International Neuromodulation Society

Kazakh Neuromodulation Society

INS Interim Meeting

Almaty | Kazakhstan

October 2-4, 2025

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Almaty, Kazakhstan

New areas of neuromodulation

Program and Abstract Book

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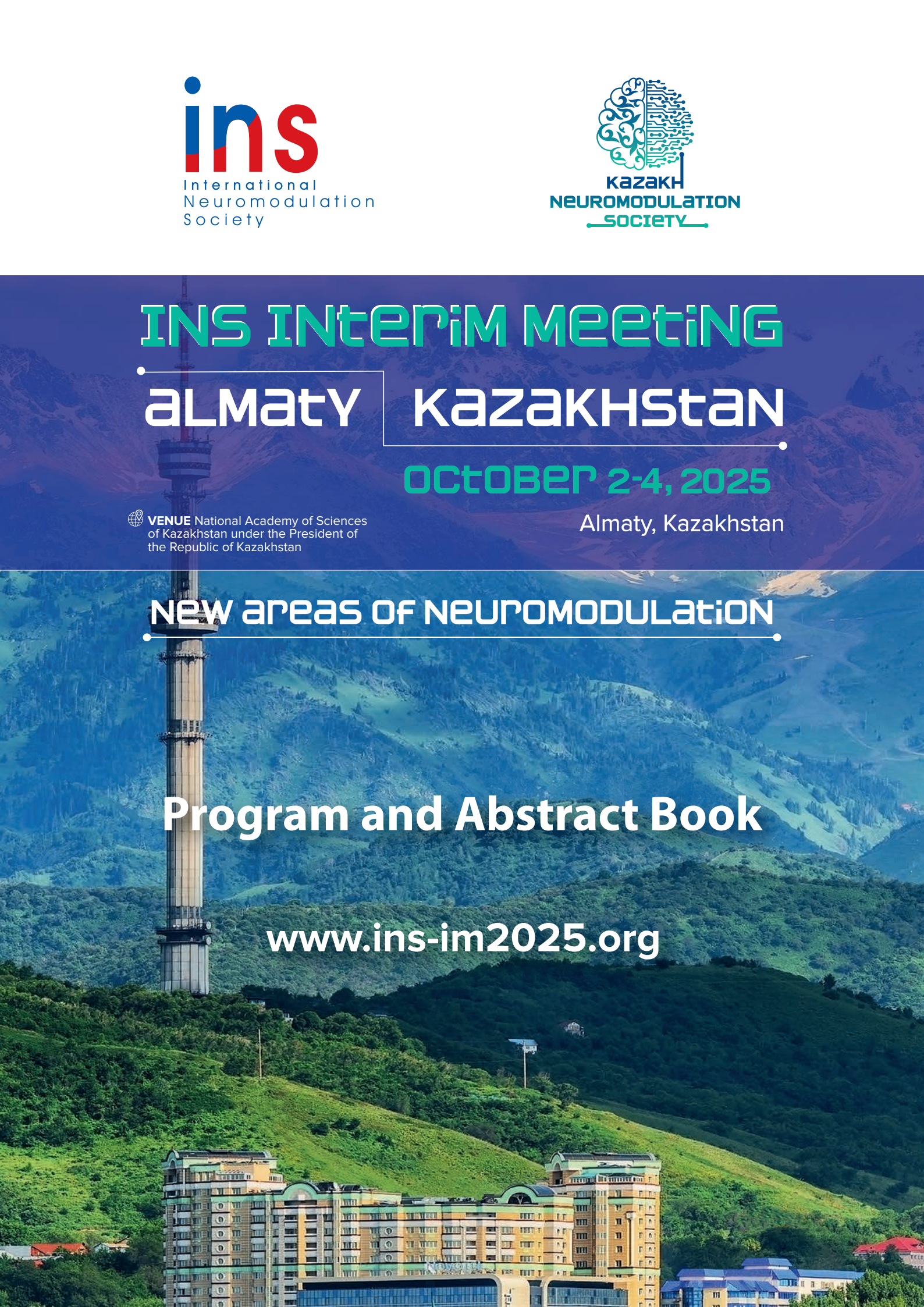

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Training Workshops

Thursday, 2 October 2025

09.00 -18.00	**TRAINING WORKSHOPS**		
	Venue: Keruen Medicus Medical Center		
09.00-15.00	**NEUROMODULATION OF PAIN**		
09.00 - 10.00	Introduction, Indications, Patient Selections		*Preeti Doshi, India*
10.00-10.30	COFFEE BREAK		
10.30 - 13.00	Pain Modulation Practice		*Ksenia Goryacheva, Russia* *Nikita Malyshev,Russia*
13.00-14.00	LUNCH		
14.00 - 15.00	Spinal Cord Stimulation Programming		*Ksenia Goryacheva, Russia* *Nikita Malyshev, Russia*
09.00-18.00	**DEEP BRAIN STIMULATION**		
09.00-10.45	DBS Target Planning		*Atilla Yılmaz, Türkiye*
10.45-11.00	COFFEE BREAK		
11.00-13.30	Neuroimaging Analysis		*Bassam Al-Fatly, Germany* *Ningfei Li, Germany*
13.30-14.15	LUNCH		
14.15-18.00	DBS Programming		*Jenns Volkman, Germany* *Genko Oyama, Japan*
16.15-16.30	COFFEE BREAK		
14.00-18.00	**PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS) THERAPY**		
14.00-14.30	Introduction, Indications, Patient Selection		*Arun Bhaskar, UK*
16.15-16.30	COFFEE BREAK		
14.30-18.00	Introduction, Indications, Patient Selection		*Arun Bhaskar, UK*

Scientific Program

Friday, 3 October 2025

09.00 09.20	**OPENING CEREMONY — WELCOME ADRESS** ***Chairmen: Chingiz Shahskin, Kazakhstan - Konstantin Slavin, USA***	
09.20 09.40	From Reactive Treatment to Proactive Prevention: Biomarkers, AI, and Personalized Strategies for Healthy Longevity *Almaz Sharman, MD, PhD* *President, Academy of Preventive Medicine of Kazakhstan*	
09.40 10.10	Next Generation in Neuromodulation	*Konstantin Slavin, USA*
10.10-10.40	Selected Advances in Functional Neurosurgery	*Andres Lozano, Canada*
10.40-11.00	COFFEE BREAK	
11.00-12.40	**ARTIFICIAL INTELLIGENCE AND ADAPTIVE STRATEGIES IN DBS** ***Chairmen: Andres Lozano, Canada - Joachim Krauss, Germany***	
11.00-11.20	Artificial Intelligence in Neuromodulation	*Robert Levy, USA*
11.20-11.40	Current Status of Adaptive DBS in Clinical Practice	*Patricia Limousin, UK*
11.40-12.00	Digital Approaches for Optimizing DBS in Space and Time	*Jens Volkmann, Germany*
12.00-12.20	Surgical Treatment of Dystonia: State of the Art and New Developments	*Joachim Krauss, Germany*
12.20-12.40	Novel Ways of Deep Brain Stimulation Programming	*Paresh Doshi, India*
12.40-13.30	LUNCH	
13.30-15.30	**ADVANCING NEUROMODULATION FOR PAIN** ***Chairmen: Robert Levy, USA - Emil Isagulyan, Russia***	
13.30-13.50	Targeted Drug Delivery, Past, Present and Future	*Lawrance Poree, USA*
13.50-14.10	Objective Long-Term Data of Mobility Levels in SCS-treated Patients with Persistent Pain After Spine Surgery	*Kliment Gatzinsky, Sweden*
14.10-14.30	Closed Loop Neuromodulation for Pain-Personal Experience	*Marc Russo, Australia*
14.30-14.50	Role of Non-Invasive and Minimally Invasive Peripheral Neuromodulation	*Arun Bhaskar, UK*
14.50-15.10	Barriers to Invasive Neuromodulation for Pain in India: Developing World Perspective	*Preeti Doshi, India*
15.10-15.30	Neuromodulation in Russia: Yesterday, Today and Tomorrow	*Emil Isagulyan, Russia*
15.30-16.00	COFFEE BREAK	

Friday, 3 October 2025

16.00-17.40 **FROM NEUROMODULATION TO BCI**
Chairmen: Konstantin Slavin, USA - Tao Yu, China

Genlight

16.00-16.20	From Neuromodulation to BCI: Xuanwu Experience	*Tao Yu, China*
16.20-16.40	From Neuromodulation to BCI: Huashan Experience	*Xin Zhang, China*
16.40-17.00	Exploring the Parahippocampus as a Novel Target for Responsive Neurostimulation in Mesial Temporal Lobe Epilepsy	*Shiwei Song, China*
17.00-17.20	Comparison of Different Neuromodulative Techniques in the Treatment of Drug Resistant Epilepsy	*Sait Öztürk, Türkiye*
17.20-17.40	Epidural Electrical Stimulation for the Recovery of Lower Limb Motor Function After Paraplegia	*Junming Zhu, China*
17.40-18.00	Neuroimaging Analysis in Deep Brain Stimulation	*Ningfei Li, Germany*
18.00-18.20	MEG: A Non-Invasive Neuroimaging Technique for Neuromodulation	*Yoshihito Shigihara, Japan*

17:20-17:50 **ORAL PRESENTATIONS**
Chairmen: Atilla Yımaz, Türkiye - Kavita Poply, UK
OP-01 / OP-05

17.20-17.26 **OP-01:** Peripheral Nerve Stimulation Enhances Functional Outcomes in Post-Traumatic Sciatic Neuropathy: A Preliminary result of RCT
Viktor Kondratyev, Andrey Dekopov, Emil Isagulyan, Alexey Tomskiy

17.26-17.32 **OP-02:** Application of Robot-Assisted Cerebellar Dentate Nucleus Deep Brain Stimulation in Post-Stroke Hemiparesis
Liu Changqing

17.32-17.38 **OP-03:** Waveform Manipulation During Posterior Tibial Neuromodulation for Overactive Bladder and Bladder Pain Syndrome: A Preliminary Study and Proposed Randomized Trial
Stephen Safford Wolfson

17.38-17.44 **OP-04:** Withdrawn

17.44-17.50 **OP-05:** Patient reported outcomes of the use of Non-invasive Peripheral Neurostimulation for various chronic pain states– case series of more than 10000 patients: an argument for developing a neuromodulation pathway from primary care to specialised services
Arun Kumar Bhaskar, Helen Walsh, Dominic Hegarty

Saturday, 4 October 2025

07.30-08.40 **POSTER PRESENTATIONS**
Chairmen: Atilla Yımaz, Türkiye - Kavita Poply, UK
PP-01 / PP-014

07.30-07.35 **PP-01:** Intolerance to intrathecal baclofen - rare case and troubleshooting
Rui Reinas, Margarida Rodrigues, Fátima Gandarez, Vera Ermida

07.35-07.40 **PP-02:** Cervical Dorsal Root Ganglion Stimulation for Complex Regional Pain Syndrome: Technical Description and Results of Five Cases. Concepción, Chile
Germán Carlos Acuña Gamé, Eugenio Adrian Sanhueza Herreros, Francisco Bolbaran Anabalon, Paula Mackarena Retamal Vera, Fabian Cesar Piedimonte, Pablo Balmaceda, Jose Leonardo Ibarra Diaz

07.40-07.45 **PP-03:** Study of impulse control disorders in PD patients with DBS STN: tracts density distribution and brain local field potentials
Anna Buniak, Vitali Bayarchyk, Alena Mikitchuk

07.45-07.50 **PP-04:** Long-term results radiofrequency ablation Morton's neuroma
Vitali Bayarchyk, Ryszard Sidorovich

07.50-07.55 **PP-05:** Successful Sacral Neuromodulation in Patients with Chronic Complete Spinal Cord Injury: Is there hope?
Nader A Aldossary

07.55-08.00 **PP-06:** Chronic 40 Hz Light Flicker Induces Cortical LTP-Like Plasticity and Gamma Oscillations Replay
Tao Feng, Minmin Wang, Shaomin Zhang

08.00-08.05 **PP-07:** Sacral neuromodulation for fecal incontinence of different etiology: a retrospective single-center study in China
Peirui Wu, Li Lu

08.05-08.10 **PP-08:** Comparison of EEG Complexity Analysis Methods: Challenges, Advances, and Applications in Neuromodulation
Stephen Wolfson

08.10-08.15 **PP-09:** The effect of bilateral non-invasive vagus nerve stimulation on stress in healthy adults
Dovilė Karčiauskaitė, Neringa Burokiene, Jone Pukenaite

08.15-08.20 **PP-10:** Innovative use of Neuromodulation for Respiratory Recovery after a High Cervical Cord Injury
Manish Baldia, Kapil Zirpe

08.20-08.25 **PP-11:** Management of persistent trigeminal pain following treatment with gamma Knife with trigeminal field stimulation with percutaneous electrical nerve stimulation (PENS) therapy – a case series
Arun Kumar Bhaskar, Liuda Brogiene, Alfredas Vaitkus

Saturday, 4 October 2025

08.25-08.30 **PP-12:** Shared Decision-Making in Spinal Cord Stimulator Device Choice
Valentina Pauly, Adam Williams, Nicola Wade, Janet Clark

08.30-08.35 **PP-13:** Differential Effects of Low-Frequency TMS in Autism Spectrum Disorder and Specific Language Impairment
Amir Baikatov, Almira Kustubayeva, Dauren Zhumakhanov

08.35-08.40 **PP-14:** Clinical case of chronic neurostimulation in a patient with diabetic polyneuropathy and trophic ulcers
Анастасия Колесникова, Ksenia Goryacheva, Марина Горячева, Vladimir Popov

09:00-10:20	**EXPANDED APPLICATIONS of DBS and FUNCTIONAL NEUROSURGERY** ***Chairmen: Kliment Gatzinsky, Sweden - Tao Yu, China***	
09.00-09.20	Deep Brain Stimulation in Disorders of Consciousness Hypothesis and Evidence	*Darko Chudy, Croatia*
09.20-09.40	Intraoperative Interrogation of the Single Cell Mechanism of Subthalamic Deep Brain Stimulation	*Leon Amadeus Steiner, Germany*
09.40-10.00	Opportunities of Modern Stereotactic Neurosurgery in a Hybrid Operating Room Environment	*Albert Sufianov, Russia*
10.00-10.20	Complications and Risk Management in Neuromodulation	Chingiz Shashkin, Kazakhstan
10.20-10:50	COFFEE BREAK	
10.50-12.10	**CONNECTOMIC TARGETING and NETWORK-BASED DBS STRATEGIES** ***Chairmen: Atilla Yılmaz, Türkiye - Jens Volkmann, Germany***	
10.50-11.10	Mapping DBS Therapeutic Networks	*Bassam Al-Fatly, Germany*
11.10-11.30	How to Improve Accuracy of DBS	*Atilla Yılmaz, Türkiye*
11.30-11.50	The Neuromodulation for Epilepsy	*Guoming Luan, China*
11.50-12.10	Stereotactic Radiofrequency Lesioning for Tourette Syndrome	*Konstantin Kostyuk, Ukraine*
12.10 -13.10	LUNCH	

Saturday, 4 October 2025

13.10-14.50	**FROM DECODING BRAIN SIGNALS to SURGICAL STRATEGIES** ***Chairmen: Konstantin Slavin, USA - Marc Russo, Australia***	
13.10-13.30	Educational Accreditation in Neuromodulation	*Vivek Mehta, UK & Kavita Poply, UK*
13.30-13.50	Machine Learning-Based Symptom Decoding from Invasive Brain Recordings	*Timon Merk, USA*
13.50-14:10	How to Navigate in Propofol Polluted Waters – Real World Intraoperative Electrophysiology in DBS	*Galymzhan Issabekov, Germany*
14.10-14.30	Forel's Field Deep Brain Stimulation for Movement Disorders and Beyond	*Shiro Horisawa, Japan*
14.30-14.50	Endoscopically Guided Stereotactic Thalamotomy of the Anterior Thalamic Nuclei in the Surgical Treatment of Epilepsy	*Rinat Sufianov, Russia*
14.50-15.20	COFFEE BREAK	
15.20-16.50	**FOCUSED LESIONING and TARGETED NEUROMODULATION** ***Chairmen: Chingiz Shashkin, Kazakhstan - Albert Sufianov, Russia***	
15.20-15.35	Study of Impulse Control Disorders in PD Patients with DBS STN: Tracts Density Distribution and LFPs	*Anna Buniak, Belorussia*
15.35-15.50	Long-term Results Radio Frequency Ablation of Morton's Neuroma	*Vitali Bayarchyk, Belorussian*
15.50-16.05	New Approach for Thalamotomy	*Daniyar Bagautdinov, Kazakhstan*
16.05-16.20	Possibilities of Neurostimulation in Multiplese Post-Infectious Mononeuropathies	*Ksenia Goryacheva, Russia*
16.20-16.35	Clinical Experience in the Management of Movement Disorders at the Presidential Hospital, Astana	*Talgat Yermekov, Kazakhstan*
16.35-16.50	VNS: Anti-Inflammatory Action in Epilepsy	*Veronika Abzalova, Kazakhstan*
16.50	CLOSING CEREMONY	

Oral Presentations

OP-01 **[Peripheral Nerve » Pain]**

PERIPHERAL NERVE STIMULATION ENHANCES FUNCTIONAL OUTCOMES IN POST-TRAUMATIC SCIATIC NEUROPATHY: A PRELIMINARY RESULT OF RCT

Viktor Kondratyev, Andrey Dekopov, Emil Isagulyan, Alexey Tomskiy
Federal State Autonomous Institution «N. N. Burdenko National Medical Research Center of Neurosurgery» of the Ministry of Health of the Russian Federation, Moscow, Russian Federation

INTRODUCTION: Peripheral nerve stimulation (PNS) is an established method for managing chronic pain. Although PNS has been associated with muscle strength recovery in clinical observations, no randomized controlled trials have yet evaluated its efficacy in treating post-traumatic neuropathy. This study aimed to assess the efficacy and safety of surgical treatment for post-traumatic sciatic nerve neuropathy using endoscopic neurolysis combined with chronic electrical stimulation.

MATERIALS AND METHODS: Seventeen patients were randomized and divided into two groups:
• Group A (N=9): Underwent sciatic nerve neurolysis with simultaneous implantation of PNS system.
• Group B (N=8): Underwent only neurolysis.

The level of pain was assessed using the Visual Analog Scale (VAS), and muscle strength in the anterior and posterior calf muscle groups was evaluated using the MRC Scale before surgery, in the early postoperative period, and at 3 and 6 months after surgery. Data analysis was performed using the "Statistica" software.

RESULTS: Pain reduction:
Group A: VAS scores decreased from 7.88 ± 1.25 (preoperative) to 2.88 ± 1.45 at 6 months [p=0.012].
Group B: VAS scores decreased from 6.8 ± 0.78 (preoperative) to 5 ± 2.45 at 6 months [p=0.079].
Muscle strength improvement (median values) in Table 1:

CONCLUSIONS: Preliminary findings suggest that combined neurolysis and chronic electrical stimulation yields superior outcomes in pain relief and muscle strength recovery compared to neurolysis alone in post-traumatic sciatic neuropathy. However, further research with a larger cohort is necessary to validate these results.

Keywords: Peripheral Nerve Stimulation, PNS, Neuropathy, Pain, Motor recovery

Median recovery of muscle strength

	Group A (PNS)	Group B (Control)
Anterior calf muscles	+2 points	0 points
Posterior calf muscles	+1 point	0 points

OP-03

[Peripheral Nerve » Genitourinary]

WAVEFORM MANIPULATION DURING POSTERIOR TIBIAL NEUROMODULATION FOR OVERACTIVE BLADDER AND BLADDER PAIN SYNDROME: A PRELIMINARY STUDY AND PROPOSED RANDOMIZED TRIAL

Stephen Safford Wolfson
Research Department, NeuroCog Clinic, Manly NSW AUSTRALIA

BACKGROUND: Posterior Tibial Nerve Neuromodulation (PTNM) is an established treatment for Overactive Bladder (OAB), Bladder Pain Syndrome (BPS), and Interstitial Cystitis (IC). Conventional PTNM devices utilize simple sine or square waveforms, despite emerging evidence in other neuromodulation fields that waveform complexity—including spectral density and temporal structure—can influence neural recruitment, comfort, and efficacy. This abstract presents preliminary feasibility findings and outlines a proposed randomized controlled trial.

METHODS: Two healthy adult males (ages 62 and 36) received PTNM using three waveform types: (1) standard square wave (Medtronic NURO), (2) pink noise (1/f spectral density), and (3) an EEG-derived waveform generated from fixation-locked resting-state EEG converted into audio (.wav) format. Stimulation was delivered via standard posterior tibial nerve needle placement (20 mm depth) for 1–5 minutes per waveform, using a range of up to ±50 V / 10 mA. Waveforms were tested with a direct current bias range of –120 mV to +100 mV to assess comfort, tolerability, and perceptual spread of stimulation.

RESULTS: Both the pink noise and EEG-derived waveforms were well tolerated at maximum voltage and current, with no reported discomfort. In contrast, square wave stimulation produced moderate discomfort above 6–10 V in one participant. Notably, pink noise and EEG-based waveforms elicited broader radiating sensation, extending from the ankle into the leg and groin—suggesting deeper or more proximal neural engagement. These findings suggest that waveform shape and spectral features influence both tolerability and stimulation reach. Proposed Trial: A randomized controlled pilot trial is proposed with 60 participants diagnosed with OAB or BPS/IC refractory to at least two medications. Participants will be randomized to standard sine-wave PTNM or waveform-modified PTNM (EEG or pink noise). The treatment protocol includes 12 weekly and 3 monthly maintenance sessions. Primary outcomes will include PUF and OAB-q scores, 3-day voiding diaries, and Patient Global Impression of Improvement. Secondary measures will include tolerability, sensory mapping, and subjective efficacy ratings.

CONCLUSION: Preliminary results indicate that biologically inspired waveform patterns, such as pink noise and EEG-derived signals, may enhance both patient comfort and neuromodulatory efficacy during PTNM. A clinical trial is planned to evaluate whether waveform manipulation improves therapeutic outcomes in genitourinary neuromodulation.

Keywords: Neuromodulation, Posterior Tibial Nerve, Waveform Engineering, Overactive Bladder, Pink Noise, EEG-Derived Stimulation

OP-05 **[Peripheral Nerve » Pain]**

PATIENT REPORTED OUTCOMES OF THE USE OF NON-INVASIVE PERIPHERAL NEUROSTIMULATION FOR VARIOUS CHRONIC PAIN STATES– CASE SERIES OF MORE THAN 10000 PATIENTS: AN ARGUMENT FOR DEVELOPING A NEUROMODULATION PATHWAY FROM PRIMARY CARE TO SPECIALISED SERVICES

Arun Kumar Bhaskar[1], *Helen Walsh*[2], *Dominic Hegarty*[3]
[1]*Pain Management Centre, Imperial College Healthcare NHS Trust, London*
[2]*Member, Chartered Society of Physiotherapy, United Kingdom*
[3]*Department of Anesthesiology, School of Medicine, University College, Cork, Ireland*

BACKGROUND AND AIMS: The burden of chronic pain is one of the biggest drains on healthcare expenditure and many pharmacological as well as interventional treatment options have limitations due to side-effects and sustained efficacy. Neuromodulation treatments like spinal cord and dorsal root ganglion stimulation are effective treatments but is costly and is not accessible for many patients. Recent publications are questioning the efficacy and cost-effectiveness of spinal cord stimulation especially for the management of low back pain and sciatica, hence careful of selection of patients are going to be important. We are presenting over 10000 patient reported outcomes of using an external neurostimulator device for managing various pain states.

METHODS: Stimulation was administered at home using two high-frequency sinusoidal alternating signals at 3858 and 3980 Hz delivered between two electrodes placed directly over one or two locations of pain using BioWaveHOME neurostimulator (BioWave, Norwalk, CT, USA). Patients reported improvement in pain intensity and duration of pain relief, activities of daily living (ADL), pain medication consumption, quality of life (QoL), mood, sleep, functional outcomes, and satisfaction were collected two or more weeks of treatment. The information was collected from 10407 patients using surveys, Trust pilot, Google and Digital Health Platform App.

RESULTS: In the 10407 patients, the total treatments by location were 5492 with back pain and sciatica (42%), shoulder pain (14%), cervical and head pain (13%), ankle/foot/toes (7%), pelvic/ groin pain (7%) and knee pain (6%). The pain score on VAS improved from 7.8 to 3.9 with the average duration of pain relief lasted for 7.6 hours. Difficulty in performing ADLs reduced from 7.3 to 4.2 with significant improvement in sitting longer (54%), standing longer (53%), and walking further (54%). Improvement in quality of life was 93% with 56% patients sleeping better and 65% reporting improvement in mood. 43% reported reduction or elimination of analgesic medications. 97% of patients said Yes to continuing with Biowave treatment and the average score of 2917 online reviews was 4.9/5.

CONCLUSIONS: Non-invasive peripheral neurostimulation may be an efficacious, sustainable and cost-effective treatment option for managing several chronic pain conditions. The use of non-invasive neurostimulation technology that can deliver pain relief in primary care and domiciliary care could not only provide access to neurostimulation to more patients but also screen for the suitability of patients for implantable devices in several conditions including back pain and sciatica, joint pains and pelvic pains.

Keywords: Back pain, sciatica, neuropathic pain, joint pain, pelvic pain, neurostimulation

Poster Presentations

PP-01

[Spinal Cord » Spasticity]

INTOLERANCE TO INTRATHECAL BACLOFEN - RARE CASE AND TROUBLESHOOTING

Rui Reinas[1], *Margarida Rodrigues*[2], *Fátima Gandarez*[2], *Vera Ermida*[3]
[1]*Department of Neurosurgery, Unidade Local de Saúde Gaia Espinho; Department of Neurosurgery, Hospital Lusíadas Porto*
[2]*Rehabilitation Unit of Spinal Cord Injuries, Centro de Reabilitação do Norte: Dr. Ferreira Alves – Unidade Local de Saúde Gaia Espinho*
[3]*Head of Clinic for Rehabilitation of Spinal Cord Injury – Unidade Local de Saúde Viseu Dão-Lafões*

INTRODUCTION: Baclofen pumps are time-tested options for patients with severe spasticity refractory to optimized oral drug treatment. Though severe complications and side effects have previously been described with overdoses, less severe events can, nonetheless, be very crippling. We present a case of baclofen intolerance that led to removal of the pump.

CASE: A 70-year old male underwent surgery with C5-T3 laminectomy and fusion, after AO type C injury due to fall and traumatic spinal cord injury. He presented with tetraplegia AIS D NLN C6, and severe spasticity (Ashworth grade 2 in most muscle groups, grade 3 on hip extension) preventing orthostatism and walking. The patient was under a regiment of baclofen 25mg three times/day, diazepam 10mg, and tizanidine 2mg twice/day with only mild improvements. Seven months after injury, an intrathecal baclofen test was performed, being positive at 50µg, and he was implanted with a pump (Synchromed II, Medtronic®), with the catheter positioned at T6. After the surgery, the patient improved from the spasticity but presented with persistent positional headache and dizziness, temporally more associated with pump fillings, despite the pump being calibrated for the slowest perfusion setting with the lowest dose (1mcg/h). No orthostatic hypotension, respiratory or cardiac symptoms occurred, but there was severe impairment of rehabilitation, being barely capable of ambulation and ADL (activities of daily living) or even ambulation on his wheelchair. Brain MRI did not disclose signs of lesions or CSF hypotension. It was decided to test for removal of baclofen from the reservoir, replaced with saline for 7 days in-hospital – the patient presented with significant improvement of symptoms, and the pump was explanted. Contrary to expected, the patient retained the improvement in spasticity (Ashworth grade 1) no spasms and muscle tonus grade 1 after removal of intrathecal baclofen, recovering ambulation with a walking frame, with supervision.

DISCUSSION: A high degree of suspicion is necessary to run through the differential diagnosis of adverse events related to baclofen pumps. Testing for baclofen removal and replacement with saline preserves pump hardware, while providing with evidence for drug toxicity.

Keywords: Spasticity, Intrathecal Baclofen, Intolerance

PP-02 **[Basic Science of Neuromodulation]**

CERVICAL DORSAL ROOT GANGLION STIMULATION FOR COMPLEX REGIONAL PAIN SYNDROME: TECHNICAL DESCRIPTION AND RESULTS OF FIVE CASES. CONCEPCIÓN, CHILE

Germán Carlos Acuña Gamé[1], Eugenio Adrian Sanhueza Herreros[2], Francisco Bolbaran Anabalon[1], Paula Mackarena Retamal Vera[2], Fabian Cesar Piedimonte[3], Pablo Balmaceda[3], Jose Leonardo Ibarra Diaz[2]
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[3]Universidad de Concepción, Departamento de Especislidades, Chile.

INTRODUCTION: Since Mitchel described in 1864 what we now call Complex regional pain syndrome tipe 1 (CRPS1) cientific comunity has grown in understanding of this health problem. Nevertheless a group of patients do not get adequate relief with conventional treatment. Neuromodulation has been a useful alternative therapy option. Dorsal root ganglion (DRG) stimulation has demonstrated better results than conventional spinal cord stimulation (SCS) for patients with CRPS in lower limbs.

METHODS: We report five patients treated with cervical DRG stimulation for CRPS1 of upper extremity that required neuromodulation for pain relief, after poor response to conventional treatment (medication and interventional). We present retrospective data collection of five patients with 2 to 8 month follow up.

RESULTS: Five patients were implanted with a Slim-Tip MN20450 lead and Proclaim DRG 3664 IPG. All women, 3 in August 2024 and 2 in February 2025. Pain score changed from 10 to 7,5 and difficulty to movement of the upper extremity changes from 10 to 7,4 in Verbal Rating Score. Procedures were performed under local anaesthesia and intermittent light sedation.

COMPLICATIONS:

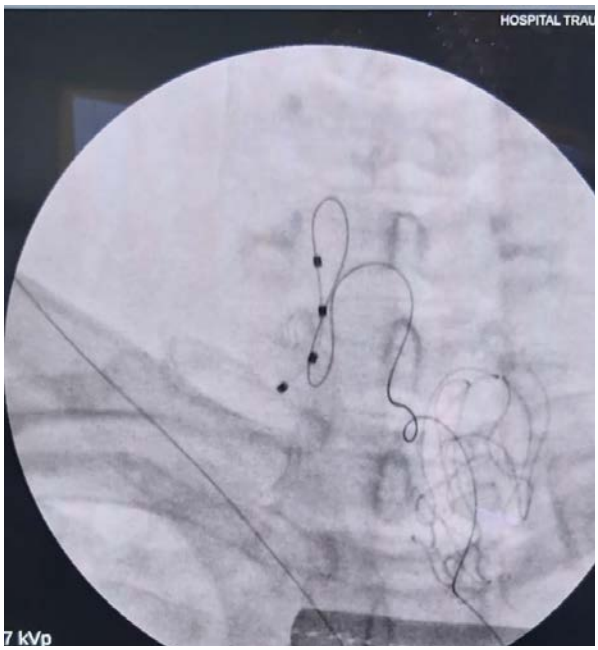
1- One patient presented left brachial flaccid paresis wich is in recovery with physiotherapy and pyramidal crural syndrome and right hypoalgesia at cervicodorsal level, not attributable to the procedure according to the neurology team

2.- one patient lost the loops and had a slight migration of the electrode, although it works appropriately.

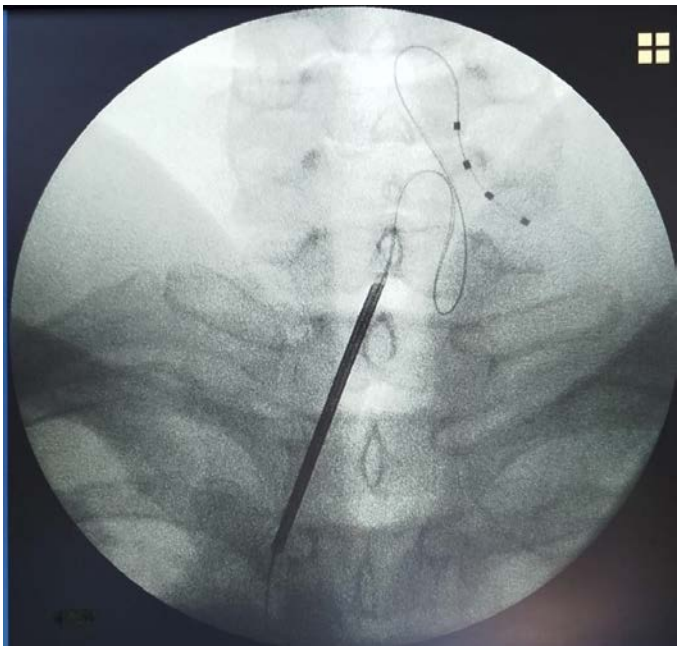
CONCLUSIONS: This study presents a promising therapeutic alternative using dorsal root ganglion stimulation in patients with upper limb CRPS type 1, showing significant clinical improvement in cases resistant to conventional treatment.

Keywords: Dorsal Root Ganglion Stimulation, Complex Regional Pain Syndrome, Refractory Pain.

DRF 3

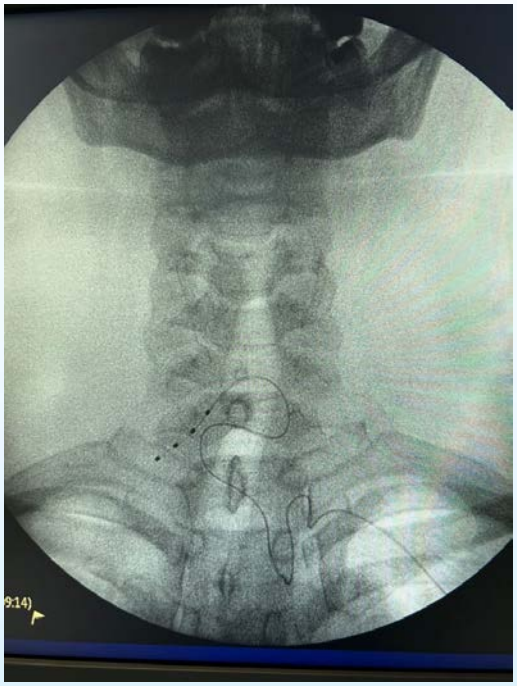


DRG 1

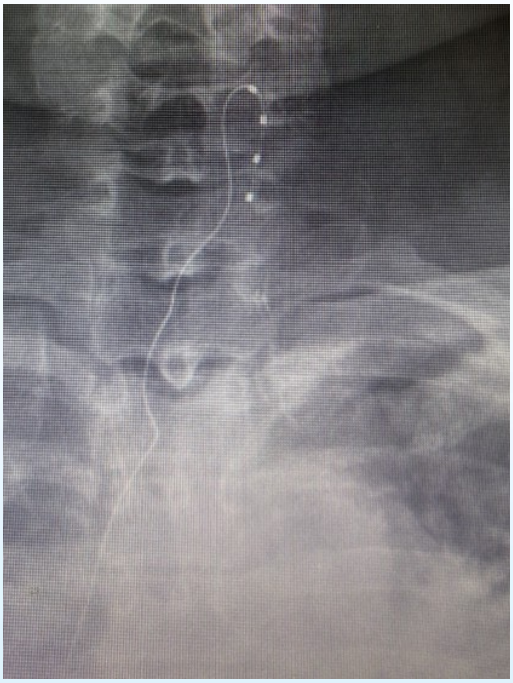


This study presents a promising therapeutic alternative using dorsal root ganglion stimulation in patients with upper limb CRPS type 1, showing significant clinical improvement in cases resistant to conventional treatment

DRG 2



DRG 4



Lost of loops

PP-03 **[Brain - Invasive Stimulation » Movement Disorders]**

STUDY OF IMPULSE CONTROL DISORDERS IN PD PATIENTS WITH DBS STN: TRACTS DENSITY DISTRIBUTION AND BRAIN LOCAL FIELD POTENTIALS

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Deep brain stimulation (DBS) of the subthalamic nucleus in Parkinson's has complex effect on brain functions, e.g., motor and neuropsychiatric. It affects recurrent negative feedback loops from subthalamic nucleus (STN) via the cerebral cortex to the selfsame STN, and connection networks with inferior frontal gyrus (IFG) and pre-supplementary motor area (SMA). These connections are studied between the main mechanisms of dynamically controlling actions. There are several perspective approaches to study the nature of impulse control disorders (ICD) in PD. STN-associated tracts with statistics of tract density distribution and brain local field potentials (LFP) are studied.

METHODS: We analyzed 64 PD patients with DBS STN, include 20 cases of ICD. Patients' characteristics are presented in the table (table 1). To assess the motor symptoms UPDRS is used, drug therapy – LEDD, QUIP is used to revealed ICD. STN feedback loops, STN-IFG, STN-SMA connection are studied with tractography, which is realized by DSI Studio with RK4 method, 10^8 seeds. Tract density (TD) is calculated, statistics of tracts ending/starting in STN are evaluated by frequentist probability definition. This allows to calculate spatial distribution of ratio of joint probabilities of tracts ending/starting in STNs (fig.1). Measurement of local field potentials (LFP) is preformed. Signals from STN are nonstationary, thus, frequency-time distribution is most informative analysis based on Fourier synchrosqueezed transform.

RESULTS: LFP energy distribution in the frequency-time is calculated for ICD- patient. One can see some time-dependent regions of LFP instantaneous frequency increasing (fig.2). TD statistical analysis shows that tracts ending in STN are more probable in axial slices near this structure in the case of ICD+. Tracts ending in STN are more probable in axial slices closer to parieto-temporal surface of cerebral hemispheres for ICD-.

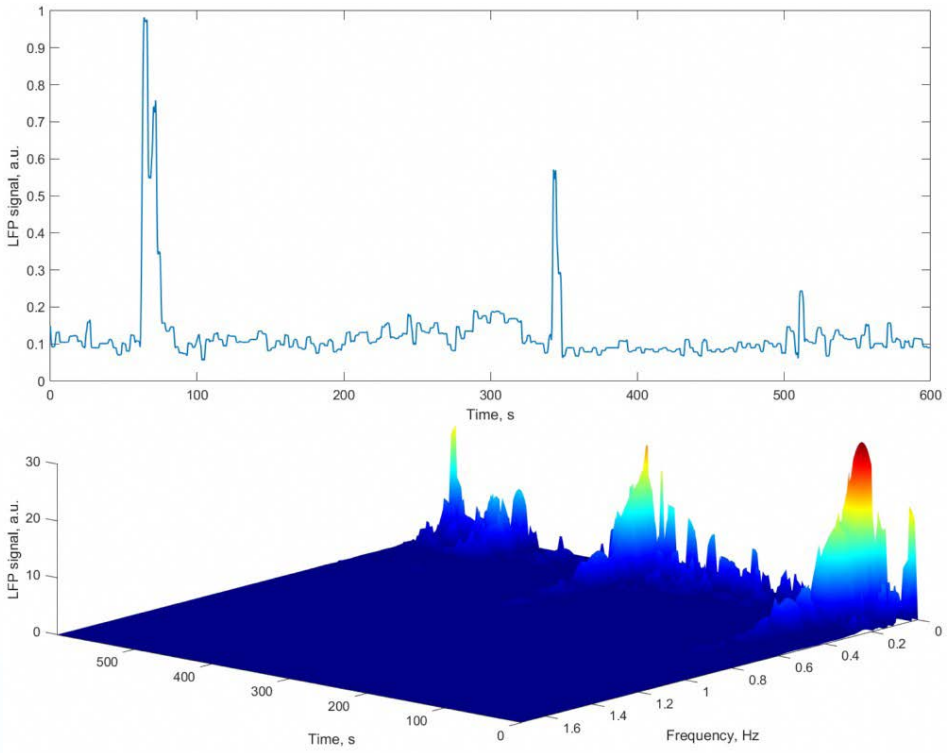
CONCLUSION: Frequency-time distribution of LFP is studied to estimate evolution of the spectral composition of the LFP signal because it potentially allows the selection of stimulation parameters that may contribute to stabilizing the current motor state (further studies are needed). Preliminary index based on spatial distribution of ratio of joint probabilities of tracts ending/starting in STNs is proposed.

Disclosure

Nothing to disclose

Keywords: Parkinson's diseases, DBS, impulse control disorders, tract density, local field potentials

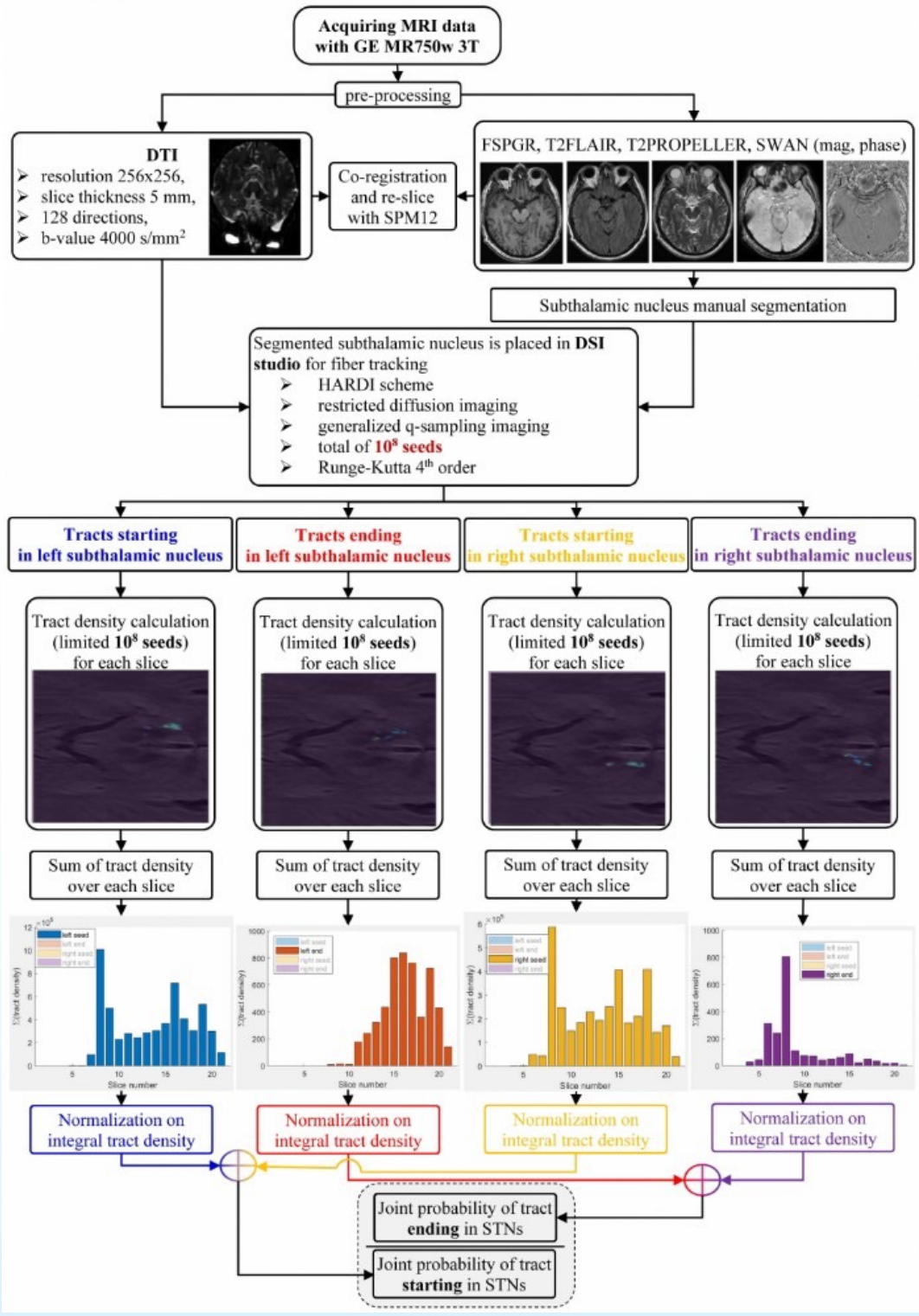
LFP energy distribution in the frequency-time



Patients' characteristics

Indicators	DBS STN ICD+	DBS STN ICD-
Amount, patients	20	44
M/F	14/6	30/14
Age, years	57,0 (95% CI 54,0;59,0)	59,0 (95% CI 50,8;62,0)
PD duration, years	10,3 (95% CI 9,3;11,2)	8,4 (95% CI 5,8;11,1)
LEDD, before	1175,0 (95% CI 1000,0;1250,0)	1050,0 (95% CI 956,0;1087,0)
III part UPDRS, off med, before	51,0 (95% CI 32,0; 64,0)	45,0 (95% CI 35,5;58,0)
QUIP-short, before	4,0 (95% CI 3,0; 5,0)	1,0 (95% CI 0,0;1,0)

The calculating spatial distribution of ratio of joint probabilities of tracts ending/starting in STNs



PP-04 **[Peripheral Nerve » Pain]**

LONG-TERM RESULTS RADIOFREQUENCY ABLATION MORTON'S NEUROMA

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Morton's neuroma is a very common cause of metatarsalgia. The purpose of this study was to investigate the effectiveness of radiofrequency ablation (RFA) in patients with chronic pain refractory to conservative therapy, evaluation of the effectiveness of second radiofrequency ablation (RFA) in these cases.

MATERIALS AND METHODS: 166 patients were studied. Continuous RFA was performed under ultrasound guidance and electrophysiological control by using one or more of 90 seconds cycle and with maintenance of the probe tip a temperature of 90 °C (130 cases in group 1). The patients of the control group underwent surgical excision of the neuroma (36 cases in group 2). We followed patients for a more than 12 months to assess their change in visual analogue pain scores (VAS), PainDETECT scores, symptom improvement, complications.

RESULTS: Reduction of pain intensity was achieved after RFA from 8[8:9] to 1[0;3] VAS score and from 16[12;19] to 5[3;9] PainDETECT score. Reduction of pain intensity was achieved after surgical excision of the neuroma from 8[7;9] to 2,5[1;4,5] VAS score and from 12,5[11,0;16,0] to 8,5[6,0;11,0] PainDETECT score. Duration of hospital treatment was 1,0[1,0;2,0] day in group 1 and 5,0[4,0;6,5] day in group 2. The number of complications in the postoperative period: two cases (1,5%) in the main group and five cases (13,9%) in the control group. Positive outcome of treatment in patients of group 1 was observed in 109 cases (83,9%), unsatisfactory – in 21 cases (16,2%). Positive outcome of treatment in patients of group 2 was observed in 27 cases (75.0%), unsatisfactory – in 9 cases (25.0%). 9 patients from group 1 and 2 patients from group 2 underwent second RFA of neuroma. After second RFA, in group 1 reduction of pain intensity was achieved from 8[7;9] to 1[1;2] VAS score and from 14[12;16] to 7[4;8] PainDETECT score. In group 2 reduction of pain intensity was achieved from 9,5[9;10] to 3[1;5] VAS score and from 20,5[18;23] to 9[7;11] PainDETECT score. An unsatisfactory result was observed in one case (9,1%) from group 2

CONCLUSION: Radiofrequency ablation is a safe and effective, minimally invasive technique for the treatment of Morton's neuroma. also for the treatment recurrence of pain syndrome after neurosurgical treatment of Morton's neuroma

Keywords: Pain, neuroma, radiofrequency ablation

PP-05 **[Peripheral Nerve » Genitourinary]**

SUCCESSFUL SACRAL NEUROMODULATION IN PATIENTS WITH CHRONIC COMPLETE SPINAL CORD INJURY: IS THERE HOPE?

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OBJECTIVE: After MRI-compatible lead introduction, sacral neuromodulation use for neurogenic bladder increased despite off-label status. Reports show successful trials in incomplete spinal cord injury patients, but none exist for complete injury. We present the first successful implantation in chronic (>2 years post-injury) complete spinal cord injury.

MATERIALS-METHODS: A 31-year-old male sustained complete spinal cord injury at T2-3 (ASIA-A) from a May 2022 motor vehicle accident, causing spastic paraplegia, double incontinence, and erectile dysfunction. He had an implanted baclofen pump. Renal tests and upper tract imaging were normal. Video urodynamics showed a small bladder (250 mL), neurogenic detrusor overactivity, impaired compliance, but no stress incontinence or reflux. Initial management included self-catheterization, anticholinergics, followed by 300 IU botulinum toxin A injections with good response.

Due to limited options, shared decision-making led to an sacral neuromodulation trial despite low expected success. Stage I was uneventful; baclofen was reduced from 450 mcg to 200 mcg. A 6-week trial began with daily diaries.

Initial Programming:

Settings: Program +3, -1, 0; Amplitude: 0.7V (scrotal/penile sensation); Pulse Width: 210 µsec; Pulse Rate: 14 Hz. Outcome: No significant improvement in incontinence, urine volume, or stool consistency.

Day 10 Modification: Settings: Program +0, -2, 3 (anal/scrotal sensation); Amplitude: 0.6V (increased 0.1V every other day); Pulse Width: 300 µsec; Pulse Rate: 21 Hz initially, reduced to 18 Hz after 2 weeks.

RESULTS: Day 14: 50% reduction in urinary incontinence episodes; drained urine volume increased to 380–450 mL.

Day 20: Softer stools and improved erectile function.

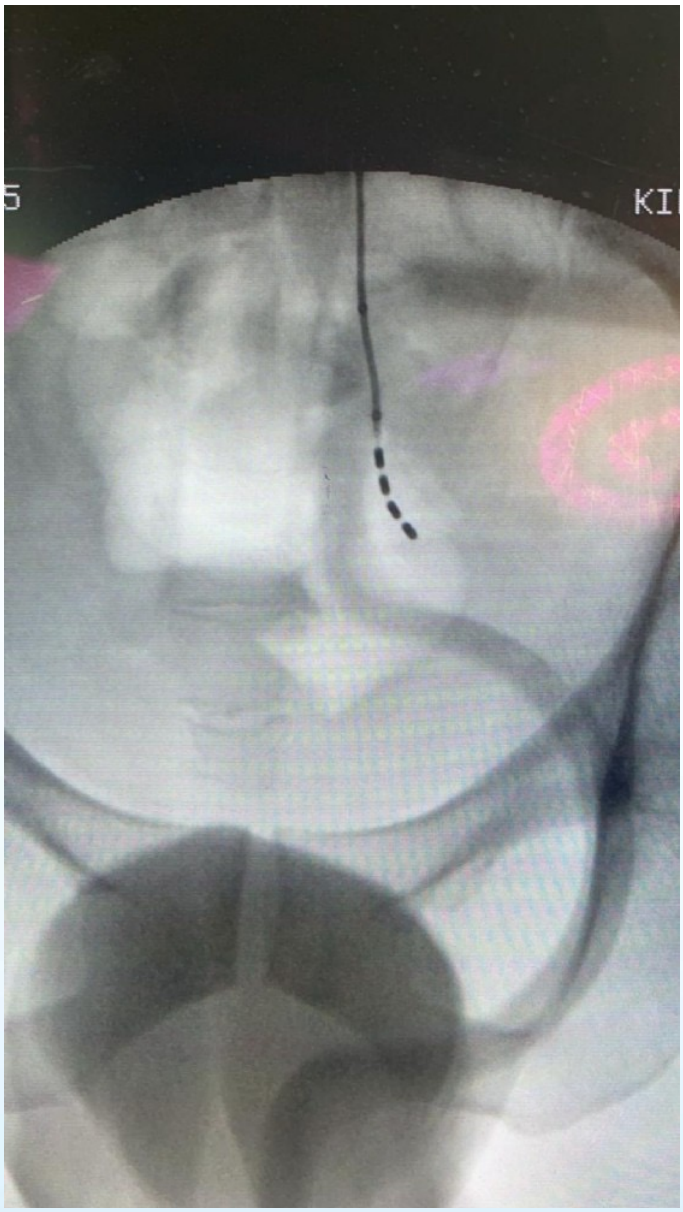
Week 5 (Amplitude 2.6V): Urinary incontinence improved 60%; fecal incontinence improved 40–50%; erection improvement 30%.
The neuromodulator was implanted at week 6.
At 3-month follow-up, symptoms remained controlled. Lower limb spasticity significantly reduced, allowing baclofen decrease from 430 mcg to 90 mcg.

DISCUSSION: Sacral neuromodulation shows promise in incomplete spinal cord injury, with studies reporting 45-75% improved bladder/bowel function, especially ASIA-C & D patients. No success was reported in complete injury (ASIA-A), particularly chronic cases. This case suggests sacral neuromodulation may benefit carefully selected complete spinal cord injury patients.

CONCLUSION: Although chronic complete spinal cord injury patients lose neuroplasticity, the mechanism of efficacy here is unclear. This case indicates potential benefits. Adjusting programming parameters (pulse rate, gradual voltage increments) may help elicit responses. Further studies are needed to explore sacral neuromodulation's role in complete spinal cord injury.

Keywords: Sacral neuromodulation, Spinal cord injury, Neurogenic bladder

Sacral lead



PP-06 **[Basic Science of Neuromodulation]**

CHRONIC 40 HZ LIGHT FLICKER INDUCES CORTICAL LTP-LIKE PLASTICITY AND GAMMA OSCILLATIONS REPLAY

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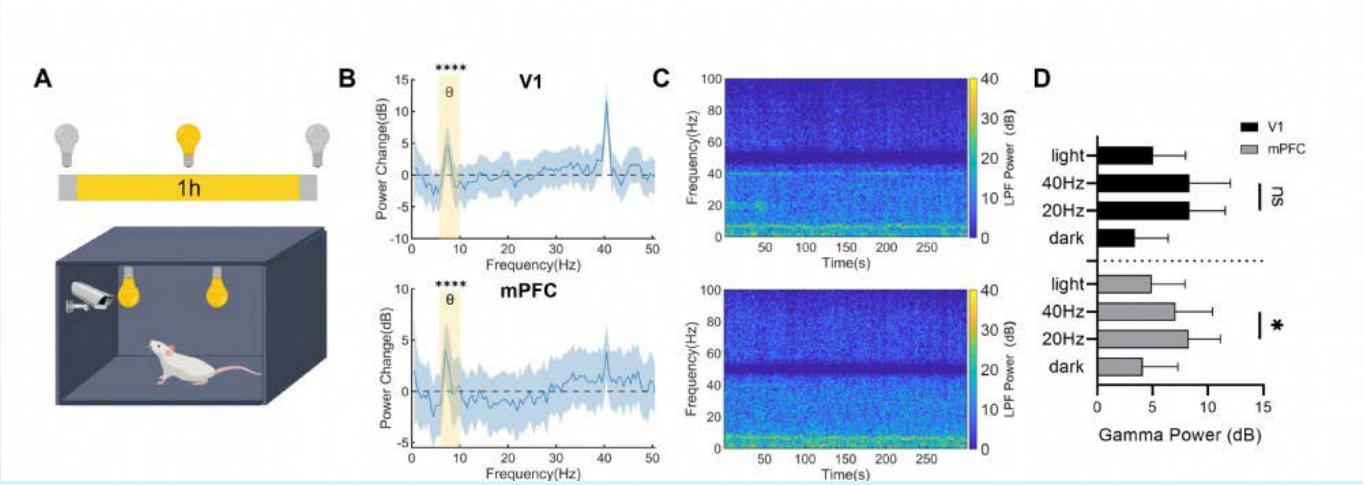
Alzheimer's disease (AD) is characterized by synaptic plasticity deficits and memory impairment. Recent studies have shown that 40 Hz sensory stimulation can reduce amyloid-beta plaques and improve cognitive function in AD animals, primarily through brain-wide gamma entrainment. However, most existing research reports that gamma entrainment only occurs during stimulation and may not reliably entrain higher-order brain regions. This raises critical questions about the mechanisms through which transient gamma entrainment exerts sustained therapeutic effects. In this study, we used local field potential recordings in healthy rats to examine both acute and chronic effects of 40 Hz flicker in the primary visual cortex (V1) and medial prefrontal cortex (mPFC). Acute 40 Hz stimulation elicited stimulus-frequency power and theta (4-10 Hz) power increases in both regions. In contrast, chronic 40 Hz (but not 20 Hz) flicker induced lasting response potentiation in V1 and triggered spontaneous gamma oscillations replay even in darkness. These findings suggest that chronic 40 Hz flicker could initiate a consolidation process within relevant neural circuits, ultimately leading to self-sustained activity that persists beyond stimulus termination. This offers a new perspective on its cognitive benefits beyond online brain-wide gamma entrainment, suggesting potential applications in cognitive enhancement and resilience training.

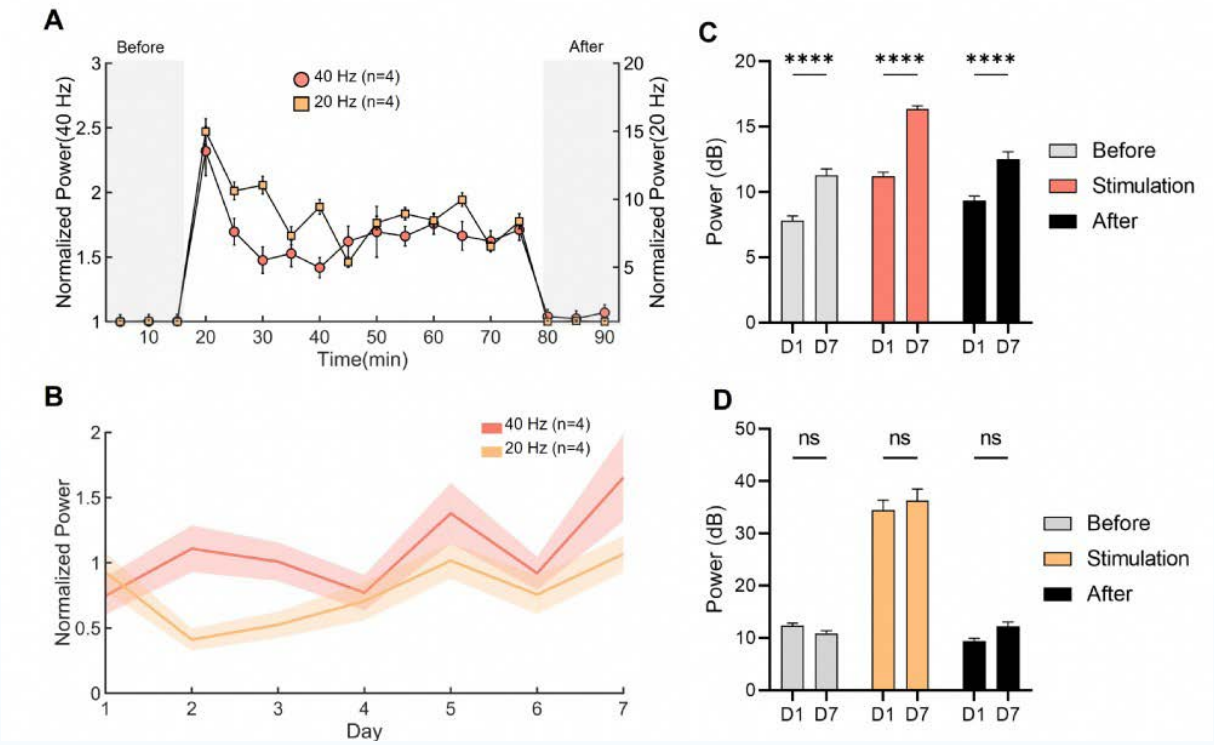
Keywords: Gamma Oscillations, 40 Hz Light Flicker, Neuromodulation, Replay

Figure 1. Illustration of light flickering stimulation and neural oscillation change in different brain regions



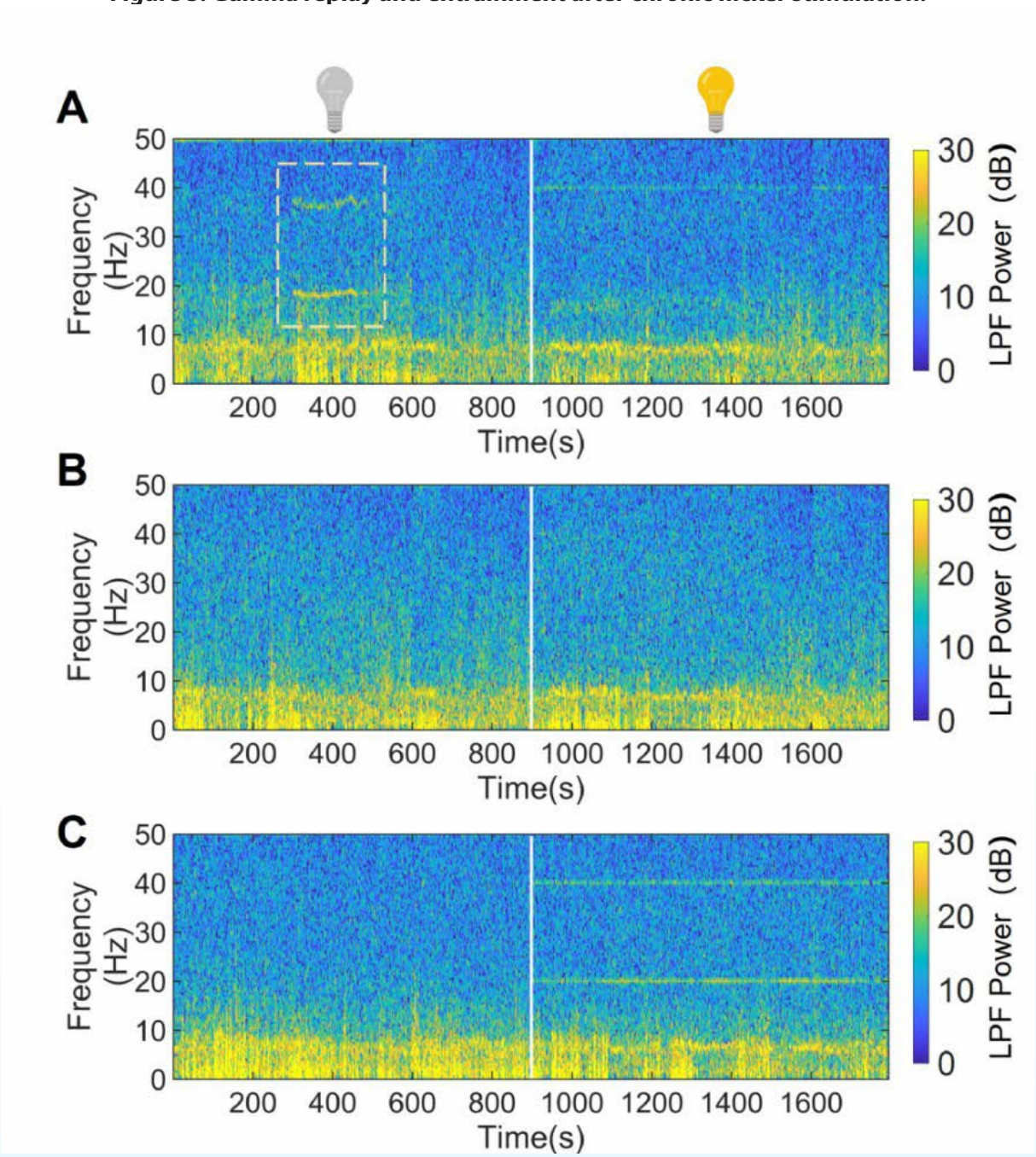
*(A) Illustration of single session time arrangement and stimulation paradigm. (B) Example time-resolved spectrogram of V1, and mPFC recordings. (C) Mean power spectra ± SEM. from V1 (top) and mPFC (bottom) recording sites during acute 40 Hz stimulation (n=8, ****P<0.0001). (D) Group average gamma power (30-100 Hz) under for respective conditions in V1 and mPFC. (n=8; ****P<0.0001;)*

Figure 2. Frequency- and Time-Dependent Oscillatory Dynamics During Acute and Chronic Flicker Stimulation.



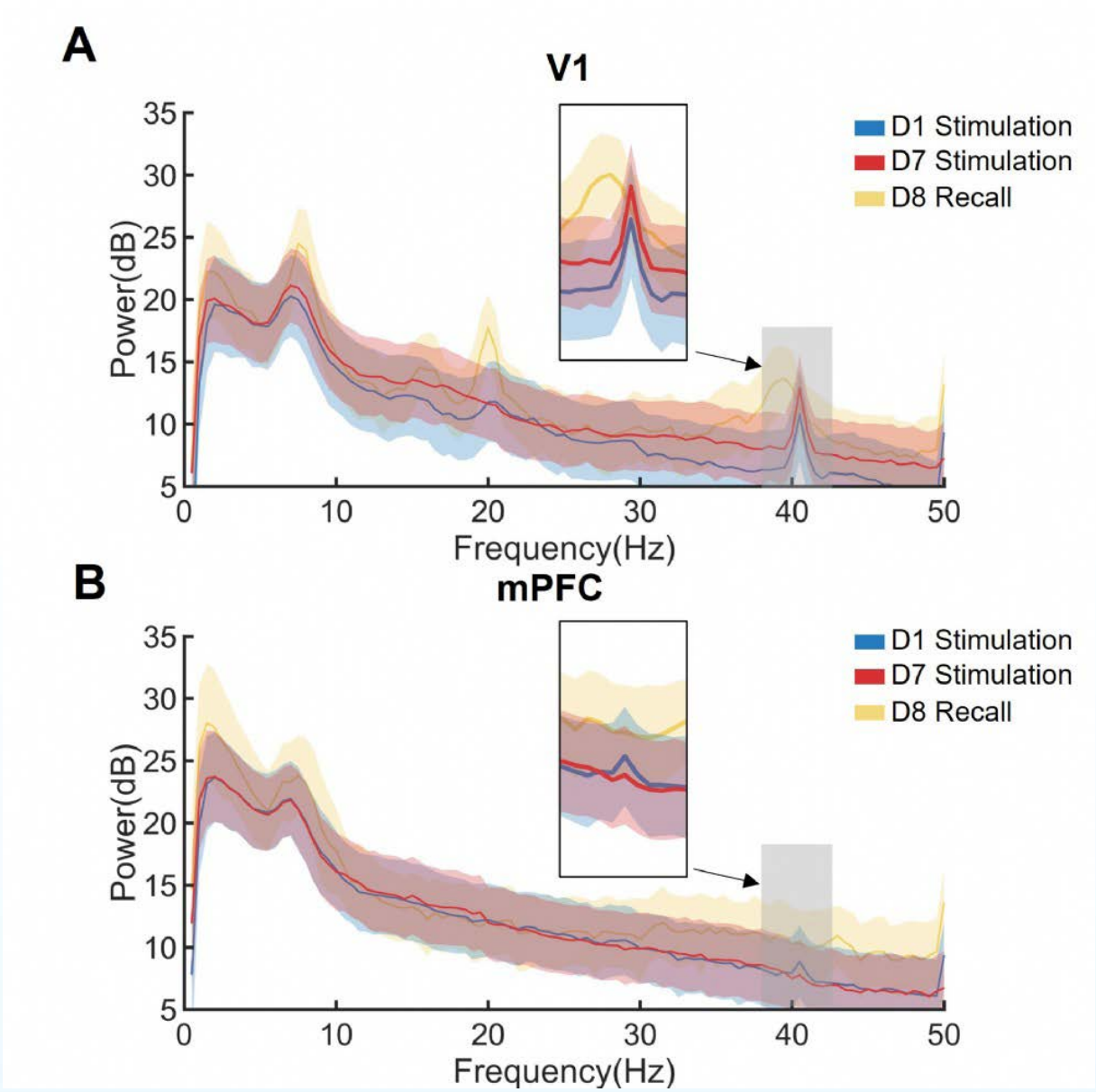
*(A) Time-resolved stimulus-frequency power modulation in visual cortex during a single 90-minute session (15-min pre-stimulation baseline, 60-min stimulation, 15-min post-stimulation). (B) Evolution of stimulus-frequency power across 7 days of daily 1-hour stimulation. Shaded regions represent mean ± SEM for 40 Hz (red) and 20 Hz (orange) conditions. (C-D) Comparison of pre-, during-, and post-stimulation stimulus-frequency power between Day 1 and Day 7 for 40 Hz (C) and 20Hz (D) conditions. A (****P<0.0001).*

Figure 3. Gamma replay and entrainment after chronic flicker stimulation.



(A) V1 spectrogram (40 Hz group, Day 7): Baseline dark period (0-900 s), 40 Hz stimulation (900-1800 s). Yellow dashed box marks spontaneous 40 Hz gamma replay during pre-stimulation darkness. (B-C) Day 7 spectrogram of 40 Hz group (B) and 20 Hz group (C) in mPFC

Figure 4. Reorganization of Brain Oscillations in V1 and mPFC After Chronic Flicker Stimulation.



(A-B) Spectral profiles in (A) V1 and (B) mPFC across three phases: Day 1 stimulation (acute, blue), Day 7 stimulation (chronic, red), and Day 8 stimulus-free replay (yellow). Shaded bands represent mean ± SEM.

PP-07 **[Peripheral Nerve » Gastrointestinal]**

SACRAL NEUROMODULATION FOR FECAL INCONTINENCE OF DIFFERENT ETIOLOGY: A RETROSPECTIVE SINGLE-CENTER STUDY IN CHINA

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INTRODUCTION: Sacral neuromodulation (SNM) is a well-established treatment modality for patients with fecal incontinence (FI), leading to its successful application across patients with FI of different etiologies. This retrospective study aimed to report our experiences on the efficacy of SNM for patients with FI.

METHODS: Analyzed the clinical data of 34 patients with FI treated with SNM in our center from April 2021 to December 2024. Wexner incontinence score, fecal incontinence quality of life (FIQL), were recorded before and after treatment. Follow-up was done by questionnaire contact from the same group of researchers.

RESULTS: A total of 34 patients, 14 females and 20 males with a median age of 52 years (10-78), with a median duration of 5 years (0.5-24) of history of FI. Before the surgery, with the comprehensive evaluation the FI etiologies were classified: Low anterior resection syndrome (LARS) for rectal cancer (n=11), neurological dysfunction (n=9), congenital anorectal malformations (n=5), idiopathic (n=3), trauma-related sphincter damage (n=3), obstetric trauma-related sphincter damage (n=2), neoadjuvant chemoradiation/radiotherapy for cervical cancer (n=1). All patients underwent SNM and the median test stimulation period was 6 weeks (2-9), 30 (88.2%) patients reported more than 50% improvement in symptoms and 29 (85.3%) accepted for permanent implantation of the implantable pulse generator (IPG). The median follow-up of all patients who had received permanent implants was 32 months (range, 5–48 months) at the control date (May 1, 2025). There was a significant improvement of FI symptoms 18.1±2.3 before SNM to test phase 6.6±5.35 ($p<0.001$), 6 months follow-up 5.3±2.7 ($p<0.001$). The mean FIQL scores improved significantly from the baseline score of 7.8±2.2 before SNM to test phase 17.7±3.2 ($p<0.001$), 6 months follow-up 18.1±2.7 ($p<0.001$). 2 cases (5.82%) were incision infections, 1 case (2.94%) with impaired healing and 1 patient (2.94%) undergone the loss of efficacy and treated with re-implantation.

DISCUSSION: SNM has become a key therapy for FI. The current indications include a wide variety of pathological causes, but SNM has also reached beyond FI to include complex conditions such as LARS and other neuromuscular degeneration diseases.

CONCLUSIONS: SNM offers an effective sustainable treatment in selected patients with FI, it may help delineate which patients will show both symptom and quality of life improvement in this combined group.

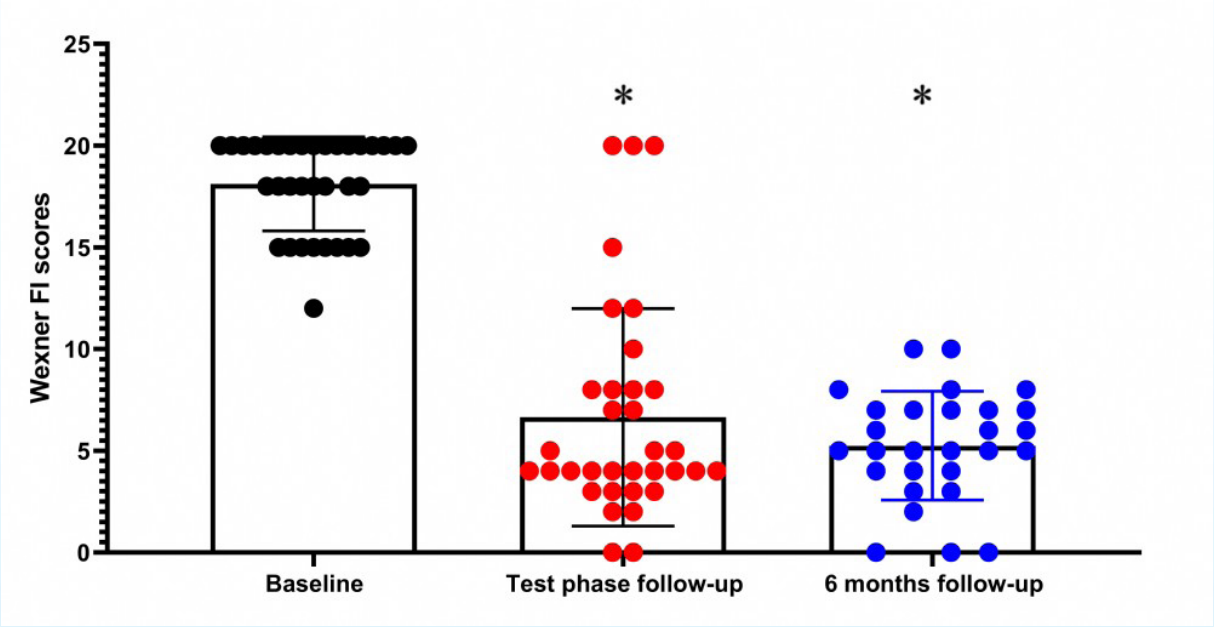
Keywords: Sacral Neuromodulation, Fecal incontinence, Efficacy, Different etiology, Follow-up

Patient Characteristics

Cause of FI	n	Age (yr) median (range)	History of FI (yr) median (range)
LARS	11	61 (43-66)	1(0.5-6)
Neurologic	5	52 (41-78)	2(1-4)
Spinal cord injury	1		
Carbon Monoxide Poisoning	1		
Meningomyelocele	1		
Multiple sclerosis	1		
Parkinson's disease	1		
Anal sphincter damage	6	36(29-53)	3(1-7)
Pelvic fracture	3		
Delivery	2		
Muscular dystrophy (radiation)	1		
Congenital anorectal malformations	5	15(10-24)	15(10-24)
Idiopathic	3	67(52-72)	2(1-7)
Total	34	52(10-78)	5(0.5-24)

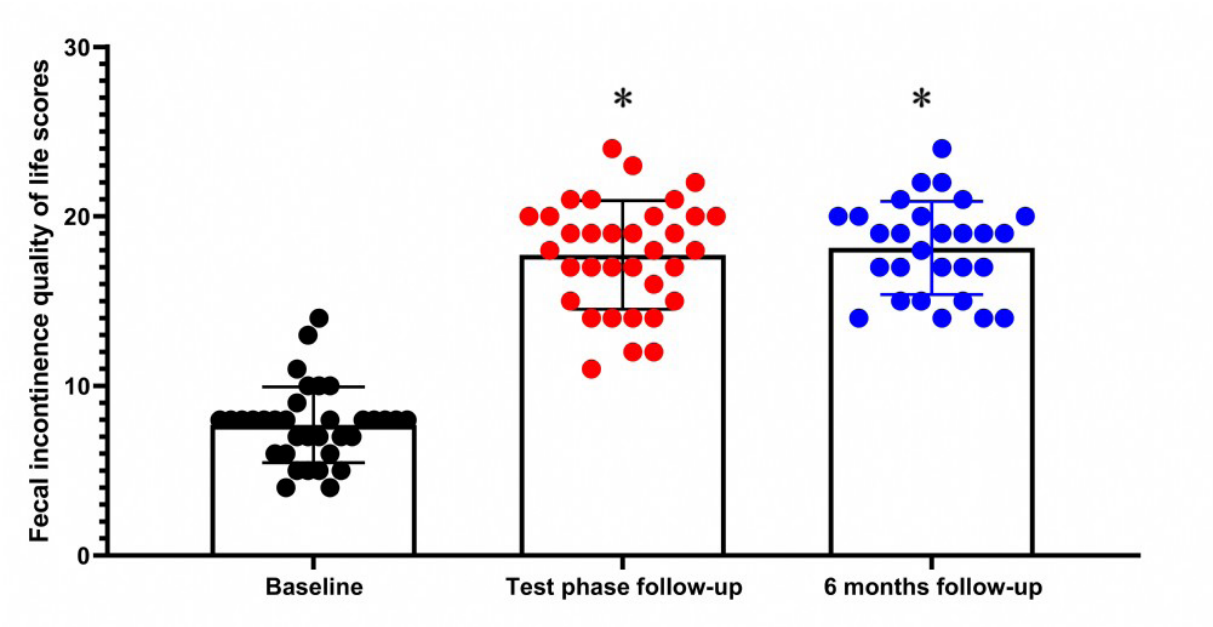
FI: Fecal incontinence; LARS: Low anterior resection syndrome;

Figure 1. Results of Wexner FI scroes 6 months after permanent implantation *P<0.001



Results of Fecal Incontinence symptoms Evaluation 6 Months After Permanent Implantation

Figure 2. Results of QOL evaluation 6 months after permanent implantation *P<0.001



Results of QOL Evaluation 6 Months After Permanent Implantation

PP-08 **[Basic Science of Neuromodulation]**

COMPARISON OF EEG COMPLEXITY ANALYSIS METHODS: CHALLENGES, ADVANCES, AND APPLICATIONS IN NEUROMODULATION

Stephen Wolfson
NeuroCog Pty Ltd

BACKGROUND: Complexity analysis of EEG signals offers powerful tools for capturing nonlinear, fractal, and chaotic dynamics underlying brain function. Traditional linear analyses (e.g., power spectral density) provide limited insight into the temporal evolution and deterministic structure of neural activity. Recent advances in computational power and nonlinear mathematics have revived interest in characterizing EEG with complexity metrics such as Fractal Dimension (FD), Correlation Dimension (CD), Lyapunov Exponents (LLE), Multiscale Entropy (MSE), Lempel-Ziv Complexity (LZc), and Multifractal Detrended Fluctuation Analysis (MFDFA). These methods promise higher sensitivity to brain states and pathophysiological changes but face challenges in standardization, signal preprocessing, and interpretation.

METHODS: This review synthesizes over four decades of complexity-based EEG studies and compares methods along two major axes: geometric (e.g., FD, CD) and informational (e.g., entropy, LZc). We explore their mathematical foundations, computational implementation, sensitivity to noise and preprocessing, and use cases across domains such as sleep staging, cognitive load, anesthesia depth, seizure prediction, schizophrenia, and autism spectrum disorder (ASD). Emphasis is placed on how signal processing decisions (e.g., referencing, filtering, component removal) impact nonlinear metrics.

RESULTS: Evidence supports the utility of FD and MSE in differentiating brain states and neuropsychiatric conditions. For instance, Higuchi's FD has been effective in distinguishing REM sleep from seizure states, and lower MSE has been consistently reported in ASD and depression. However, variability across preprocessing pipelines and the inconsistent application of dimensional scaling or entropy thresholds has led to contradictory findings in schizophrenia and multifractality in sleep studies. Benchmarking with synthetic data (e.g., Weierstrass functions) and real-time BCI applications (e.g., LZc, MFDFA) show that complexity metrics capture dynamic information lost in linear methods. Combined use of linear and nonlinear features—especially in machine learning classifiers—yields the highest diagnostic accuracy in current literature.

CONCLUSION: EEG complexity analysis is a promising but underutilized framework in neuromodulation research. Standardization of preprocessing pipelines and comparative trials are urgently needed to improve reproducibility and clinical translation. Future studies should explore the integration of EEG complexity metrics in closed-loop neuromodulation protocols, potentially enabling real-time adaptive stimulation based on dynamic brain states.

Keywords: EEG complexity, Fractal dimension, Lyapunov exponent, Multiscale entropy, Neuromodulation, Nonlinear dynamics

PP-09 **[Brain - Non-Invasive Stimulation » Psychiatric Disorders]**

THE EFFECT OF BILATERAL NON-INVASIVE VAGUS NERVE STIMULATION ON STRESS IN HEALTHY ADULTS

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[2]Clinical Trial Center INLITA, Vilnius, Lithuania

BACKGROUND: Stimulation of the vagus nerve has been shown to influence both hypothalamic–pituitary–adrenal (HPA) axis activity and autonomic regulation. Non-invasive approaches such as transcutaneous vagus nerve stimulation (tVNS) offer a potential therapeutic pathway for stress-related symptoms. The objective of this study was to evaluate the effect of unilateral and bilateral cervical tVNS on stress biomarkers and psychological outcomes in healthy adults.

METHODS: Forty healthy volunteers (aged 21–64 years) were recruited, of whom 37 completed a four-week protocol. Participants were randomized to receive either unilateral or bilateral stimulation using the Pulsetto device. Stimulation was delivered twice daily for eight minutes. Stress-related biomarkers were assessed through hair cortisol and cortisone levels before and after the intervention. Psychological outcomes were measured at baseline, week 2, and week 4 using validated questionnaires: Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder-7 (GAD-7), and Pittsburgh Sleep Quality Index (PSQI).

RESULTS: Across the full sample, hair cortisol decreased significantly after four weeks (Wilcoxon signed-rank test, $V = 514$, $p = 0.013$). Bilateral stimulation led to a significant reduction ($p = 0.024$), whereas unilateral stimulation did not ($p = 0.159$). Cortisone showed a near-significant reduction in the bilateral group ($p = 0.058$). Changes in cortisone correlated with changes in cortisol ($\rho = 0.50$, $p = 0.002$), suggesting shared HPA-axis modulation. Significant improvements were also observed across all self-reported outcomes. Depression symptoms decreased strongly (PHQ-9, $p < 0.001$), as did anxiety (GAD-7, $p < 0.001$). Sleep quality improved markedly in both groups (PSQI, $p < 0.001$).

CONCLUSIONS: Bilateral tVNS significantly reduced hair cortisol and improved depression, anxiety, and sleep quality in healthy adults, supporting its potential as a non-invasive intervention for stress-related disorders. These findings highlight the role of vagus nerve modulation in regulating both physiological stress markers and psychological well-being.

Keywords: vagus nerve stimulation, non-invasive neuromodulation, HPA axis, cortisol, depression, sleep

PP-10 [Other]

INNOVATIVE USE OF NEUROMODULATION FOR RESPIRATORY RECOVERY AFTER A HIGH CERVICAL CORD INJURY

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[2]*Department of Critical Care, Ruby Hall Clinic, Pune*

BACKGROUND: High cervical spinal cord injuries resulting in quadriplegia often necessitate prolonged mechanical ventilation, which can lead to severe complications such as ventilator-associated pneumonia, pressure ulcers, and recurrent infections. These conditions not only limit ambulation and rehabilitation efforts but also impose significant financial and psychosocial burdens on patients and families due to prolonged intensive care unit (ICU) stays.

Case Presentation: We report the case of a 57-year-old male with a history of Guillain-Barré syndrome (1999), obstructive sleep apnea, and ankylosing spondylitis, who sustained a traumatic C3-C4 spinal cord injury with anterior subluxation at C3–C4 following a fall. Post-injury, the patient developed quadriplegia and required prolonged mechanical ventilation. He underwent C4 corpectomy, C3-5 fusion and C2–C6 lateral mass fusion, with no significant neurological or respiratory improvement over five months. To address ventilator dependency, bilateral phrenic nerve stimulation was performed using deep brain stimulation (DBS) electrodes and an implantable pulse generator. Cyclic-phase stimulation was administered with a 1-second "ON" and 3-second "OFF" pattern to minimize diaphragmatic fatigue, with a gradual increment in stimulation duration over time. Gradual weaning from mechanical ventilation was achieved over a period of 10 weeks with intermittent stimulation.

Outcomes: At 7-month follow-up, the patient remained off mechanical ventilation and was actively participating in physical rehabilitation, showing satisfactory clinical progress.

CONCLUSION: Phrenic nerve stimulation using DBS electrodes presents a viable and effective alternative to prolonged mechanical ventilation in patients with high cervical spinal cord injury. It offers potential for improved respiratory autonomy, enhanced rehabilitation, and reduced ICU-related complications.

Keywords: Phrenic nerve stimulation, Diaphragm pacing, Cervical cord injury, Ventilator-dependent patients, Early Rehabilitation

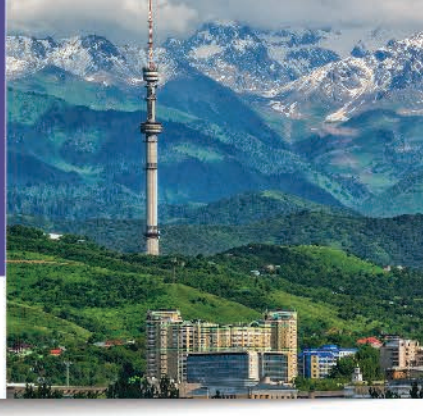
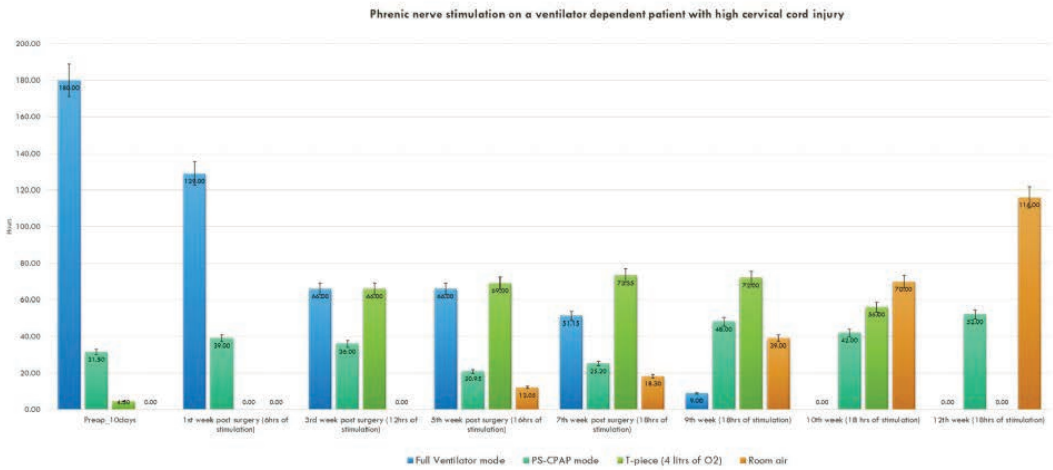
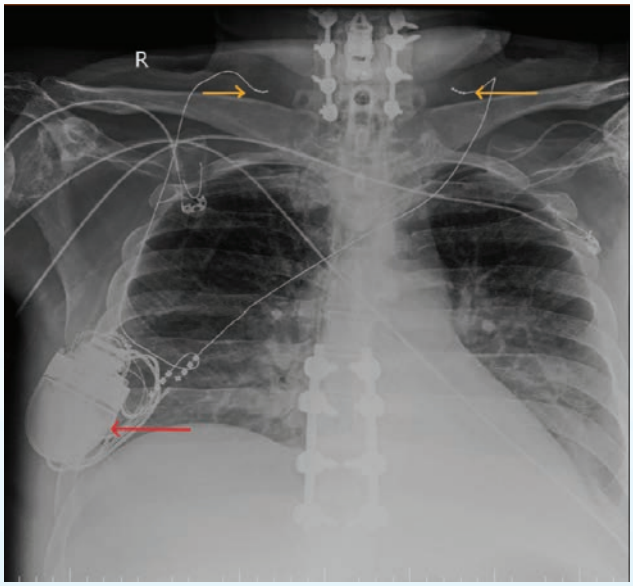


Figure 1: Progressive respiratory improvement following phrenic nerve stimulation in a ventilator-dependent patient with high cervical spinal cord injury



This bar graph depicts the weekly duration (in hours) spent on different modes of respiratory support, measured at serial postoperative time points from the preoperative baseline to 12 weeks following phrenic nerve stimulation surgery. The Y-axis represents the number of hours per week, while the X-axis corresponds to the type of respiratory support across various postoperative intervals. A progressive reduction in ventilator dependence is observed in conjunction with the gradual increase in stimulation duration. By the 10th postoperative week, the patient achieved complete weaning from mechanical ventilation.

Figure 2: Postoperative Chest X-ray



Postoperative chest radiograph demonstrating bilateral four-contact linear stimulation leads (indicated by yellow arrows) positioned along the phrenic nerves in the supraclavicular regions. The implantable pulse generator (IPG) is visible in the right infraclavicular chest area (indicated by red arrow).

PP-11

[Peripheral Nerve » Pain]

MANAGEMENT OF PERSISTENT TRIGEMINAL PAIN FOLLOWING TREATMENT WITH GAMMA KNIFE WITH TRIGEMINAL FIELD STIMULATION WITH PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS) THERAPY – A CASE SERIES

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Trigeminal Neuralgia and Neuropathic facial pains are debilitating painful conditions that are difficult to treat. Microvascular decompression can provide meaningful analgesia if a vascular loop can been identified on imaging. Treatments include carbamazepine, neuropathic pain medications, opioids and interventions targeting the Trigeminal ganglion in the Meckel's cave with radiofrequency lesioning or balloon compression. Gamma knife surgery has been used for managing this pain but has not been successful in 30-50% of patients and has reported side-effects including facial numbness and deafferentation pain. Neurostimulation could be a useful tool in managing these pains and could be used as a minimally invasive treatment option. We are reporting a case series of patients from two centres in Lithuania who has had failed Gamma knife surgery for Trigeminal pain who were treated with Percutaneous Electrical Nerve Stimulation (PENS) Therapy. Five patients (2 males/ 3 females) with an age range 32-79 presented with persistent Trigeminal pain despite having several other treatments. These included neuropathic pain medications and Carbamazepine, as well as interventions including Trigeminal Ganglion Radiofrequency, Nerve blocks targeting supra-orbital nerves, maxillary and mandibular and injections of Botulinum toxin and steroids. Additionally, all these patients had Gamma knife surgery with the duration since surgery ranging from 2 months to 4 years. All patients underwent treatment with Percutaneous Electrical Nerve Stimulation (PENS) Therapy (Algotec Corp) using a 50 mm electrode to deliver trigeminal field stimulation across the temporal bone using 2Hz and 100 Hz alternating every 3 seconds for 30 minutes. Pain scores immediately after treatment, at 24, 48 and 72 hours were compared with baseline scores. Patients were followed up for repeat treatments and their pain assessed. Baseline pain scores on VAS prior to treatment was 7-10 and immediately after treatment, all the patients reported complete pain relief except one who had baseline pain in V1,V2 and V3 territories; she had 70% reduction in V1, no change in V2 and 100% relief in V3. At 24 hours 3/5 patients had total pain relief. One patient had total pain relief for 3 days and another for 7 days. Two patients had repeat treatment with same effect. Further treatments and follow-ups are being carried out. PENS Therapy could be an initial treatment option that can be efficacious, sustainable and cost-effective treatment option for managing Trigeminal pain which can be used in isolation or as a diagnostic tool prior to implantable devices or ablative treatment options.

Keywords: Trigeminal neuralgia, facial pain, neuropathic pain, gamma knife, neurostimulation

PP-12 **[Socioeconomics of Neuromodulation]**

SHARED DECISION-MAKING IN SPINAL CORD STIMULATOR DEVICE CHOICE

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Since its inception, the spinal cord stimulator (SCS) market has expanded from a handful of manufacturers producing non-rechargeable devices providing basic tonic stimulation to a wealth of providers and models, with more growth expected in the coming years [1,2]. From stimulation settings to charging, MRI compatibility, wireless reprogramming, and company representatives, there are numerous factors that will deeply and constantly impact patients daily life and long-term chronic pain journey once they get implanted. Currently, as experts on the benefits and effectiveness of different models, clinicians decide what specific device a patient will receive. However, patients are the experts on their own needs, preferences, and social circumstances and should therefore lead this decision-making process, with healthcare professionals providing knowledge and support [3]. The aim of this project is to put together a leaflet giving an unbiased comparison of SCS devices available to chronic pain patients at Southmead hospital to support a patient-lead choice. The key aspect is to understand what information and features are particularly important to patients when choosing SCS devices. The information included in the leaflet was based on information from company websites, booklets and representatives. Furthermore, patients planning for an SCS implant were asked what they would want to know about their SCS device. Current SCS implanted patients were asked what they wished they had known before receiving their implant, and what their feedback was. These results were used to produce a leaflet giving a comprehensive overview of the SCS device options available to patients to aid in the shared decision-making process. Ongoing collection of feedback from patients will elucidate what information is relevant and helpful, and what is superfluous or overwhelming. Emphasis is also placed on the language used in the leaflet: it should be clear and concise, easily understood by the target audience, and unbiased towards different devices. This project will produce a leaflet that can be presented to patients by their pain management team and then be taken home for private consultation. It will be used by patients to guide the choice for their SCS device, together with the support and knowledge from clinicians.

1. Delveinsight. Spinal Cord Stimulators Market Insights, Competitive Landscape, and Market Forecast - 2032 [Internet]. 2025 [cited 2025 Jun 12].

2. International Neuromodulation Society. Spinal Cord Stimulation's Role in Managing Chronic Disease Symptoms [Internet]. 2019 [cited 2025 Jun 12].

3. NHS England. About shared decision making [Internet]. [cited 2025 Jun 10]

Keywords: Spinal cord stimulation, shared decision-making, patient-lead choice

PP-13 **[Brain - Non-Invasive Stimulation » Psychiatric Disorders]**

DIFFERENTIAL EFFECTS OF LOW-FREQUENCY TMS IN AUTISM SPECTRUM DISORDER AND SPECIFIC LANGUAGE IMPAIRMENT

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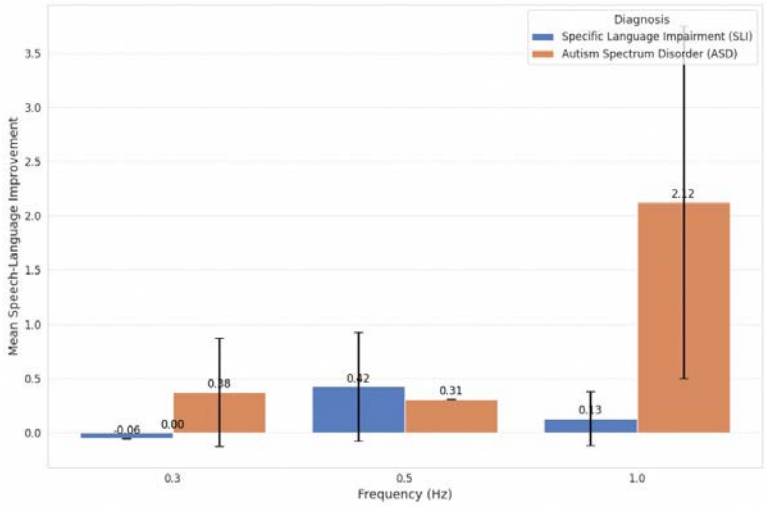
Low-frequency transcranial magnetic stimulation (TMS) has emerged as a promising intervention for modulating cortical excitability in developmental speech and language disorders (Vaishnavi, 2023). This retrospective study analyzed clinical data from 131 children aged 3–12 years (mean = 7.2, SD = 2.3) with Autism Spectrum Disorder (ASD) or Specific Language Impairment (SLI), treated in a single center in Almaty, Kazakhstan. All participants completed at least two TMS courses delivered with a figure-of-eight coil (Neuro-MS/D, Neurosoft) over the dorsolateral prefrontal cortex, Broca's, or Wernicke's areas at 0.3, 0.5, or 1 Hz (80% RMT, 6–24 sessions). Speech and language abilities were rated on a structured 10-point impairment scale, with data analyzed using linear regression and ANOVA models ($p < 0.05$). Results demonstrate that 1 Hz stimulation yielded statistically significant improvements, particularly in children with ASD ($\beta = 1.5495$, $p = 0.004$), supporting earlier findings on gamma-range hyperactivity reduction and improved neuroplasticity in this population (Casanova et al., 2020; Sokhadze et al., 2010; Oberman et al., 2016). Lower frequencies (0.3 Hz, 0.5 Hz) produced marginal or inconsistent effects, aligning with recent literature suggesting diminishing clinical utility of sub-1 Hz protocols (Tarhan et al., 2023). For children with SLI, stimulation of Broca's ($\beta = 1.5176$, $p = 0.004$) and Wernicke's areas ($\beta = 1.1497$, $p = 0.019$) improved language comprehension and production, consistent with prior studies on post-stroke aphasia recovery (Yao et al., 2020; Cotelli et al., 2012). However, these effects were less pronounced than those observed in the ASD cohort under 1 Hz stimulation, suggesting that SLI may require distinct protocols or a deeper understanding of underlying mechanisms to optimize therapeutic benefit. Response variability within the ASD group highlights the heterogeneity of cortical response profiles (Mottron & Bzdok, 2020), indicating that even within a diagnosis, TMS protocols must be individualized. Children with comorbid motor delays responded significantly less to stimulation ($\beta = -1.2028$, $p = 0.014$), reinforcing the interconnectedness of motor and language systems (Gao et al., 2022). While 1 Hz stimulation appears broadly beneficial for ASD, protocol optimization must account for neurophysiological variability, developmental stage, and comorbidities. The findings caution against generalized application of low-frequency TMS and support a tailored neuromodulation approach guided by emerging evidence.
This research was supported by the Committee of Science of the Ministry of Science and Higher Education (Grant No. BR27198099) and approved by the Local Ethical Committee of Al-Farabi Kazakh National University (Protocol № IRB-A843, IRB00010790).

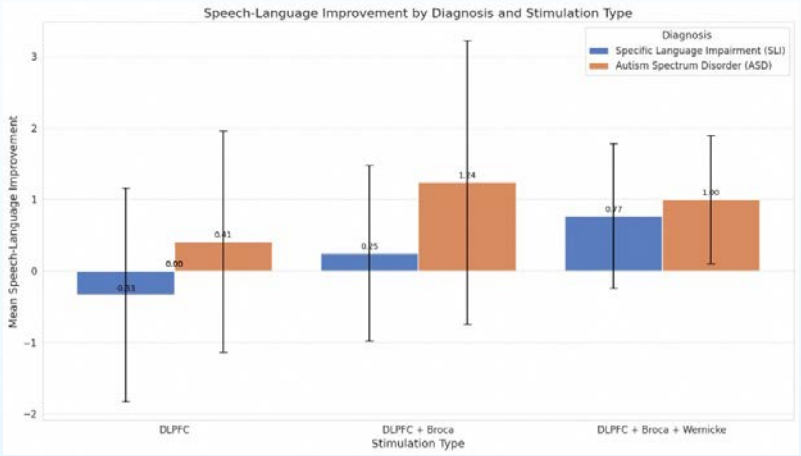
Keywords: TMS, ASD, SLI, retrospective cohort, pediatric neuromodulation

Speech-Language Improvement by Stimulation Frequency in Patients with SLI and ASD



The analysis revealed that 1 Hz stimulation had the most significant impact on speech and language outcomes in children with ASD, with a beta coefficient of β = 1.5495 (p = 0.004). These participants showed measurable improvements in vocabulary comprehension, speech fluency, and sentence construction. This aligns with previous studies demonstrating that 1 Hz stimulation normalizes hyperactive cortical oscillations and improves neuroplasticity in individuals with ASD. Lower frequencies, such as 0.3 Hz and 0.5 Hz, showed moderate but less pronounced effects, indicating that the choice of frequency is critical for optimizing outcomes in this population.

Speech-Language Improvement by TMS Stimulation Target in SLI and ASD Patients



For children with SLI, targeted stimulation of Broca's and Wernicke's areas resulted in significant enhancements in language comprehension and production, with effects of β = 1.5176 (p = 0.004) and β = 1.1497 (p = 0.019), respectively. These results are consistent with studies in post-stroke aphasia patients, where stimulation of these regions facilitated recovery in language processing. Improvements with additional stimulation were also present in the ASD group, but with a wider spread, highlighting the condition's heterogeneity.

PP-14 **[Spinal Cord » Pain]**

CLINICAL CASE OF CHRONIC NEUROSTIMULATION IN A PATIENT WITH DIABETIC POLYNEUROPATHY AND TROPHIC ULCERS

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Diabetic polyneuropathy is the most common complication of diabetes mellitus, developing in more than half of patients and accompanied by neurological impairments, including severe pain syndrome. The primary prevention of this disease involves endocrinologist-supervised treatment, which, unfortunately, does not address the alleviation of core symptoms such as neuropathic pain, sensory disturbances, autonomic dysfunction, and trophic disorders.

Patient V. (69-year-old female), suffering from type 2 diabetes mellitus complicated by polyneuropathy with the development of atrophic ulcers and no evidence of vascular pathology (confirmed by CT angiography FINDINGS: CT signs of abdominal aortic tortuosity with an acute angle formation; CT signs of atherosclerosis of the lower extremity vessels).

She was referred for consultation to a specialist in the chronic pain management department. Her complaints included severe pain in the lower extremities (10 points on the Visual Analog Scale (VAS), with both neuropathic and nociceptive components), and inefficacy of pharmacotherapy (pregabalin 600 mg/day, gabapentin 3600 mg/day, duloxetine 120 mg/day, tramadol 400 mg/day). Due to the presence of ulcers, the patient was under the care of a surgeon at a diabetic foot center and was trained in self-bandaging. However, adequate healing of the ulcers was not achieved due to the severity of the pain syndrome and her inability to fully comply with the surgeon's recommendations. Ulcer debridement was performed under general anesthesia. During anesthesia, significant complications occurred, and further use of this approach was not recommended due to the patient's high tolerance to the medications used, complicating subsequent dressing changes. Test stimulation was proposed to the patient.

Based on the results of the test stimulation (10 days) – which demonstrated an 80% reduction in pain intensity – the decision was made to implant a permanent neurostimulator. A leadless/battery-free neurostimulator (StimWave) was chosen to minimize postoperative complications associated with generator implantation.

Two spinal electrodes were implanted into the epidural space of the spinal cord: paramedian and at the "sweet spot" level (T8-T10 vertebrae). The following stimulation program was selected:

Amplitude – 6.5 mA

Frequency – 1000 Hz

Pulse Width – 150 μs

Cycle: 8 seconds on – 2 seconds off.

During stimulation, a reduction in pain syndrome was observed, enabling further surgical debridement of the ulcers in the purulent surgery department.

CONCLUSION: Our experience in treating painful forms of diabetic polyneuropathies aligns with current global trends. Recent evidence indicates that SCS can provide safe and effective pain management.

Keywords: SCS, PDPN, Pain Management.

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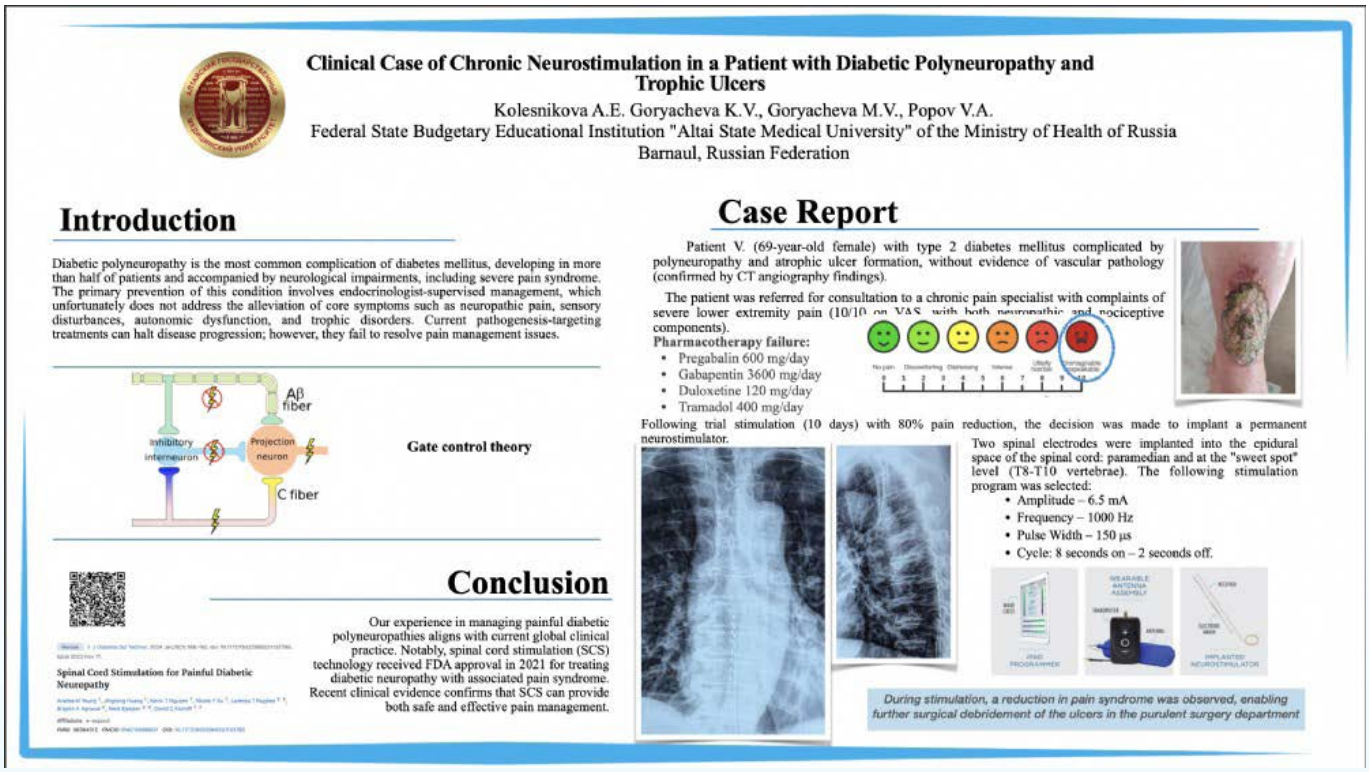

Clinical Case of Chronic Neurostimulation in a Patient with Diabetic Polyneuropathy and Trophic Ulcers

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Introduction

Diabetic polyneuropathy is the most common complication of diabetes mellitus, developing in more than half of patients and accompanied by neurological impairments, including severe pain syndrome. The primary prevention of this condition involves endocrinologist-supervised management, which unfortunately does not address the alleviation of core symptoms such as neuropathic pain, sensory disturbances, autonomic dysfunction, and trophic disorders. Current pathogenesis-targeting treatments can halt disease progression; however, they fail to resolve pain management issues.

Aβ fiber
Inhibitory interneuron
Projection neuron
C fiber

Gate control theory

Conclusion

Our experience in managing painful diabetic polyneuropathies aligns with current global clinical practice. Notably, spinal cord stimulation (SCS) technology received FDA approval in 2021 for treating diabetic neuropathy with associated pain syndrome. Recent clinical evidence confirms that SCS can provide both safe and effective pain management.

Spinal Cord Stimulation for Painful Diabetic Neuropathy

Case Report

Patient V. (69-year-old female) with type 2 diabetes mellitus complicated by polyneuropathy and atrophic ulcer formation, without evidence of vascular pathology (confirmed by CT angiography findings).

The patient was referred for consultation to a chronic pain specialist with complaints of severe lower extremity pain (10/10 on VAS, with both neuropathic and nociceptive components).

Pharmacotherapy failure:

- Pregabalin 600 mg/day
- Gabapentin 3600 mg/day
- Duloxetine 120 mg/day
- Tramadol 400 mg/day

Following trial stimulation (10 days) with 80% pain reduction, the decision was made to implant a permanent neurostimulator.

Two spinal electrodes were implanted into the epidural space of the spinal cord: paramedian and at the "sweet spot" level (T8-T10 vertebrae). The following stimulation program was selected:

- Amplitude – 6.5 mA
- Frequency – 1000 Hz
- Pulse Width – 150 μs
- Cycle: 8 seconds on – 2 seconds off.

During stimulation, a reduction in pain syndrome was observed, enabling further surgical debridement of the ulcers in the purulent surgery department

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