Predictors of Motor Recovery

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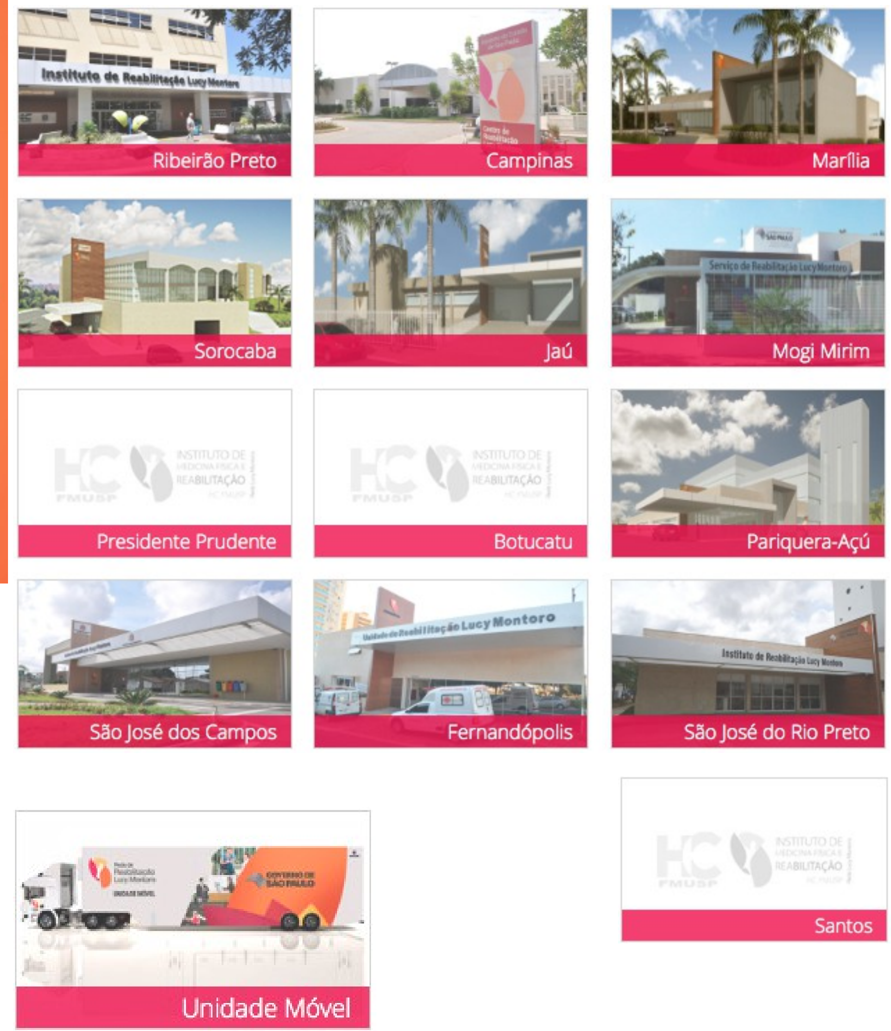
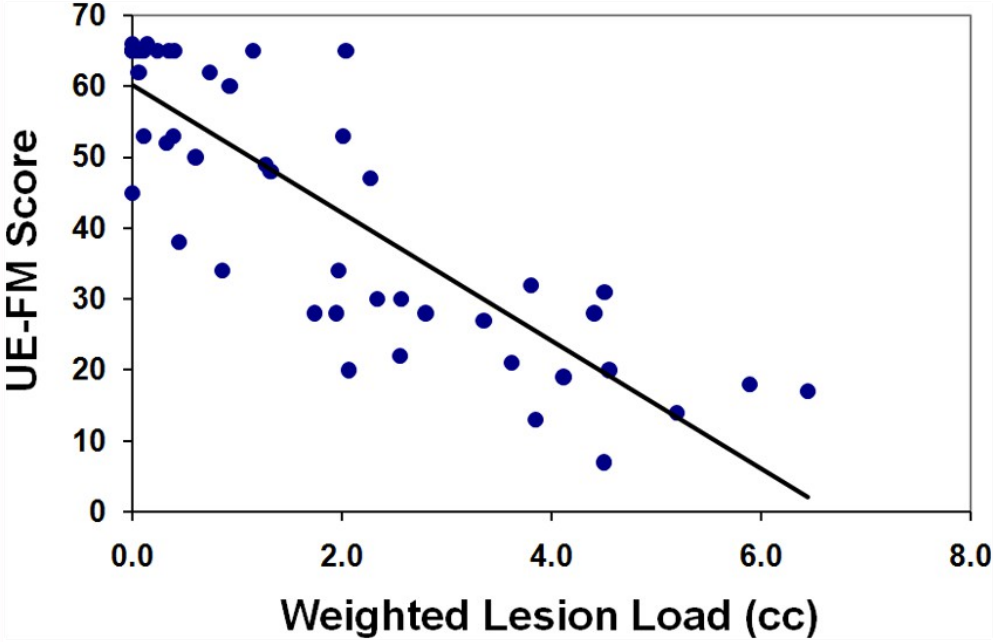


Serving more than 100,000 patients per month.

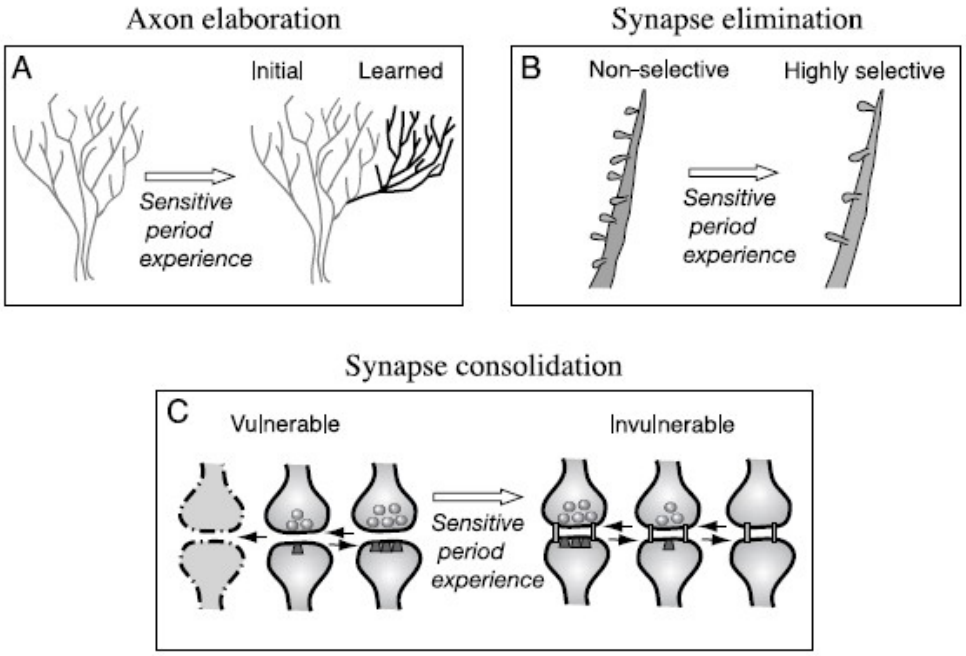


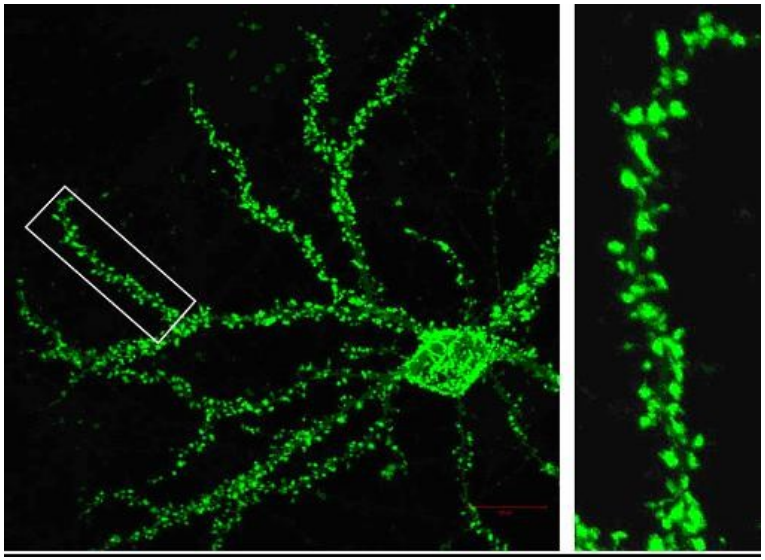
Patient	UE-FM	Lesion Size	Raw Lesion Load	Weighted Lesion Load
A	32	86.06 cm^3	2.11 cm^3	3.81 cm^3
B	62	86.64 cm^3	0.06 cm^3	0.03 cm^3
C	27	9.03 cm^3	1.72 cm^3	3.35 cm^3

Lin L. Zhu et al., 2010

mechanisms of neuronal plasticity

Reorganization of neural networks
Increase the "spines" of dendrites
Changes in synaptic strength





Knudsen, 2004, J Cogn Neurosc

http://www.bristol.ac.uk/anatomy/images/jmhfig2.jpg

TMS

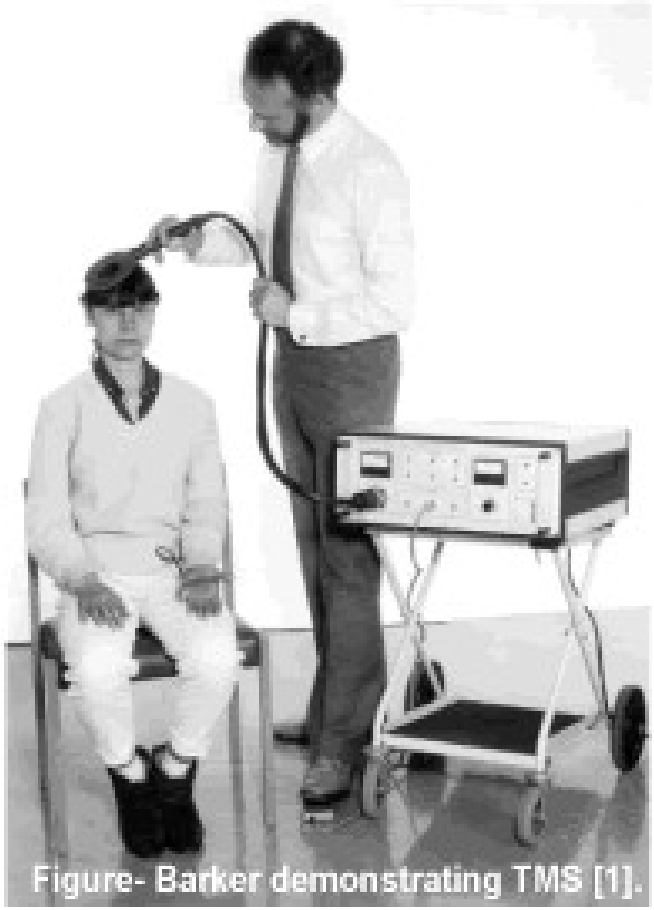
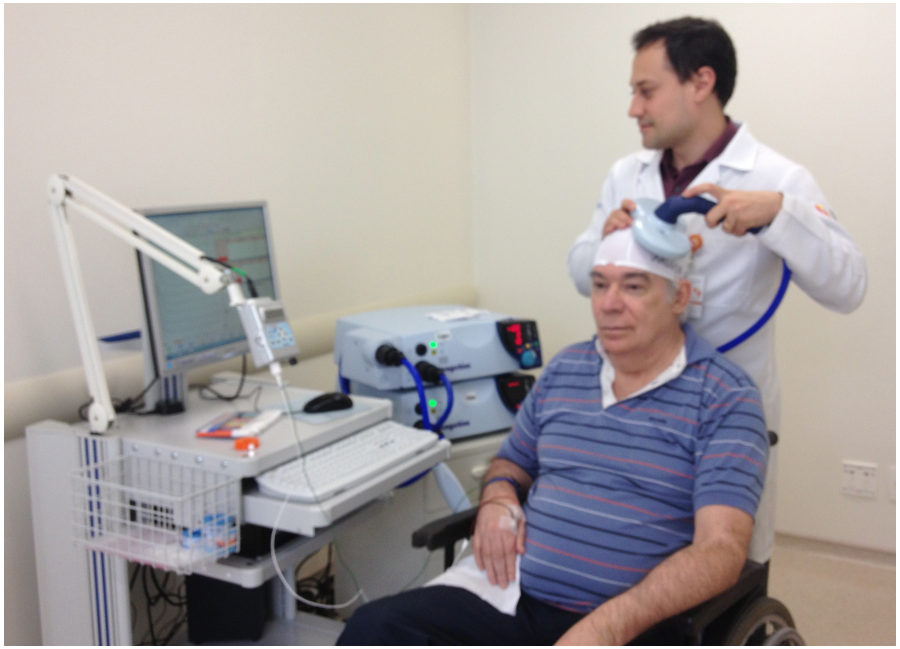
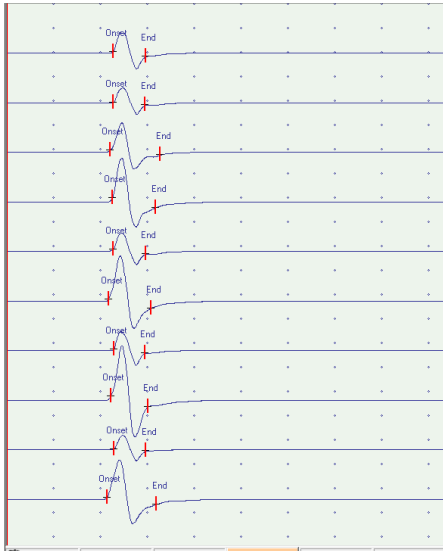


Figure- Barker demonstrating TMS [1].

Barker AT, et al., 1985




Onset
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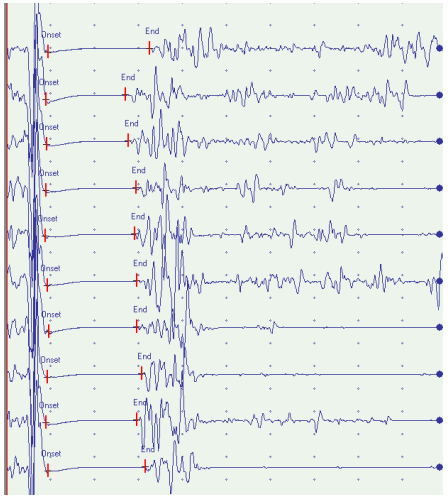
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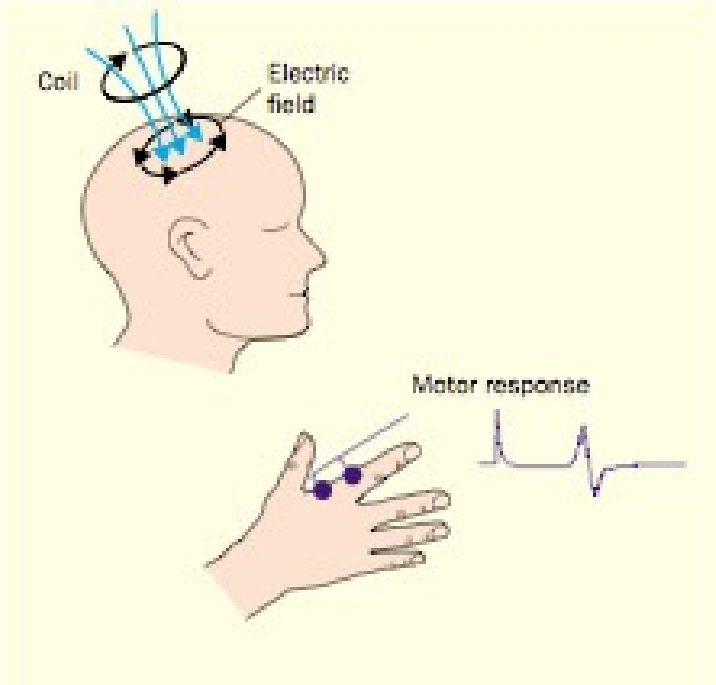
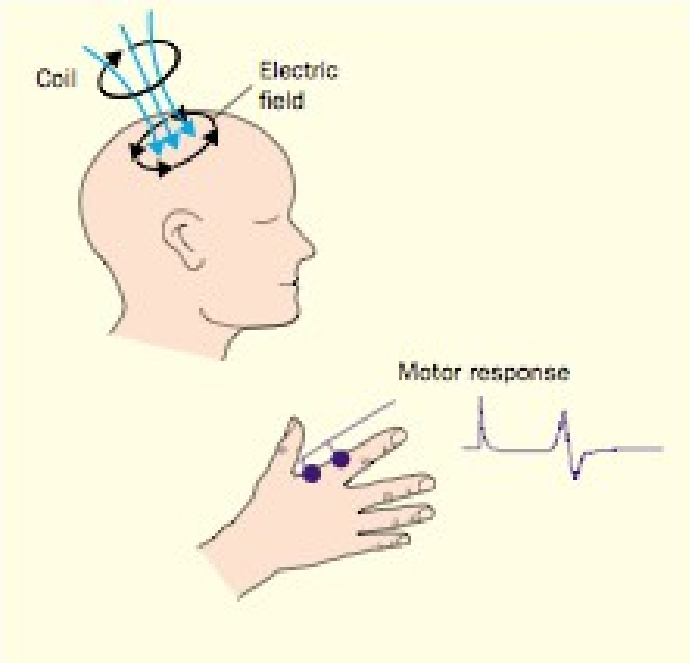
Motor Evoked Potential



Kobayashi M and Pascual-Leone A. THE LANCET Neurology Vol 2 March 2003

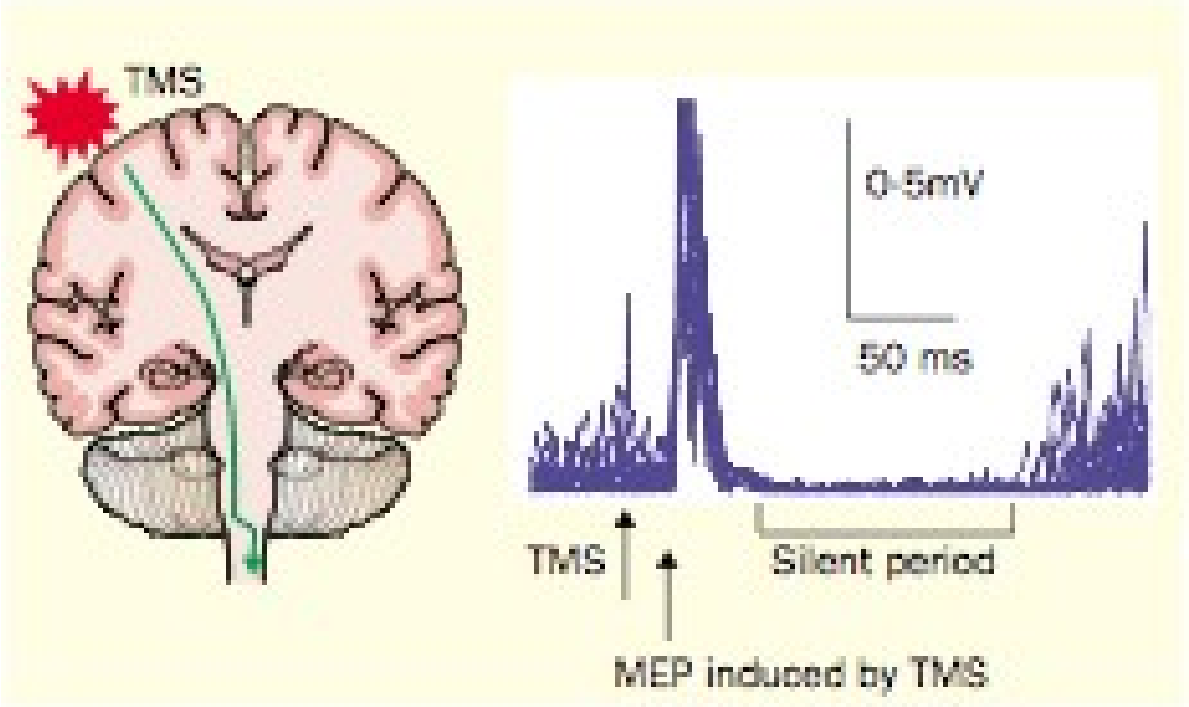
Motor threshold

- Lowest stimulus (applied in an appropriate place) capable of generating a motor evoked potential (MEP) with minimum amplitude of 50μV in at least 50% of applications



Kobayashi M and Pascual-Leone A. THE LANCET Neurology Vol 2 March 2003

Silent Period



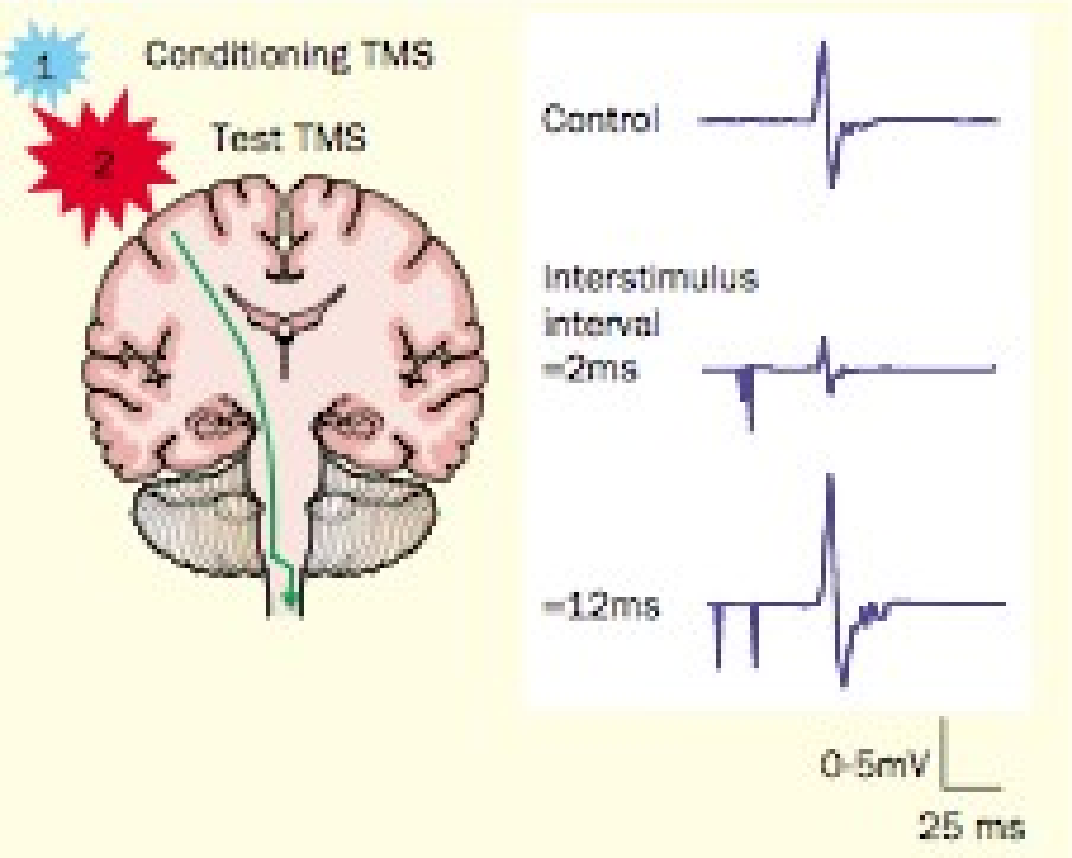
Kobayashi M and Pascual-Leone A. THE LANCET Neurology Vol 2 March 2003

Paired pulse

- Conditioning pulse (80% MT)
- Test pulse

(1-5 ms)

(10-15 ms)



Kobayashi M and Pascual-Leone A. THE LANCET Neurology Vol 2 March 2003

So what?

Prognosis

High motor thresholds or a complete absence of MEPs in the paretic hand after subacute stroke are associated with poorer prognosis in terms of motor recovery

Neurorehabil Neural Repair. 2010 February ; 24(2): 125–135. doi:10.1177/1545968309345270.

Contribution of transcranial magnetic stimulation to the understanding of mechanisms of functional recovery after stroke

Michael A. Dimyan, MD and **Leonardo G. Cohen, MD**
Human Cortical Physiology and Stroke Neurorehabilitation Section, NINDS, NIH

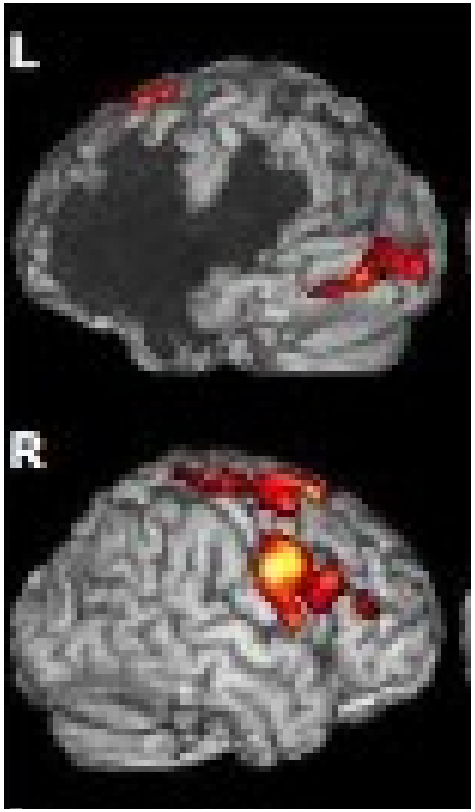
Prognosis

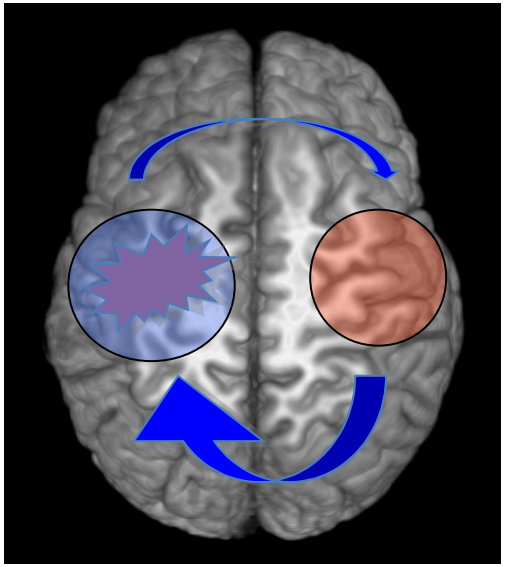
Surrogate outcome

Efficacy of treatment

To Guide therapies

Interhemispheric Imbalance





Martin PI et al., 2009

Neuromodulation Therapies

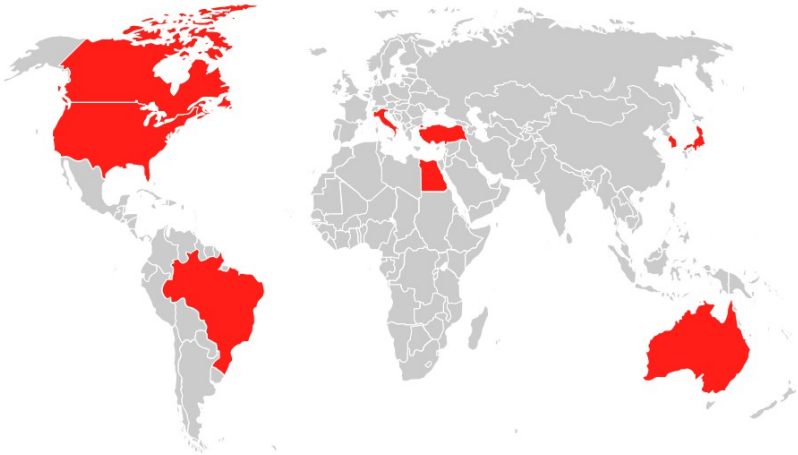
A Sham-Controlled Trial of a 5-Day Course of Repetitive Transcranial Magnetic Stimulation of the Unaffected Hemisphere in Stroke Patients

Felipe Fregni, MD, PhD; Paulo S. Boggio, MSc; Angela C. Valle, PhD; Renata R. Rocha; Julia Duarte; Merari J.L. Ferreira; Tim Wagner, MSc; Shirley Fecteau, PhD; Sergio P. Rigonatti, MD, PhD; Marcelo Riberto, MD; Steven D. Freedman, MD, PhD; Alvaro Pascual-Leone, MD, PhD

- (Stroke . 2006;37:2115-2122.)

Neurologic recovery of stroke: neurophysiological measurements of affected and unaffected motor cortex – a cross-sectional, multi-center individual patient data analysis study

- **Marcel Simis** [1, 2]
- **Vincenzo Di Lazzaro**[3]
- **Adam Kirton**[4]
- **Giovanni Pennisi**[5]
- **Rita Bella**[5]
- **Yun-Hee Kim**[6]
- **Naoyuki Takeuchi**[7]
- **Eman M Khedr**[8]
- **Lynn M. Rogers**[9, 10]
- **Richard Harvey**[9, 10]
- **Satoko Koganemaru**[11 12]
- **Bulent Turman**[13]
- **Sultan Tarlacı**[14]
- **Rubens J. Gagliardi**[2]
- **Felipe Fregni**[1]



- [1]Laboratory of Neuromodulation, Spaulding Rehabilitation Hospital and Massachusetts General Hospital, Harvard Medical School, Boston, US
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- [6]Department of Physical and Rehabilitation Medicine, Stroke and Cerebrovascular Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea
- [7]Department of Physical Medicine and Rehabilitation, Tohoku University Graduates School of Medicine, Sendai, Japan
- [8]Department of Neurology, Faculty of Medicine, Assiut University Hospital, Assuit, EGYPT
- [9]Sensory Motor Performance Program, Rehabilitation Institute of Chicago, Chicago, US
- [10]Department of Physical Medicine and Rehabilitation, Northwestern University Feinberg School of Medicine, Chicago, US
- [11]Department of Brain Pathophysiology, Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan
- [12]Department of Physical and Rehabilitation Medicine, Hyogo College of Medicine, Nishinomiya, Japan
- [13]School of Medicine, Bond University, Australia.
- [14]Universal Special Health Hospital, Alsancak, Izmir, Turkey.

Center	Number of patients	Age Average	Age SD	%Male
São Paulo	13	56.5	17.5	46.2
Assiut	36	60.3	8.8	64
Sapporo	38	61.6	10.0	60.5
Catania	40	64.1	11.0	62.5
Chicago	22	56.0	16.5	59.1
Kyoto	20	56.7	9.7	60
Rome	81	66.1	13.1	40.7
Izmir	9	61.6	8.4	77,8
Seoul	39	52.8	13.1	48.7
Calgary	45	11.8	3.9	40.0
Total	**341**	**54.4**	**20.5**	**56.9**

Linear regression model

- **dependent variables:**

-Motor Threshold

- **independent variables:**

-age

-Gender

-lesion side (right or left)

-single stroke (yes or no),

-time since stroke (in months),

-stroke mechanism (ischemic or hemorrhagic)

-site of the lesion (divided in exclusive cortical and not exclusive cortical)

-severity of motor deficit

-Centers with dummy variable

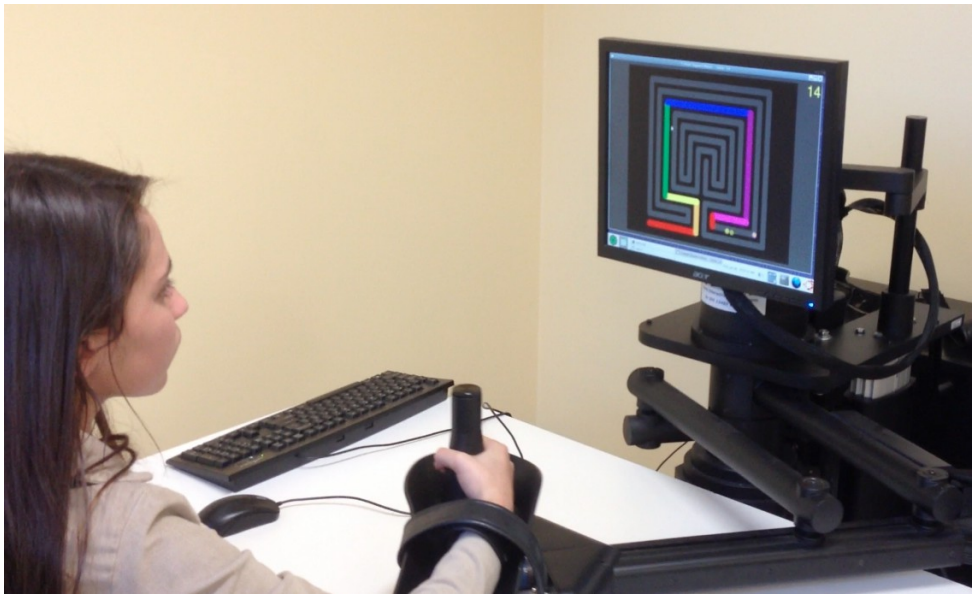
Final

Variables	All data		Scenario one		Scenario two		Scenario three	
	β coefficient	P value	β coefficient	P value	β coefficient	P value	β coefficient	P value
Age	**-0.195**	**0.046**	-0.171	0.081	**-0.199**	**0.032**	**-0.186**	**0.030**
Severity	**13.397**	**0.0001**	**14.173**	**0.0001**	**7.24**	**0.0001**	**11.167**	**0.0001**
Mechanism	NSU	NSU	-6.435	0.067	-5.28	0.174	NSU	NSU
Gender	NSU	NSU	NSU	NSU	NSU	NSU	2.691	0.178
Time month	**-0.308**	**0.007**	**-0.297**	**0.007**	NSU	NSU	**-0.242**	**0.015**
IMS	**0.179**	**0.011**	**0.185**	**0.006**	NSM	NSM	**0.136**	**0.027**

Limitation

- Limited information about cortical excitability
- Just cross sectional

NARLE



X

“InMotion ARM™ Robot”

Constraint-induced movement therapy

NARLE

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Linear regression model

•**dependent variables:**

-Variation in Motor function

•**independent variables:**

-Cortical excitability

-EEG

-age

-gender

-lesion side (right or left)

-Number of stroke,

-time since stroke (in months),

-stroke mechanism (ischemic or hemorrhagic)

-site of the lesion

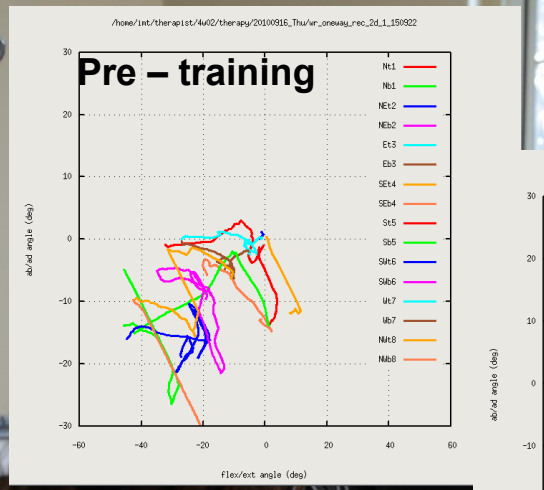
-severity of motor deficit

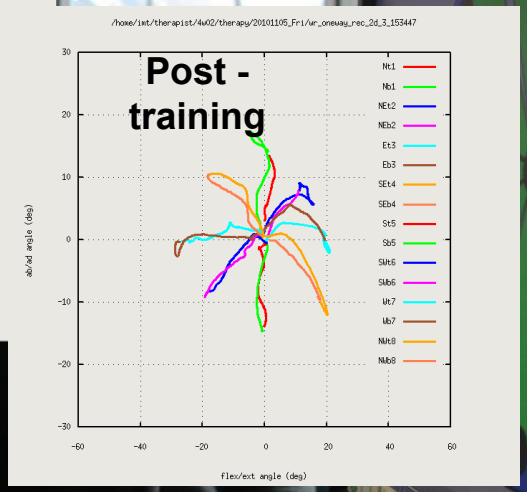
-use of medications with impact on the central nervous

-comorbidities

-BDNF

Robotics for assessment of performance kinematics





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How to measure severity of motor deficit?

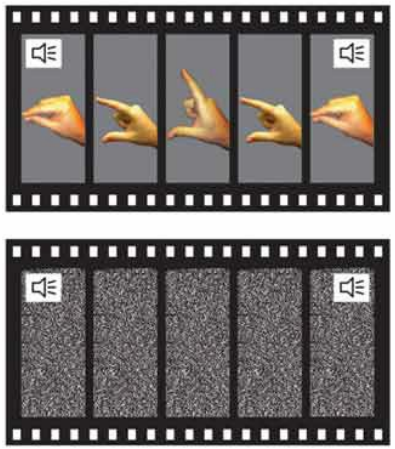
World Health Organization International Classification of Functioning, Disability and Health (WHO-ICF)

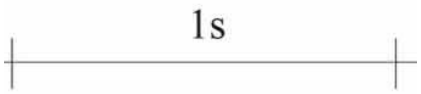
- Impairment
- Activity Limitations
- Participation Restrictions

psychometric properties

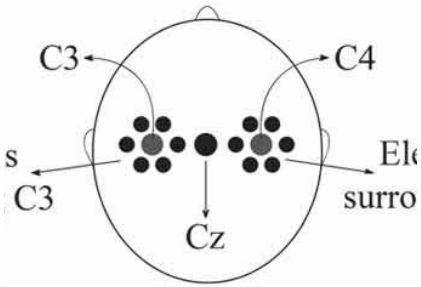
-validity,
-reliability,
-responsiveness

Predictors of Motor Recovery





EEG



frontiers in
HUMAN NEUROSCIENCE

ORIGINAL RESEARCH ARTICLE
published: 06 June 2013
doi: 10.3389/fnhum.2013.00256

Je pense donc je fais: transcranial direct current stimulation modulates brain oscillations associated with motor imagery and movement observation

*Olivia M. Lapenta[1], Ludovico Minati[2], Felipe Fregni[3] and Paulo S. Boggio[1]**

[1] Social and Cognitive Neuroscience Laboratory, Center for Healthy and Biological Sciences, Mackenzie Presbyterian University, Sao Paulo, Brazil
[2] U.O. Direzione Scientifica, Fondazione IRCCS Istituto Neurologico "Carlo Besta," Milano, Italy
[3] Laboratory of Neuromodulation, Harvard Medical School, Spaulding Rehabilitation Hospital, Massachusetts General Hospital, Boston, MA, USA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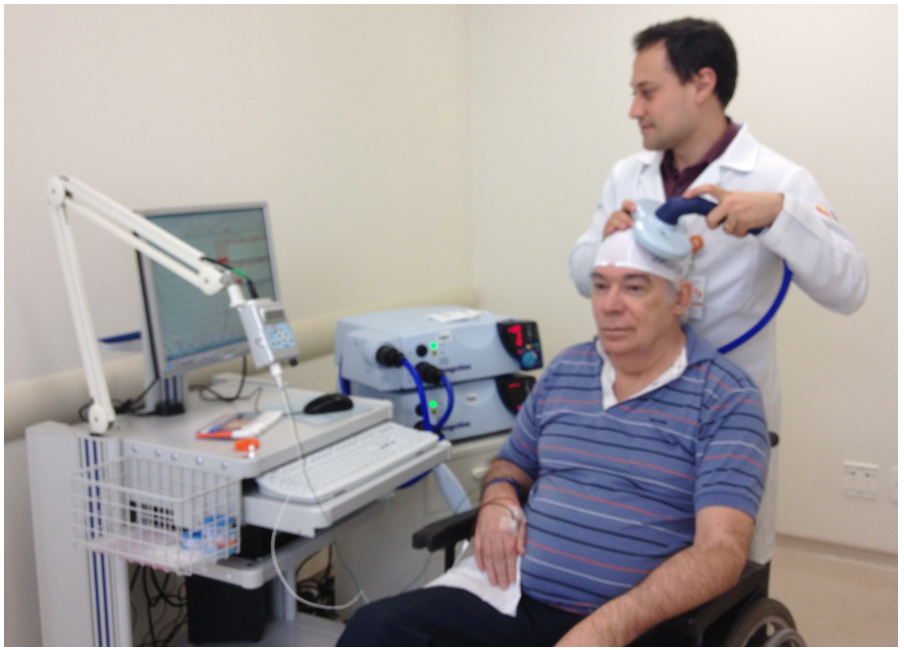

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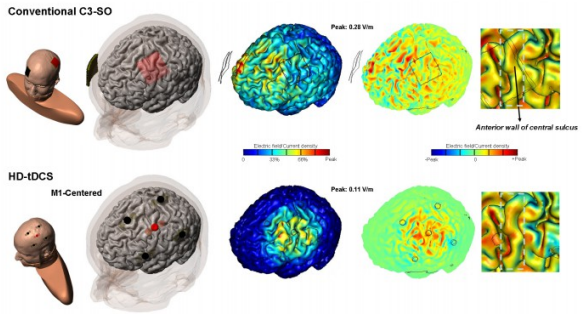

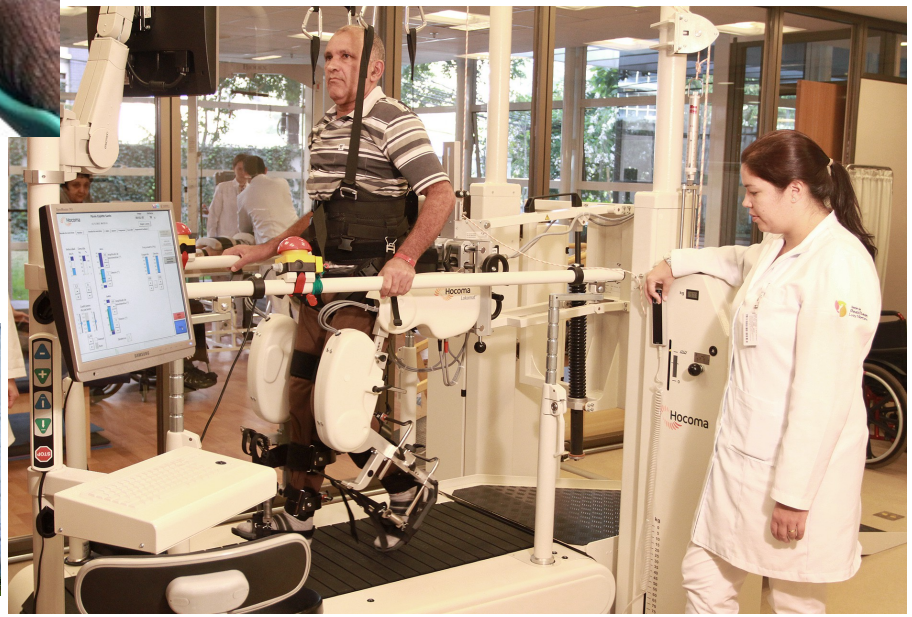

Thank you

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