Effects of Peripheral Somatosensory Neurostimulation

Adriana Conforco, MD, PhD
Researcher, Hospital Israelita Albert Einstein
Chief, Stroke group and Neurostimulation Laboratory, Neurology Department
Hospital das Clínicas/São Paulo University
Disclosures

Active Grants

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Topics

RPSS: what and why

Timeline: Cross-over studies and clinical trials
Repetitive peripheral sensory stimulation (RPSS)

Parameters that stimulate afferent fibers
Repetitive peripheral sensory stimulation:
(RPSS)
Repetitive peripheral sensory stimulation: (RPSS)

Probability Barthel Index ≥95

- Pure motor
- Motor + SS
- Motor + SS + hemianopia

Reding e Potes. Stroke 1988
Repetitive peripheral sensory stimulation: Hypothesis (RPSS)

Manipulation of sensory input → Modulation of motor excitability/function

- Reding and Potes. Stroke 1988
- Nudo et al. Science 1996
- Conforto et al. Ann Neurol 2002
- Conforto et al. NNR 2018
2-h ulnar nerve stimulation

- Repetitive peripheral sensory stimulation (RPSS)

- MEP
- ADM

1 mV
50 ms

Before: Solid
After: Dotted

Ridding et al Exp Brain Res 2000
Kaeling-Lang et al J Physiol 2002
Repetitive peripheral sensory stimulation (RPSS)

Wu et al. NeuroImage 2005

↑M1 > S1> PM
Repetitive peripheral sensory stimulation:
(RPSS)
Repetitive peripheral sensory stimulation: (RPSS)

Paretic hand

Change in strength (N)

Increase in Hand Muscle Strength of Stroke Patients after Somatosensory Stimulation
Adriana B. Conforto, MD, Alain Kaelin-Lang, MD, and Leonardo G. Cohen, MD

Ann Neurol 2002;51:122–125
Repetitive peripheral sensory stimulation: (RPSS)

Effects of Somatosensory Stimulation on Use-Dependent Plasticity in Chronic Stroke
Lumy Sawaki, Carolyn W.-H. Wu, Alain Kaelin-Lang and Leonardo G. Cohen
Stroke 2006;37;246-247; originally published online Dec 1, 2005.

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Effects of Somatosensory Stimulation on Use-Dependent Plasticity in Chronic Stroke
Larry Tsuchi, Carolyn W. Hs, Alain Kaelin-Lang and Leonardo G. Cohen
Stroke 2006;37:2346-2347, originally published online Oct 1, 2006.

Influence of Electric Somatosensory Stimulation on Paretic-Hand Function in Chronic Stroke
Carolyn W. Wu, PhD, Renee-Jung Ar, MD, Leonardo G. Cohen, MD
Arch Phys Med Rehabil 2006;87:351–7

2002

2006

2006

2006

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Repetitive peripheral sensory stimulation: (RPSS)
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Abstract
Background—Recent work demonstrated that application of peripheral nerve and cortical stimulation independently can induce modest improvements in motor performance in patients with stroke.

Objective—To test the hypothesis that combining peripheral nerve stimulation (PNS) to the paretic hand with anodal direct current stimulation (tDCS) to the ipsilesional primary motor cortex (M1) would facilitate beneficial effects of motor training more than each intervention alone or sham (tDCS Sham and PNS Sham).

Methods—Nine chronic stroke patients completed a blinded, cross-over designed study. In separate sessions, we investigated the effects of single applications of PNS+tDCS, PNS+tDCS Sham, tDCS+PNS Sham and PNS Sham+tDCS Sham prior to motor training on the ability to perform finger motor sequences with the paretic hand.

Results—PNS+tDCS resulted in a 41.3% improvement in the number of correct key presses relative to PNS Sham+tDCS Sham, 15.4% relative to PNS+tDCS Sham and 22.7% relative to tDCS+PNS Sham. These performance differences were maintained 1 and 6 days after the end of the training.

Conclusions—These results indicate that combining PNS with tDCS can facilitate the beneficial effects of training on motor performance beyond levels reached with each intervention alone, a finding of relevance for the neurorehabilitation of motor impairments after stroke.

Keywords: stroke; rehabilitation; transcranial direct current stimulation; nerve stimulation

Correspondence to: Pablo Celnik, MD, Johns Hopkins Hospital, 600 North Wolfe Street, Phipps 181, Baltimore, MD 21287, Phone: (410) 502-2441; Fax: (410) 502-4900, E-mail: pcelnik@jhmi.edu or Leonardo G. Cohen, MD, National Institute of Neurological Disorders and Stroke, NIH, Building 10, Room 5N226, Bethesda, MD 20892, Ph (301) 496-9782, FAX (301) 402-7010, EMAIL: cohenl1@mail.nih.gov. *Pablo Celnik and Nam-Jong Paik have contributed equally to this investigation.

Conflicts on Interest Disclosures
None of the authors have any conflicts of interest to disclose.
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Conflicts on Interest Disclosures

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Repetitive peripheral sensory stimulation: (RPSS)

Combined brain and peripheral nerve stimulation in chronic stroke patients with moderate to severe motor impairment

Isabella S. Menezes, PT, MS¹, Leonardo G. Cohen, MD², Eduardo A. Mello, PT¹, André G. Machado, MD, PhD³,⁴, Paul Hunter Peckham, MS, BS, PhD¹, Sarah M. Anjos, OT, MS¹,⁵, Inara L. Siqueira, UGS¹, Juliana Conti, OT¹, Ela B. Plow, PT, PhD³,⁴, and Adriana B. Conforto, MD, PhD¹,⁵

¹Hospital das Clínicas/São Paulo University, São Paulo, Brazil
²Human Cortical Physiology and Stroke Neurorehabilitation Section, National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, Maryland, United States
³Department of Neurosciences, Lerner Research Institute, Cleveland Clinic, Cleveland, Ohio, United States
⁴Case Western Reserve University, Cleveland, Ohio, United States
⁵Departments of Physical Therapy and Occupational Therapy, School of Health Professions, University of Alabama at Birmingham, Birmingham, Alabama, United States
⁶Hospital Israelita Albert Einstein, São Paulo, Brazil
Repetitive peripheral sensory stimulation: (RPSS)

- Mildly affected patients
- Crossover design
- n < 20
- Chronic phase

MOTOR FUNCTION IN CHRONIC STROKE, Wu

Arch Phys Med Rehabil Vol 87, March 2006
Nerve Stimulation Enhances Task-Oriented Training in Chronic, Severe Motor Deficit After Stroke
A Randomized Trial
Cheryl Carrico, MS, OTR/L; Kenneth C. Chelette, II, MS; Philip M. Westgate, PhD; Elizabeth Powell, MS; Laurie Nichols, BS, OTR/L; Anne Fleischer, MPH, OTR/L, CLT-LANA; Lumy Sawaki, MD, PhD

Repetitive peripheral sensory stimulation: (RPSS)

N=36
10 sessions

RPSS or sham
Task-oriented training
2h 4h

Background and Purpose
During performance of motor tasks, repetitive active action has been shown to increase motor cortical excitability and enhance outcomes of motor skill acquisition. However, there is a need for further research to establish whether a similar intervention can have benefit in cases of severe impairment (almost no active movement).

A sensory-based intervention called peripheral nerve stimulation (PNS) has been shown to increase motor cortical excitability and enhance outcomes of motor training after stroke. In a study of 22 subjects <6 months after stroke, PNS paired with 1 week of intensive task–oriented training resulted in some success.

However, there is a need for further research to establish whether a similar intervention can have benefit in cases of severe impairment (almost no active movement). Further research is needed to establish whether a larger group, as well as longer follow-up, are needed.

Methods
Subjects with chronic, severe poststroke hemiparesis (n=36) were randomized to receive 10 daily sessions of either active or sham stimulation (2 hours) immediately preceding intensive task-oriented training (4 hours). Upper extremity movement function was assessed using Fugl–Meyer Assessment (primary outcome measure), Wolf Motor Function Test at postintervention (95% confidence interval [CI], 1.1–6.9; P=0.008) and 1-month follow-up (95% CI, 0.6–8.3; P=0.025). Only the active stimulation condition was associated with statistically significant within-group benefit on all outcomes at 1-month postintervention (95% CI, 0.8–7.3; P=0.015) and 1-month follow-up (95% CI, 0.6–8.4; P=0.020), and Action Research Arm Test at postintervention (95% CI, 0.8–7.3; P=0.025).

Conclusion
The current study provides preliminary evidence that the combined intervention of active PNS followed by intensive task-oriented training may have beneficial effects on severe impairments after stroke.

Key Words: Nerve Stimulation Enhances Task-Oriented Training in Chronic, Severe Motor Deficit After Stroke

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Correspondence to Lumy Sawaki, MD, PhD, Department of Physical Medicine and Rehabilitation, HealthSouth Cardinal Hill Hospital, University of Kentucky, Lexington; HealthSouth Cardinal Hill Rehabilitation Hospital, Lexington (L.N., L.S.); Department of Occupational Science and Occupational Therapy, Eastern Kentucky University, Richmond (A.F.); and Department of Neurology, Wake Forest University, Winston-Salem, North Carolina (P.M.W.).

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From the Department of Physical Medicine and Rehabilitation (C.C., K.C.C., E.P., L.N., L.S.) and Department of Biostatistics, College of Public Health, University of Kentucky, Lexington; Department of Neurology, Wake Forest University, Winston-Salem, North Carolina; HealthSouth Cardinal Hill Rehabilitation Hospital, Lexington, Kentucky; and Department of Occupational Science and Occupational Therapy, Eastern Kentucky University, Richmond, Kentucky. Received January 6, 2016; final revision received April 13, 2016; accepted April 19, 2016.
Repetitive peripheral sensory stimulation: (RPSS)

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A Randomized Trial

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N=36
10 sessions

RPSS or sham training

2h 4h

MCID, ARAT: 5.7
Repetitive peripheral sensory stimulation: (RPSS)

Chronic phase: Standardized mean difference 1.00 (0.64-1.37)

$I^2=0$
Home-based stimulation

Chronic phase
Home-based
Peripheral stimulation
+ Training
Home-based stimulation

![Graph showing JTT (%) for Active and Control groups at D30 and D150.](image)
Active studies

R01NS076348-01: Shorter duration of training and RPSS compared to previous studies

2018/03737-8: Comparison of RPSS in chronic and subacute stages after stroke

2018/16352-7: RPSS in acute stroke
Take-home messages

Promising

Needs:

More knowledge about mechanisms
Optimal duration and parameters
Bigger trials with clinically relevant outcomes

Match right patient to right treatment
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André Machado
Cleveland Clinic

P. Hunter Peckham
Case Western Reserve University

Patients

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