECT probably about 50%**

Charles H. Kellner, SC/NY

Editorial: Towards the modal ECT treatment

J ECT 2001; 17:1-2

Per

Right unilateral vs Bifrontal vs Bitemporal

Far better to take the bull by the horns and give every patient a treatment that has the best chance of success:

- **Maximum-dose unilateral ECT**
- **Age-based bifrontal ECT**
- **Half-age-based bitemporal ECT**

and with no demonstrated long-term or persistent side effects.

Richard Abrams, IL

Stimulus titration and ECT dosing:
Response to commentaries on stimulus titration and ECT dosing
J ECT 2002;18:14-5

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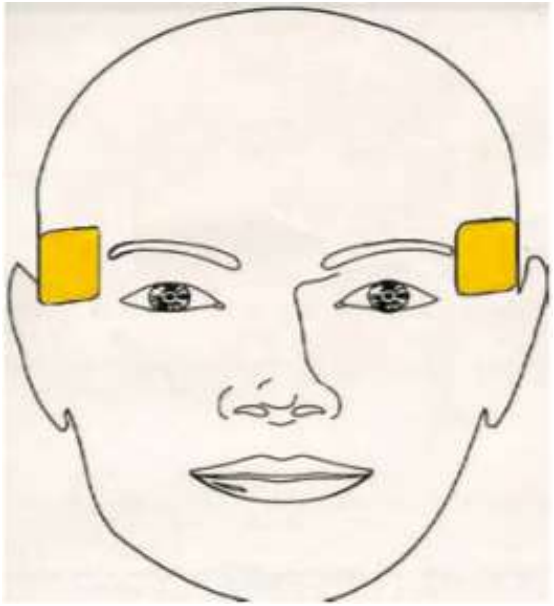
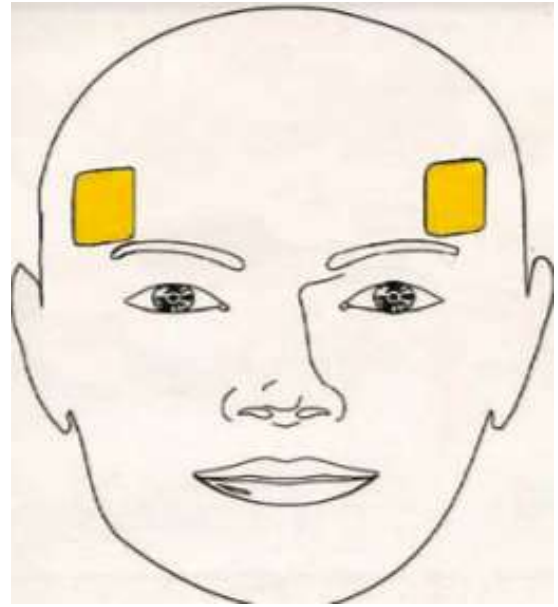
ELECTRODE PLACEMENTS

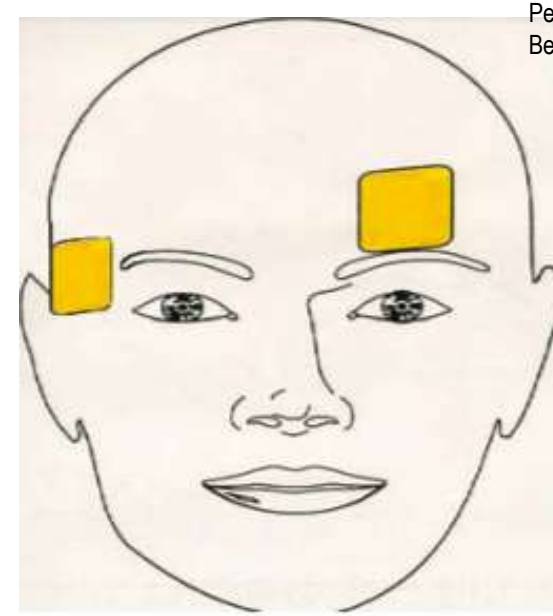
Per Bergsholm



Bitemporal (BT)



Bifrontal (BF)



Left anterior right temporal (LART)

Right unilateral (RUL)

RUL: A common variation relocates the upper electrode backwards midway between the vertex and the occiput, over the parietal lobe. Probably most unilateral ECT in the United States is given with this variation. With its spacing wider it should be at least as effective.

Conrad M Swarts 2009

Figures: Conrad M Swartz (Illinois) & Alexander I Nelson (Moscow) Rational electroconvulsive therapy electrode placement. Psychiatry (Edgmont) 2005;2:37-43

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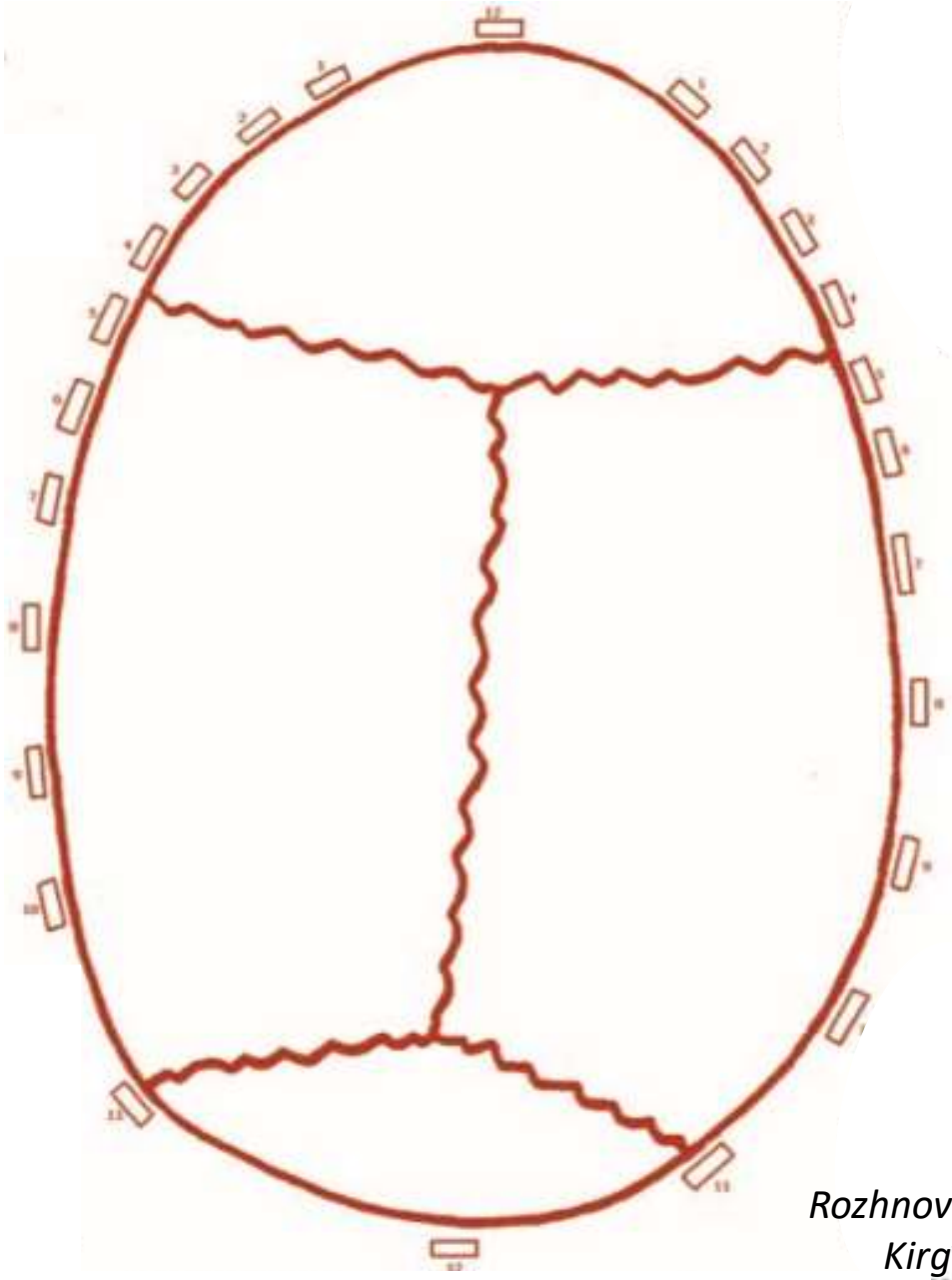

Rozhnov's sequence of electrode placements

It stands to reason that side effect aggregation should be diminished by decreasing the repition of any particular placement. Why not rotate among the four modern placements until the ECT course is concluded?

Conrad M. Swartz

Rozhnov VA. Electroconvulsive therapy with the changing electrode position. Kirghiz State Medical Institute Proceedings, Frunze, 1951;VII:365–71. In: Conrad M Swartz CM & Alexander I Nelson. Psychiatry 2005;2:37-43

Bitemporal vs High-dose right unilateral

Review and meta-analysis of 7 studies (n=792) 2000-2016

High-dose unilateral ECT does not differ from moderate-dose bitemporal ECT in antidepressant efficacy but has a cognitive advantages on retrograde autobiographical memory.

The only study that favoured bitemporal ECT (although not statistically significant) in terms of autobiographical memory used right unilateral ECT at 8 × seizure threshold (McCall et al 2002). This indicates that there is no cognitive advantage in going beyond 6 × seizure threshold for right unilateral ECT.

Erik Kolshus, Ana Jelovac, Declan McLoughlin (Dublin)

Bitemporal v. high-dose right unilateral electroconvulsive therapy for depression:
a systematic review and meta-analysis of randomized controlled trials

Psychological Medicine 2017;47:518-30

Per

Bifrontal vs Bitemporal and Right unilateral

Review and meta-analysis of 8 studies (n=617) 1993-2010

- **Efficacy was equal between BF and BT ECT, and BF and RUL ECT**
- **Post-treatment MMSE score decline was less for BF than for BT ECT, but not less than for RUL ECT**
- **RUL ECT impaired Complex figure recall more than BF ECT**
- **BF ECT impaired word recall more than RUL ECT**
- **BF ECT has potential advantages, but requires better characterization**

Ross A Dunne, Declan M McLoughlin

Systematic review and meta-analysis of bifrontal electroconvulsive therapy versus bilateral and unilateral electroconvulsive therapy in depression

World J Biol Psychiatry 2012;13: 248-58

Per

Design for switch studies in non-responders

Unilateral non-response → High-dose unilateral
Unilateral non-response → Bilateral

Bilateral non-response → The same bilateral position
Bilateral non-response → High-dose RUL

Bilateral non-response → The same bilateral position
Bilateral non-response → A different bilateral position

When the first 6-10 right unilateral ECT sessions have produced no improvement

Retrospective comparison

	Continued RUL (n = 34)	Switched to BT (n = 27)	χ^2
Considerable improvement	19 (59%)	11 (41%)	0.84 NS
No considerable improvement	15	16	

Since bilateral ECT may severely impair memory for weeks or months

the patients should not be stressed by a change to this technique

Lizzy Sand Strömgren. Aarhus, Denmark

Is bilateral ECT ever indicated? Acta Psychiatr Scand 1984:69:484-90

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When the first 5-8 right unilateral ECT sessions have produced no response in older depressed patients

Randomized prospective comparison

	RUL ECT 5.5 × (n=13)	BT ECT 2.5 × (n=11)	p
Reductionon in HAM-D, %	68	60	0,707
Remission, %	46 (6/13)	18 (2/11)	0,211
Response, %	62 (8/13)	64 (7/11)	0,999
MMSE change	1,5	- 3,6	0,048

Older patients who fail to respond to moderate-charge [2.5 × threshold] RUL ECT may benefit from a switch to high-charge RUL ECT rather than BL ECT

Tew JD Jr, Mulsant BH, Haskett RF, Dolata D, Hixson L, Mann JJ. Pittsburg, USA

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

J Clin Psychiatry 2002;63:1102-5

Per

INTERACTIONS BETWEEN PULSE WIDTH, PULSE FREQUENCY, STUMULUS DURATION, CHARGE, CURRENT and ELECTRODE PLACEMENT

Per

Surprize!

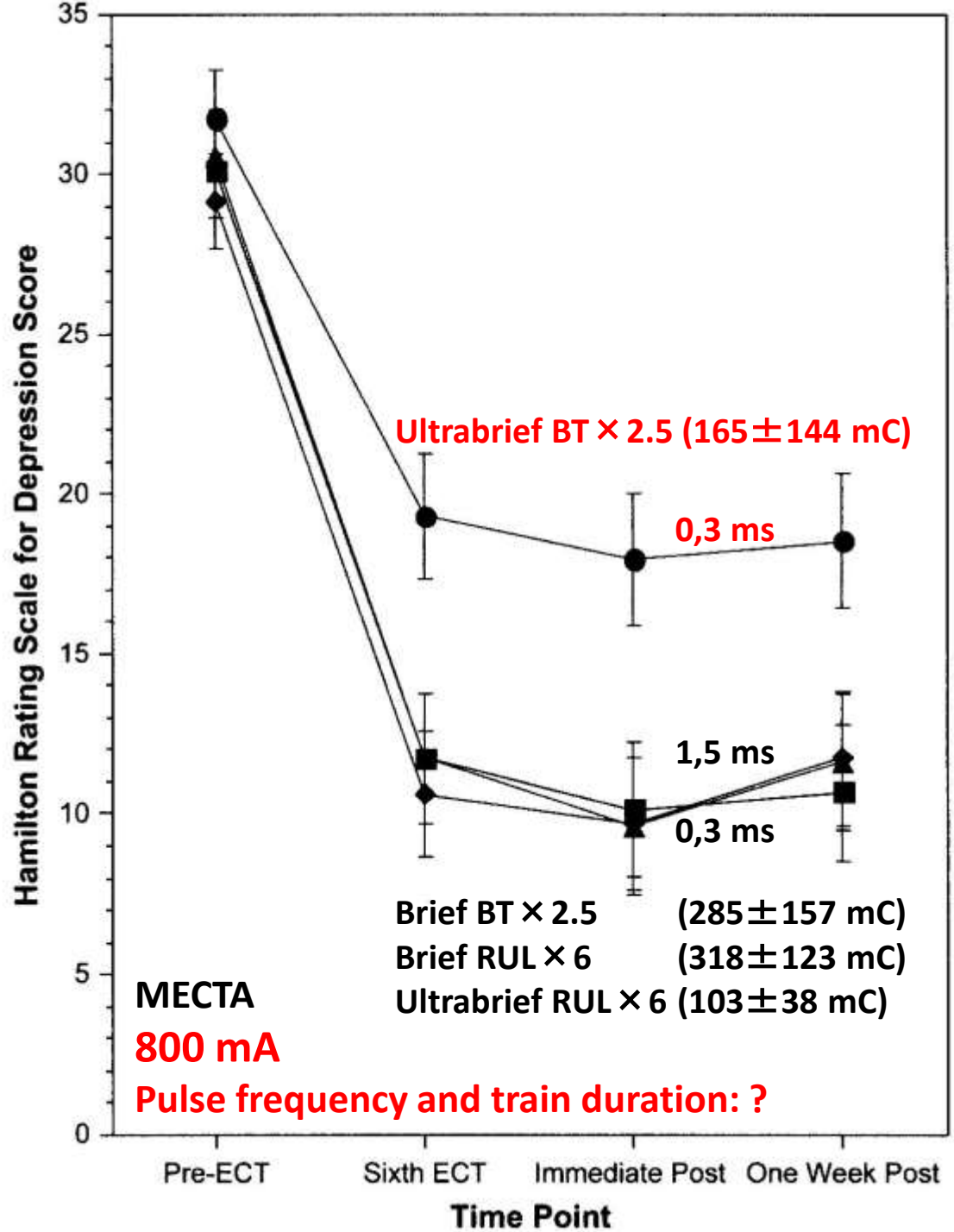
Bitemporal ultrabrief (0.30 ms) inferior

Randomized controlled

Sackeim HA et al (NY)

Effects of pulse width and electrode placement on the efficacy and cognitive effects of electroconvulsive therapy

Brain Stimulation 2008;1:71-83



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Bitemporal ultrabrief (0.1 ms) not quite so good as brief (1.5 ms)

Prospective randomized

Anyone got a picture of Börje Cronholm ? ☺

Konvulsator III, 700 mA. Elther ES, 2100 mA

Outcome (n=41)	Pulse Width 0.1 ms	Pulse Width ~1.5 ms	P
Change in depression score	−8.1	−9.9	0.10
Pronounced improvement	13/21 (62%)	18/20 (90%)	0.10 >p > 0.05
Recovered	8/21 (42%)	13/20 (65%)	
Number of treatments	7.3	6.1	NS

Cronholm B, Ottosson J-O

Stockholm, Sweden

Ultrabrief stimulus technique in eletroconvulsive therapy. II. Comparative studies of therapeutic effects and memory disturbances in treatment of endogenous depression with the Elther ES electroshock apparatus and Siemens Konvulsator III.

J Nerv Ment Dis 1963;137:268-76

Per

Bitemporal ultrabrief (0.25 ms) as good as brief (0.5 ms)

Retrospective

Thymatron IV, 900 mA

Outcome (n=65)	Pulse Width 0.25 ms	Pulse Width 0.5 ms	P
Change in HAM-D	−20.1 (8.9)	−19.3 (9.7)	0.947
Response	14/19 (73.6%)	34/46 (75.6%)	1.000
Remission	8/19 (42.1%)	21/46 (46.6%)	0.794

Niemantsverdriet L, Birkenhäger TK, van den Broek WW

Rotterdam, The Netherlands

The efficacy of ultrabrief-pulse (0.25 millisecond) versus brief-pulse (0.50 millisecond) bilateral electroconvulsive therapy in major depression

J ECT 2011;27:55-8

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Pulse width v Pulse train duration v Pulse frequency

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Author, year	El plac	Efficiency by threshold↓ & clinical response > = better than
Swartz & Larson 1989, USA	BT	Duration↑ 2 s > 1 s (2 s with 0.75 ms/60 Hz or 1.5/30 > 1 s with 1.5 /60)
Isenberg et al 1996, USA	BT, RUL	Duration↑ and Width↓ until 8 s/0.5 ms > 2 sec/1 ms
Devanand et al 1998, USA	BT	Duration↑ > Frequency↑ (1→3.5 s/30 Hz > 40→140 Hz/0.75 s)
Swartz CM & Manly 2000, USA	LART	Width↓ 0.5 ms > 1 ms (0.5 ms/30 or 60 Hz > 1 ms/30 or 60 Hz)
Chanpattana et al 2000, Thai	BT	Width↓ Duration↑ lower threshold in 79%
Andrade et al 2002, India 	rats	Duration↑ > Amplitude↑ or Frequency↑
Sudha et al 2003, India	rats	Width↓ 0.6 ms > 2.0 ms. Frequency↑ 100 Hz > 30 Hz
Girish et al 2003, India	BT	Frequency↓ > ↑ (50 pps/0.5→4.5 s > 200 pps/0.125→1.125 s) (charge↓)
Kotresh et al 2004, India	RUL	Frequency↓ > ↑ **Response** ↔ (RCT n=40) (charge↓)
Sackeim et al 2008, USA	BT, RUL	Width↓ 0.3 ms > 1.5 ms. **Response BT 0.3 ms**↓ RUL 0.3 = RUL 1.5 = BT 1.5
Roepke et al 2011, Germany	RUL	Frequency↓ 40 Hz > 100 Hz → **Response**↑ (RCT n=40)
Andrade on Roepke et al 2011		Frequency↓ + Duration↑ ± charge↑
Ravishankar et al 2013, Ind	BT	Frequency↓/Duration↑ 50 pps/9 s > 125 pps/3.6 s **Response**↑ (n=1) (540 mC)
Thirthalli et al 2017, India 	BT, BF,RUL	Frequency↓/Duration? 50 pps > 125 pps **Response**↑ (n=10) (charge?)
Andrade on Thirtalli 2018, India		Lower pulse frequency or longer stimulus duration?
Thanki et al 2018, India	BT, BF	Lower pulse frequency, not longer stimulus duration (however, somewhat)

Per Bergholm

Ravishankar V ... Gangadhar, BN. Altering pulse frequency to enhance stimulus efficiency during electroconvulsive therapy. J ECT 2013;29:e14-5. Thirthalli J ... Gangadhar, BN. Novel method of altering stimulus parameter to facilitate seizure induction during electroconvulsive therapy. Brain Stimul 2017;10:1143-4

NIVIQURE device (Technonivilak Bangalore, India), 800 mA. !.5 ms

N=1 Session	Unsuccessful seizure with 125 pps (BT)			Successful seizure with 50 pps (BT) (-60%)		
	Charge (mC)	Train duration (s)	Motor seizure (s)	Charge (mC)	Train duration (s)	Motor seizure (s)
1	180	1.2	0	540	9.0 (+150%)	47
2	360	2.4	0	540	9.0 (+150%)	18
3	480	3.2	0	540	9.0 (+150%)	25
4	540	3.6	15-17-0	540	9.0 (+150%)	26

Pat. No	Age Sex	Electrode placement	Number of sessions with 125 pps		Electrode placement	Number of sessions with 50 pps (-60%)	
			Received	Failed		Received	Failed
1	45, M	BF	4	4	BF	9	0
2	59, M	BT	4	4	RUL	8	3
3	59, F	BF	6	5	BF	8	2
4	44, F	BT	6	6	BT	4	0
5	49, F	BT	8	8	BT	10	0
6	70, M	RUL,BF,BT	4	2	BF	7	0
7	52, M	BF	11	4	BF	4	0
8	62, M	BF	2	2	BF	7	0
9	71, M	BF	3	3	BF	6	0
10	54, F	BT	2	2	BT	4	0

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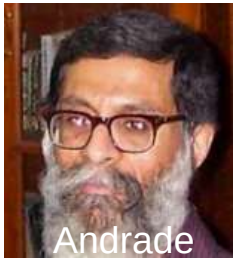
Bergsholm

Facilitating electroconvulsive therapy seizure induction: Lower pulse frequency or longer stimulus duration?

Chittaranjan Andrade. *Brain Stimulation 2018;11/1:244*



If stimulus duration was unchanged, implying total charge was reduced, lowering pulse frequency reduced the threshold.
If stimulus duration was increased to compensate for the reduced pulse frequency, then it is a moot point [a matter of opinion] whether eliciting an adequate seizure resulted from reduced pulse frequency or increased stimulus duration.

Lower pulse frequency, and not longer stimulus duration, helps reduce seizure threshold in ECT

Thanki MV ... Gangadhar BN. *Brain Stimulation 2018;11/3:656-7*

800 mA. !.5 ms

Pat. No	Age, Sex	Eletrode placement	Last unsuccessful seizure with 125 pps and charge rate 150 mC/s		First successful seizure with 50 pps and charge rate 60 mC/s (-60%)	
			Charge (mC)	Train duration (s)	Charge (mC)	Train duration (s)
11	37, M	BT	540	3.6	210 (-61%)	3.5 (-3%)
12	46, F	BF	480	3.2	240 (-50%)	4.0 (+25%)
13	39, F	BF	540	3.6	240 (-56%)	4.0 (+11%)
14	53, F	BF	480	3.2	240 (-50%)	4.0 (+25%)

Per
Bergsholm

Reducing frequency and/or increasing stimulus duration

Towards Scandinavian Konvulsator-long pulse-train, or longer? ☺

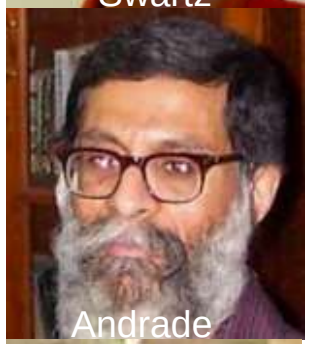
Below 0.5 msec, within 8 seconds, particularly high frequency is necessary. This may degrade efficiency by **'stimulus crowding'**

Swartz & Manly 2000

Increasing current

Stimulus dose in 'volume of seizure foci' is proportional to charge × **current cubed.** Therefore, **900-mA** are substantially more effective than 800 mA, giving **~50 % higher** seizure foci dose. Higher current is **desirable with ultrabrief ECT.**

Swartz 2006, 2011



Swartz CM. Ann Clin Psychiatry 1994;6:205-6. Devanand DP et al. JECT 1998;14:227-35. Swartz CM, Manly DT. Am J Psychiatry 2000;157:1504-6. Swartz CM. J ECT 2006;22: 54-8. Swartz CM. Electroconvulsive and neuromodulation therapies, 2009. Swartz CM. J ECT 2011;27:340-1.

Charge rate (mC/s) = 2 × frequency(Hz) × pulse width (ms) × current (A)

Phern-Chern Tor, **A Bautovich, M-J Wang, D Martin, SB Harvey,** **Colleen Loo**
Sidney/Singapore

A Systematic review and meta-analysis of **brief versus ultrabrief right unilateral electroconvulsive therapy** for depression

	Efficacy	Effect size	P	Remission %	P	NNT	No of sessions
4 RCTs + 2 non-RCTs	**1.0-1.5 ms > 0.3 ms**	0.25	.004	45 v 34	.045	12	8.7 v 9.6
The 4 RCTs only	**1.0-1.5 ms ≥ 0.3 ms**		.121				

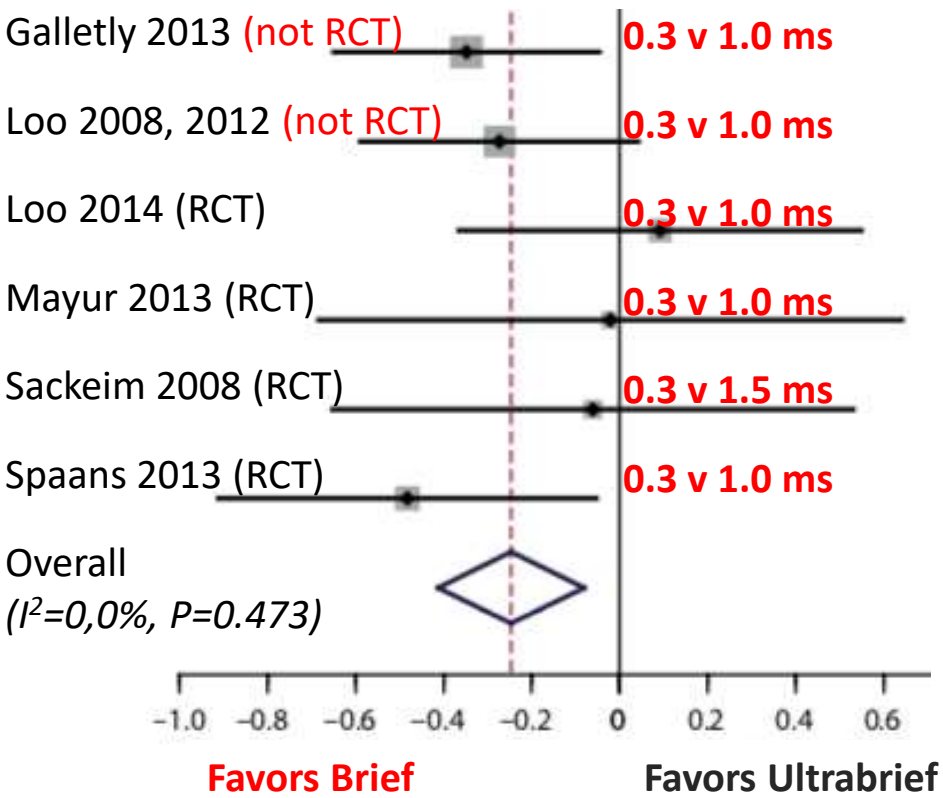
J Clin Psychiatry 2015;76:e1092-8

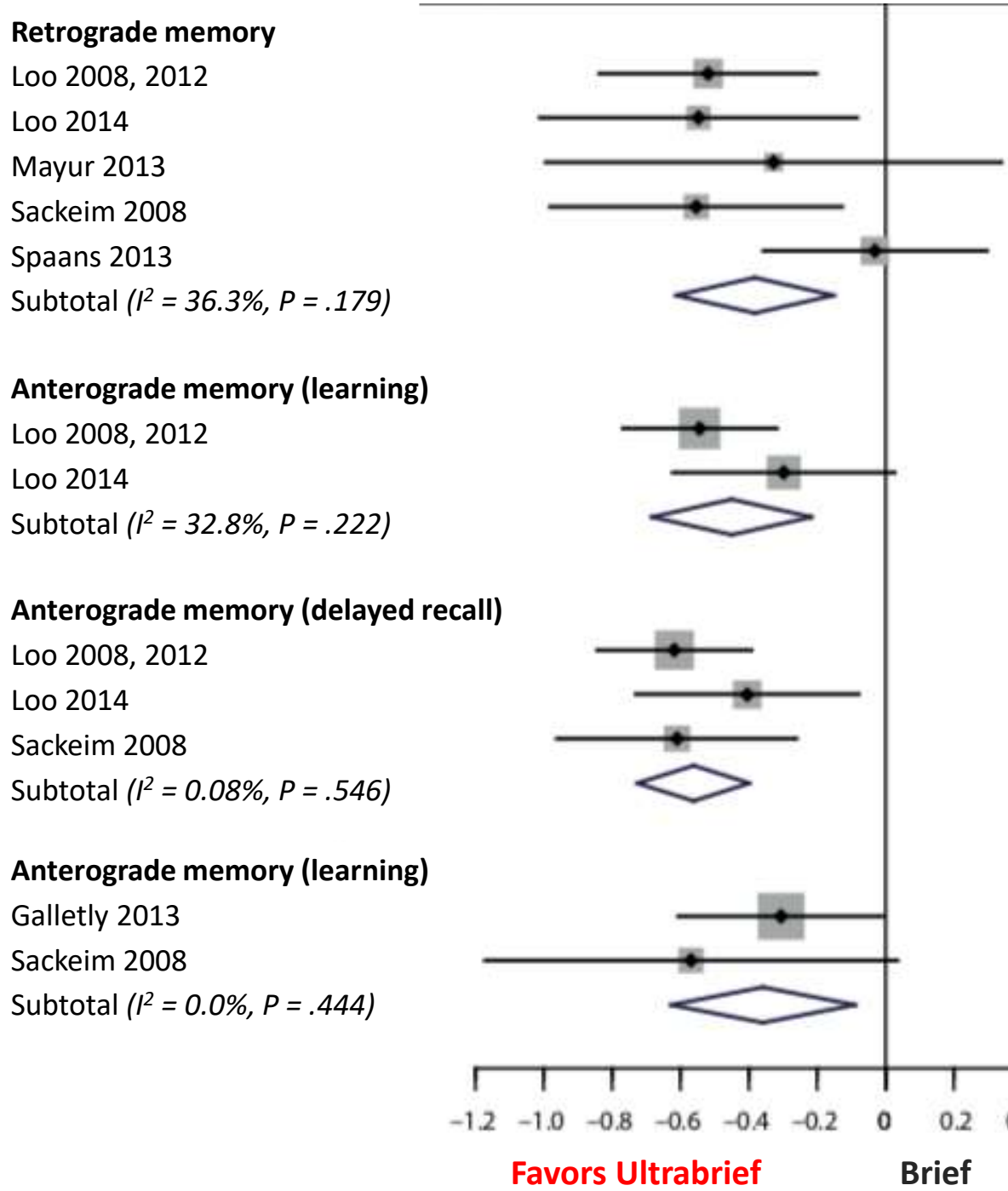
Per

Colleen Loo

Phern-Chern Tor

Forest plots of efficacy and cognitive tests for **brief pulse versus ultrabrief pulse RUL ECT** in depression at end of acute ECT course





Pascal Sienart (Leuven, Belgium) – Commentary
The ideal ECT technique or the ideal ECT patient
What should be the focus of research?

J Clin Psychiatry 2015;76:e1132-3

- **UBP ECT should not be the standard of care. UBP ECT should be considered in patients in whom avoiding cognitive side effects, even temporary ones, is of primary importance**
- **if, in a given patient, a "safer" technique that results in less favorable effects of ECT is selected, the burden of side effects might be heavier.**
- **a study comparing UBP ECT with the widely used "standard" pulse of 0.5 msec, rather than 1 msec.**

Per

Pulse Width in Electroconvulsive Therapy: How Brief Is Brief?

Pascal Sienaert, Harm-Pieter Spaans, Charles H. Kellner. *J ECT 2018;34:73-4*

Initial seizure threshold for different pulse width in right unilateral ECT

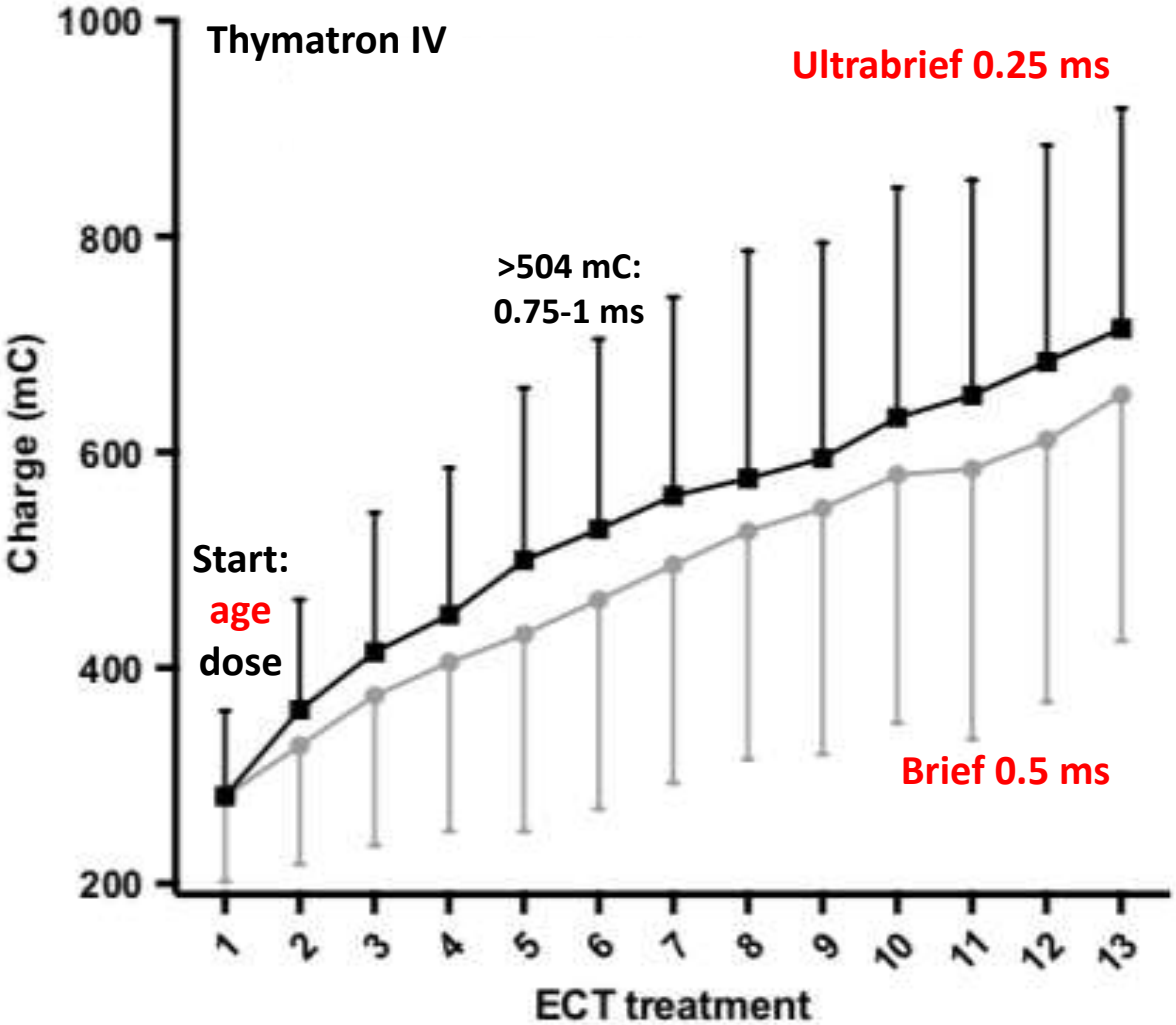
Author, year	0.3 ms	0.5 ms	–	1.0 ms	–	1.5 ms	*P*
Loo et al 2007	28 (14)			78 (42)			<0.0001
Rosa et al 2013	36 (15)	40 (15)					NS
Sackeim et al 2008	22 (8)					70 (27)	<0.05
Sienart et al 2009	38 (25)						
Spaans et al 2013	23 (10)			62 (21)			<0.001

- **might be a continuum of increasing efficacy and adverse effects with pulse width**
- **seizure thresholds does not differ between 0.3 and 0.5 ms**
- **the number of treatments in a course with 0.5 ms resembles UB studies**
- **0.5 ms may be considered ultrabrief**

Per

CASBAS - Clinical and seizure based stimulation

RUL ultrabrief 0.25 v brief 0.5 ms – naturalistic comparison



	Brief	Ultrabrief	P
N	162	83	
Age at first session	57±14	55±15	
No of sessions	11	13	0.001
Mean charge per session, mC	444±175	517±159	0.001
Patients with dose increase %	86	92	
Sessions per series with dose increase	3.0	3.7	0.009
Restimulation %	6.9	6.4	
Switch to LART, %	36	52	0.049
«UBP was a less efficient stimulation than BP»			
«Strong clinical improvement in both groups»			

Isabelle Brunner and Michael Grözinger (Aachen, Germany)

Brief vs. ultrabrief pulse ECT: focus on seizure quality. Eur Arch Psychiatry Clin Neurosci 2018;268:831-8

Per

RUL ultrabrief 6 × threshold

Right unilateral ultrabrief 0.25/0.30 ms pulse ECT 6 × threshold, combined with venlafaxine, is a rapidly acting and highly effective treatment option for depressed geriatric patients, with excellent safety and tolerability

Response 70%, remission 62%, non-remission 10%, drop-out 28%

Charles H Kellner et al, New York

Right unilateral ultrabrief pulse ECT in geriatric depression: Phase 1 of the PRIDE (Prologing Remission In Depressed Elderly) study

Am J Psychiatry 2016;173:1101-9

Per

Brief 0.5 ms RUL age and BF half-age with gender adjustment

RUL 0.5 ms age, male +5%/female -5%
Age 74. Response 68%, remission 39%
18% increased charge: 366→409 mC

BF 0.5 ms half-age, male +5%/female -5%
Age 76. Response 64%, remission 51%
86% increased charge: 191→356 mC

Bjølseth TM et al. J Affect Disord 2015;175:8-17

RUL 0.5 ms age, male +5-10%/female -5-10%
Highly resistant bipolar depression
Age 48. Response 74%, remission 35%
Charge 244 mC

Kessler U et al 2010. BMC Psychiatry 2010;10: Epub date 2010/02/25. Schoeyen H, Kessler U et al. Am J Psychiatry 2015; 172:41-51

MONITORING

Seizure parameters and outcome – correlations and predictive value

Author, year	Seizure duration	EEG EMG	Short time to high ictal slow waves	Regularity Patterning Stereotypy	(Mid)ictal slow wave amplitude	Inter-hemispheric coherence	Postical suppression	Peak heart rate
Krystal et al 1992/93/95/96/98* (US)			Pos	Pos	Pos	Pos	Pos	
Nobler et al 1993* (US)	No	No	Pos	Pos	Pos		Pos	
McCall, Farah 1995 (US)	Neg	Neg		Pos			No	
Hrdlicka et al 1996 (CZ)				Pos	Pos		Pos	
Folkerts 1996 [2] (D)				Pos	Pos		Pos	
Suppes et al 1996 (US)							Pos	
Gangadhar et al 1997/98/99* (IND)				Pos	Pos	Pos	Pos	
Krystal et al 2000 (US)							Pos	
Nobler et al 2000** (US)					Pos		Pos	
Frey et al 2001 (A)	Neg							
Swartz 2002 (US)								Pos[1]
Perera et al 2004 (US)					Pos	Pos	Pos	
Kho et al 2004** (NL)					Pos[2]			

Pos Neg No: positive, negative and no correlation to outcome. Red: Predictive value *Manual and computer **Computer

[1] With anticholinergic [2] Seizure energy index

Per

Seizure parameters and outcome – correlations and predictive value

Author, year	Seizure duration EEG	Seizure duration EMG	Short time to high ictal slow waves[1]	Regularity Patterning Stereotypy	(Mid)ictal slow wave amplitude	Interhemi-spheric coherence	Postical suppres-sion	Peak heart rate	Postictal reorient. time
Azuma et al 2007 (J)			No	No	No		Pos	Pos[3]	
Kimball et al 2009* (US)	No	No		Pos			No		
Combination predictive: EEG seizure duration + EEG regularity + postictal suppression + age + gender									
Azuma et al 2011** (J)							Pos	Neg[3]	
Abhishekh et al 2013** (IND)					Pos			Pos[4]	
Bjølseth et al 2016 (N)									Pos
Minelli et al 2016* (I)	Pos				*Pos*	*Pos*	Pos[5]	Pos[1]	
Seizure Quality	1/0				1/0	1/0	1/0	1/0	
Gálves et al 2017 (AUS)			No	No	Pos[6]		Pos[6]		
Kranaster et al 2018** (D)		Pos			Pos	Pos	Pos	Pos[4]	
Seizure Quality Index (SQI)		1/0			1/0	1/0	1/0	1/0	
Brunner, Grösinger* (D) 2018 (D) CASBAS	1/0				1/0	1/0	1/0	1/0	

Pos Neg No: positive, negative and no correlation to outcome Red: Predictive value *Manual and computer **Computer. [1] With anticholinergic
[3] No anticholinergic [4] Anticholinergic not mentioned [5] Postictal suppression index [6] Predicitve of threshold increase

Per

Seizure quality measures

Alessandra Minelli et al. Brescia/Verona /Bolzano, Italy. *J ECT 2016; 32: 88-92.*

Where is Laura?

Laura Kranaster ... Alexander Sartorius. Mannheim, Germany. *Eur Arch Psychiatry Clin Neurosci 2018;*

Isabelle Brunner, Michael Grözinger, Aachen, Germany. *Eur Arch Psychiatry Clin Neurosci*

Thymatron	Minelli et al 2016 – SQ Markers	Kranaster ... Sartorius 2018 – SQ Index	Brunner, Grözinger 2018 - CASBAS
	BT, 4. and 6. session	RUL, 2. session	RUL, all sessions
	Rating: 1 or 0 for each of five items		
EMG seizure duration, s		≤ 30/55	
EEG seizure duration s,	> 25		≥ 20
EMG/EEG concordance		≤ 0.70	
Midictal max amplitude, uV	≥ 180	≤ 200/215	>150
Coherence/synchronisity, %	± adequate	≤ 98	> 85
Peak heart rate, b/min	≥ 120	≤ 150/155	> 110
Postictal suppression, %	≥ 80		good
SQ Good 3.5–5.0 SQ Medium 1.8–3.4	75% responders	SQI ≤ 2 (< 65 yrs) predictive of non-response/remission	≥ 3 - increase dose if not improved at 6th
SQ Poor 0–1.7	38.5% responders		≤ 2 - restimulate

Per

Postictal Reorientation Time (PRT) or Time to Recover Orientation (TRO)*

- **Longer PRTs at the first and third treatments predicted a more rapid decline and a lower end-point in continous $HRSD_{17}$ scores**
- **None of the patients who recovered from disorientation in less than 5 min met the remission criterion**
- **All patients with PRTs of 35 min or more achieved remission after 12 treatments or less**

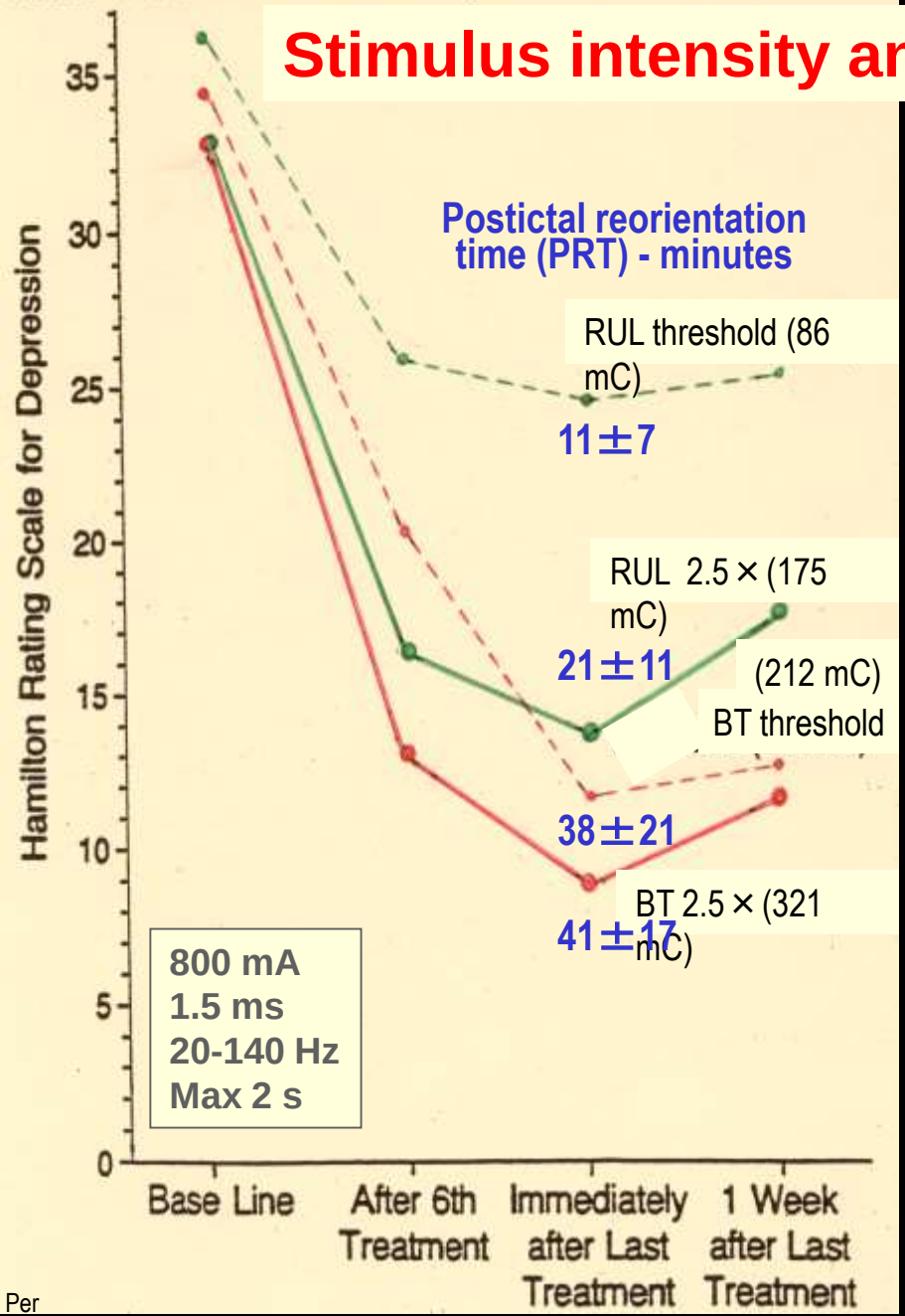
Tor Magne Bjølseth, Engedal K, Benth JS, Bergsholm, Strømnes Dybedal G, Gaarden TL, Tanum L
Speed of recovery from disorientation may predict the treatment outcome of electroconvulsive therapy (ECT) in elderly patients with major depression. J Affective Disord 2016;190:178-86

*Youssef. NA et al. Brain Sci 2019;9/99

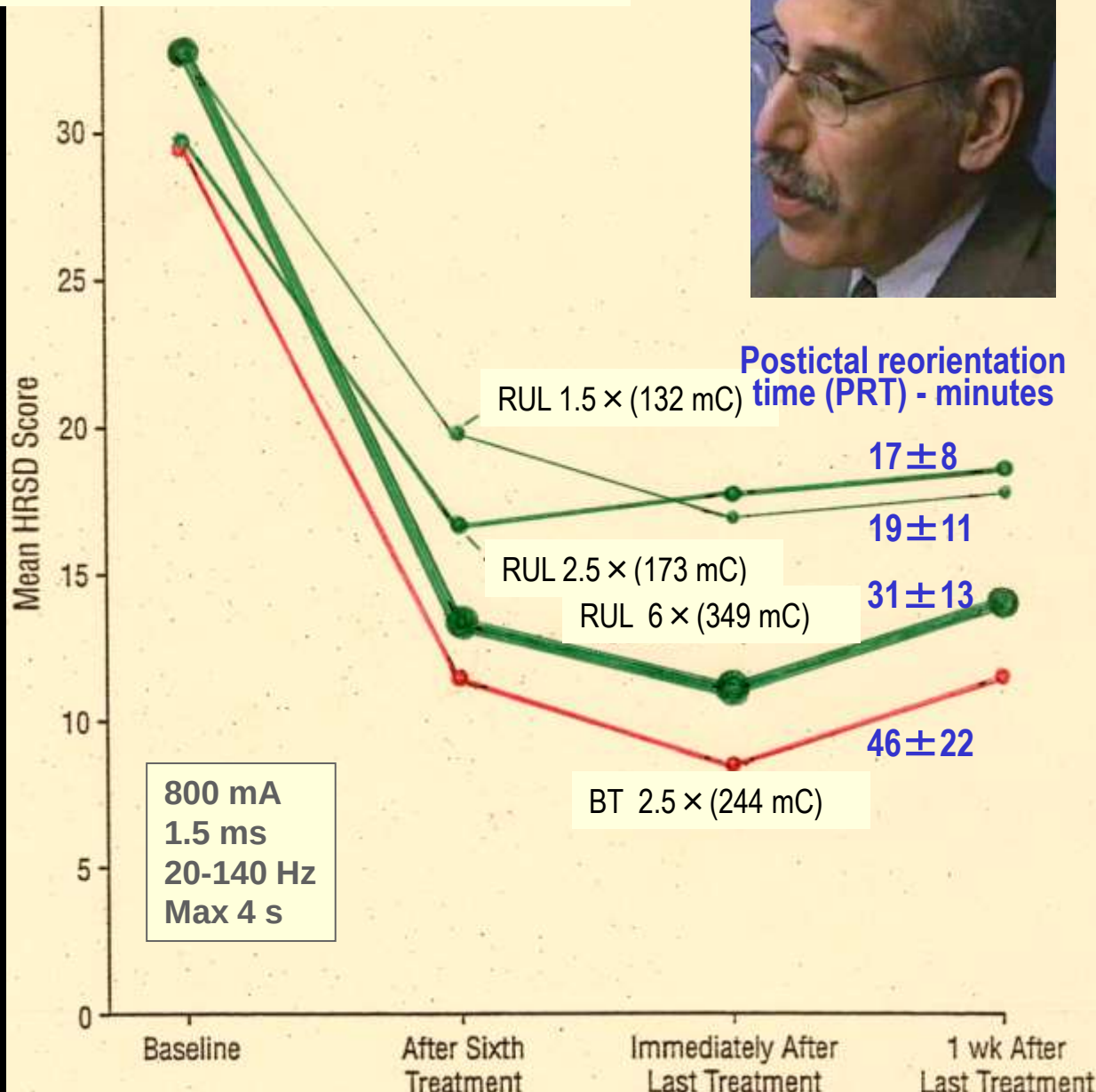
Per

Stimulus intensity and electrode placement

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.



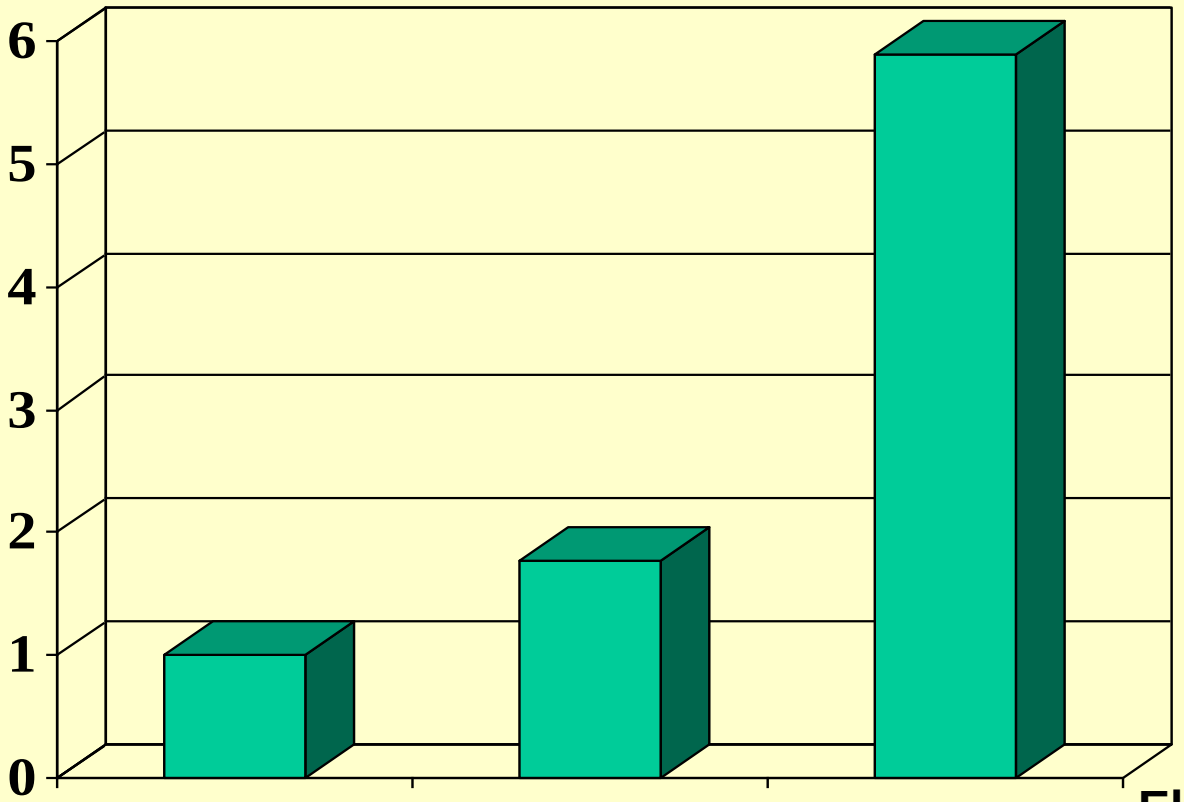
A PROSPECTIVE, RANDOMIZED, DOUBLE-BLIND COMPARISON OF BILATERAL AND RIGHT UNILATERAL ELECTROCONVULSIVE THERAPY AT DIFFERENT STIMULUS INTENSITIES. Sackeim HA et al. Arch Gen Psychiatry 2000;57:425-34.



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

Willian Vaughn McCall, DM Reboussin, RD Weiner, HA Sackeim

Arch Gen Psychiatry 2000;57:438-44



Antidepressant odds ratio

	2.25x	3-5x	8-12x
Postictal reorientation time (PRT) - minutes	14±12	18±15	27±17

Electrical dose as a multiple of the seizure threshold (MECTA brief-pulse)

Per

The Scandinavian liminal titration method

Anyone got a picture of Lizzie? ☺

Stimulation

1. Unilateral nondominant with long electrode distance
2. Stimulus duration not prefixed
3. Current interrupted as soon as the clonic contractions shift to the tonic phase, most readily observed in the plantar extension of the great toes

Observation

1. **The convulsion usually ends by degrees, succeeded by a comatose stage from which consciousness is gradually regained**
2. **The dissociative convulsion is followed by early awakening**
3. **The clonic form has no tonic phase, ends abruptly and simultaneously in the whole body, last only 10 to 20 s**
   Both have lower antidepressant efficacy

Giacomo d'Elia (1934-), **Jan-Otto Ottosson** (1925-), Gothenburg, **Lizzie Sand Strömgren** (1928-2007), Aarhus
Present Practice of Electroconvulsive Therapy in Scandinavia. *Arch Gen Psychiatry 1983;40:577-81*

Per

Is it time for a return to the Scandinavian liminal titration method?

Börje Cronholm
(1913-83)

Jan-Otto Ottosson
1925-

Lizzie Sand Strömgren
1928-2007

Giacomo d'Elia
1934-

d'Elia G, Ottosson J-O, Sand Strömgren L

Present Practice of Electroconvulsive Therapy in Scandinavia

Arch Gen Psychiatry 1983;40:577-81

Per

Adjusting dose to clinical response

Measure clinical response to each treatment and adjust the dose accordingly. This direct method has, remarkably, never been tested. Contrary to popular belief, effects often become manifest quite early – the first week.

- **Depression scale 24 h following each ECT**
- **Sleep: number of hours of each night. REM-sleep**
- **Weight and food intake daily**
- **Motor activity level. Motor tapping speed**
- **Reaction time** (and concentration - trail-making test A and B)
- **Body temperature** (Increased oral temperature correlated to response: Chen, Malmstrom, Nasrallah 2018)

Richard Abrams (Chicago)

Stimulus titration and ECT dosing. J ECT 2002;18:3-9

Per

Pupillary response

- **Time to Return Of Pupillary response to Light (ROPL) in sec is longer than motor and EEG seizure duration - 34 v 47 v 60 s.**
  Venkataramaiah et al 2018

- **Constriction ratio - pupillary enlargement.**
  Shirozu, Murayama, Yamaura 2019

- Venkataramaiah S ... Thirthalli J (**Bangalore**). Duration of Pupillary Unresponsiveness to Light: A Physiological Adjunct to Electroencephalography and Motor Seizure Duration Monitoring During Electroconvulsive Therapy. *J ECT 2018;34:e61-64.*
- Shirozu K, Murayama K, Yamaura K (**Kyushu, Japan**). Pupillary Response as Assessment of Effective Seizure Induction by Electroconvulsive Therapy. *J Vis Exp 2019;146:epub date 2019/04/30.*

Still confused,
but on a higher level?

per.bergsholm@gmail.com