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SCS—50 YEARS OLD THIS WEEK!

In the July-August 1967 issue of the journal *Anesthesia & Analgesia,* Shealy, Mortimer, and Reswick reported the first use of "dorsal column" stimulation to treat otherwise intractable pain (Shealy CN, Mortimer JT, Reswick JB. Electrical inhibition of pain by stimulation of the dorsal columns: preliminary clinical report. *Anesth. Analg* 46(4):489-491, 1967) The introduction to nearly every scientific report on SCS cites this paper.

After confirming Wall and Sweet's report (Wall PD, Sweet WH. Temporary abolition of pain in man. *Science* 155(3758):108-109, 1967) that peripheral nerve stimulation is effective in the specific area of innervation, Shealy's team found they could not relieve diffuse pain with this technology. They turned their attention instead to the spinal cord and to the father of a nurse anesthetist. This unfortunate man had severe pain from terminal cancer and was willing to undergo testing of "dorsal column stimulation." On March 24th 1967, 50 years ago this week, Dr. Shealy implanted a Vitallium electrode with subcutaneous attachments for an external stimulator. The team began stimulation at 6pm, and the patient reported the sensation that we now call "paresthesia" in his back and chest. The stimulation immediately relieved the pain, but the relief only lasted 5 to 15 minutes before it had to be recaptured through "a simple change in frequency." Pinprick testing during stimulation yielded normal results. They continued to provide pain relief through stimulation for another hour that evening and then again for 10 hours the next day, during which time the patient did not receive narcotics. The pain relief, again, was controlled by changing the frequency when discomfort reappeared. Unfortunately, the next day, "the patient was too confused for testing," and he died on March 30th of previously undiagnosed endocarditis. The patient's response to stimulation was so profound, however, that it inspired continued testing and an effort to improve equipment (Mortimer JT. *Pain suppression in man by dorsal column electroanalgesia* [thesis]. Cleveland, Ohio, Case Western Reserve University Engineering Design Center, Report EDC 4-68-21, 1968) and to refine techniques that continues to this day.

DONATIONS

Please visit the ***DONATE*** link on the WIKISTIM homepage for information on tax-deductible donations! Our goal is to keep WIKISTIM available free of charge. And please consider including The Neuromodulation Foundation, Inc. in your estate planning, as Dr. Richard North did this month!

March 2017 Status

- 444 subscribers
- DBS citations 2995
- DRG citations 43
- GES citations 473
- PNS citations 48
- SCS citations 2018
- SNS citations 818

CITATIONS OF NEW PAPERS THAT REPORT PRIMARY DATA ADDED MARCH 2017

DBS Depression (adding to our comprehensive list)

1. Bewernick BH, Kayser S, Gippert SM, Switala C, Coenen VA, Schlaepfer TE. Deep brain stimulation to the medial forebrain bundle for depression- long-term outcomes and a novel data analysis strategy. Brain Stimul 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28259544
2. Harati S, Crowell A, Mayberg H, Jun Kong, Nemati S. Discriminating clinical phases of recovery from major depressive disorder using the dynamics of facial expression. Conf Proc IEEE Eng Med Biol Soc 2016 2016:2254-2257 https://www.ncbi.nlm.nih.gov/pubmed/28268777
3. McInerney SJ, McNeely HE, Geraci J, Giacobbe P, Rizvi SJ, Ceniti AK, Cyriac A, Mayberg HS, Lozano AM, Kennedy SH. Neurocognitive predictors of response in treatment resistant depression to subcallosal cingulate gyrus deep brain stimulation. Front Hum Neurosci 2017 epub 11:74 https://www.ncbi.nlm.nih.gov/pubmed/28286473
4. O'Halloran R, Kopell BH, Sprooten E, Goodman WK, Frangou S. Multimodal neuroimaging-informed clinical applications in neuropsychiatric disorders. Front Psychiatry 2016 epub 7:63 https://www.ncbi.nlm.nih.gov/pubmed/27148092

DBS OCD (adding to our comprehensive list)

1. De Vloo P, Raymaekers S, van Kuyck K, Luyten L, Gabriëls L, Nuttin B. Rechargeable stimulators in deep brain stimulation for obsessive-compulsive disorder: a prospective interventional cohort study. Neuromodulation 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28256778
2. O'Halloran R, Kopell BH, Sprooten E, Goodman WK, Frangou S. Multimodal neuroimaging-informed clinical applications in neuropsychiatric disorders. Front Psychiatry 2016 epub 7:63 https://www.ncbi.nlm.nih.gov/pubmed/27148092

DBS PD & Miscellaneous (we only list recent publications here even though we continue to add older citations to the database)

1. Cao C, Zhang H, Li D, Zhan S, Zhang J, Zhang X, Zuo C, Sun B. Modified fluorodeoxyglucose metabolism in motor circuitry by subthalamic deep brain stimulation. Stereotact Funct Neurosurg 2017 95(2):93-101 https://www.ncbi.nlm.nih.gov/pubmed/28259880
2. Dinkelbach L, Möller B, Witt K, Schnitzler A, Südmeyer M. How to improve patient education on deep brain stimulation in Parkinson's disease: the CARE monitor study. BMC Neurol 2017 17(1):36 https://www.ncbi.nlm.nih.gov/pubmed/28222691
3. Golshan HM, Hebb AO, Hanrahan SJ, Nedrud J, Mahoor MH. A multiple kernel learning approach for human behavioral task classification using STN-LFP signal. Conf Proc IEEE Eng Med Biol Soc 2016 2016:1030-1033 https://www.ncbi.nlm.nih.gov/pubmed/28268500

4. Guo Z, Feng Z, Yu Y, Zhou W, Wang Z, Wei X. Detection of single unit spikes during orthodromic-high frequency stimulation in rat hippocampus. Conf Proc IEEE Eng Med Biol Soc 2016 2016:5813-5816 https://www.ncbi.nlm.nih.gov/pubmed/28269576
5. Hollister BE, Duffley G, Butson C, Johnson C, Rosen P. Visualization for understanding uncertainty in activation volumes for deep brain stimulation. Eurograph IEEE VGTC Symp Vis 2016 2016:37-41 https://www.ncbi.nlm.nih.gov/pubmed/28217766
6. Honorato-Cia MC, Martinez-Simón A, Guridi J, Alegre M, Nuñes-Cordoba J. Sedation during surgery for movement disorders and perioperative neurological complications: an observational study comparing local anesthesia, remifentanil and dexmedetomidine. World Neurosurg 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28179174
7. Koirala N, Fleischer V, Granert O, Deuschl G, Muthuraman M, Groppa S. Network effects and pathways in deep brain stimulation in Parkinson's disease. Conf Proc IEEE Eng Med Biol Soc 2016 2016:5533-5536 https://www.ncbi.nlm.nih.gov/pubmed/28269510
8. Lange M, Mauerer J, Schlaier J, Janzen A, Zeman F, Bogdahn U, Brawanski A, Hochreiter A. Underutilization of deep brain stimulation for Parkinson's disease? A survey on possible clinical reasons. Acta Neurochir (Wien) 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28258308
9. Lee KJ, Shim I, Sung JH, Hong JT, Kim IS, Cho CB. Striatal glutamate and GABA after high frequency subthalamic stimulation in Parkinsonian rat. J Korean Neurosurg Soc 2017 60(2):138-145 https://www.ncbi.nlm.nih.gov/pubmed/28264233
10. Merola A, Mandybur G, Biddell K, Tareen TK, Wilson-Perez H, Espay AJ, Duker AP. Subthalamic or red nucleus? A puzzling question arising during intraoperative recording for DBS. Clin Neurophysiol 2017 128(4):558-560 https://www.ncbi.nlm.nih.gov/pubmed/28231473
11. Mideksa KG, Singh A, Hoogenboom N, Hellriegel H, Krause H, Schnitzler A, Deuschl G, Raethjen J, Schmidt G, Muthuraman M. Comparison of imaging modalities and source-localization algorithms in locating the induced activity during deep brain stimulation of the STN. Conf Proc IEEE Eng Med Biol Soc 2016 2016:105-108 https://www.ncbi.nlm.nih.gov/pubmed/28268291
12. Muthuraman M, Deuschl G, Koirala N, Riedel C, Volkmann J, Groppa S. Effects of DBS in parkinsonian patients depend on the structural integrity of frontal cortex. Sci Rep 2017 epub 7:43571 https://www.ncbi.nlm.nih.gov/pubmed/28262813
13. O'Halloran R, Kopell BH, Sprooten E, Goodman WK, Frangou S. Multimodal neuroimaging-informed clinical applications in neuropsychiatric disorders. Front Psychiatry 2016 epub 7:63 https://www.ncbi.nlm.nih.gov/pubmed/27148092
14. Ostrem JL, San Luciano M, Dodenhoff KA, Ziman N, Markun LC, Racine CA, de Hemptinne C, Volz MM, Heath SL, Starr PA. Subthalamic nucleus deep brain stimulation in isolated dystonia: a 3-year follow-up study. Neurology 2017 88(1):25-35 https://www.ncbi.nlm.nih.gov/pubmed/27903810
15. Petrossians A, Whalen JJ, Weiland JD. Improved electrode material for deep brain stimulation. Conf Proc IEEE Eng Med Biol Soc 2016 2016:1798-1801 https://www.ncbi.nlm.nih.gov/pubmed/28268677
16. Picillo M, Vincos GB, Sammartino F, Lozano AM, Fasano A. Exploring risk factors for stuttering development in Parkinson disease after deep brain stimulation. Parkinsonism Relat Disord 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28237852
17. Popovych OV, Lysyansky B, Rosenblum M, Pikovsky A, Tass PA. Pulsatile desynchronizing delayed feedback for closed-loop deep brain stimulation. PLoS One 2017 12(3):e0173363 https://www.ncbi.nlm.nih.gov/pubmed/28273176
18. Pujol S, Cabeen R, Sébille SB, Yelnik J, François C, Fernandez Vidal S, Karachi C, Zhao Y, Cosgrove GR, Jannin P, Kikinis R, Bardinet E. In vivo exploration of the connectivity between the subthalamic nucleus and the globus pallidus in the human brain using multi-fiber tractography. Front Neuroanat 2017 epub 10:119 https://www.ncbi.nlm.nih.gov/pubmed/28154527

GES (updating our comprehensive list)

1. Takami E, Sanchez JJ, Province R, Torres AJ. Implantable gastric electric stimulator with automatic daily activity compliance reporting. Conf Proc IEEE Eng Med Biol Soc 2016 2016:5254-5257 https://www.ncbi.nlm.nih.gov/pubmed/28269449

SCS (updating our comprehensive list)

1. Ahmadi SA, Vesper J, Schu S, Slotty PJ. High-frequency spinal cord stimulation in surgery-naïve patients—a prospective single-center study. Neuromodulation 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28266756
2. Choi YH, Lee SU. Enhancement of brain plasticity and recovery of locomotive function after lumbar spinal cord stimulation in combination with gait training with partial weight support in rats with cerebral ischemia. Brain Res 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28237545
3. Han JL, Murphy KR, Hussaini SM, Yang S, Parente B, Xie J, Pagadala P, Lad SP. Explantation rates and healthcare resource utilization in spinal cord stimulation. Neuromodulation 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28205332
4. Huang M, Desai VR, Ho D, Simpson RK. Acute neuropathic orchalgia and scrotalgia after percutaneous spinal cord stimulator lead placement: two cases with an unusual complication. Cureus 2017 9(1):e1003 https://www.ncbi.nlm.nih.gov/pubmed/28286722
5. Naar J, Jaye D, Linde C, Neužil P, Doškář P, Málek F, Braunschweig F, Lund LH, Mortensen L, Linderoth B, Lind G, Bone D, Scholte AJ, Kueffer F, Koehler J, Shahgaldi K, Lang O, Ståhlberg M. Effects of spinal cord stimulation on cardiac sympathetic nerve activity in patients with heart failure. Pacing Clin Electrophysiol 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28206674
6. Reddy CG, Flouty OE, Holland MT, Rettenmaier LA, Zanaty M, Elahi F. Novel technique for trialing peripheral nerve stimulation: ultrasonography-guided StimuCath trial. Neurosurg Focus 2017 42(3):E5 https://www.ncbi.nlm.nih.gov/pubmed/28245667
7. Thomson SJ, Kruglov D, Duarte RV. A spinal cord stimulation service review from a single centre using a single manufacturer over a 7.5 year follow-up period. Neuromodulation 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28244180
8. Wei X, Benmassaoud M, Meller M, Kuchibhatla S. Novel fractal planar electrode design for efficient neural stimulation. Conf Proc IEEE Eng Med Biol Soc 2016 2016:1802-1805 https://www.ncbi.nlm.nih.gov/pubmed/28268678

SNS (updating our comprehensive list)

1. Kavvadias T, Huebner M, Brucker SY, Reisenauer C. Management of device-related complications after sacral neuromodulation for lower urinary tract disorders in women: a single center experience. Arch Gynecol Obstet 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28255769
2. Rydningen M, Dehli T, Wilsgaard T, Rydning A, Kumle M, Lindsetmo RO, Norderval S. Sacral neuromodulation compared with injection of bulking agents for faecal incontinence following obstetric anal sphincter injury—a randomised controlled trial. Colorectal Dis 2017 epub https://www.ncbi.nlm.nih.gov/pubmed/28211186
3. Sreepati G, James-Stevenson T. Use of sacral nerve stimulation for the treatment of overlapping constipation and fecal Incontinence. Am J Case Rep 2017 18:230-233 https://www.ncbi.nlm.nih.gov/pubmed/28265107
4. Zhang P, Zhang JZ, Wu LY, Zhang XD. Effects of appropriate prolonged sacral neuromodulation testing in improving implantation rate of a permanent implantable pulse generator in patients with refractory lower urinary tract dysfunctions in mainland China. Chin Med J (Engl) 2017 130(4):439-444 https://www.ncbi.nlm.nih.gov/pubmed/28218218

FINANCIAL SUPPORT TO DATE FOR 2016/17

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- NEVRO
- Richard B. North, MD
- The NANS Foundation, now the Institute of Neuromodulation
- Thomas Abell, MD

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- The International Neuromodulation Society (publicity and conference registration)
- The Neuromodulation Foundation (parent non-profit, overhead and development)
- The North American Neuromodulation Society (publicity and conference registration)

Disclosure

WIKISTIM includes citations for indications that are or might be considered off-label in the United States.

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