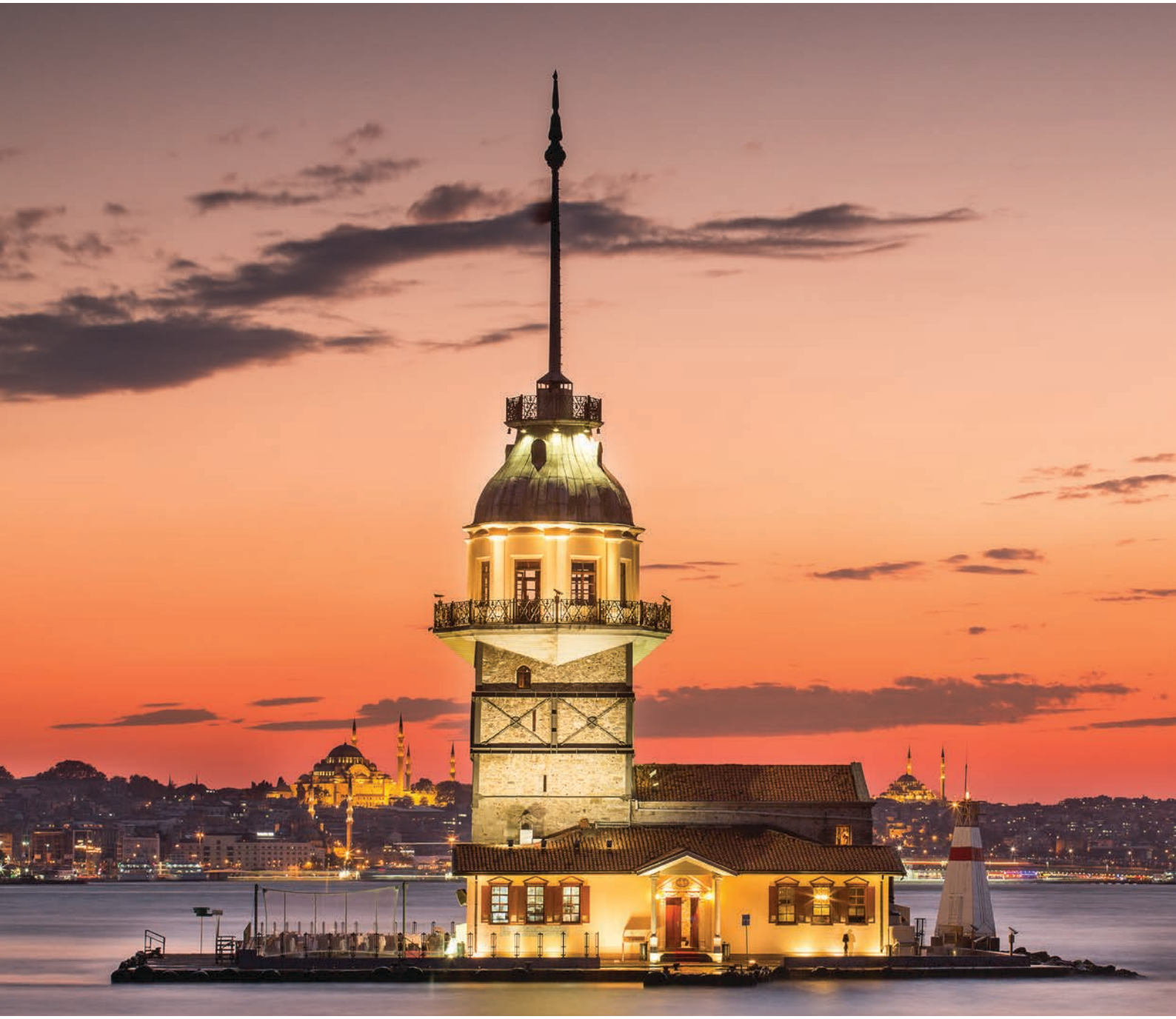
2nd Congress of the Deep Brain Stimulation Society

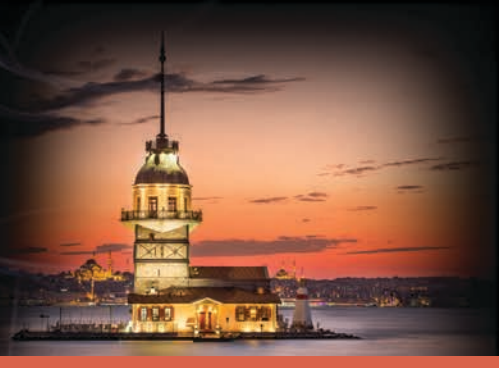
May 29-31, 2024

Renaissance Polat İstanbul Hotel
Yeşilyurt, İstanbul – Türkiye

www.dbss2024.org



PROGRAM AND ABSTRACTS BOOK



OPENING

Dear Friends and Colleagues,

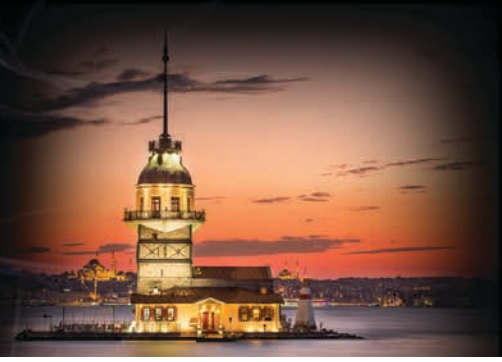
After the great success of our first congress in Grenoble in 2023, during which we celebrated the 30th anniversary of subthalamic nucleus (STN) Deep Brain Stimulation (DBS), and on behalf of the DBS Society and the organizing committee, it's my great privilege to invite you to the second Congress of the Society. This meeting will take place on May 29-31, 2024 at the Renaissance Polat Hotel in one of the most beautiful city, Istanbul, Turkey. In partnership with the National Society for Deep Brain Stimulation, a satellite symposium will be held on May 29 afternoon from 1pm to 7pm.

Our congress will be a unique opportunity for international experts to meet and discuss DBS, which has revolutionized the treatment of Parkinson's disease and other neurological and psychiatric disorders. All attendees are invited and encouraged to play an active role in the congress by interacting with faculty members in a hospitable atmosphere and by submitting abstracts for oral and poster presentations.

We hope you will join us for this high level educational Congress and excellent networking opportunity.

We look forward to welcoming you in Istanbul!

Prof. Abdelhamid Benazzouz
President of the DBS Society



29 MAY 2024, WEDNESDAY — HALL 2

Program of the Satellite Workshop

Organized by the National Turkish DBS Society

13:00-13:30 **Opening**

Abdelhamid Benazzouz (President of the DBS Society)
Yasin Temel *(Vice President of the DBS Society)*
Ersoy Kocabıçak *(Chair of the Organizing Committee & Council member)*

13:30-15:00 **Oral Presentation Session 1**
OP-01 / OP-06
Chairs: Ayşe Bora Tokçaer (Turkey), Bekir Tuğcu (Turkey)

OP-01 Delirium Risk Factors in Parkinson's Disease Patients After Deep Brain Stimulation Surgery. Specific Considerations Regarding Different Neuroanatomical Targets
Gulsah Ozturk Ozluk, Enes Ozluk

OP-02 The Interplay Between Neuroinflammatory Pathways and Insights into Deep Brain Stimulation Mechanisms in Parkinson's Disease
Pinar Eser, Ersoy Kocabicak, Ahmet Bekar, Yasin Temel

OP-03 Anteromedial GPi DBS in Tourette's syndrome: clinical outcome of 7 cases
Ilkay Işıkay, Aytül Karabekiroğlu, Yıldız Karalar, Meltem Can Ike, Ersoy Kocabıçak

OP-04 Speech Changes Following Subthalamic Nucleus Deep Brain Stimulation: A Clinical and Tractography Study
Ozan Haşimoğlu, AYCA Altınkaya, TAHA Hanoğlu, Tuba Ozge Karacoban, Ozan Barut, Ozan Tüysüz, Bekir Tuğcu

OP-05 Comparison of Apathy and Cognitive Symptoms in Pre- and Postoperative Period in Deep Brain Stimulation Surgery.
Selim Polat, Miray Erdem, Melih Çekinmez, Gökhan Çavuş

OP-06 Deep Brain Stimulation (DBS) From the Perspective of Relatives and Caregivers: A Qualitative Analysis and Caregiver Burden
Tuğçe Saltoğlu, Yeşim Sücüllü Karadağ

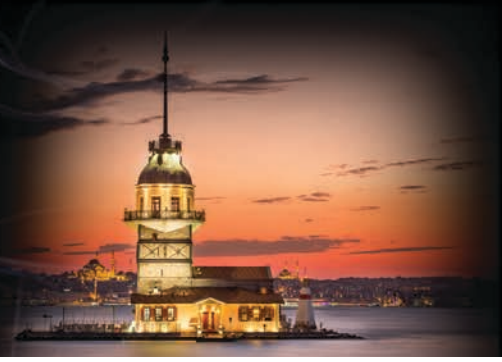
15:00-15:30 Coffee break

15:30-17.00 **Interactive Discussion in Light of DBS Questionnaire of Turkey**
Chairs: Okan Doğu (Turkey), Murat Vural (Turkey)

Information: *Cihan İşler(Turkey), Pınar Eser (Turkey)*
Panelists: *All participants*

17:00-17:45 **Plenary Lecture**
Chairs: Tanju Uçar (Turkey), Cihan İşler (Turkey)

A Parkinson's patient's journey from diagnosis to deep brain stimulation treatment and beyond
Dilek Günal (Turkey)



29 MAY 2024, WEDNESDAY — HALL 3

13:30-15:00 **Oral Presentation Session 2**
OP-07 / OP-12
Chairs: Haşmet Hanağası (Turkey), Gençer Genç (Turkey)

OP-07 Specific programming of motor and speech functions to improve stimulation-induced dysarthria in DBS cases
Batu Hergünsel, Mustafa Kılıç, Derya Selçuk Demirelli, Gül Teksin, Hacer Acar Çakan, Saime Ayça Şahin, Kardelen Utangeç, Uğurcan Çiler, Gençer Genç

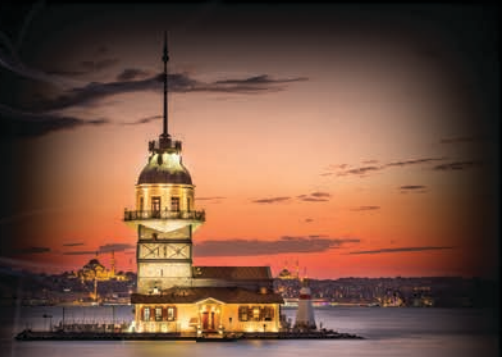
OP-08 GPİ Deep Brain Stimulation for Cervical Dystonia
Mustafa Kılıç, Gözde Öngün, Gül Teksin, Kardelen Utangeç, Gencer Genç

OP-09 Burden of Hardware Infection in Deep Brain Stimulation Surgery
Hakan Simsek

OP-10 Deep Learning and Artificial Intelligence Based Stereotactic Planning Software
Sait Ozturk, Mustafa Şahin, Muhammed Talu

OP-11 Comparison of facial movements in patients with Parkinson's disease when deep brain stimulation is switched on and off using artificial intelligence-based software
Sefa Öztürk, Duygu Dolen, Eren Andıç, Cafer Ikbal Gulsever, Senem Kılıç Öztürk, Pulat Akın Sabancı

OP-12 Deep Brain Stimulation and Stigma in Movement Disorder Patients
Doruk Taş, Tanju Uçar, Sibel Sehür Özkaynak, Özge Baysal, Burçin Özkaya, Özmen Metin, Gizem Kızılay



30 MAY 2024, THURSDAY — HALL 1

Program of the DBS Society Congress

08:45-09:00 **Welcome and Introduction**

Abdelhamid Benazzouz *(President of the DBS Society)*
Ersoy Kocabıçak *(Chair of the Local Organizing Committee)*

09:00-10:30 **Plenary Session 1: DBS Advances in Parkinson's Disease**
Chairs: Rubens Cury (Brazil), Elena Moro (France)

09:00-09:30 Adaptive DBS in PD: Is this happening?
Gerd Tinkhauser (Switzerland)

09:30-10:00 The impact of genotype and phenotype on DBS indication and outcome
Vladimira Vuletic (Croatia)

10:00-10:30 Non-motor symptoms and DBS: Different targets and timing compared to motor symptoms?
Rubens Cury (Brazil)

10:30-11:00 Coffee break

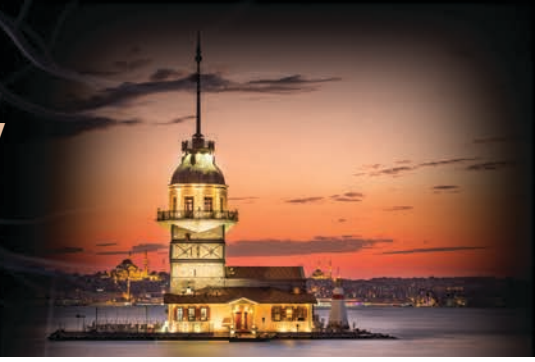
11:00-12:30 **Parallel Symposium 1: The Mechanisms of DBS: Learning from Models**
Chairs: Abdelhamid Benazzouz (France), Clement Hamani (Canada)

11:00-11:25 The cellular mechanisms of DBS
Clement Hamani (Canada)

11:25-11:50 Brain plasticity in DBS
Lee Wei Lim (Hong Kong)

11:50-12:15 STN DBS and pain in PD
Abdelhamid Benazzouz (France)

12:15-12:30 Discussion



30 MAY 2024, THURSDAY — HALL 2

11:00-12:30 Parallel Symposium 2: Managing Epilepsy with DBS
Chairs: Sibel Ertan (Turkey), Steve Ojemann (USA)

11:00-11:25 Update on indications
Yasin Temel (The Netherlands)

11:25-11:50 Comparing DBS targets
Steve Ojemann (USA)

11:50-12:15 Neurophysiology and imaging in thalamic targets of DBS in epilepsy
Cristina Torres (Spain)

12:15-12:30 Discussion

12:30-13:30 Lunch

30 MAY 2024, THURSDAY — POSTER AREA

13:30-14:30 Poster Session 1
PP-01 / PP-22
Chairs: Mohamed Faouzi Belahsen (Morocco), Selçuk Peker (Turkey)

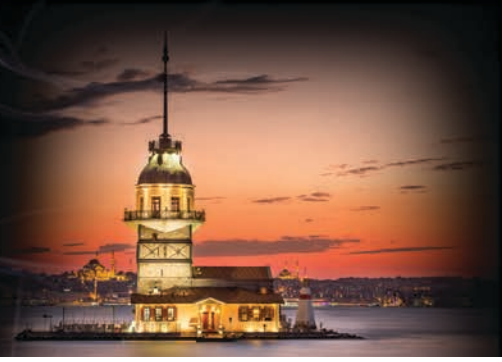
14:30-15:30 Plenary Session 2: DBS Advances in Other Movement Disorders
Chairs: Okan Doğu (Turkey), Joohi Jimenez-Shahed (USA)

14:30-15:00 The impact of genes in dystonia
Amaal Aldakheel (Saudi Arabia)

15:00-15:30 Long term outcome with different targets in Tourette syndrome
Linda Ackermans (The Netherlands)

15:00-15:30 Is there a future of DBS for tremor?
Francesco Cavallieri (Italy)

15:30-16:00 Coffee Break



30 MAY 2024, THURSDAY — HALL 1

16:00-17:30 **Parallel Symposium 3: Expanding the Role of Neurophysiology for DBS**
Chairs: Claudio Pollo (Switzerland), Alberto Priori (Italy)

16:00-16:25 Unveiling neurophysiology of dystonia with DBS
Zvi Israel (Israel)

16:25-16:50 Are beta oscillations a real biomarker in PD?
Alberto Priori (Italy)

16:50-17:15 Effects of age on STN neuronal activity in PD
Marcus Janssen (The Netherlands)

17:15-17:30 Discussion

17:30-18:30 **DBS Society General Assembly**

19:00-19:30 **Opening Ceremony**

Awarding the DBS Society
Alim-Louis Benabid and Pierre Pollak Prizes

30 MAY 2024, THURSDAY — HALL 2

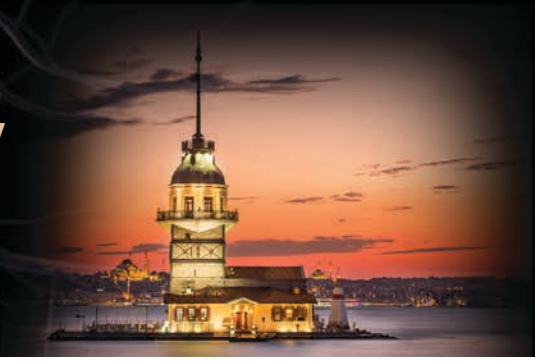
16:00-17:30 **Parallel Symposium 4: Cutting Edge in Neurotechnology for DBS**
Chairs: Sara Marceglia (Italy), Hemmings Wu (China)

16:00-16:25 Closed-loop technology in DBS for tremor and Tourette
Ayşegül Gündüz (USA)

16:25-16:50 Unlocking the potential of DBS bi-directional brain-computer interfaces
Carina Oehrn (USA)

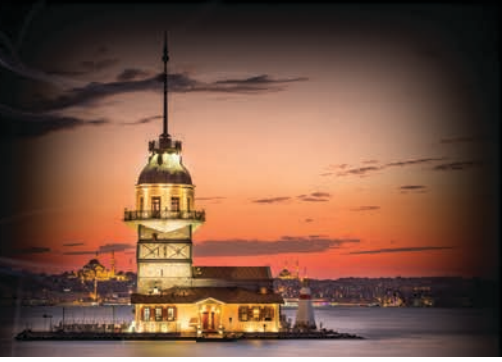
16:50-17:15 DBS and brain computer interfacing
Hemmings Wu (China)

17:15-17:30 Discussion



31 MAY 2024, FRIDAY — HALL 1

09:00-10:30	**Plenary Session 3: DBS Advances in Psychiatry** ***Chairs: Adriana Lopez (Colombia), Cristina Torres (Spain)***
09:00-09:30	Update on DBS targets and long-term outcome in OCD *Philippe Domenech (France)*
09:30-10:00	DBS and Artificial Intelligence in depression *Christopher J. Rozell (USA)*
10:00-10:30	DBS long-term outcome in aggressiveness *Adriana Lopez (Colombia)*
10:30-11:00	Coffee Break
11:00-12:30	**Plenary Session 4: Innovation & Future of DBS** ***Chairs: Abdelhamid Benazzouz (France), Yasin Temel (The Netherlands)***
11:00-11:30	**Plenary Lecture 11** Next generation deep brain stimulation: A vision for personalized therapy *Thomas Brionne (France)*
11:30-12:00	**Plenary Lecture 12** Abbott brain therapies – Expanding access to care through patient centric innovation *Chris Palmer (USA)*
12:00-12:30	**Plenary Lecture 13** Advancing DBS Boundaries: Optimizing Clinical Practice and Research
12.00-12.15	How can Image Guided DBS workflow optimize Clinicians' Experience and Patients' Outcomes? *Claudio Pollo (Switzerland)*
12.15-12.30	Is image guided programming improving standard of care? *Philipp Capetian (Germany)*
12:30-13:30	Lunch



31 MAY 2024, FRIDAY — POSTER AREA

13:30-14:30 **Poster Session 2**
PP-23 / PP-43
Chairs: Miguel Coelho (Portugal), Ali Shalash (Egypt)

31 MAY 2024, FRIDAY — HALL 1

14:30-16:00 **Plenary Session 5: DBS Advances in Other Disorders**
Chairs: Paresh Doshi (India), Yasin Temel (The Netherlands)

14:30-15:00 Expanding the field of DBS in epilepsy
Jukka Peltola (Finland)

15:00-15:30 Should we still investigate DBS for dementia?
Andres Lozano (Canada)

15:30-16:00 Long-term outcome of DBS in pain
Claudio Pollo (Switzerland)

16:00-16:30 Coffee Break

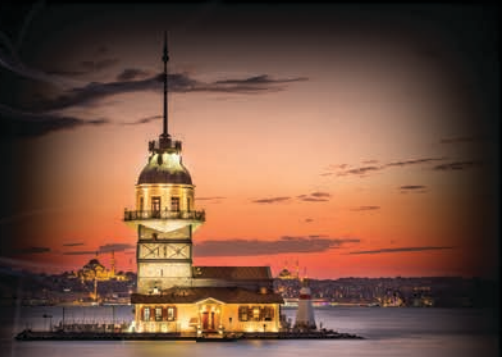
16:30-18:00 **Parallel Symposium 5: Managing Parkinson's Disease after DBS: Overview and Practical Recommendations**
Chairs: Patricia Limousin (United Kingdom), Chun-Hwei Tai (Taiwan)

16:30-16:55 Gait and balance issues after DBS
Ioannis Isaias (Italy)

16:55-17:20 Failures of DBS treatment: The neurosurgeon's point of view
Joachim K. Krauss (Germany)

17:20-17:45 Failures of DBS treatment: The neurologist's point of view
Yıldız Değirmenci (Turkey)

17:45-18:00 Discussion



31 MAY 2024, FRIDAY — HALL 2

16:30-18:00 **Parallel Symposium 6: Oral Presentations Selected from Abstracts**
OP-13 / OP-18
Chair: Vladimira Vuletic (Croatia)

OP-13 DUE TO LACK OF REGISTRATION, CANCELLED.

OP-14 Convergent Pallidal Neural Patterns Across Genetic Dystonia Syndromes: Spiking Regularity and Neural Bursts
Ahmet Kaymak, Fabiana Colucci, Vincenzo Levi, Giovanna Zorzi, Miryam Carecchio, Holger Prokisch, Michael Zech, Barbara Garavaglia, Hagai Bergman, Roberto Eleopra, Alberto Mazzoni, Luigi Michele Romito

OP-15 Advancing personalized aDBS: Predicting the dynamic nature of beta-power distributions
Salvatore Falciglia, Laura Caffi, Chiara Palmisano, Ioannis Ugo Isaias, Alberto Mazzoni

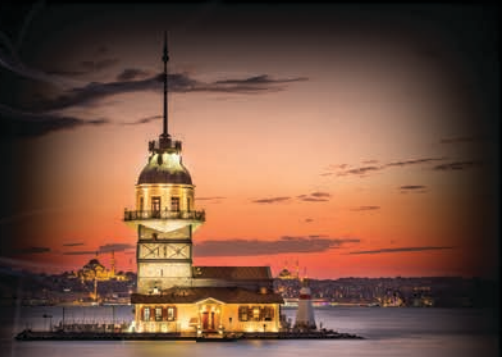
OP-16 The application of magnetic nanodiscs for neuromodulation
Anouk Wolters, Lorenzo Signorelli, Danijela Gregurec, Christian Herff, Yasin Temel1, Gunter Kenis, Sarah Anna Hescham

OP-17 Subjective Patient Rating as a Novel Feedback Signal for DBS Programming
Jing Dong, Sophia Peschke, Angelina Kirchner, Thomas Koeglsperger

OP-18 Decreased brain volume may be associated with the occurrence of peri-lead edema in Parkinson's disease patients with deep brain stimulation
Marina Raguz, Petar Marcinkovic, Hana Chudy, Darko Oreskovic, Marin Lakic, Domagoj Dlaka, Natasa Katavic, Valentino Racki, Vladimira Vuletic, Darko Chudy

29 MAY 2024, WEDNESDAY — HALL 1

18:00-18:15 **Closing Remarks**



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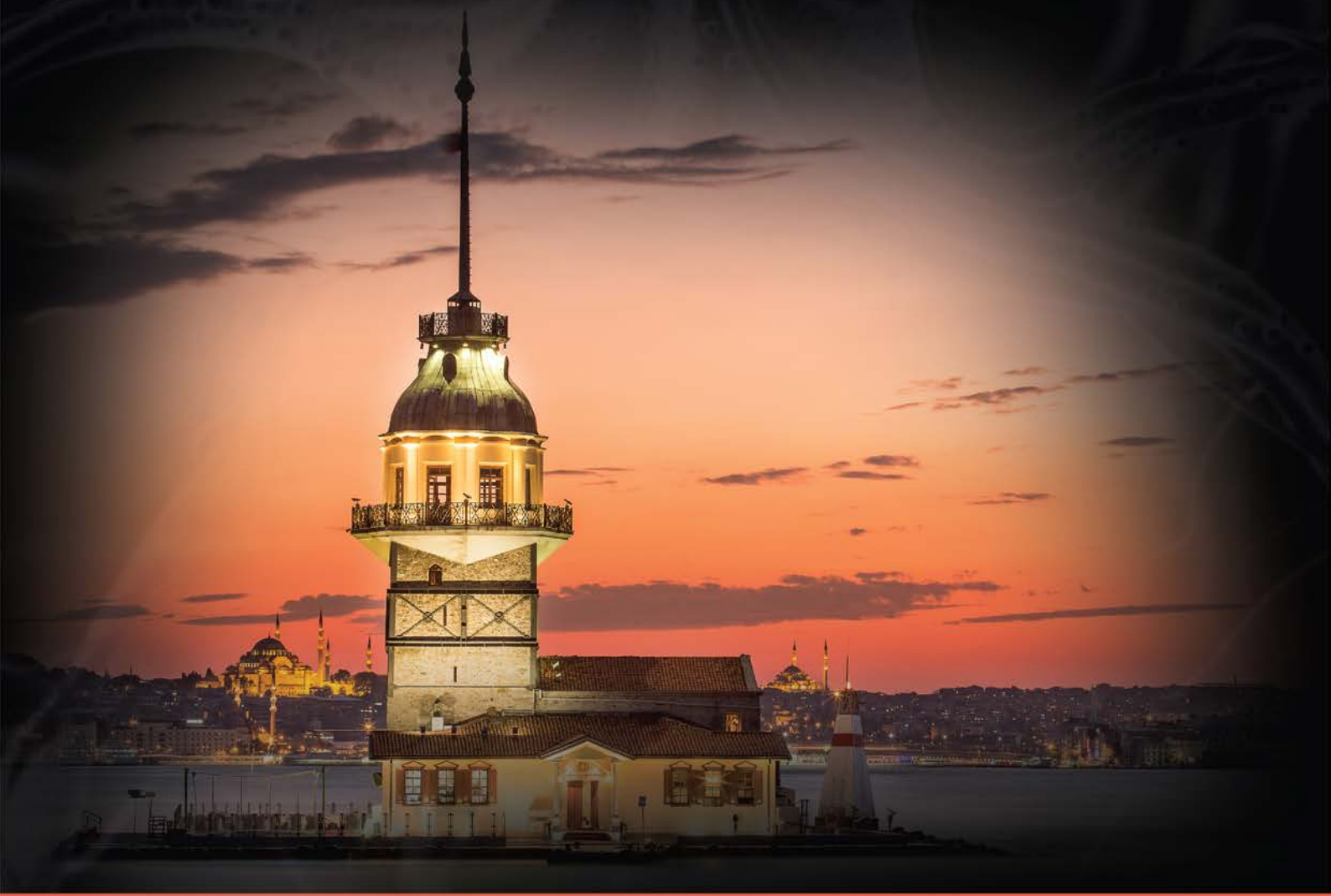
Oral Presentations



OP-01

DELIRIUM RISK FACTORS IN PARKINSON'S DISEASE PATIENTS AFTER DEEP BRAIN STIMULATION SURGERY. SPECIFIC CONSIDERATIONS REGARDING DIFFERENT NEUROANATOMICAL TARGETS

Gülşah Öztürk Özlük[1], Enes Özlük[2]
[1]Neurosurgery, Memorial Sisli Hospital
[2]Radiology, Basaksehir Cam Sakura City Hospital

BACKGROUND: In this study, risk factors for postoperative delirium were evaluated in patients who underwent deep brain stimulation (DBS) for Parkinson's Disease (PD) treatment.

METHODS: The information of 83 PD patients who underwent bilateral DBS between 2016 and 2023 was evaluated retrospectively. Twenty-two parameters, including but not limited to patient's demographic features, duration of disease, preoperative cognitive status and silent ischemia, brain atrophy, DBS target, type and duration of surgery, duration of anesthesia, UPDRS-3 scores, Hoehn and Yahr scores, postoperative brain edema and electrolyte imbalances were analyzed with logistic regression.

RESULTS: The targets of DBS were globus pallidus interna (Gpi) and subthalamic nucleus (STN) in 84.3% and 15.7% of patients, respectively. Five patients (6.0%) developed post-DBS delirium. Patient's age, disease duration, rates of cerebral atrophy and postoperative brain edema were significantly higher in patients who developed delirium with p-values of 0.009, 0.001, 0.002, and 0.026, respectively. Logistic regression analyses revealed disease duration and cerebral atrophy as independent risk factors with ODD ratios of 1.52 (CI:1,102-2,086) and 21.79 (CI:1,34-353,63), respectively.

CONCLUSIONS: Published research analyzing risk factors of post-DBS delirium is not many and mainly included patients whose DBS targets were STN. This study examined the highest number of patients implanted with Gpi electrodes among investigations reported. The rate of delirium observed in this cohort is relatively lower than previously reported rates, which may relate to the DBS target, and the obtained results reveal the higher necessity of clinical alertness in patients with cerebral atrophy and longer disease duration for early diagnosis.

Keywords: GPi, STN, Delirium, Parkinson's Disease, DBS

OP-02

THE INTERPLAY BETWEEN NEUROINFLAMMATORY PATHWAYS AND INSIGHTS INTO DEEP BRAIN STIMULATION MECHANISMS IN PARKINSON'S DISEASE

Pinar Eser[1], Ersoy Kocabicak[2], Ahmet Bekar[1], Yasin Temel[3]
[1]Department of Neurosurgery, Bursa Uludag University School of Medicine, Bursa, Turkey
[2]Neuromodulation Center, Ondokuz Mayis University, Health Practise and Research Hospital, Samsun, Turkey
[3]Department of Neurosurgery, Maastricht University Medical Center, Maastricht, The Netherlands

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by the gradual degeneration of the nigrostriatal dopaminergic pathway, leading to neuronal loss within the substantia nigra pars compacta (SNpc) and dopamine depletion. While the primary cause of PD is the loss of dopaminergic neurons, the precise mechanisms behind this loss remain incompletely understood. However, current evidence indicate that this process is influenced by various molecular factors, including neuroinflammation, impaired protein homeostasis, and mitochondrial dysfunction. Further exploration of the intricate interplay between neuroinflammation and mitochondrial dysfunction is warranted to advance our understanding of PD pathogenesis. Deep brain stimulation (DBS), a neuromodulation technique involving electric current delivered through stereotactically implanted electrodes, represents a transformative intervention in neurosurgery, offering precise and minimally invasive treatments for various neurological and movement disorders. While the exact mechanism of action is not fully elucidated for DBS, it is acknowledged as a successful therapeutic choice for PD. A growing body of evidence suggests its potential for anti-neuroinflammatory and neuroprotective effects, although contrasting perspectives exist. Contrary to initial concerns, DBS demonstrates anti-inflammatory effects, impacting cytokine release, glial activation, and neuronal survival. Comprehending the potential influence of DBS on inflammatory processes holds substantial ramifications for addressing neurological and neuropsychiatric conditions marked by neuroinflammation, such as PD. Such insights may lead to the development of novel therapeutic strategies that combine DBS with anti-inflammatory approaches, opening new avenues for managing complex neurological disorders.

Keywords: Deep brain stimulation, neuroinflammation, Parkinson's disease

OP-03

ANTEROMEDIAL GPI DBS IN TOURETTE'S SYNDROME: CLINICAL OUTCOME OF 7 CASES

Ilkay Işıkay[1], Aytül Karabekiroğlu[3], Yıldız Karalar[4], Meltem Can Ike[5], Ersoy Kocabıçak[2]
[1]Department of Neurosurgery, Hacettepe University, Ankara, Turkey
[2]Department of Neurosurgery, Ondokuz Mayıs University, Samsun, Turkey
[3]Department of Psychiatry, Ondokuz Mayıs University, Samsun Turkey
[4]Department of Psychiatry, Medicine Hospital, Atlas University, İstanbul, Turkey
[5]Department of Neurology, Medicine Hospital, Atlas University, İstanbul, Turkey

OBJECTIVE: Tourette's Syndrome (TS) is a complex neuropsychiatric disorder characterized by chronic motor and vocal tics. Deep Brain Stimulation (DBS) of the anteromedial Globus Pallidus internus (GPi) has emerged as a therapeutic option for patients with refractory symptoms. This study evaluates the clinical outcomes of anteromedial GPi DBS in patients with TS.

METHODS: We conducted a retrospective review of clinical and radiological data for seven patients with severe, treatment-resistant TS who underwent anteromedial GPi DBS. Surgical target localizations were verified using postoperative CT scans fused with preoperative MRI. The severity of tics before and after the procedure was quantitatively assessed using the Yale Global Tic Severity Scale (YGTSS), with the percentage improvement recorded for each patient.

RESULTS: The cohort included three female patients, with a mean age of 33.7±12.0 years and a mean disease duration of 25.7±12.2 years prior to surgical intervention. The mean target coordinates (X, Y, Z) relative to the mid-commissural point were as follows: for the right side, 13.0, 11.3, -0.2; for the left side, -12.3, 10.8, -0.2. The mean follow-up period was 29.1 months (range: 24-48 months). All patients experienced a significant reduction in tic severity, with an average decrease of 53.0±9.5% in the YGTSS total score at the last follow-up. One patient encountered a wound infection at the implantable pulse generator (IPG) site, necessitating the extraction of both the IPG and leads.

CONCLUSION: Anteromedial GPi DBS has demonstrated safety and efficacy in reducing tic severity and enhancing the quality of life in patients with severe, treatment-refractory TS. This study supports the growing evidence in the literature advocating for the anteromedial GPi as a viable target for DBS in TS management. Despite the promising outcomes, the occurrence of a wound infection highlights the need for meticulous postoperative care.

Keywords: Tourette's syndrome, anteromedial GPi, tic disorder

OP-04

SPEECH CHANGES FOLLOWING SUBTHALAMIC NUCLEUS DEEP BRAIN STIMULATION: A CLINICAL AND TRACTOGRAPHY STUDY

Ozan Haşimoğlu, AYCA Altınkaya, TAHA Hanoğlu, Tuba Ozge Karacoban, Ozan Barut, Ozan Tüysüz, Bekir Tuğcu
Başakşehir Çam ve Sakura Şehir Hastanesi

OBJECTIVES: Parkinson's disease (PD) commonly induces speech changes in 70-90% of patients, impacting their quality of life. This study focuses on the speech effects following Subthalamic Nucleus Deep Brain Stimulation (STN-DBS) in PD patients and explores the correlation between these changes and clinical, MRI, and tractography findings. While STN-DBS is well-established for improving motor symptoms, its impact on speech remains controversial. The study aims to provide insights into the nuanced relationship between STN-DBS and speech alterations.

METHODS: Participants included 47 PD patients undergoing STN-DBS. Comprehensive preoperative assessments, including Unified Parkinson's Disease Rating Scale (UPDRS) and neuropsychological tests, were conducted. Speech and voice samples were collected using the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) and acoustic analysis. STN-DBS surgery was performed, and structures within the Volume of Tissue Activated (VTA) were analyzed. The relationship of the Corticospinal Tract (CST), Internal Capsule (IC), Dentatorubrothalamic Tract (DRTT), Medial Lemniscus (ML), Medial Forebrain Bundle (MFB), and Substantia Nigra (SN) with the VTA was assessed. Postoperative assessments and correlations with clinical features were conducted.

RESULTS: Speech analysis revealed that 82.3% of patients experienced either improved or unchanged speech after STN-DBS, while 14.9% exhibited deterioration. The results of speech analysis worsened in elderly patients and those with worse postoperative motor symptoms. There was no significant relationship found between tract involvement and speech changes.

CONCLUSION: This study underscores the predominantly positive or neutral effects of STN-DBS on speech in PD patients, with negative outcomes linked to older age and worsening motor symptoms. However, the study's early-term focus, low stimulation parameters, and absence of cognitive speech tests highlight the necessity for extensive, long-term research to comprehensively grasp the intricate effects of STN-DBS on speech in PD.

Keywords: Subthalamic Nucleus, Deep Brain Stimulation, Parkinson's Disease, Tractography, Motor Symptoms, Speech Analysis

OP-05

COMPARISON OF APATHY AND COGNITIVE SYMPTOMS IN PRE- AND POSTOPERATIVE PERIOD IN DEEP BRAIN STIMULATION SURGERY

Selim Polat[1], Miray Erdem[2], Melih Çekinmez[3], Gökhan Çavuş[4]
[1]Department of Mental Health and Diseases, Adana City Training and Research Hospital, Adana, Turkey
[2]Department of Neurology, Adana City Training and Research Hospital, Adana, Turkey
[3]Department of Neurosurgery, Private Adana Ortadogu Hospital, Adana, Turkey
[4]Department of Neurosurgery, VM Medical Park Mersin, Mersin, Turkey

OBJECTIVE: Parkinson's disease is the most common disease after Alzheimer's disease and is characterized by degeneration of brain cells.The prevalence of this disease,which is classified among hypokinetic diseases, is 0.2%-0.3% in the general population and increases in older ages to approximately 1%-2% among people over 55 years of age.The aim of the study was to investigatie apathy and cognitive functions in Parkinson's disease patients who underwent deep brain stimulation surgery on bilateral subthalamic nuclei.

MATERIAL-METHODS: This study included 18 patients with Parkinson's disease who were accommodated in theParkinson's and Movement Disorders Center of Adana City Training and Research Hospital for treatment in 2022.Patients were evaluated by psychiatry, neurology and neurosurgery specialists with a multidisciplinary approach and found to be surgically appropriate. Standardized Mini-Mental Test and Montreal Cognitive Assessment Scale,Apathy Evaluation Scale,and Hamilton Anxiety and Depression Scale were administered to each patient before the operation and at 6 months after effective stimulation parameters were reached.

RESULTS: The mean apathy score at the preoperative zeroth month was 47.77±15.83 in patients having deep brain stimulation surgery and 30.83±13.59 in the postoperative sixth month.The average Hamilton Anxiety Scale scores at the preoperative zeroth month was 11.50±5.14 and 10.22±5.57 at the postoperative sixth month,with no clinical significance (P =.280). The determined value for the Unified Parkinson's Disease Rating Scale,on treatment,was 22.55±7.53 in the preoperative zeroth month and 14.50±6.99 in the postoperative sixth month,with statistical significance (P <.001).The Unified Parkinson's Disease Rating Scale,off treatment,score was revealed to be significant in the preoperative zeroth month (37.44±9.85) in comparison to that of the postoperative sixth month (23.44±7.86; P <.001).

CONCLUSION: This study showed that bilateral subthalamic stimulation improves nonmotor and motor symptoms in patients having Parkinson's disease.The mechanism is complex,and we believe that future studies focusing on pharmacological and nonpharmacological treatments involving more patient groups will be useful for clinicians.

Keywords: Parkinson's disease, deep brain stimulation, apathy, cognitive

OP-06

DEEP BRAIN STIMULATION (DBS) FROM THE PERSPECTIVE OF RELATIVES AND CAREGIVERS: A QUALITATIVE ANALYSIS AND CAREGIVER BURDEN

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One of the most important conditions for success in DBS, which has been proven effective for more than thirty years and has had encouraging results is the patient and the patients' relatives comply with the treatment and are aware.In this treatment where the support of the patients' relatives is significant, it may cause the caregiver to experience a care burden.In this study, we aimed to determine the caregiven burden and awareness levels of caregivers of patients under DBS treatment.

In our study, a 22-question caregiver burden scale(Zarid et al.) and a 10-question questionnaire (Prasad et al.) were administered to the caregivers of 14 patients who applied to our center between 2019 and 2024 and were treated with DBS treatment.The mean age of the patients was 60.57(39-76) and the mean Zarid care scale score was 27.57(5-50).None of the relatives knew the explicit name of DBS and the types of DBS batteries.5 of 14 patients said they knew the cost of DBS but the answers were wrong. Only 1 of the relatives stated that they would not have DBS if they were back in the past.There was a negative correlation between the increase in Zarid care burden scale scores and the level of awareness of the patients' relatives.

It was observed that the majority of the patients' relatives were quite satisfied with the treatment and did not regret that this treatment was applied.As the level of knowledge decreased, the care burden scale increased.Information about DBS should start early so that patients can make the best decision and adapt better to the post-treatment process.Patients' relatives should know that recovery will be gradual and the risks and benefits of this treatment. In conclusion, we would like to emphasize that relatives should be better informed to increase the success of treatment and reduce the burden on caregivers.

Keywords: Deep Brain Stimulation, Caregiver Burden Scale, Post-treatment process

OP-07

SPECIFIC PROGRAMMING OF MOTOR AND SPEECH FUNCTIONS TO IMPROVE STIMULATION-INDUCED DYSARTHRIA IN DBS CASES

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INTRODUCTION: One of the side effects of deep brain stimulation in movement disorders is stimulation-induced dysarthria. In our study, we aimed to discuss the results of alternative programming for speech and movement in patients who had improvement in motor functions after stimulation but suffered from speech impairment.

MATERIALS AND METHODS: Stimulation-induced dysarthria was observed in one essential tremor patient and in one Parkinson's patient during post-DBS programming. The patients each received two different DBS settings, one to improve motor function and the other to improve speech skills, and their motor and speech functions were evaluated under both settings.

RESULTS: The first patient (52, M) underwent bilateral Vim and posterior subthalamic area targeting using a single lead on each side. The second patient (56, M) had bilateral STN stimulation. Both cases reported better motor functioning but reduced speech intelligibility at relatively higher voltage settings. Both cases were professionals who needed to communicate on the phone while at work. In order to improve their quality of life, the cases were offered two different programming options, one to improve speech intelligibility and the other to improve movement skills. At the end of the one-month follow-up period, the first case reported that he switched

between programs to facilitate his daily activities, but the second case reported that he continued with a single program despite partial deterioration of speech.

CONCLUSION: Stimulation-induced dysarthria is an undesirable effect of DBS that negatively affects the social skills of the patients. Patients' quality of life can be improved by independently improving their speech and motor skills with alternative stimulation parameters.

Keywords: deep brain stimulation programming, movement disorders, dysarthria

OP-08

GPİ DEEP BRAIN STIMULATION FOR CERVICAL DYSTONIA

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Cervical dystonia is characterized by involuntary contractions of the cervical muscles. Cervical dystonia is the most common focal dystonia in adults. The globus pallidus internus (GPi) has been the primary target of deep brain stimulation (DBS) to treat severe drug-resistant dystonia. Some patients with primary cervical dystonia may not respond adequately to GPi stimulation. In these patients, Subthalamic nucleus DBS and VIM DBS may provide an alternative option for the treatment of Cervical dystonia. Our aim in this study is to present the 1st Year results of 3 Cervical Dystonia patients for whom we targeted GPI.

In this study, we analyzed the effect of bilateral GPI DBS on three patients with primary cervical dystonia refractory to medical therapy. The severity of dystonia was measured preoperatively using the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) and was followed up at 1, 3, 6, and 12 months postoperatively. Any changes in mental status were recorded using the Mini Mental State Examination (MMSE) score. GPI DBS was well tolerated by all patients with no side effects. All patients had an improvement of over 80% in their overall TWSTRS score at the end of the 1st year. No mental deterioration was observed in any patient.

As a result of 1-year follow-up, GPI DBS can be considered an effective procedure, especially in severely affected patients with primary cervical dystonia.

Keywords: Cervical dystonia, globus pallidus internus, focal dystonia

OP-09

BURDEN OF HARDWARE INFECTION IN DEEP BRAIN STIMULATION SURGERY

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BACKGROUND: Hardware infection in deep brain stimulation surgery is a devastating complication, that often requires multiple surgical interventions sometimes leading to explantation of the system and despair in the afflicted patients and their families.

OBJECTIVES: We aimed to evaluate the salvage methods and their efficacy in managing surgical cite infections before deciding explantation of the system.

METHODS: Among 112 patients who underwent DBS surgery by the same neurosurgeon between 2012 January and 2024 January, 6 hardware infections were detected (5.35%). Multiple salvage procedures including abscess drainage via subcutaneous puncture (n=4), primary repair of the dehiscent skin or scalp (n=5) all accompanied by antibiotics according to the antibiotic susceptibility tests where available, and finally complete removal of the hardware (n=2).

RESULTS: Of 6 patients, 4 had multiple (2-4) interventions where 2 of them eventually had explantation surgery. 2 of 6 patients benefited from abscess drainage accompanied by antibiotic regimen for hardware infection, solely. One of the patients who underwent explantation surgery had meningitis and had his treatment in the intensive care unit for ten days, but did not require intubation. One month after the completion of his treatment, he had reimplantation surgery and his postoperative course was uneventful.

CONCLUSION: Infections following DBS surgery incur severe burdens in terms of hardware supply, hospitalization and concurrent multiple surgical salvage interventions. According to our experience, early diagnosis and launching prompt salvage methods yield satisfactory results.

Keywords: Deep brain stimulation, infection, explantation, burden, complication

OP-10

DEEP LEARNING AND ARTIFICIAL INTELLIGENCE BASED STEREOTACTIC PLANNING SOFTWARE

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INTRODUCTION: Many functional surgical procedures, especially brain biopsy and deep brain stimulation surgery, can be performed with low mortality rates with the aid of stereotactic softwares. However, there is a 0.1-5% risk of intracerebral bleeding in stereotactic procedures. In addition, determining the appropriate trajection is a process that in some cases takes serious time and requires significant experience.

PURPOSE: In this study; The aim is to create an automated stereotactic software, unique in the world, that enables the determination of the most reliable surgical trajection within seconds using deep learning and artificial intelligence technology, using advanced engineering techniques.

METHOD: Classical stereotactic softwares were examined and it was seen that all of them had two sessions and manual planning. Without MRI-CT fusion, visible anatomical structure detection and verification stages in the classical system, subjective processes in our study were automated with artificial intelligence and deep learning architectures (Figure 1). Eloquent areas, vascular structures and ventricular anatomy were segmented and introduced to the software (Figure 2). During the planning phase of the images, the surgical trajectory with the lowest risk score was automatically calculated (Figure 3). The risk score of a tragedy is obtained by combining two risk values (geometric and structure) in a certain ratio. Geometric risk was calculated with the information on trajection length, skull bone thickness, and similarity to the principal axis of the anatomical target. In addition, "Automated stereotactic planning" software was produced by adding 3D Slicer to each submodule.

CONCLUSION: Thanks to advanced engineering technologies such as deep learning and artificial intelligence, a highly reliable stereotactic software that is automated and reveals trajectories within seconds has been produced for the first time in our country and in the world.

Keywords: stereotactic software, functional neurosurgery, stereotactic biopsy, deep brain stimulation, deep learning, artificial intelligence

OP-11

COMPARISON OF FACIAL MOVEMENTS IN PATIENTS WITH PARKINSON'S DISEASE WHEN DEEP BRAIN STIMULATION IS SWITCHED ON AND OFF USING ARTIFICIAL INTELLIGENCE-BASED SOFTWARE

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INTRODUCTION: Facial bradykinesia is a common motor symptom of Parkinson's disease (PD). It is characterised by a reduction and slowing of facial movements affecting both the upper and lower parts of the face. The aim of this study is to compare the changes in facial movements in PD patients when deep brain stimulation is switched on and off using an artificial intelligence-based software.

METHOD: The study included five patients with PD. These patients were asked to look at the camera for 1 minute to determine the number of blinks. They were then asked to perform three blinks and three laughs to detect mimic movements. The recorded videos were uploaded to a software developed by the authors, which identified 68 specific points on the face. The software recorded the

time-dependent coordinate changes of these points, including the vertical and horizontal movements of the oral commissure and the medial part of the eyebrow, the number of blinks, the blink rate and the laugh rate

RESULT: The study included three male and two female patients who had been DBS implanted for more than two years. There were no significant differences found in the number of blinks, blink rates, laughing rates, vertical and horizontal movements of the oral commissure, movements of the upper and lower eyelids, horizontal movements of the medial part of the eyebrow when DBS was on and off. Only a significant difference was found between the vertical movement of the medial part of the eyebrow and blink rates (Refer to Table 1).

CONCLUSION: The qualitative results obtained with this software show that there is no significant change in patients with PD in a short period of time when the neurostimulator is switched on and off, except for the blink rate and the movement of the medial part of the eyebrow.

Keywords: Deep brain stimulation, Artificial intelligence, Parkinson's disease, Facial bradykinesia, Neurostimulator

OP-12

DEEP BRAIN STIMULATION AND STIGMA IN MOVEMENT DISORDER PATIENTS

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INTRODUCTION: Gait disturbance, tremor, mask face, Excessive drooling (sialorrhea) and many other symptoms can be associated with the experience of stigma in daily life in patients with movement disorders, especially idiopathic Parkinson's disease (PD). Perception of stigma is an experience with negative consequences experienced by individuals as a result of social stigma. Stigma can most commonly be defined as "the combination of components such as labeling, stereotyping, segregation, loss of status, and discrimination." DBS is a method used successfully in Parkinson's disease. The rapid improvement in patients' symptoms after the operation is encouraging. Therefore, it can be expected to reduce the patient's perception of social and internal stigma.

PURPOSE: Our study aimed to compare movement disorder patients who had DBS surgery and those who did not have DBS and were receiving medication in terms of stigma and hope levels.

METHOD: In this study, patients with movement disorders (dystonia, tremor, Parkinson's Disease) who came to the outpatient clinic were evaluated. The study sample consisted of patients who had a DBS operation and patients who did not have a DBS operation but used medication. After the patients were evaluated in terms of psychiatric diagnosis by performing a Structured Clinical Interview for DSM Disorders (SCID I), patients who did not have another chronic disease nor psychiatric diagnosis filled out the sociodemographic data form, the Turkish form of Continuous Hope Scale and the Expected Stigma in Chronic Diseases scales.

RESULT: No significant difference was detected between the two groups in terms of age, education level, gender and employment status. A statistically significant difference was found between movement disorder patients without DBS and patients with DBU ($P<0.05$). Stigma scores in patients without DBS were found to be higher than in patients with DBS.

Keywords: DBS, stigma, Parkinson's Disease,

OP-13

DUE TO LACK OF REGISTRATION, CANCELLED.

OP-14

CONVERGENT PALLIDAL NEURAL PATTERNS ACROSS GENETIC DYSTONIA SYNDROMES: SPIKING REGULARITY AND NEURAL BURSTS

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Genetic dystonia is a complex movement disorder with diverse clinical manifestations arising from pathogenic mutations in various genes. The growing body of research indicates shared pathomechanism among these genes, yet the neural dynamics facilitating this convergence in globus pallidus are largely unexplored.

We analyzed neural patterns within globus pallidus to identify shared neural dynamics underlying functional convergence across dystonia genes. We identified 1714 pallidal neurons, isolated from explorative microelectrode recordings collected during deep brain stimulation surgery, across 32 dystonic patients with mutations in AOPEP, GNAL, KMT2B, PANK2, PLA2G6, SGCE, THAP1, TOR1A, and VPS16 genes. Neural dynamics exhibited significant differences among dystonia genes. GNAL-THAP1 and SGCE-PANK2 pairs displayed variations across >70% of neural features (Mann–Whitney U-test, $P \leq 0.05$). AOPEP, PANK2, and THAP1 neurons demonstrated higher firing regularity (Mann–Whitney U-test, $P \leq 0.05$), while GNAL, PLA2G6, KMT2B, and SGCE shared a substantial fraction of bursting neurons (>26.6%), surpassing rates in other genes (one-sided Fisher Exact, $P \leq 0.05$). TOR1A and VPS16 genes constituted an intermediate group bridging these two main gene groups. Hierarchical clustering algorithms, based on these neural dynamics, validated the findings from first-order comparisons.

We observed that dystonia genes, even those without common molecular pathways, can still exhibit largely overlapping structures of neural patterns. We suggest that spiking regularity and neural bursts emerge as two primary candidates for convergent neural dynamics in the globus pallidus for genetic dystonia syndromes.

Keywords: genetic dystonia, GPi-DBS, deep brain stimulation, microelectrode recordings, pathogenesis, neural patterns

OP-15

ADVANCING PERSONALIZED ADBS: PREDICTING THE DYNAMIC NATURE OF BETA-POWER DISTRIBUTIONS

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Beta frequency activity (12-30 Hz) in the basal ganglia is crucial for functional motor and non-motor behavior [1], but it is pathologically intensified in Parkinson's disease (PD) [2]. Adaptive Deep Brain Stimulation (aDBS) based on the intensity of the beta activity of local field potentials (LFPs) of the subthalamic nucleus (STN) has emerged as an effective stimulation paradigm [3, 4]. Despite exhibiting

superior efficacy over conventional stimulation in the short-term [5, 6], aDBS faces the challenge of addressing beta power variations in time. Due to these variations, the initial aDBS parameters may become suboptimal, necessitating regular clinician involvement for recalibration.

Here, we propose a Deep Learning framework designed to forecast STN beta power distribution shifts across varying temporal scales, weeks or even days, based on previous recording history. Data were collected with the AlphaDBS device by Newronica [7], which delivers linearly amplitude-modulated current based on beta activity [6]. We found that beta power distributions exhibited a relatively extended temporal memory, as inferred through recurrent analysis of sequential daily recordings. Crucially, training efficacy was optimized when conducted separately for waking and sleep states (see Figure). Moreover, preliminary results indicate that our framework is effective in accomplishing the distributional regression task for a second patient when trained on sufficiently long recordings from a single patient. This indicates promising generalization capabilities.

Integration of the proposed algorithm with aDBS therapy appears to be feasible, thereby enhancing its efficacy as a long-term treatment strategy for PD. These results pave the way for an innovative treatment approach by providing clinicians with real-time predictions of STN beta power distributions, enabling more precise adjustments of aDBS parameters. This integration would represent a significant advancement in personalized medicine, enhancing the role of AI in supporting clinical decision-making at the point-of-care.

Keywords: aDBS, Parkinson's disease, beta oscillations, wake/sleep, Deep Learning, Artificial Intelligence

OP-16

THE APPLICATION OF MAGNETIC NANODISCS FOR NEUROMODULATION

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Deep Brain Stimulation (DBS) is a widely used neurosurgical technique involving the stereotactic implantation of electrodes to deliver targeted electrical currents to subcortical structures, primarily used for alleviating symptoms in neurological disorders like Parkinson's disease (PD). Despite its therapeutic benefits, challenges such as wired and permanent implants and the need for periodic battery replacements. Addressing these limitations, innovative approaches leveraging nanotechnology to develop minimally invasive and wireless neuromodulation techniques have been explored. One promising method is magnetomechanical DBS, utilizing magnetite nanodiscs (MNDs) and weak alternating magnetic fields (AMF) to induce neuronal excitation through mechanical energy.

In this study, we demonstrate that the torque of MNDs can trigger Ca2+ influx in various cell types, including HEK293, primary cortical neurons, human embryonic stem-cell-derived cortical neurons and human organotypic brain slice cultures through endogenous PIEZO1 channel activation. This stimulation leads to repeated calcium transients, suggesting the potential for generating in vivo action potentials. PIEZO1, a mechanosensitive ion channel widely expressed in the brain, was selectively stimulated by MNDs, as confirmed by experiments with PIEZO1 agonists and antagonists. In post-mortem brain tissue analysis, we observed Piezo1 and TRPV4 expression in mature subthalamic nucleus (STN) neurons in PD patients and non-demented controls. Notably, a difference in PIEZO1-positive and TRPV4-positive cells was identified between PD subtypes, specifically non-tremor dominant

and tremor dominant, aligning with the general decrease in neurons in these subgroups.

This research introduces an MNDs-based magnetomechanical approach for wireless neuronal stimulation without genetic manipulation. The endogenous expression of PIEZO1 in healthy and PD brain tissue further underscores the translational potential of magnetomechanical DBS.

Keywords: DBS, Nanotechnology, Neuromodulation, Parkinson's Disease

OP-17

SUBJECTIVE PATIENT RATING AS A NOVEL FEEDBACK SIGNAL FOR DBS PROGRAMMING

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OBJECTIVE: This study aims to evaluate the feasibility of using patients' subjective ratings as feedback for deep brain stimulation (DBS) programming.

BACKGROUND: Deep brain stimulation (DBS) is a proven therapy for alleviating motor symptoms in Parkinson's disease (PD) patients, notably tremor, rigidity, and bradykinesia. The precise placement of electrodes and personalized postoperative programming significantly influence the efficacy of DBS. Adjusting stimulation parameters post-implantation is crucial for optimizing treatment outcomes and minimizing the need for further surgical interventions. Given the time and resources involved in DBS programming, there's a need for efficient methods to adjust parameters accurately.

METHODS: In this retrospective study, 11 PD patients with STN-DBS underwent subjective visual analogue scale (VAS) scoring alongside mapping into standard space, sweet spot mapping, and connectivity analyses to determine optimal DBS settings. An independent cohort of 7 patients (227 settings) was used for cross-validation.

RESULTS: The highest VAS scores corresponded to the dorsolateral STN, aligning with established sweet spot locations. Enhanced connectivity between supplementary motor area (SMA) and primary motor cortex (M1) to the STN correlated with higher VAS scores across patients. Connectivity profiles accurately predicted clinical outcomes in the independent cohort ($R = 0.28$, $p<0.001$).

CONCLUSIONS: While further multi-center and long-term studies are necessary to validate VAS-based DBS programming, our findings support the potential of patients' subjective ratings as a valuable feedback signal for personalized DBS settings.

Keywords: Visual Sanalogue Scale, DBS, Parkinson's Disease

OP-18

DECREASED BRAIN VOLUME MAY BE ASSOCIATED WITH THE OCCURRENCE OF PERI-LEAD EDEMA IN PARKINSON'S DISEASE PATIENTS WITH DEEP BRAIN STIMULATION

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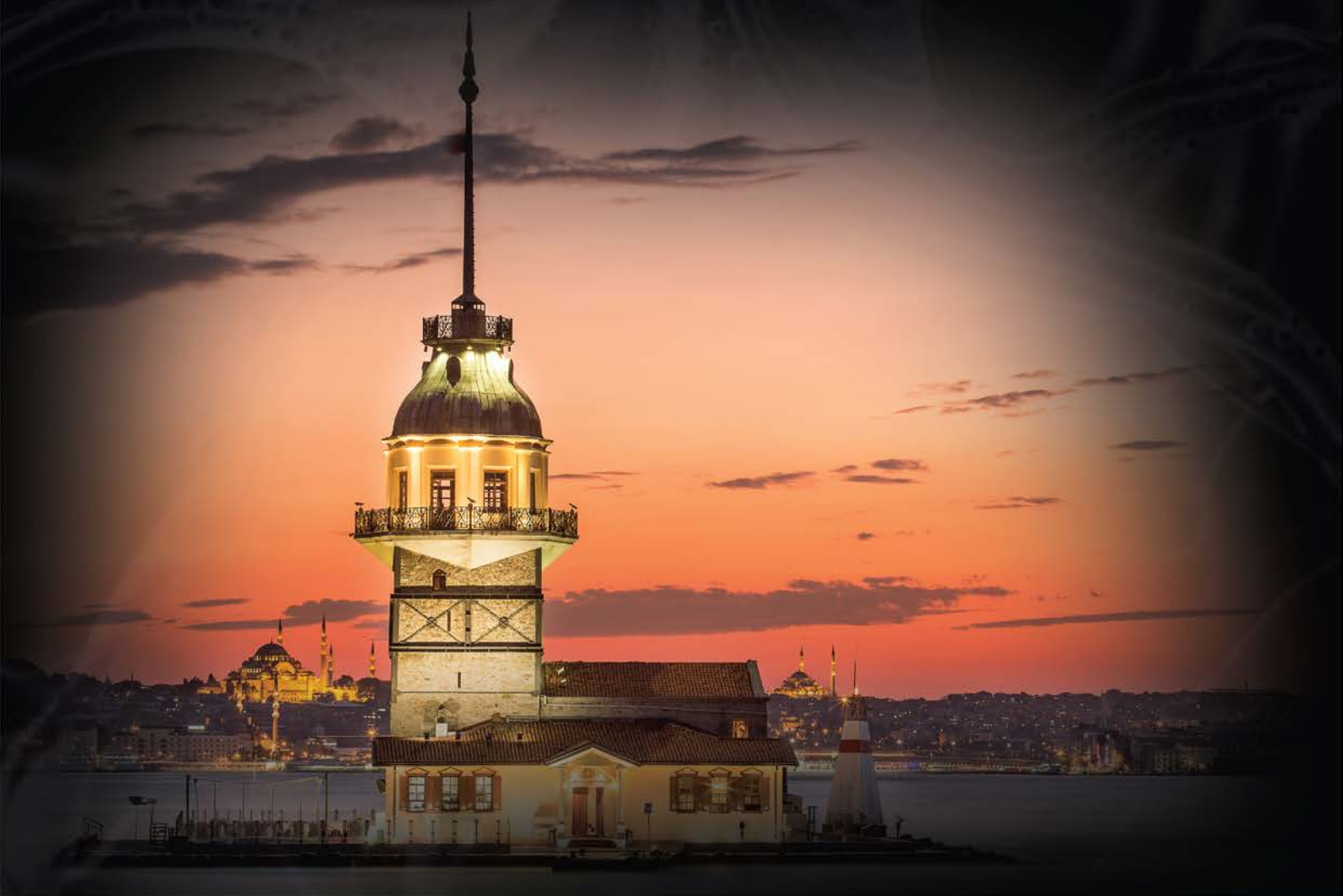
Peri-lead edema (PLE) is a poorly understood complication of deep brain stimulation (DBS), which has been described in patients presenting occasionally with profound and often delayed symptoms with an incidence ranging from

Poster Presentations



PP-01

THE DBS EFFECT IN CONTROLLING ABNORMAL MOVEMENT DISORDER AND OBSERVABLE BRAIN LESION

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INTRODUCTION: Abnormal movements can be caused by brain lesions that can be see in MRIs. CVA or continuous bleeding from cavernous angioma in the basal ganglion region can cause long term side effects of abnormal movement disorders. In almost all cases, the abnormal movement disorders is unilateral and can lead to severe disabilities in effective usefulness of limbs performance if it happens on the dominant side of the brain. Usually, many of these cases do not benefit from medical management, and require treatments similar to DBS surgery.

MATERIAL-METHOD: There were two cases with observable brain lesions in MRIs and obvious brain lesion with abnormal movement disorders that did not have benefit from medical management, but benefited from DBS methodologies. Case 1: a 40 year old male with a history of cardiac problems and a lacunar ischemic infarct in the region of left STN from 2 years prior. The patient had accumulated with severe unilateral hemibalismus, especially in his right hand. All medical management procedures failed and the patient underwent GPi-DBS. He experienced a complete recovery within 2 months after surgery. Case 2: a 32 years old female presented with unilateral arm paresis and severe arm tremors. There was a cavernous hemangioma with bleeding was seen in the thalamus in her MRI. Medial management procedures failed, and the patient candidate underwent unilateral GPi-DBS. During the follow up period, there was a significant increase in tremor control.

CONCLUSION: DBS surgery should be considered in some of the observable MRI lesions with abnormal movement disorders and, in many cases, achieves the most optimal results regarding the control of abnormal movement disorders after surgery.

Keywords: DBS, CVA, Hemibalismus, Tremor, Cavernous hemangioma,

PP-02

A VAC-14 MUTATION POSITIVE DYSTONIA CASE SUCCESSFULLY TREATED WITH BILATERAL GPI-DBS

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OBJECTIVES: Dystonia, a complex movement disorder marked by involuntary movements and abnormal posturing, poses challenges for traditional pharmacological treatments due to modest efficacy and adverse effects. However, advancements in deep brain stimulation (DBS) offer improved efficacy and safety, particularly for inherited or idiopathic dystonia while acquired dystonia and dystonia linked to neurodegenerative disorders often show less favorable responses to DBS. We aimed to share our experience in a patient with dystonia due to a rare neurodegenerative condition.

Case presentation: Here, we describe a case of progressive mixed-type dystonia in a 26-year-old woman, initially involving her right arm and gradually spreading to her neck, jaw, and right hip within a year. She also presented with hoarseness and difficulty swallowing. Neurological examination revealed various dystonic features including dysarthric speech, tongue laterotrusion, jaw opening dystonia, and dystonic postures in the neck and right hip. Genetic analysis identified a homozygous variant in the VAC14 gene, confirmed by cranial MRI showing bilateral increased basal ganglia intensity and iron deposition, indicative of striatonigral degeneration (Fig.1A). Despite unsuccessful oral medications and partial response to botulinum toxin injections, the patient underwent bilateral posteroventral globus pallidus internus (GPi)-DBS under general anesthesia (Left Gpi: x: 21, y: 5.5, z: 0; Right Gpi: x: 19.5, y: 5.5, z: 0) (Fig. 1B). Significant improvements were noted at the fifth-month follow-up, including decreased BFMDRS score from 49 to 11, reduced dysarthria and hypophonia, improved dysphagia, and amelioration of dystonic postures in the hand and neck, along with decreased dystonia in the leg.

CONCLUSION: VAC14-related dystonias, especially in the presence of brain iron accumulation, should be considered in the differential diagnosis of dystonias. Our case underscores the limited effectiveness of oral medications and supports the use of GPi-DBS in genetically confirmed dystonia and select cases of rare conditions such as VAC14-related striatonigral neurodegeneration.

Keywords: Dystonia, GPi-DBS, neurodegeneration, VAC 14

PP-03

TESTING MAGNETOELECTRIC NANOMATERIALS IN ORGANOTYPIC HUMAN BRAIN SLICE MODELS

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BACKGROUND: Deep brain stimulation (DBS), has emerged as an established neuromodulatory approach for symptom management in movement disorders like Parkinson's Disease, dystonia, and essential tremor. However, its invasiveness, need for periodic battery replacement, and associated risks underscore the necessity for safer, less invasive, and cost-effective alternatives. To address those limitations, we explore the neurostimulatory potential of magnetoelectric nanoparticles (MENPs) which might offer a less invasive alternative to contemporary DBS.

METHODS: Herein we tested the MENPs in organotypic human brain slice cultures (BSCs). Brain tissue obtained from patients undergoing resective epilepsy surgery was cultured to generate neocortical BSCs. These cultures were then transduced using AAV Retrograde viral particles derived from pGP-AAV-syn-jGCaMP7f-WPRE. Following transfection, the cultures were divided into three groups: intervention, sham, and control. The intervention and sham groups received injections of MENPs comprising BaTiO3 (coating)/ CoFe2O4 (core). Stimulation was applied to the intervention and control cultures using a custom coil system operating at 6-mT and 140-Hz AC frequency. Calcium transitions were monitored under a microscope, and pre- and post-stimulation electrophysiological recordings were conducted using a multi-electrode array. Finally, the cultures were fixed, and immunohistochemical (IHC) staining for c-Fos was performed.

RESULTS: Upon analyzing the initial findings of the study, enhanced c-Fos expression was observed in the intervention group during IHC staining compared to both the sham and control groups. Furthermore, increased calcium transitions were evident through calcium imaging in the intervention group compared to the other groups.

CONCLUSION: Our preliminary results indicate that magnetoelectric nanomaterials have the potential to stimulate neuronal activity in BSCs. Our research will continue optimize the parameters related to MENPs load and concentration as well as the stimulation parameters such as field strength, field frequency and duration of stimulation. Optimizing these parameters is crucial for the successful translation of this approach into clinical settings.

Keywords: organotypic human brain slice, deep brain stimulation, Magnetoelectric nanomaterials

PP-04

ALTERNATIONS IN THE NEUROPHYSIOLOGY OF THE SUBTHALAMIC NUCLEUS DURING OFF-MEDICATION STATE IN PARKINSON'S DISEASE PATIENTS WITH LEVODOPA-INDUCED DYSKINESIA

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Although Levodopa is the standard treatment for Parkinson's disease(PD), prolonged use of Levodopa would lead to dyskinesia, known as Levodopa-induced dyskinesia(LID). The pathophysiology of LID has been studied for long time. Several studies explored neurophysiology and found alternation in firing rate, burst discharge and neuron oscillation in basal ganglia. In addition, a narrow frequency band within 60 to 90 Hz, termed finely-tuned gamma (FTG), is found prominent in the subthalamic nucleus(STN) and was proposed as a marker for adaptive deep brain stimulation (aDBS). However, most studies focused on neurophysiology change during on-medication and dyskinesia manifestation. As PD progresses, a stable dosage of Levodopa might induce dyskinesia. This phenomenon suggests that the extent of neuron degeneration is crucial in the pathophysiology of LID. Herein, we retrospectively analyzed microelectrode recordings(MER) of the STN in patients with PD who received DBS under an off-medication state. From August 2017 to July 2021, 22 PD patients were enrolled with dyskinesia(n=11) and without dyskinesia(n=11). There was only a statistical difference in Part IV of the unified Parkinson's disease rating scale(UPDRS Part IV) among the two groups of patients. We characterized spiking properties by inter-spike interval, distinguished burst discharge through the Poisson surprise method, and calculated oscillatory activities via spike density analysis. In the dyskinesia group, we observed a significant increase in firing rate, around the twofold decline

in the inter-burst interval, and a significant increase in the raw power of both lower(30-60Hz) and higher(60-90Hz) gamma oscillation. Our results suggest that PD patients with LID exhibit a denser and more concentrated firing distribution, and the higher raw power in gamma oscillation is a good marker in aDBS. Ultimately, our study revealed that PD patients with LID might have a more severe condition of neuron degeneration with alternation in neuron firing, bursting, and oscillation.

Keywords: Parkinson's disease, Levodopa induced dyslinesia, Microelectrode recording, Subthalamic nucleus

PP-05

A NOVEL APPLICATION UTILIZING DIGITAL PEN AND TABLET FOR QUANTIFYING TREMOR SEVERITY

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Assessing tremor severity to determine the optimal electrode position in DBS surgery traditionally relies on subjective visual observation. Many proposed quantitative methods require additional sensors or smartphones, presenting significant drawbacks. Our innovative application uses a digital pen with a touch screen tablet, providing a practical solution for evaluation of action tremor during surgery.

We conducted an initial evaluation on four patients undergoing DBS therapy for Essential Tremor. Pen traces recorded during a ballistic movement task were analyzed to derive metrics from both the time and frequency domains. Additionally, accelerometry was recorded in parallel for two of the patients. We compared metrics across three conditions: Optimal DBS, Suboptimal DBS, and Off DBS.

As anticipated, significant differences were observed between Off DBS and the other conditions across all metrics evaluated. Effect sizes (Cohen's *d*) for these differences were large, ranging from 0.72 to 2.96. The largest effects were observed for root-mean-square pen trace acceleration and average pen pressure. Notably, these metrics also differed significantly between Suboptimal and Optimal DBS conditions, with an effect size of 0.85 for root-mean-square and 1.7 for pen pressure. There was a strong correlation between root-mean-square acceleration of the pen and hand (r =.77), as well as between the pen and wrist (r =.75).

Our findings provide preliminary evidence that commercial touch screen tablets with pen input can efficiently measure and quantify the effects of DBS on tremor suppression in real-time. Such devices could be readily employed in an intraoperative setting. By enabling automated tremor quantification, our software allows for tracking tremor state within a time frame of seconds, a significant improvement over the time scales associated with traditional clinical ratings. An intriguing avenue for further exploration lies in assessing whether our software could facilitate automated or closed-loop DBS programming for tremor management.

Keywords: tremor, tablet, digital outcome measures, automated programming

PP-06

EFFECT OF ANT-MAMMILLOTHALAMIC TRACT DBS ON SEIZURE FREQUENCY REDUCTION IN REFRACTORY EPILEPSY

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BACKGROUND: Deep Brain Stimulation (DBS) is a neurosurgical procedure that involves the implantation of depth-electrodes into specific regions of the brain, and it is aimed at modulating neural activity and relieve symptoms associated with neurological disorders. DBS of the anterior nucleus of the thalamus (ANT-DBS) has been established as an effective treatment option for drug-refractory epilepsy patients. Here we present the follow-up data of our institutional series of ANT-DBS treated epilepsy patients.

METHODS: Retrospective cohort-study. We analyzed a selection sample of 27 drug-refractory epilepsy patients that underwent ANT DBS surgery in the last 9 years.

RESULTS: The cohort consisted of 9 females and 18 males, with a median age of 39 years. 25 patients had focal epilepsy, 1 multifocal and 1 generalized epilepsy with 18 of them presenting with tonic-clonic seizures. As previous treatment, 20 of them had a Vagus Nerve Stimulator (VNS), 1 had a Temporal Lobe Resection (TLR), and 1 had VNS as well as TLR. With and average follow-up of 42.5 months, 20 patients had a median seizure reduction of 48,6% with 4 of them seizure free, 6 patients had no seizure reduction, and one of the patients experienced an increased seizure frequency.

CONCLUSIONS: DBS of the anterior nucleus of the thalamus (ANT-DBS) is an effective treatment option for some patients in our own institutional series. More research is still needed to optimize the use of ANT DBS in epilepsy, the current evidence suggests that it can be an effective treatment for patients with drug-refractory epilepsy.

Keywords: Epilepsy, Refractory Epilepsy, DBS, ANT-mammillothalamic tract, Seizure Frequency Reduction.

PP-07

MAGNETOELECTRIC NANOPARTICLES FOR WIRELESS DBS IN A MOUSE MODEL OF PD

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Deep brain stimulation (DBS) is a long established surgical treatment option for symptomatic relief of Parkinson's Disease (PD) patients. The procedure involves an invasive craniotomy and costly materials aimed at targeting the basal ganglia with wired electrodes, connected to a pulse generator and battery, which are implanted under the skin. Common complications of DBS include displacement and poor targeting within the desired target area due to the large size of the conventional electrodes. In this project, we used magnetoelectric particles (MENs) as a substitute electrode for DBS in a mouse model. Based on previous positive results in naïve mice, we now stimulated a 6-hydroxidopamine (6-OHDA) PD mouse model in an attempt to alleviate some of the landmark motor symptoms of this model. Additionally, we also studied the long-term effects and retention of the MENs in vivo. Naïve and parkinsonian mice were implanted with the MENs before undergoing magnetic stimulation and a battery of behavioral tests to measure motor features. Brains were extracted at the end of the study to analyze the extent of the stimulated area, and to study the retention and long-term effects of MENs in living tissue. Histology revealed that some of the MENs used were improperly manufactured and were not electrically active, resulting in under powering of the behavioral data to determine if an alleviation of PD symptoms occurred. Analysis for long-term retention and local effects showed no significant damage or dispersion of the MENs at the target site after 18 months.

Keywords: Magnetoelectric Materials, deep brain stimulation, Parkinson's Disease

PP-08

THE ROLE OF THE SUBTHALAMIC NUCLEUS IN DECISION-MAKING AND REWARD PROCESSING

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Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is a standard treatment method for improving Parkinson's disease (PD) motor symptoms. However, the effects of DBS on cognition and behavior are less clear. To evaluate and improve this existing treatment option and its potential side effects, such as impulsivity and apathy, it is of high importance to disentangle the neural mechanisms of decision-making and reward processing in the STN. For this purpose, we plan to record neural activity in the STN using the Medtronic percept while PD patients perform two different cognitive tasks. With these experiments, we aim at capturing different previously proposed mechanisms of STN influence on reward processing and decision-making. In a first task, we want to evaluate the neural mechanisms of processing different types of rewards and punishments. Participants will be asked to imagine receiving a specific reward or punishment and to give a rating concerning subjective valence and arousal of this outcome. In a second task, we aim at studying the mechanisms of impulsiveness in PD patients when responding to a

difficult information integration and decision-making task. In an adapted weather prediction task, participants first learn a category associated with a stimulus to later predict a category for a combination of multiple stimuli. The behavioral outcomes, such as average ratings, reaction time and correct response-rate, will be correlated to the UPDRS scores for impulsivity and apathy to validate the direct link to these disorders commonly associated with PD. By analyzing the neural correlates of these tasks, we hope to gain further insights into the processes of decision-making and reward processing as well as potential behavioral and cognitive effects of DBS.

Keywords: STN, decision-making, reward processing, Medtronic percept, EEG

PP-09

THE EFFECT OF DIFFERENT STIMULATION FREQUENCIES OF STN DBS ON GAIT AND DUAL-TASK WALKING IN PARKINSON'S DISEASE

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Parkinson's disease (PD) is a common neurodegenerative disorder with the cardinal symptoms of rest tremor, rigidity, and bradykinesia. Besides the motor symptoms, patients with PD also suffer from various non-motor symptoms, including cognitive dysfunction, thought to be related to the widespread PD pathology (alpha-synuclein) and the involvement of other neurotransmitters besides dopamine. Dual-tasking (DT), the ability to perform two tasks simultaneously, is crucial for daily functioning. Motor and cognitive dysfunction contribute to impaired dual-tasking in PD. Despite being a standard treatment for PD, the impact of deep brain stimulation (DBS) on gait, dual-tasking (DT), and the optimal parameter settings to treat these symptoms remain inconclusive. Therefore, this study explores the effect of high-frequency (HF)-130 Hz and low-frequency (LF)-60 Hz DBS on gait parameters during usual walking and DT walking in PD. Twelve PD patients with bilateral subthalamic nucleus (STN) DBS were recruited in this study. DBS amplitude was universally set at 3 V, and the pulse width at 60 μs. Patients were assessed in their medication "on" status. The usual gait and DT gait analysis were performed twice in each patient, with the second assessment performed 30 minutes after adjusting the DBS to another frequency. The main outcomes were analyzed using the Wilcoxon sign-ranked test. The statistical significance level was set at $p \leq 0.05$. During usual walking, we found that stance time on the less affected side and the step length variability on the more affected side were shorter and smaller during LF stimulation compared to HF stimulation, respectively. During cognitive DT walking, LF DBS had a better effect on step length on both sides and smaller step length variability on the less affected side. Our study suggested that LF DBS may have a better effect than HF DBS on treating gait difficulty and DT walking in PD.

Keywords: STN DBS, dual-task walking, Parkinson's disease

PP-10

DEEP BRAIN STIMULATION FOR COMPLEX TREMORS

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OBJECTIVE: Symptomatic tremors associated with non-Parkinsonian and non-essential tremor, constitute a great challenge for the physicians. Deep brain stimulation (DBS) of various targets offer promising results for alleviating tremor caused by various inflammatory (e.g. multiple sclerosis), neurodegenerative (e.g. Wilson disease) and other miscellaneous conditions. The aim of this study is to present surgical treatment strategies addressing symptomatic tremor in relatively rare indications.

METHODS: We conducted a retrospective review of clinical and radiological data for 14 patients who had severe tremor and been surgically treated with DBS between 2012 and 2023. Demographic data, preoperative disease duration, surgical targets, pre-operative and post-operative Fahn-

Tolosa-Marin Tremor Rating Scale (FTMTRS) scores and follow-up duration were noted.

RESULTS: In the study, there were 14 patients, of which 7 were female. Avarage age of patients at the time of treatment was 42.4±10.1 years. Avarage duration of symptoms before surgery was 8.2±7.3 years. The causes of tremor varied among the participants: multiple sclerosis was identified in 6 patients, Wilson's disease in 2, ischemic stroke-related brain injury in 2, dystonia in 2, traumatic brain injury in 1, and hemorrhagic brain injury in another patient. Surgical targets included, Vim, Vop, PSA and GPi. Avarage improvement of tremor assesed with FTMTRS was 63.1±16.8%.

CONCLUSION: This study demonstrates the potential of DBS as a significant therapeutic option for patients with severe, symptomatic tremors stemming from a variety of non-Parkinsonian and non-essential tremor conditions. Achieving a remarkable improvement in tremor severity underscores the procedure's effectiveness across diverse patient profiles and tremor etiologies, including multiple sclerosis, Wilson's disease, and various forms of brain injury. The selection of surgical targets, such as Vim, Vop, PSA, and GPi, exhibit the personalized nature of DBS therapy, allowing for tailored treatment plans that address the unique challenges presented by each case.

Keywords: DBS, multiple sclerosis, wilson's disease, dystonic tremor, complex tremor

PP-11

RELATIONSHIP OF PATIENT SELF-REPORTED DIARIES AND WEARABLE INERTIAL SENSORS IN PARKINSON'S PATIENTS WITH AN ADAPTIVE DBS SYSTEM

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Wearable inertial sensor based medical devices to quantify motor symptoms in Parkinson's patients now are widely available.

Adaptive deep brain stimulation (DBS) is also under intense investigation for the treatment of Parkinson's disease. Adaptive DBS automatically adjusts stimulation amplitude throughout the day by measuring local field potentials (LFP) that correlate with symptoms. The primary aim of adaptive DBS is to reduce motor fluctuations. Long term motor fluctuation reduction data is not widely available and largely dependent on qualitative assessments. Wearable sensors hold the promise to quantify motor symptoms in the real-world setting, and to measure specific activities of daily living (walking, rest, etc.).

Here we report data evaluating validated patient self-reported diaries, inertial sensor data and chronic local field potentials (LFP) recordings in patients receiving adaptive DBS or conventional DBS of the subthalamic nucleus in a feasibility study.

"Good on time without troublesome dyskinesia" (GOT) from patient diaries was used as "ground truth" of the clinical benefit of aDBS or cDBS, and compared to longitudinal inertial sensor as well LFP measurements to identify correlations between the clinical and sensor data.

Patients treated with adaptive DBS reported an increase in "Good On time without troublesome dyskinesia" when compared to conventional DBS. Wearable inertial sensor-based symptom stratification confirmed symptom improvements. Continuous beta power tracking from LFP recordings showed distinct patterns during daytime and nighttime, and med ON and med OFF periods, and while adjusting DBS stimulation amplitude proportionally to LFP beta power.

Future sensor and adaptive DBS research should focus on the detection and treatment of a broader spectrum of symptoms such as gait, falls and quality of life. Wearable sensor and LFP data integration potentially will improve DBS patient management, validate future biomarkers, and lead to better closed loop DBS algorithms.

Keywords: adaptive deep brain stimulation, aDBS, inertial sensors, Parkinson's, Local field potentials

PP-12

APERIODIC SPECTRAL COMPONENT AS A POTENTIAL NEW MARKER AND INPUT SIGNAL FOR ADBS

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OBJECTIVE: New stimulation devices enable to record and analyze the local field potentials (LFPs) anytime, even during the deep brain stimulation therapy (DBS). The aim of our work was to study individual differences in LFPs, their evolution in time and to evaluate the influence of DBS on parameters of aperiodic spectral component, which has become recently an increasing focus of research interest.

METHODS: LFP were recorded from the subthalamic nucleus (STN) in Parkinson´s disease patients (PD) (n=16) during a simple experimental paradigm that included 5 minutes of resting state and a short gait during DBS „off" and „on" conditions („off" medication). Classical spectral analysis was performed using Fast Fourier Transform (FFT). In subset of the patients the progression in time could be already evaluated analyzing control measurement after one year. Finally, the analysis of the aperiodic component was performed by fitting oscillations and one-over-F (FOOOF) approach.

RESULTS: Typical beta power peaks, that represent a well-known correlate of PD main motor symptoms could be detected in the majority of our group of patients.. Moreover, the frequency slowing of beta peak was detected in some cases comparing baseline and control measurement. Aperiodic slope and offset were significantly modified by DBS (p=0.0003 and p=0.001) tested by Wilcoxon signed rank test.

CONCLUSION: Beta power sensing is a well-established method in the DBS field, but has its limitations in the clinical practice. Evaluation of the aperiodic component in LFPs has the potential to better reflect the pathological activity of the neuronal network and might serve as a new clinical marker for adaptive DBS in the future.

Keywords: adaptive DBS, aperiodic spectral component, LFP, STN, Parkinson's disease

PP-13

NONINVASIVE ELECTRICAL STIMULATION AS AN APPROACH FOR THE OPTIMAL DBS TARGET SELECTION

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INTRODUCTION: Temporal Interference stimulation (TIS) is a novel non-invasive brain electrical stimulation technique that has a potential to reach small size deep brain regions. The approach utilizes two high frequency signals (>1kHz), which constructively interfere to create low frequency envelope modulating the target structure. The main goal of this pilot work was to verify the capability of TIS to focus the subthalamic nucleus (STN) and to study the effect of TIS on the pathological beta oscillations in Parkinson's disease.

METHODS: Implanted leads for deep brain stimulation (DBS) were temporally externalized to register local field potentials (LFP) in 4 patients with Parkinson's disease indicated for DBS therapy of subthalamic nucleus (STN). TIS was performed by 2 pairs (f1 = 9.00kHz; f2 = 9.13kHz, 2mA per pair max.) of scalp electrodes placed in frontoparietal regions to focus the maximum of 130Hz interference envelope into the motor part of the STN.

RESULTS: The maximal amplitude of 130Hz envelope was localized in the motor part of STN. The comparison of the reference LFPs and recordings after TIS and after conventional DBS 5 minutes sessions showed substantial suppression of beta power peak after both types of stimulation in all patients. Moreover, the power of 130Hz envelope was significantly ($p<0.05$) anticorrelated with pathological beta activity during TIS in three patients.

CONCLUSION: This pilot testing confirmed that TIS is capable to effectively focus STN. The power increase in 130Hz envelope corresponds to the decrease of the pathological beta activity in STN during TIS. Next steps are to verify these

results on larger group of subjects and to test the effect in other stimulation targets. Great challenge for the future is the usage of TIS for the testing of the responsiveness on various targets before DBS treatment.

Keywords: DBS target, Parkinson's disease, TIS, LFP

PP-14

NEURAL PROPERTIES OF THE MEDIAL GENICULATE BODY OF THE THALAMUS IN HUMAN USING INTRA-OPERATIVE MICRO-ELECTRODE RECORDINGS DURING DEEP BRAIN STIMULATION

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Deep brain stimulation (DBS) has emerged as a promising therapeutic venue for alleviating tinnitus, a condition characterized by the perception of sound in the absence of an external stimulus. A potential target for DBS is the medial geniculate body (MGB) of the thalamus. The MGB is in a key position of the tinnitus network and tonotopically organized. Tinnitus induced in rats led to different sustained- and stimulus-induced response properties in MGB neurons. Here, we aim characterize the neural firing properties of MGB neurons in humans and their response to auditory stimuli. In a total of four patients, micro-electrode recordings were conducted during an awake stereotaxic surgery for the implantation of DBS-electrodes in the MGB. Recordings were performed in steps of 0.5mm, after baseline recordings. In patients 2-4, external auditory stimuli were presented using in-ear headphones. Auditory stimuli were 200ms white noise bursts or 50ms random 3-tone chord beeps, with frequencies covering the entire audible range. We found both excitatory and inhibitory responses to white noise bursts. Inhibitory responses were followed by a positive off response. Chord beeps led to strongly locked neuronal activity. We found evidence of highly specific frequency tuning of single-cell neuronal responses. This study advances our understanding of MGB neural dynamics and their implications for tinnitus management. By delineating firing patterns and responsiveness to specific auditory stimuli, insights into MGB subdivisions and lead placement optimization in tinnitus patients are gained. Ultimately, these findings may inform tailored DBS interventions, offering targeted relief, and improving the quality of life for individuals suffering from tinnitus.

Keywords: tinnitus, deep brain stimulation, medial geniculate body, micro-electrode recordings, auditory stimuli

PP-15

FEASIBILITY OF COMBINING REMOTE PROGRAMMING AND REMOTE MONITORING TOWARDS A CLOSED LOOP DBS SYSTEM

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BACKGROUND: Deep Brain Stimulation (DBS) is an effective therapy for Parkinson's disease (PD). However, it is currently applied in an open loop fashion and symptom management relies on iterative programming. In clinical practice, this may pose geographic and financial obstacles to patients and their caregivers, as well as translate to suboptimal clinical outcomes. The future of this field is trending towards a closed loop system. Thus, we here aim to combine remote monitoring and programming to identify specific sensor signals that correlate with DBS programming and symptom profile changes.

METHODS: Ten subjects undergoing STN-DBS implantation for the treatment of PD with the Abbott Infinity DBS system were included. Kinematic data of tremor and dyskinesia was collected using a smartwatch. In addition, the MDS UPDRS-III was collected remotely, together with other surveys regarding quality of life (PDQ-8), caregiver burden (ZARIT-12) and satisfaction with remote programming. Remote programming was administered using the Abbott

Neurosphere Virtual Clinic platform.

RESULTS: The study is currently in data collection phase, with currently preliminary results from nine patients. Postoperatively, 46% of the DBS-finetuning appointments were remote. All of the 31 remote programming sessions were initiated and completed successfully, without any remote-care related adverse events. Both patient (88%) and clinician (84%) satisfaction with remote programming was high. At 6-months postoperatively, the MDS UPDRS-III scores improved by 41% and the levodopa equivalent dose decreased by 56%. Remote programming decreased both time (322 min ± 181 min) and financial (55 € ± 44 €) expenditures. Compliance with remote monitoring was high, both before (110%) and following surgery (83%).

CONCLUSION: Remote programming is a safe, feasible and clinically effective option to complement physical appointments during the DBS-finetuning phase. Moreover, remote programming is associated with both high patient and clinician satisfaction, as well as decreased burden for patients and their caregivers.

Keywords: DBS, telemedicine, remote, programming, monitoring

PP-16

BETA POWER SLEEP-WAKE MODULATION IN PATIENTS WITH PARKINSON'S DISEASE AND CONVENTIONAL OR ADAPTIVE DEEP BRAIN STIMULATION

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Increased beta power oscillations in the subthalamic nucleus (STN) are a pathological hallmark of Parkinson's disease (PD). However, their physiological contribution to motor and non-motor tasks is still poorly understood. Suppression of subthalamic beta power oscillations during sleeping time has been described in PD patients both in off-stimulation and under conventional deep brain stimulation (cDBS), making it a potential biomarker for novel adaptive DBS paradigms (aDBS). However, the impact of cDBS and aDBS on sleep-wake subthalamic beta power fluctuations in PD is still not clear and may influence the clinical benefit of DBS differently in the two modes. We acquired subthalamic local field potentials (LFP) in eight patients with idiopathic PD and implanted with the AlphaDBS device (Newronika SpA). This device can operate in either cDBS, with constant stimulation parameters, or aDBS, adjusting the current amplitude linearly with respect to subthalamic beta power. Patients were recorded consecutively for ten days in both stimulation modes, i.e. cDBS and aDBS, and with unchanged drugs doses. We calculated the amplitude of the STN-LFPs in a patient-specific frequency range centered around the most prominent beta peak with 1-minute resolution and analyzed its distribution separately for the sleeping and waking time. Two patients out of eight showed a consistent reduction in subthalamic beta power during sleeping compared to waking hours with both stimulation modes (median reduction of 23% and 12% in cDBS and 20% and 14% in aDBS). For all other patients, beta power reduction was less than 10% in both cDBS and aDBS. In all cases, sleep-wake beta power modulation did not differ between stimulation modes. Our preliminary data show a patient-specific modulation of subthalamic beta power during sleep-wake with comparable impact of cDBS and aDBS, supporting the use of this biomarker for future aDBS paradigms.

Keywords: Parkinson's disease, adaptive deep brain stimulation, subthalamic nucleus, local field potential, beta power, sleep-wake

PP-17

FOCAL DYSTONIA AND DBS

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INTRODUCTION: Focal dystonia, is a neurological condition that affects a muscle or group of muscles in a specific part of the body. There are many different types of focal dystonia, each affecting a different region of the body. Areas of the body that can be affected include: Neck (cervical dystonia), Eyelids, Jaw or tongue (oromandibular dystonia), Voice box and vocal cords(laryngeal dystonia), Hand and forearm.In

this presentation we will share our DBS experiences on these patients.

MATERIAL: We have totaly 34 dystonia patients treated with DBS including generalized and focal segmental dystonias.6 of the patients have oromandibular dystonia, 9 of them have cervical dystonia an one patient have meige syndrome. We could not analyzed the effect of DBS on these cases with BFMDRS because of some technical and procedural reasons. Mean follow up duration was 60month (Between 108 and 11 month). Our target was Gpi for all cases.

RESULTS: Early Clinical improvement has been started 4 months after DBS. But ıt is dfficult to give an avarage and statistical improvment time for this group, because each cases have dfifferent clinics.We will share our video record of our patients for evaluation.

Keywords: Focal Dystonia, DBS, GPi, muscle

PP-18

OCD AND CERVICAL DYSTONIA TREATMENT IN ONE TARGET IN THE SAME PATIENT

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A patient with a thirty-year history of Obsessive-Compulsive Disorder (OCD) and, additionally, the onset of cervical dystonia symptoms eight years ago applies to our department. In August 2023, the patient underwent Gamma-Knife radiosurgery at the ALIC for OCD symptoms. Despite the absence of improvement in symptoms during follow-up, bilateral deep brain stimulation (DBS) was administered to the anterior part of the subthalamic nuclei in January 2023. Preoperative assessments indicated TWSTRS scores of 20/35 and Y-BOCS scores of 38, whereas postoperatively, there was a significant regression in scores, with TWSTRS decreasing to 9/35 and Y-BOCS diminishing to 22.

Keywords: Obsessive-compulsive disease, dystonia, deep brain stimulation, subthalamic nuclei

PP-19

NEUROINFLAMMATORY MECHANISMS BEHIND PARKINSON'S DISEASE

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Parkinson's disease (PD) is the second most prevalent neurodegenerative disorder worldwide, predominantly affecting the elderly. Besides aging, the pathophysiological development of PD is influenced by a mix of environmental, idiopathic, and genetic factors. Notably, less than 10% of PD cases have a familial origin, with the majority being idiopathic and largely linked to environmental factors.

While the histopathological changes in Parkinson's disease (PD) are well-documented, the precise pathophysiological mechanisms driving these alterations remain incompletely elucidated. However, emerging evidence highlights the role of neuroinflammation in disease progression, triggered by activated microglia due to aberrant accumulation of toxic α-synuclein. This underscores mitochondrial dysfunction and involvement of both innate and adaptive immune systems, including uncontrolled microglial activation, release of proinflammatory mediators such as cytokines, nitric oxide, and reactive oxygen/nitrogen species, heightened autoreactive T lymphocytes in the peripheral nervous system, and increased antigen-presenting cells and MHC II complexes in both peripheral and central nervous systems. Viral infections have also been implicated in the degeneration of dopaminergic neurons.

Understanding neuroinflammatory mechanisms driving PD progression is crucial for developing targeted therapeutic interventions. Targeting neuroinflammation, mitochondrial dysfunction, and immune system dysregulation holds promise for novel treatment strategies aimed at halting or slowing disease progression, ultimately improving the quality of life for individuals affected by PD. Further research into the specific molecular mechanisms underlying neuroinflammation in PD is warranted to uncover potential therapeutic targets and advance the development of effective disease-modifying therapies.

Keywords: Mitochondria dysfunction, neuroinflammation, Parkinson's disease

PP-20

DUE TO LACK OF REGISTRATION, CANCELLED.

PP-21

ELECTROPHYSIOLOGICAL INSIGHTS INTO PARKINSON'S DISEASE PROGRESSION: A STUDY OF SUBTHALAMIC NUCLEUS AND SUBSTANTIA NIGRA PARS RETICULATA ACTIVITY IN DEEP BRAIN STIMULATION PATIENTS

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Parkinson's disease (PD) is a progressive neurodegenerative disorder that originates from diminished dopaminergic signaling in the substantia nigra pars compacta (SNc), thereby disrupting motor circuitry in the basal ganglia. The subthalamic nucleus (STN) is a preferred target for deep brain stimulation (DBS) due to its crucial role in alleviating PD motor symptoms. There is substantial evidence regarding abnormal STN activity in animal models of PD and PD patients. Besides, substantia nigra pars reticulata (SNr) is crucial in basal ganglia circuits, making it interesting to characterize SNr activity in different PD stages. However, to our knowledge, there was only one human study in which an increased firing rate of the STN was found in the advanced stage of PD. Hence, we retrospectively analyzed microelectrode recordings (MER) of the STN and SNr in PD patients who received DBS. From August 2017 to July 2021, 40 PD patients were enrolled with Hoehn and Yahr stages 4 (H&Y 4, n=20) and Hoehn and Yahr stages 3 (H&Y 3, n=20). There were only statistical differences in Part III and the total of the unified Parkinson's disease rating scale (UPDRS) among the two groups of patients. Neuron spikings were characterized by inter-spike interval (ISI), bursting patterns were distinguished through the Poisson surprise method, and oscillatory activities were calculated via spike density. In the H&Y 4 group, the STN exhibited a significant decrease in the coefficient of variation of ISI and a significant increase in spectrum power of higher frequency (>13Hz). Likewise, in the SNr of the H&Y 4 group, there were significant increases in both the firing rate and burst index, along with a significant decrease in the pause index. Our results implied a tendency toward high-frequency firing in STN and SNr with PD progression and provided more human-based electrophysiological evidence on PD pathophysiology.

Keywords: Parkinson's Disease, Pathophysiology, Subthalamic nucleus, Substantia Nigra Pars Reticulata, Microelectrode recording

PP-22

DUE TO LACK OF REGISTRATION, CANCELLED.

PP-23

EMERGENCY CONDITIONS IN PARKINSON'S DISEASE PATIENTS WITH DEEP BRAIN STIMULATION

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BACKGROUND: Deep brain stimulation (DBS) in Parkinson's disease (PD) is a frequently applied therapy. The target of choice is typically the subthalamic nucleus (STN). The STN has a central position in the basal ganglia. DBS of the STN allows for a substantial reduction in dopamine replacement drugs. In most clinical series, the reduction of medication is in the order of 50%. Patients can experience severe side-effects of medication reduction but also of (abrupt) cessation of stimulation. Here, we review the literature on withdrawal syndromes in patients with Parkinson's disease who have received DBS.

METHOD: A detailed search strategy was applied and papers reporting on withdrawal syndrome, dopamine, Levodopa and DBS were selected. We evaluated cases with with Deep Brain Stimulation withdrawal syndrome and Levodopa, dopamine agonists, neuroleptic malignant withdrawal syndrome. We have only included DBS cases in PD.

RESULTS: Two types of withdrawal syndrome were identified: 1. Reducing or stopping medication can result in an acute withdrawal syndrome, also referred to as Parkinsonism Hyperpyrexia Syndrome (PHS), or Neuroleptic Malignant Syndrome (NMS).

2. Stopping or interrupting of STN DBS can result in an acute DBS withdrawal syndrome.

Thus far, we have identified 21 cases of DBS withdrawal syndrome in PD patients and 4 cases of PHS in PD patients with DBS.

CONCLUSION: Our preliminary research indicates that Managing DBS withdrawal syndrome poses a clinical challenge, and strategies for tapering or discontinuing stimulation must be carefully considered. The development of guidelines and protocols to mitigate the risk of withdrawal syndrome is crucial for optimizing patient outcomes and ensuring the safe and effective use of DBS. Further research is needed to enhance our understanding of the neurobiological underpinnings of DBS withdrawal syndrome and to refine clinical approaches for minimizing its occurrence and managing its impact on patients' quality of life.

Keywords: Deep brain stimulation, emergency, withdrawal syndrome, Neuroleptic malignant syndrome, Parkinson's disease

PP-24

GAIT CHANGES FOLLOWING DEEP BRAIN STIMULATION IN PARKINSON'S DISEASE: PRELIMINARY FINDINGS

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INTRODUCTION: Deep brain stimulation (DBS) presents a promising method for managing motor symptoms in Parkinson's disease (PD). Subthalamic nucleus deep brain stimulation (STN-DBS) has been shown to improve key gait metrics, such as speed, stride length, and cadence, as well as reduce variability in lower limb movements, suggesting enhanced gait stability. However, the efficacy of DBS in resolving gait disturbances continues to be contentious, with up to 42% of PD patients receiving STN-DBS reporting a subjective worsening of their gait performance six months after the procedure despite experiencing overall motor improvements. This pilot study explores the effects of DBS surgery on various gait metrics in a PD patient, comparing outcomes in both medicated and unmedicated conditions.

METHODS: The study was carried out at the Motion Analysis Lab-KUTTAM, involving a single 48-year-old PD patient in the pilot phase. Using APDM OPAL sensors, gait analyses were conducted under four conditions: before surgery without medication (pre-op/med-off), before surgery with medication (pre-op/med-on), six months after surgery without medication (post-op/med-off), and six months after surgery with medication (post-op/med-on). Each assessment involved two 2-minute walk tests.

RESULTS: The levodopa equivalent daily dose (LEDD) decreased from 1613 mg to 940 mg. Gait speed significantly improved after surgery and was within the normative range after the operation, suggesting a return to a more typical gait speed. Similar to gait speed, stride length, and cadence significantly increased post-surgery. There was a significant decrease in the time the participant spent in the double support phase of gait post-surgery, suggesting improved balance and gait stability.

CONCLUSION: These preliminary findings suggest that STN-DBS surgery enhances several gait parameters even when the LEDD decreases significantly after surgery. However, it is important to note that these results are for a single participant and may not be generalizable.

Keywords: deep brain stimulation, gait metrics, levodopa equivalentdailydose,Parkinson'sdisease,subthalamicnucleus

PP-25

PSYCHOTIC SYMPTOMS FOLLOWING STN-DBS IN A PATIENT WITH PARKINSON' S DISEASE: PROGRAMMING STRATEGIES

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Deep Brain Stimulation (DBS) is an established treatment option in patients with Parkinson's disease (PD) with motor fluctuations and/or dyskinesias that are not adequately controlled with optimized medical therapy, or with medication-refractory tremor. Most commonly used targets

in DBS for PD are subthalamic nucleus (STN), ventralis intermediate nucleus (Vim) and globus pallidus interna (GPi). Although all three targets are shown to be almost eqully effective in alleviating the motor symptoms of PD, it is a common consensus to choose Vim in tremor dominant PD, while STN should be considered the main target if a decrease in the dopaminergic medications is required. Moreover, Gpi is a favorable target for older patients with prominent dyskinesias. We here reported a-51 years old man with15 years of PD diagnosis who had left side dominant bilateral akinetic-rigid parkinsonism with motor fluctuations, wearing off and freezing off periods under p.o. levodopa-carbidopa-entacapone 150 mg 5x/day, rasagiline qid, levodopa-carbidopa extended-release formulation 25/100 qid and amantadine 100 mg tid treatment regimen who underwent bilateral STN-DBS procedure. Monopolar review which was performed 3 weeks after surgery revealed the deepest contacts with the best therapeutic window in both sides, thus the basal settings were adjusted at the deepest contacts with 60 µs, and 130 Hz. The amplitudes were 2mA and 1.5 mA for the right STN, and left STN, respectively. Since the patient presented to the clinic with hypomania, psychosis and hallucinations after 2 weeks, we here discussed the programming strategies in psychotic symptoms related to STN-DBS in the light of literature review.

Keywords: Parkinson' s Disease, Deep Brain Stimulation, STN, Psychotic symptoms

PP-26

DUE TO LACK OF REGISTRATION, CANCELLED.

PP-27

DEEP BRAIN STIMULATION IN CHOREA-ACANTHOCYTOSIS: IS IT ALWAYS A GOOD TREATMENT OPTION?

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Chorea-acanthocytosis (ChAc) is a rare autosomal recessive neurodegenerative disease due to mutation of the VPS13A gene encoding the protein chorein. ChAc is a slowly progressive disorder that typically presents in early adulthood, and whose clinical features include chorea and dystonia with involuntary lip, cheek, and tongue biting. Seizures may be seen in due course of the disease. Since there is no curative treatment, symptomatic treatments to alleviate chorea, dystonia and additional symptoms are used in management strategies. Literature review reveals limited number of patients treated with bilateral deep brain stimulation (DBS) of the globus pallidus interna (GPi) with varying degrees of favourable outcomes. However, we here reported a- 40 years old man with ChAc with family history, suffering from generalized choreatetoid movements, tongue biting, postural instability, speech and gait difficulties and epileptic seizures who were under symptomatic treatment. Following 6 months of interval that he did not show up to his follow-up visits, he suddenly presented to our clinic with the history of GPi-DBS procedure performed in a private clinic and worsened gait, speech and balance problems despite the mild improvement in choreic movements. We here reported this case to emphasize the importance of careful assessment of each individual patient when deciding a DBS procedure, and to keep in mind that DBS may not be a favourable treatment for all patients with the diagnosis of ChAc.

Keywords: Chorea-acanthocytosis, Deep Brain Stimulation, Globus Pallidus İnterna

PP-28

THE SUBTHALAMIC NUCLEUS CONTROLS NOCICEPTIVE INTEGRATION IN THE SPINAL CORD AND REVERSE NOCICEPTIVE HYPESENSITIVITY IN PARKINSON'S DISEASE

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Pain is one of the non-motor symptoms affecting quality of life in Parkinsonian patients. More than 80% of patients suffer from pathological nociceptive hypersensitivity, which may be due to changes in the processing of somatosensory information in basal ganglia, including the subthalamic nucleus (STN). However, the underlying mechanisms are not yet defined. The aim of this study was i) to characterize the responses of STN neurons to peripheral nociceptive stimulation

under normal and pathological conditions and ii) to investigate the effects of deep brain stimulation (DBS) of the STN on nociception abnormalities and on the electrical activity of dorsal horn of spinal cord (DHSC) neurons. We used the 6-OHDA rat model of Parkinson's disease (PD). In vivo electrophysiological results have shown that STN neurons are able to detect nociceptive stimuli, encode their intensity and generate windup-like plasticity. However, these phenomena are impaired in dopamine-depleted animals. Indeed, the intensity response is altered in both subthalamic and wide dynamic range spinal neurons. Moreover, STN deep brain stimulation in 6-OHDA rats showed an improvement in mechanical and thermal allodynia compared to sham animals. This effect is mediated by descending brainstem projections leading to normalization of nociceptive integration in DHSC neurons. Our study highlights the centrality of the STN in nociceptive circuits, its interaction with the DHSC and its key involvement in pain sensation in Parkinson's disease. Furthermore, our results provide for the first-time evidence that subthalamic DBS produces analgesia by normalizing the responses of spinal WDR neurons via descending brainstem pathways.

Keywords: Parkinson's disease, Pain, Subthalamic nucleus, Deep Brain Stimulation, DREAADs

PP-29

ADVANCING EPILEPSY MANAGEMENT IN IRAN: FIRST REPORT OF DEEP BRAIN STIMULATION IMPLEMENTATION IN 5 REFRACTORY EPILEPSY CASES

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BACKGROUND: Deep Brain Stimulation (DBS) has recently gained attention for refractory epilepsy. By precisely modulating neural activity in specific brain regions, DBS has the potential to disrupt aberrant seizure circuits while minimizing side effects. With evidenced efficacy, adjustability, and potential for improving quality of life, DBS represents a valuable addition to the treatment armamentarium for refractory epilepsy.

Case Description and Outcomes: 5 Female patients (mean age: 25 years, range: 17-37) with refractory epilepsy were nominated for DBS surgery. All cases suffered generalized tonic-clonic (GTC) seizures, with 60% experiencing aura. The first case also had a history of myoclonic jerks and absence seizures. The epilepsy of patient 3 stems from Lance-Adams syndrome (LAS), which marks the first DBS placement for LAS-induced epilepsy. Seizures lasted 2-3 minutes (except case 2, lasting 10 minutes), with postictal unconsciousness lasting 2-3 minutes (except immediate recovery in case 5). Carbamazepine, levetiracetam, and clonazepam were used by the patients. Patient One also used ethosuximide. All patients underwent bilateral open-loop DBS electrode placement surgery in the anterior nucleus of the thalamus (ANT), except for patient 3 with LAS, where the electrode was placed in the globus pallidus internus (GPi). The surgery went uneventful in all cases, with no postsurgical complications, including hemorrhage and infection. 2 weeks later, the patients underwent a second surgery for battery placement, and two weeks later, the device was programmed and activated. After one month of follow-up, patient One reported some improvements in seizure frequency, and others did not report any complications. Since it usually takes weeks or months to see DBS effects, a longer follow-up is needed to evaluate the outcomes.

CONCLUSION: DBS could be considered as a safe intervention for patients with refractory epilepsy. Also, it could be considered as a safe and potentially effective intervention for the Lance-Adams syndrome epilepsy.

Keywords: Stereotactic Neurosurgery, Deep Brain Stimulation (DBS), Refractory Epilepsy, Lance-Adams Syndrome, Anterior Nucleus of Thalamus (ANT), Globus Pallidus internus (GPi)

PP-30

MAGNETOELECTRIC NANOMATERIALS ENABLE REMOTE NEUROMODULATION

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Contemporary neuromodulation techniques, such as deep brain stimulation, while highly beneficial for therapeutic use, present a multitude of challenges and risks. These rely on chronic implantation of macroscale electronics, thus include invasiveness, patient discomfort, application complexity,

and the potential for infection or injury during implantation. Considering these concerns, magnetoelectric nanomaterials have acquired significant interest in this field due to their minimal invasiveness, demonstrated ability to facilitate remote neuronal control in awake, untethered animals. This positions them as promising alternatives, offering the potential to mitigate several limitations associated with traditional neuromodulation techniques. In this study, we combine the magnetic sensitivity of magnetic nanodiscs with the piezoelectric properties of polyvinylidene difluoride (PVDF) to create a novel smart fibrous material. Our magnetoelectric composite can effectively convert the kinetic energy generated by the magnetostrictive core into electric fields on the surface under external magnetic field. The potential applications of such a material are vast and promising. We demonstrate applicability of this material for wireless motor cortex stimulation in mice. Minimal invasiveness, coupled with the ability for wireless stimulation, could greatly enhance patient comfort, and reduce the risk of complications associated with invasive procedures.

Keywords: Magnetoelectric, Nanofibers, PVDF, Wireless, Neurostimulation

PP-31

LONG-TERM REAL-LIFE EFFICACY OF CHRONIC ADAPTIVE DBS IN PARKINSON'S DISEASE: TOWARDS UNDERSTANDING PERSONALIZED STRATEGIES

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The recent availability of implantable pulse generators (IPG) with the capability of simultaneous recording of deep brain activity and delivery of stimulation moment-by-moment adapting to the patient's clinical state opened the ground to the chronic application of adaptive deep brain stimulation (aDBS) as an alternative option to conventional DBS (cDBS). The investigation of aDBS vs cDBS is currently ongoing with the twofold expectation of making aDBS commercially available and to further optimize its therapeutic potential based on personalized strategies. We now report the case of seven patients who are currently under chronic aDBS treatment, delivered through the AlphaDBS device (Newronika SpA, Milan, Italy) for at least 8 months (range 8-19 months). Patients were previously included in a one-month pilot study comparing aDBS vs. cDBS (NCT04681534) and are currently engaged in the open-label extension phase. Four patients received the AlphaDBS device during their IPG replacement procedure, while three were at their first surgery for DBS. At the end of the pilot study period, patients blindly decided on their preferred mode and continued DBS therapy. After at least 8 months, patients were asked to fill-in a three-day diary (Hauser diary). Of the seven patients involved in the pilot study, six preferred and continued with aDBS. At a median follow-up of 9 months, the mean good on time (GOT, ON time without troublesome dyskinesia) was 96% of the awake time, showing an additional 11% GOT improvement from the initial pilot study period. In addition to clinical assessments, aDBS provided benefits in speech and gait (anecdotal reports from patient, caregivers and clinicians) that will be better captured through the analysis of recorded signals. In this very long-term assessment, aDBS confirmed to be an effective treatment, with specific patient-perceived improvement that requires further investigation.

Keywords: adaptive deep brain stimulation, long-term follow up, local field potentials

PP-32

SUCCESSFUL TREATMENT OF PARKINSONISM WITH BILATERAL DEEP BRAIN STIMULATION IN A PATIENT WITH LRRK2 GENE MUTATION

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INTRODUCTION: In recent years, there have been major advances in research into molecular and genetic landscape of Parkinson's Disease (PD). However, it is still not well-defined whether the genotype influences treatment decisions in PD. Here, we present a patient with a LRRK2 mutation in whom deep brain stimulation (DBS) was applied to the subthalamic nucleus (STN).

CASE: A 58-year-old female Algerian patient with advanced PD was referred to our clinic for the evaluation of therapeutic options. Her complaints began 12 years ago with left hand tremor, stooped posture, and have been progressed over the years. Her family history was unremarkable. Once she was referred to our center, she was taking ropinirole 8 mg tablet once daily, levodopa/carbidopa 100 mg tablet six times daily, and controlled release levodopa/benserazide 125 mg tablet once daily. She was fully responsive to levodopa, but there was worsening of severe motor fluctuations with a drug response duration of only 2 hours and mild dyskinesias. Her OFF-medication examination revealed severe bradykinesia, tremors and rigidity predominantly involving left extremities, hypomimia and hypophonia. Her genetic testing revealed the heterozygous presence of LRRK2 p.Arg1441Cys variant. Since she was dependent for activities of daily living, she underwent bilateral STN DBS surgery. Her post-surgery 3-month UPDRS part III scores were markedly (nearly 70%) improved and levodopa dosage was decreased by 50%.

CONCLUSION: The applied surgery for genetic PD is rare, but the reported outcomes on DBS generally consist of good outcome except GBA mutation carriers. Although some reports show that the benefit from DBS might be limited in some LRRK2 patients, our case report shows that DBS may significantly alleviate motor symptoms in patients with LRRK2 mutations and should be considered as a treatment option.

Keywords: LRRK2 gene mutation, molecular and genetic landscape of Parkinson's Disease, parkinsonism

PP-33

SUBJECTIVE PATIENT RATING AS A FEEDBACK SIGNAL FOR DBS PROGRAMMING IN ESSENTIAL TREMOR

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Deep Brain Stimulation (DBS) is a standard treatment for medically intractable essential tremor (ET). In addition to the correct surgical device implantation, effective programming is regarded to be the most important factor for clinical outcome. While neuronal biosignals like local field potentials (LFPs) are currently explored in Parkinson's disease (PD), DBS programming remains time- and resource-intensive, emphasizing the need for novel programming strategies for accurate parameter and electrode configuration adaptation in ET. We previously proposed using patient subjective ratings via a visual analog scale (VAS) as a potential feedback signal in PD. Here, we tested the utility of a VAS for real-time DBS parameter adjustment in ET. Stimulation parameters (contact and amplitude) for VIM-DBS in ET patients (n = 13) were optimized using the patient's VAS rating. Minkowski distance (Md) compared individual parameter combinations with those from classical programming based on clinical signs. Results showed no statistically significant difference in clinical outcomes (Fahn-Tolosa-Marín tremor rating scale) between VAS-based and classical programming. Minkowski distances indicated comparable amplitude and contact selection, with VAS-based programs having significantly lower stimulation amplitudes and total electrical energy delivered (TEED). In conclusion, our data suggest that VAS-based and classical programming yield similar short-term results in ET at the expense of reduced energy consumption. While further research is needed to validate VAS-based DBS programming, our findings support using the patient's subjective rating as an additional and valid feedback signal for personalized DBS adjustment in ET.

Keywords: Essential Tremor, Visual Analogue Scale, DBS Programming

PP-34

DEEP BRAIN STIMULATION IN DISORDERS OF CONSCIOUSNESS: 10 YEARS OF A SINGLE CENTER EXPERIENCE

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Disorders of consciousness (DoC), namely unresponsive wakefulness syndrome (UWS) and minimally conscious state (MCS), represent severe conditions with significant consequences for patients and their families. Several studies have reported the regaining of consciousness in such patients using deep brain stimulation (DBS) of subcortical structures or brainstem nuclei. Our study aims to present the 10 years' experience of a single center using DBS as a therapy on a cohort of patients with DoC. Eighty Three consecutive patients were evaluated between 2011 and 2022; entry criteria consisted of neurophysiological and neurological evaluations and neuroimaging examinations. Out of 83, 36 patients were considered candidates for DBS implantation, and 32 patients were implanted: 27 patients had UWS, and five had MCS. The stimulation target was the centromedian-parafascicular complex in the left hemisphere in hypoxic brain lesion or the one better preserved in patients with traumatic brain injury. The level of consciousness was improved in seven patients. Three out of five MCS patients emerged to full awareness, with the ability to interact and communicate. Two of them can live largely independently. Four out of 27 UWS patients showed consciousness improvement with two patients emerging to full awareness, and the other two reaching MCS. In patients with DoC lasting longer than 12 months following traumatic brain injury or 6 months following anoxic-ischemic brain lesion, spontaneous recovery is rare. Thus, DBS of certain thalamic nuclei could be recommended as a treatment option for patients who meet neurological, neurophysiological and neuroimaging criteria, especially in earlier phases, before occurrence of irreversible musculoskeletal changes. Furthermore, we emphasize the importance of cooperation between centers worldwide in studies on the potentials of DBS in treating patients with DoC.

Keywords: DBS, disorders of consciousness, CM-pf

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EXPLORING GENETIC FACTORS INFLUENCING BRAIN STRUCTURAL CHANGES FOLLOWING DEEP BRAIN STIMULATION IN PARKINSON'S DISEASE USING MULTI-OMICS ANALYSIS

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Previous studies have demonstrated that deep brain stimulation (DBS) implantation leads to localized reductions in brain structure volumes, particularly in regions targeted by the electrode placement in Parkinson's Disease (PD) patients. Leveraging Mendelian randomization (MR), which offers a powerful tool to elucidate causal relationships between brain and disease phenotypes, we aim to investigate potential genetic determinants underlying DBS-induced structural changes. Specifically, we intend to integrate MR analyses with neuroimaging data, in order to identify genetic variants associated with Parkinson's disease risk that may modulate individual susceptibility to structural alterations following DBS implantation. Here, we examined the causal relationships between PD and eight brain structures using TwoSampleMR. We identified significant correlations between PD and volume of the right and left thalamus (OR=2.11 and 1.50, p-value=0.0001 and 0.003, respectively) and the right and left putamen (OR=1.08 and 1.08, p-value=0.007 and 0.008, respectively). The correlations between PD and the volume of the amygdala, hippocampus, pallidum, brainstem, accumbens, and caudate did not reach significance after multiple testing corrections. Furthermore, we will explore the causal relationship between DBS therapeutic protein,

PD and structures. Our ongoing neuroimaging analyses will allow us to explore whether these identified genetic targets can be used to predict individual responses to DBS therapy.

Keywords: Deep Brain Stimulation, Parkinson's Disease, Brain Structure, Target Protein, Mendelian Randomization

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TRANSDUCTION OF ACH3.0 GRAB SENSOR IN A TRANSGENIC RAT MODEL OF ALZHEIMER'S DISEASE

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Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by memory loss and cognitive decline, with amyloid plaques and neurofibrillary tangles leading to cholinergic alterations at the core of its pathology. Current therapeutic strategies including pharmacological interventions have provided limited benefits and often come with undesirable side effects. In the search for more effective treatments, deep brain stimulation (DBS) shows promise in alleviating AD symptoms by targeting the nucleus basalis of Meynert, a cholinergic brain center with widespread projections. Before broad clinical implementation, it is crucial to validate DBS efficacy in animal models, such as the TgF344-AD rat line, which closely mirrors human AD pathology. The GRAB ACh3.0 sensor, enabling in-vivo monitoring of acetylcholine release, may shed light on the effects of DBS for AD. However, prior to in-vivo experiments, it is imperative to confirm in-vitro whether TgF344-AD rats can express the ACh3.0 sensor. The project aimed to confirm the successful expression of the ACh3.0 sensor in TgF344-AD rat brains after viral vector microinjections using immunohistochemical staining and fluorescence microscopy.

Keywords: Alzheimer's disease (AD), Deep brain stimulation (DBS), Animal Modeling, GRAB sensors, Immunohistochemical staining

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EFFECT OF LOW- AND HIGH-FREQUENCY DEEP BRAIN STIMULATION ON GAIT MODULATION IN VIRTUAL REALITY IN PARKINSON'S DISEASE

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High-frequency (>100Hz, HFS) deep brain stimulation (DBS) of the subthalamic nucleus is a mainstay treatment for Parkinson's disease (PD), but its efficacy on gait disturbances is often unsatisfactory. Low-frequency (<100Hz) stimulation (LFS) has been shown to improve gait, but evidence is inconclusive and limited to non-ecological and poorly standardized environments. We studied the effect of HFS and LFS on gait adaptation in response to a moving obstacle in a fully immersive virtual reality (VR) environment replicating ecological surroundings in a standardized set-up. We assessed 12 PD patients after overnight withdrawal of all dopaminergic medications in three conditions: (i) with chronic HFS, (i) after switching off the stimulation for at least one hour (OFF), and (iii) after one hour with LFS and clinically optimized stimulation parameters (adjusted total electrical energy delivered). The stimulating contacts and pulse width were kept unchanged. Patients walked in a VR environment that mimicked a daily life scenario (i) without obstacles, and then (ii) interacting with a virtual agent (VA) programmed to cross the walking path in a standardized manner. Patients were instructed to modulate their gait to avoid collision with the VA. Gait cycle parameters were assessed during steady-state walking and gait modulation, i.e., the first three steps (modulators) after the start of the VA. Preliminary findings on the first four patients showed that HFS and LFS improved similarly linear gait, increasing stride length and velocity compared with the OFF condition. HFS provided a greater increase of stride length and speed of all the three modulators than LFS as compared to the OFF condition, but the large variability in the data suggests the presence of individual modulation strategies. Our experimental setup was effective in studying gait modulation in PD and our result suggest that different stimulation frequencies can result in multiple individualized patterns of gait modulation.

Keywords: gait modulation, stimulation frequency, Parkinson's disease, gait disturbances

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SURGICAL TREATMENT OF PARKINSON'S DISEASE FOLLOWING DESTRUCTIVE UNILATERAL THALAMOTOMY WITH STEREOTACTIC RADIOSURGERY AND RADIOFREQUENCY THERMOABLATION PROCEDURES IN TWO CASES.

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BACKGROUND: Since the implementation of surgical procedures including deep brain stimulation (DBS), ablative procedures (pallidotomy, thalamotomy), dopaminergic drug infusion pumps, and non-surgical stereotactic radiosurgery processes, management of Parkinson's disease (PD) has evolved into a much-complicated form. Moreover, in the last decade, MR-guided focused ultrasound has been added to the gamut. Eventually, patient selection emerged as a challenging and utmost important step of the management of a patient with PD to yield a satisfactory outcome.

OBJECTIVES: We aimed to emphasize the importance of selecting the appropriate candidates for a certain procedure for favorable outcomes as aforementioned procedures might not be equally beneficial for all PD patients.

CASE DESCRIPTIONS AND RESULTS: We present two cases with PD one of whom was a 50-years-old woman who had undergone left side SRS (Gamma Knife) ventral intermediate nucleus (ViM) thalamotomy in 2016 (Fig 1). She has been on medication for PD for 13 years and she did not benefit from SRS ablation procedure. Bilateral STN-DBS surgery was performed and leads were placed at the STN. She benefited from surgery and her quality of life improved. Second case was a 64 years-old-man with PD (on medication for 10 yrs) who had undergone left side invasive procedure with radiofrequency thermoablation technique (Fig 2). As the lesion was within the margins of the internal capsule, patient presented with right arm paresis. STN-DBS was planned and bilateral leads were placed. UPDRS improved and postoperative course was favorable for the patient.

CONCLUSION: Our experience confirms that great care should be taken when irreversible lesions are intended in terms of target selection and accurate shooting. Therefore, reversible and adjustable procedures should be given priority.

Keywords: Deep brain stimulation, STN-DBS, radiofrequency thermoablation, Stereotactic radiosurgery, thalamotomy, Parkinson's disease

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BILATERAL STN DBS FOR PARKINSON'S DISEASE: RETROSPECTIVE ANALYSIS OF SINGLE CENTER EXPERIENCE

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INTRODUCTION: The most commonly used target in deep brain stimulation (DBS) for Parkinson's disease (PD) is the subthalamic nucleus (STN). This treatment provides significant improvement in motor functioning and quality of life. However, serious adverse events might ocur. This study aims to demostrate the complications and outcomes of patients treated by bilateral STN DBS for PD in our clinic.

MATERIAL-METHODS: A retrospective analysis was conducted using hospital records to identify the patients treated by bilateral STN DBS implantation at our institution from 2020 to 2023. Telephone surveys were used to determine final outcomes. The severity of PD was assessed by the Unified Parkinson's Disease Rating Scale (UPDRS).

RESULTS: The demographics of the 45 patients included in the study were as follows: mean age of 59 years, 32 male (71%), 13 female (29%), 14 patients (%31) had at least one medical comorbidity. One patient had lead fractures, two dislodgements, eight wound detachments, five infections, one capsular side effect, one psychosis, one methemoglobinemia, and two hematomas. Among five patients with infection, one proceeded to encephalitis and the system was removed; after appropriate antibiotherapy, the patient was reoperated; and one died because of meningitis. 82% of patients with tremors responded to treatment, and 55% with rigidity responded. The mean UPDRS II scores in the preoperative period were 27±4.2 in the medication-off period, 9±5.3 in the medication-on period, and in postoperative six-month follow-up periods, 12.6±5.1 in the stimulation-off period, 6.7±3.1 in stimulation-on period respectively. Other motor symptoms remained stable. Multivariate analysis revealed no significant correlation between age, sex, comorbidities and the final UPDRS and ADLs.

CONCLUSIONS: Bilateral STN DBS is an effective treatment for PD. It reduces medication requirements in short and intermediate follow-up periods and significantly improves final UPDRS and ADLs. However, serious adverse events should be considered before surgery.

Keywords: Deep brain stimulation, Parkinson's disease, subthalamic nucleus

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ADAPTIVE CLOSED-LOOP DEEP BRAIN STIMULATION FOR TOURETTE SYNDROME: INSIGHTS FROM CHRONIC NEURAL RECORDINGS IN THE CENTROMEDIAN THALAMUS AND GLOBUS PALLIDUS INTERNA

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Tourette Syndrome (TS) poses significant challenges due to its debilitating motor and phonic tics. Deep Brain Stimulation (DBS) has emerged as a promising intervention for refractory cases, particularly in mitigating motor symptoms. This investigation delves into the efficacy of closed-loop DBS, targeting the Centromedian (CM) Nucleus of the Thalamus and the Anterior Globus Pallidus Interna (aGPi), in ameliorating TS symptoms. Our nine-month study involves multi-phase exploration, encompassing the identification of optimal stimulation sites, fine-tuning of adaptive parameters, and rigorous testing of optimized settings. Utilizing a comprehensive approach, we collect data during rest, voluntary hand movements, and spontaneous tics, employing Medtronic Percept implants and Delsys Wearable Sensors for real-time monitoring. Preliminary findings drawn from a female subject with bilateral CM and aGPi electrode implantation underscore the efficacy of lower frequency bands (1-10 Hz) in discerning tics from rest (p-value < 0.1). Notwithstanding hardware limitations, we have successfully initiated closed-loop DBS using the recorded Local Field Potential (LFP) signal. Moving forward, our research trajectory emphasizes the periodic assessment of stimulation thresholds to uphold therapeutic efficacy and forestall habituation. Furthermore, we are working to refine closed-loop DBS parameters through continuous monitoring of neural dynamics and symptom progression. Crucially, we seek to elucidate the impact of CM and aGPi stimulation on TS-related psychiatric comorbidities, thereby fostering a holistic understanding of DBS outcomes. While our initial subject lacks psychiatric comorbidities, forthcoming investigations will elucidate the broader effects of DBS on associated conditions. Moreover, we aim to streamline tic detection methodologies to expedite data analysis, recognizing the inherent challenges of current video labeling techniques. In summary, our study underscores the potential of closed-loop DBS targeting CM and aGPi in the management of TS. Future efforts will focus on refining therapeutic strategies to accommodate individual patient profiles and enhance treatment outcomes.

Keywords: Deep brain stimulation, Tourette Syndrome, Adaptive DBS, Psychiatric disorders

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SUBTHALAMIC NUCLEUS DEEP BRAIN STIMULATION INDUCES FUNCTIONAL DEFICITS IN FOREBRAIN NOREPINEPHRINERGIC NEUROTRANSMISSION IN A PARKINSON'S DISEASE MODEL

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BACKGROUND: Deep brain stimulation of the subthalamic nucleus (STN-DBS) has been repeatedly linked to cognitive impairment and other non-motor symptoms such as depression or apathy in Parkinson's disease (PD). Objective/Hypothesis: Since both dopaminergic and norepinephrinergic neurotransmissions play important roles in certain cognitive functions/non-motor symptoms, we analyzed morphological alterations of the catecholaminergic system as well as effects of STN-DBS on norepinephrine and dopamine availability in different brain regions in the 6-hydroxydopamine rat model of PD.

METHODS: We applied six weeks of continuous unilateral STN-DBS or sham stimulation, respectively, in groups of healthy and 6-hydroxydopamine-lesioned rats to quantify catecholaminergic cell counts in the substantia nigra pars compacta, ventral tegmental area and locus coeruleus. In addition, we analyzed norepinephrine and dopamine contents in the striatum, olfactory bulb and dentate gyrus after one week of STN-DBS in a different cohort.

RESULTS: Six weeks of STN-DBS did not alter catecholaminergic neuron counts in mid- and hindbrain regions and dopaminergic fibre density in the dorsal and ventral striatum. However, one week of STN-DBS decreased norepinephrine levels in forebrain regions, i.e. the striatum and olfactory bulb in 6-hydroxydopamine-lesioned animals; in contrast, dopamine levels were reduced in the dentate gyrus. We found no effects of STN-DBS on catecholamine systems in any of the examined regions in healthy animals.

CONCLUSION: STN-DBS modulates norepinephrinergic neurotransmission in forebrain regions in a PD rat model. This mechanism might contribute to cognitive impairment related to the treatment, but this relationship must of course still be confirmed by suitable behavioural studies. Funding: This work was funded by the Deutsche

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Keywords: animal model, 6-OHDA, Parkinson´s disease, deep brain stimulation, norepinephrine, dopamine

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AUTOMATED GAIT ANALYSIS TO QUANTIFY MOTOR PERFORMANCE DURING STN-DBS IN THE 6-HYDROXYDOPAMINE HEMIPARKINSON RAT MODEL

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BACKGROUND: To further elucidate DBS mechanisms, research in animal models could make a significant contribution. However, it is often difficult to reliably quantify the symptom improvement during DBS in small animal models.

OBJECTIVE: This study aims to quantify motor performance during six weeks of continuous subthalamic nucleus deep brain stimulation (STN-DBS) in freely-moving 6-hydroxydopamine (6-OHDA) hemiparkinson rats using a commercially available gait analysis system.

METHODS: Animals received unilateral electrode implantation in the STN four weeks after ipsilateral 6-OHDA lesion. A novel, fully implantable stimulation device, described in previous studies, was used over six weeks. Motor performance was assessed at two pre- and postoperative time points using a commercially available gait analysis system. Various gait parameters, such as stride length, speed, stance, and swing time, were used to assess motor performance.

RESULTS: Preliminary analysis revealed significant changes in different gait parameters, such as total speed and stride length, in PD rats compared to healthy controls. However, our preliminary results did not show an improvement of gait during long-term STN-DBS.

CONCLUSION: Gait analysis was successfully established to quantify motor symptoms in 6-OHDA hemiparkinsonian rats. However, in this model, the gait analysis system could not reliably detect effects of long-term STN-DBS on motor performance. In future studies, it would be advantageous to use a bilateral animal model and other motor performance tests, such as the rung-ladder test in combination with histological examinations, to provide insight into STN-DBS's potential mode of action.

Keywords: Gait analysis, 6-hydroxydopamine, animal model, Parkinson´s disease

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ACUTE THERAPY OF INFECTED DBS THERAPIES IN SEVERELY AFFECTED PATIENTS - A FEASIBLE ALTERNATIVE TO REMOVING THE HARDWARE

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BACKGROUND: Infections of deep brain stimulation (DBS) hardware are an unwanted but common complication in DBS surgeries. Minor infections might be treated by a wound revision followed by iv antibiotic treatment. If hardware is visibly infected, almost all centers will remove the infected hardware, leaving the patient in the preoperative state. Patients with severe tremor are in need of care afterwards. In order to spare patients from being in need of care a novel technique was thought of, since most infections occur at the generator or retroauricularly

METHODS: After tagging the target using stereotactic x-rays without being in need of new CT or MR scans new electrodes are palced and are led to the contralateral side. New extensions and a new generator can be placed to contralateral side as well. After that the infected system will be removed. In this case series six patients were included.

RESULTS: The DBS system was implanted on average for 272 days before the second surgery. One system had to be removed due to reoccurring infection after 18 months, the

others are still unaffected. In only one half of the patients' laboratory alterations and pathogens were found.

CONCLUSIONS: This surgical technique is safe, well tolerated and an alternative to removing the system, saving the patients from being in need of care.

Keywords: Infection, severe essential tremor, trouble shooting

0.4% up to even 100%. Our study aims to investigate the association of brain and brain compartment volumes on magnetic resonance imaging (MRI) with the occurrence of PLE in Parkinson's disease (PD) patients after DBS implantation in subthalamic nuclei (STN).

This retrospective study included 125 consecutive PD patients who underwent STN DBS at the Department of Neurosurgery, Dubrava University Hospital from 2010 to 2022. Qualitative analysis was done on postoperative MRI T2-weighted sequence marking PLE on midbrain, thalamus, and subcortical levels as mild, moderate, or severe. Quantitative volumetric analysis of brain and brain compartment volumes was conducted using an automated CIVET processing pipeline on preoperative MRI T1 MPRAGE sequences.

PLE was observed in 32.17%. Mild PLE was observed in the majority of patients, regardless of the level observed. Age, sex, diabetes, hypertension, vascular disease, and use of anticoagulant therapy showed no association with PLE. Total grey matter volume showed a significant association with the PLE occurrence and cortex volume. Cortical hemisphere volumes, overall hemisphere volumes, and hemisphere/total intracranial volume ratio showed significant association with the PLE occurrence. The volume of cortex and total grey volume represent moderate indicators, while hemisphere volumes, cortical hemisphere volumes, and hemisphere/total intracranial volume ratio represent mild to moderate indicators.

The results of our study suggest that the morphometric MRI measurements, as a useful tool, can provide relevant information about the structural status of the brain in patients with PD and represent moderate indicators of possible PLE occurrence. Identifying patients with greater brain atrophy, especially regarding grey matter before DBS implantation, will allow us to estimate the possible postoperative symptoms and intervene promptly.

Keywords: DBS, MRI, Parkinson's disease, Peri-lead edema, Volumetry

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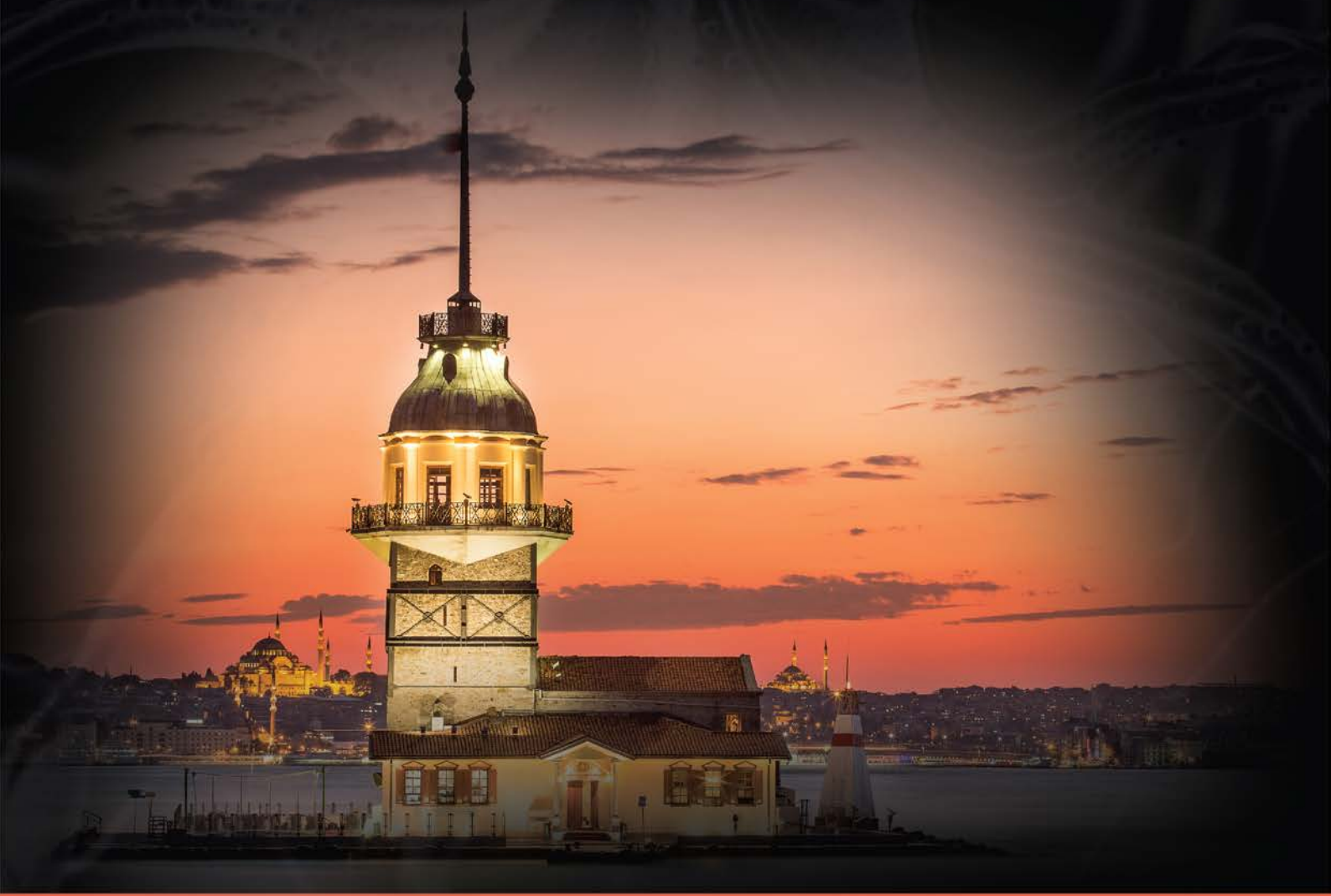

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