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Oral Presentations

O001 / #126

Topic: *AS01. Movement Disorders*

CLINICAL AND SAFETY OUTCOMES USING DBS SYSTEMS WITH DIRECTIONALITY AND MULTIPLE INDEPENDENT CURRENT CONTROL - REAL-WORLD, USA EXPERIENCE

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Introduction: Deep Brain Stimulation (DBS) is an effective strategy for reducing Parkinson's Disease (PD) motor complications. Data collected from a wide variety of implanting centers (based on standard of care) treating PD patients may help provide addtional insights regarding real-world, clinical use and outcomes of DBS. Here, we present preliminary outcomes from an ongoing prospective, multicenter outcomes registry conducted at centers in the United States consisting of patients implanted with directional DBS systems capable of multiple independent current control (MICC) for use in management of the motor signs and symptoms in levodopa-responsive PD.

Methods: Prospectively-enrolled participants were implanted with Vercise DBS systems (Boston Scientific), a multiple-source, constant-current system, and assessed up to 3-years post-implantation as part of an on-going DBS patient outcomes registry (clinicaltrials.gov identifier: NCT02071134). Clinical measures recorded at baseline and during follow-up included MOS-Unified Parkinson's disease Rating Scale (MDS-UPDRS), Parkinson's Disease Questionnaire (PDQ-39), Global Impression of Change (GIC), and the Non-Motor Symptom Assessment Scale (NMSS). Adverse events and device-related complications were also collected.

Results: To date, a total of 141-subjects (mean age: 64.0 ± 9.0 years, 71.5% male, disease duration 9.4 ± 5.1 years, n=137) have been enrolled to date, and 116 of these have undergone device activation. A 53.4% improvement (27-points, $p<0.0001$) in motor function was noted at 6-months as assessed by the MDS-UPDRS lll in the "off" medication condition. At 6-months follow-up, over 95% of subjects and over 90% of clinicians noted improvement as compared with Baseline. To date, no lead fractures or unanticipated adverse events were reported. Additional and updated data will be presented.

Conclusions: Real-world outcomes from this large, prospective, multicenter outcomes registry demonstrated improvement in motor function, quality-of-life, and satisfaction following DBS. This on-going

registry will continue to provide insight regarding application of MICC-based directional DBS Systems for PD as applied in real-world settings.

Keyword: Deep Brain Stimulation, DBS, Parkinson's disease, registry

O002 / #467

Topic: *AS04. Psychiatric Disorders*

IDENTIFYING ETHOLOGICALLY RELEVANT NEUROBEHAVIORAL BIOMARKERS OF EMOTIONAL STATE

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Introduction: Affective disorders are the most common subset of psychiatric conditions. Major depressive disorder (MDD), in particular, affects over 120 million people worldwide and is the leading cause of disability as well as death from suicide. Emotion dysregulation is the hallmark of depression and other affective disorders, so developing tools for objective, quantitative characterization of the temporal, behavioral, and neural dynamics underlying emotional state change is critical for properly diagnosing and treating these debilitating conditions.

Methods: We analyzed continuous, synchronized audio, video, and neural recordings during naturalistic conversations in human neurosurgical patients implanted with both stereo-EEG (sEEG) and deep brain stimulation (DBS) electrodes as part of a clinical trial (NCT03437928) for treatment-resistant depression (TRD). We then developed a pipeline for automated transcription with diarization and utterance-level timestamps of audio recordings and used natural language processing (NLP) tools to identify emotional state change points. Pre-trained affective computing models were then used for extraction of linguistic, acoustic, and kinesic features associated with emotional state change. These behavioral features were then correlated to measures of self-reported affect, as well as brain-wide features of concurrent spontaneous neural activity. Finally, we used a multi-modal intermediate fusion model to investigate whether cross-modal features can better predict self-reported affect and neural activity, than any single modality alone.

Results: Both content-relevant (linguistic, semantic) and content-irrelevant (acoustic, kinesic) features of emotional state change in naturalistic behavior were correlated with asynchronous self-reported affect, as well as with brain-wide neural features previously found to be associated with mood. Convergence points across multiple modalities showed a stronger correlation with self-reported affect than any single modality alone. Cross-modal behavioral features associated with positive emotional state also showed a positive correlation with high-gamma activity in limbic

regions.

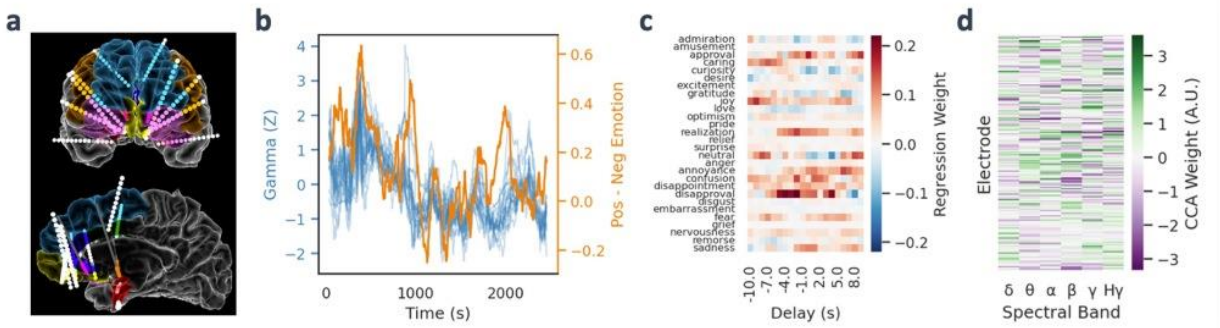

Figure 2. Neural analyses linking limbic activity to content-relevant emotion features. 3D reconstruction of sEEG leads implanted in a TRD patient (**b**) Brain-wide neural timeseries (blue) of Z-scored gamma band power overlaid with emotion timeseries (orange) based on extracted linguistic features. (**c**) Temporal response profiles for all emotion states in the gamma band in the left medial prefrontal lobe. (**d**) Spatio-spectral feature map of a canonical component that encodes positive versus negative emotions, based on linguistic features from text transcript analysis.

Conclusions: Naturalistic conversations provide a wealth of objective, quantifiable behavioral data that is highly temporally resolved and closely aligned with underlying neural activity. By relating semantic features from “what” is expressed, as well as acoustic and kinesic features from “how” it is expressed, to simultaneous neural activity, we can build multi-modal models for more effective diagnosis, assessment, and treatment of affective disorders.

Keywords: Treatment-resistant depression, Emotion, Deep Brain Stimulation

O003 / #149

Topic: *AS03. Pain*

STRUCTURAL CONNECTIVITY PREDICTS OUTCOMES OF BILATERAL ANTERIOR CINGULOTOMY FOR CHRONIC PAIN

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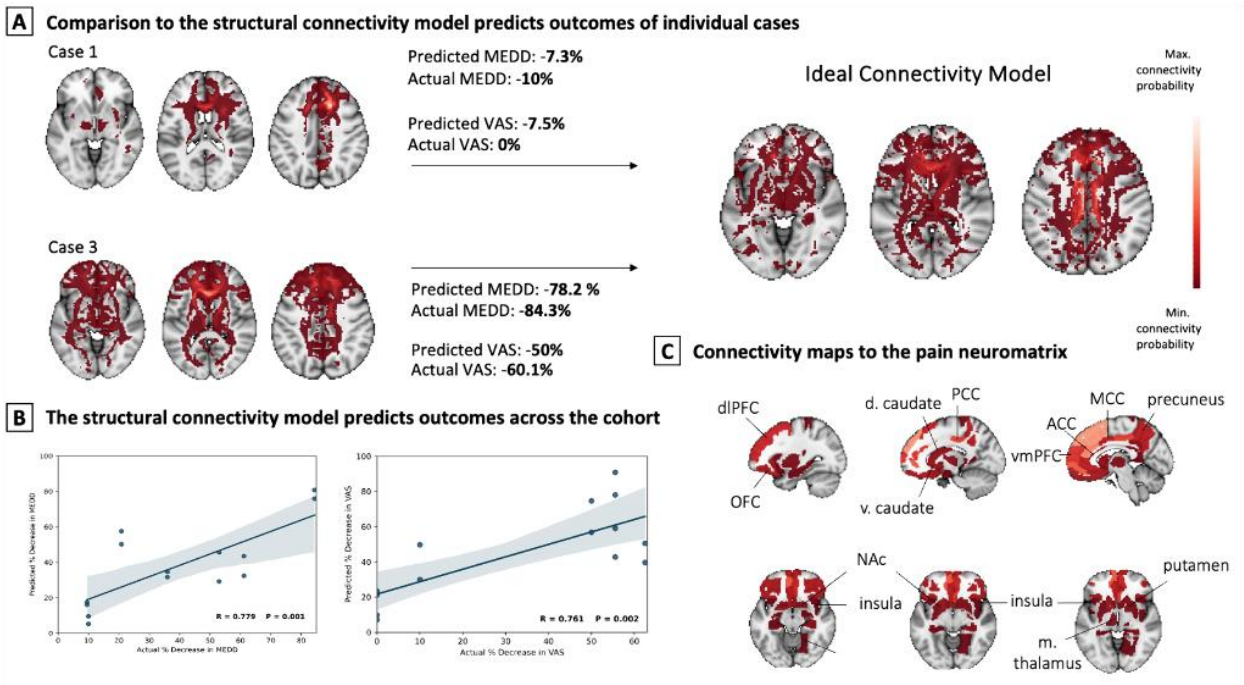
Introduction: Stereotactic dorsal anterior cingulotomy is a neurosurgical intervention for refractory cancer pain and chronic pain. However, the mechanism by which lesioning modulates pain networks remains unknown.

Methods: This multicentre prospective study used stereotactic lesions from 26 patients (52 hemispheres) to generate whole-brain probabilistic tractography with patient-derived diffusion-weighted MRI (dMRI). Resulting connectomes were used to identify connectivity patterns associated with changes in numeric rating scale (NRS) pain scores and morphine equivalent daily dose (MEDD). The derived computational model was then used to predict outcomes in individual patients. Model convergence to a functional connectome was assessed by computing lesion-to-whole-brain connectivity with independent, chronic-pain-specific resting-state functional MRI data (fMRI; n=57).

Results: Chronic pain aetiologies were cancer pain (n=22), neuropathic pain (n=2), mixed cancer-neuropathic pain, sickle-cell arthritic pain (n=1), and multiple systems atrophy pain (coat hanger and back pain; n=1). Pain was significantly reduced post-cingulotomy as measured by both NRS (median decrease 50% (IQR: 66.9-20); P<0.0001) and MEDD (median decrease 61.1% (IQR: 67.75-39.8); P<0.05). 73.1% of patients had good outcomes, defined as >30% reduction in NRS. Structural connectivity seeded from the lesions converged onto a previously identified chronic pain network – involving the medial prefrontal cortex (mPFC), dorsolateral PFC, insula, mediodorsal thalamus, amygdala, and striatum – and reliably predicted outcomes in individual patients, robust to leave-one-out cross-validation for MEDD (R=0.779, P=0.001) and NRS (R=0.761, P=0.002). Permutation analyses of the predictive model identified lesion connectivity with the left orbitofrontal cortex, nucleus accumbens (NAc), and insula as most significantly contributing to outcomes (P<0.05). This same predictive pattern could be derived from out-of-sample fMRI data. Additionally, mPFC-NAc connectivity alone could classify patients into good and bad responders (AUC=0.81;

P<0.05).



Conclusions: To our best knowledge, this is the largest stereotactic cingulotomy study for pain and the first study to identify a network predictive of post-neurosurgical chronic pain alleviation. Neurosurgical interventions for chronic pain should, therefore, aim to modulate this identified network and surgical targeting should be improved by preoperatively assessing patient-specific connectivity with this network. Moreover, the overlap of our predictive network with specific pain-relevant regions yields further insight into the mechanisms of chronic pain maintenance.

Keywords: connectomics, probabilistic tractography, chronic pain

O004 / #154

Topic: *AS11. Basic Science or Technology Development*

DIRECT ELECTRICAL STIMULATION OF THE BASOLATERAL AMYGDALA MODULATES OSCILLATORY DYNAMICS IN THE HIPPOCAMPUS

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Introduction: Robust information encoding and retrieval are supported by theta frequency (3-8 Hz) oscillations throughout the medial temporal lobe (MTL). Recently, our group demonstrated that direct electrical stimulation of the basolateral amygdala (BLA), a hub of the MTL networks that support memory, can enhance declarative memory in humans. Although the role of the BLA in emotional memory is well-characterized, the neurophysiological signatures of this amygdala-mediated memory enhancement are considerably less clear. This study aimed to characterize how BLA stimulation modulates hippocampal theta oscillations.

Methods: We conducted a study using intracranial recordings from 16 human neurosurgical patients undergoing clinical monitoring for medically refractory epilepsy. Patients were shown a series of neutral valence images of objects and scenes (160 images total); half of the images were followed by brief, direct theta-burst stimulation of the BLA (bipolar, 1 s, 0.5-1 mA, 8 burst trains of 50 Hz). A self-paced memory retrieval task was performed ~24 hours later. Local field potentials (LFP) were continuously recorded from depth microelectrodes, followed by offline signal preprocessing and spectral decomposition. The power spectra were then used to test for significant modulation of theta band power within each hippocampal contact. To control for false positives, we performed permutation testing against a null distribution of t-statistics generated by randomly shuffling the pre-/post labels 1000x.

Results: Robust modulation of theta frequency power was observed in 20.3% of hippocampal contacts ($p < 0.05$). Post-stimulation theta band power increases were more common compared to power decreases (76.1% vs. 23.9%, respectively).

Conclusions: Many hippocampal contacts exhibit robust, persistent theta-frequency responses to direct electrical stimulation of the BLA. Our results suggest that BLA stimulation may transiently increase the power of low-frequency oscillations in the hippocampus, supporting rhythmic patterns of activity that have long been implicated in memory encoding and retrieval.

Keywords: Stimulation, Amygdala, Memory

O005 / #246

Topic: *AS01. Movement Disorders*

SEGMENTING DEEP BRAIN NUCLEI FROM CLINICAL MRI: COMBINING REGISTRATION AND DEEP LEARNING

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Introduction: Precise segmentations of deep brain nuclei, especially the subthalamic nucleus (STN), globus pallidus internus (GPi), and ventralis intermediate nucleus (Vim), are crucial for stereotactic functional neurosurgery. Adverse outcomes in DBS are largely attributed to sub-optimal lead placement, yet common atlas-based methods fail to consider inter-individual variability, and published auto-segmentation algorithms struggle with the topography among neighbouring structures of similar contrast. The gold-standard of manual segmentation remains time-consuming and introduces human bias. Large studies using manual segmentations as ground truth therefore remain resource-expensive, hindering group comparisons for optimal lead placement and morphological studies for disease progression or early diagnosis. We present RegiNet, a robust fully-automated neural network to segment deep brain nuclei on clinical MRI. The goal is to minimise variability and eliminate human biases through standardising pipelines across MR protocols. RegiNet incorporates subject-specific probability priors of each nucleus, so that spatial context and inter-individual variability are considered.

Methods: RegiNet was trained on 155 clinical T1 and T2 scans at 1.5, 3, and 7T field strengths to simulate real-world application. We compare performance with leading academic and industry algorithms: DBSegment (Baniasadi et al., 2023) and Brainlab Elements (Brainlab AG, Germany). We are also working to enable VIM segmentation on RegiNet, through a FAT1 sequence which visualises thalamic nuclei by combining fractional anisotropy with T1 anatomy.

Results: RegiNet achieves an average Dice score similarity of 0.91 across the STN and GPi on respective sets of unseen clinical scans, superior to DBSegment (0.71) and Brainlab (0.45) ($P<.0001$). We measure Hausdorff distance (HD) as a surrogate marker of border accuracy between model output and ground truth. RegiNet's mean HD of 1.82mm suggests sufficient accuracy for many applications with minimal manual refinement, while mean HDs from Brainlab and DBSegment exceeded 4mm. Conventional pipelines are limited by domain shift, an inability to generalise to heterogenous unseen scans. RegiNet demonstrated robust performance on out-of-distribution scans –successfully generalising

to 7T scans even when trained only on 1.5 and

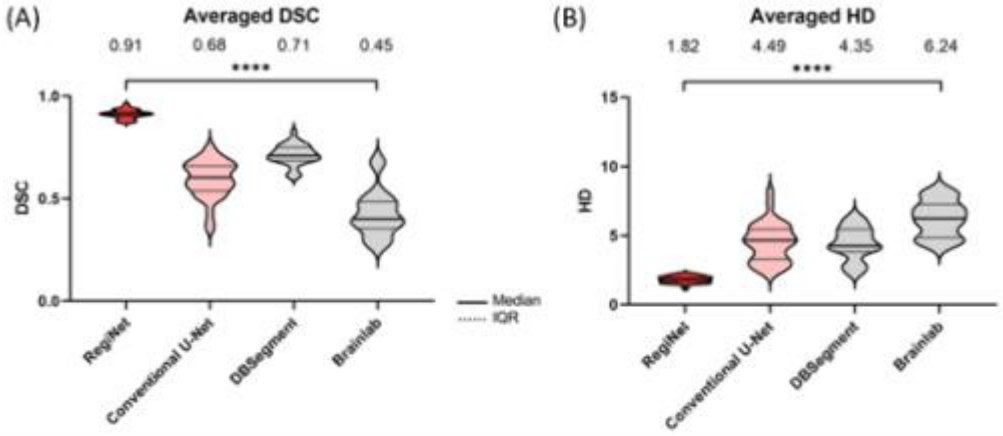

FIGURE 1. RegiNet performance on unseen data, compared to leading models.
(A, B) DSC and HD metrics averaged across the STN and GPi.

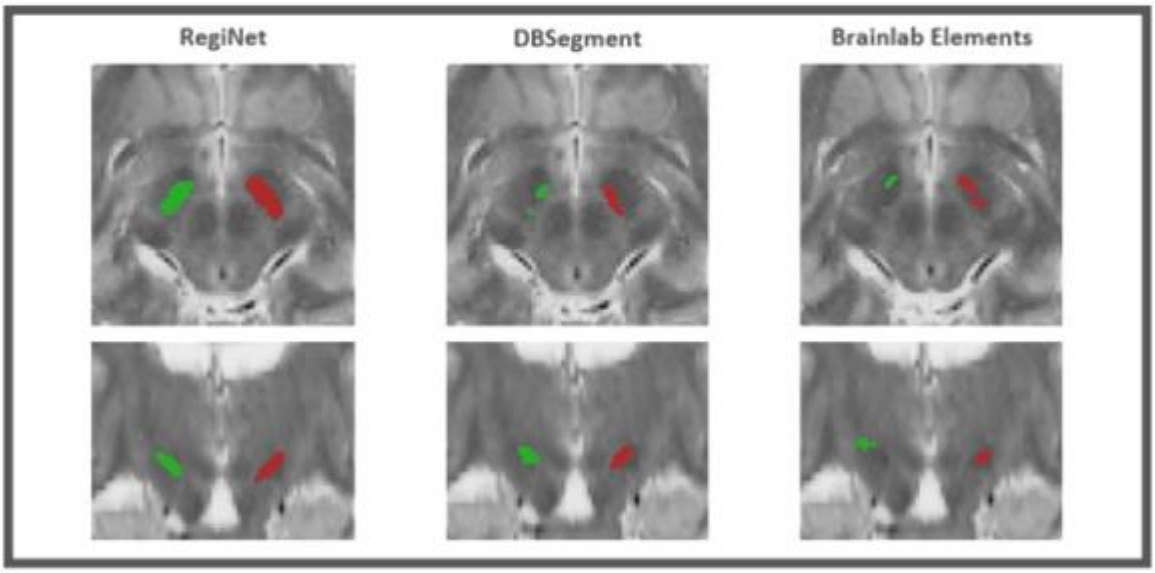

FIGURE 2.
Visual evaluation of model outputs of the STN from RegiNet, DBSegment, and Brainlab Elements on axial view (top) and coronal view (bottom) overlaid on T2 MRI. Note considerable morphological discontinuity on DBSegment and Brainlab outputs.

3T.

Conclusions: RegiNet may facilitate the adoption of auto-segmentation in clinic and research, minimise biases in surgery, and facilitate large cohort studies with improved ground truths.

Keywords: Artificial intelligence, Deep Brain Stimulation, Automatic segmentation

O006 / #311

Topic: *AS02. Epilepsy*

PROPAGATION OF SEIZURES THROUGHOUT THE BRAIN CAN BE PREDICTED WITH PATIENT SPECIFIC SEIZURE PROPAGATION PATHWAYS

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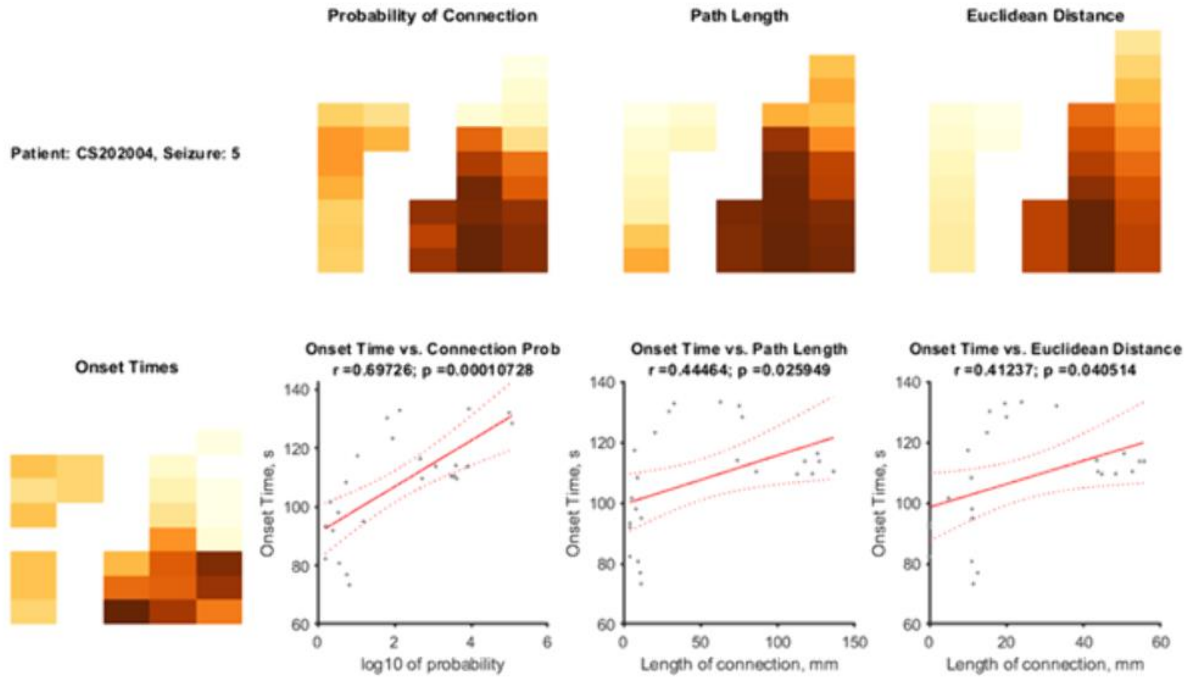
Introduction: The propagation of seizures throughout the brain is well-characterized at the cellular level, though the propagation at the network and whole brain level remains incompletely understood. To this end, the resting state connectivity and structural connectivity of the brain have been characterized and correlated with SEEG investigations and MRI imaging. However, the actual propagation of the seizures throughout the brain, and if the propagation can be predicted by structural connectivity remains to be identified.

Methods: We collated ictal and inter-ictal data from eighteen patients undergoing SEEG investigations for seizure onset zone localization. For each investigation, the location of SEEG contacts were identified in patient space. The ictal onset at each SEEG channel was determined using time series cross-correlations between clinically defined interictal and ictal segments. Using patient specific diffusion imaging, the probability of axonal connection and the white matter path length between each SEEG contact identified. In addition, the Euclidean path distance between each SEEG contact was identified as well. Linear correlations were identified between time of ictal onsets and the three propagation pathways metrics.

Results: SEEG investigation from 18 patients, with 94 distinct seizure events were analyzed. All patients and seizure events demonstrated good correlation between ictal onset time and 1) probability of connection, 2) path length, and 3) Euclidean distance between the clinically determined seizure onset zone contacts and the remaining, non-SOZ contacts (Figure 1). The correlations between the ictal onset times and the different propagation pathways ranged from ~0.3 to ~0.8 based on patient and seizure event. The dominant propagation pathway, as determined by the pathway with best correlation, differed

between patients and seizure events.



Conclusions: The propagation of seizures throughout the brain can be in part predicted by patient specific seizure propagation pathways.

Keywords: seizure propagation, structural connectivity, SEEG

O007 / #173

Topic: *AS02. Epilepsy*

THALAMIC NETWORK MAPPING IN PATIENTS WITH MULTIFOCAL EPILEPSY TREATED WITH RNS: TOWARDS NETWORK-GUIDED RNS ELECTRODE PLACEMENT.

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Introduction: Thalamic responsive neurostimulation (RNS) is effective for refractory epilepsy. Several thalamic nuclei have been targeted following the known pattern of connectivity of these nuclei. To elucidate the impact of thalamic seizure network mapping on seizure control by optimizing targeting strategies.

Methods: Retrospective analysis of 21 patients treated with thalamic RNS of the centromedian(CM), anterior nuclei of the thalamus(ANT), and pulvinar(Pul). Clinical features and seizure outcomes were recorded. RNS electrodes were then used to model the electrical field using the parameters at last follow up. Patient-specific probabilistic tractography was used to define the network of the SOZ within the thalamus. Each patient's probabilistic map was used to define the area of highest connectivity of the SOZ to the thalamus and areas of overlap of the thalamic seizure network. We then correlated the stimulated area in relation with the thalamic seizure network and the seizure outcomes.

Results: 70% of patients were responders at last follow-up. Multiple SOZs were found in frontal, cingulate, insular, and temporal areas in these patients. Within the thalamus, frontal SOZ to temporal SOZ connectivity occurred along the posterior and medial thalamus including Pul,ANT,CM/parafascicularis, and mediodorsal. Cingulate-to-temporal connectivity occurred along the ANT and Pul nuclei. Insular connectivity was found mainly in the CM. Disrupting these intrathalamic networks was associated with response. Stimulation in the areas of high connectivity from the SOZ to the thalamus was correlated with response at the last follow up($p=0.0001$). Also, high degree of connectivity from the SOZ to the stimulated thalamic area was associated with seizure control($p=0.0006$)

Conclusions: Thalamic seizure network mapping is useful in defining the networks to be targeted for seizure control using RNS. The identification of these networks prior to surgery could help to identify specific areas of seizure spread between the multiple SOZs that can be modulated with RNS to provide optimal seizure control.

Keywords: Epilepsy, tractography, responsive neurostimulation

O008 / #227

Topic: *AS02. Epilepsy*

THE CONNECTIONS OF THE CENTROMEDIAN NUCLEUS OF THE THALAMUS WITH THE BRAINSTEM NUCLEI UNVEIL A POTENTIAL COMMON MECHANISM FOR THE MANAGEMENT OF DRUG-RESISTANT EPILEPSY

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Introduction: Epilepsy is a widespread neurologic disorder and almost one-third of patients suffer from drug-resistant epilepsy (DRE). For patients with generalized DRE who are not surgical candidates, neuromodulation targeting the centromedian nucleus of the thalamus (CM) has been showing promising results. CM is a small nucleus in the intralaminar thalamus. Previous tracing studies in rodents and higher primates demonstrated direct CM connections with the brainstem as part of the mesencephalic reticular formation. Interestingly, the role of the brainstem in epileptic syndromes involving loss of consciousness (such as absence epilepsy and generalized tonic-clonic seizures) has been acknowledged for decades. Since the mechanism of action of CM-neurostimulation is still poorly understood, we hypothesize that studying CM connections with brainstem nuclei may help clarify its anti-seizure effect.

Methods: To prove our hypothesis, we performed FSL probabilistic tractography on 9 DRE patients who underwent CM-DBS (deep brain stimulation) or CM-RNS (responsive neurostimulation). We employed the VTAs (volumes of tissue activated) from stimulation parameters of implanted patients as seed and 12 brainstem nuclei co-registered from two different MNI atlases (the Harvard AAN atlas and the Levinson-Bari atlas) as targets for the tractography analysis. Using the number of streamlines that reached the brainstem target areas, the probability of connectivity of each patient's VTAs with all the targets was calculated. Patients were then divided into responders and non-responders based on the degree of reduction in seizure frequency (>50%) and the mean probabilities of connectivity were compared between the two groups with MANOVA.

Results: Four out of nine implanted patients were considered responders (mean reduction in seizure frequency: 87 ± 18.5% VS 34 ± 19.4%, p=0.005). Among all the brainstem nuclei, VTAs of responder patients had a higher probability of connectivity with the nucleus of the solitary tract (NTS) than non-responders (Prob 0.51 ± 0.15 VS 0.092 ± 0.09, p=0.001).

Conclusions: CM-stimulation seems to share a similar mechanism of action with VNS (vagus nerve stimulation), which is thought to halt seizures via vagal connection to the NTS. Based on this hypothesis, bilateral CM-stimulation could also enhance VNS anti-seizure effect as the latter surgical procedure is usually performed unilaterally on the left side.

Keywords: Epilepsy, Neuromodulation, thalamus

O009 / #307

Topic: *AS02. Epilepsy*

LOW VOLTAGE STEREOELECTROENCEPHALOGRAPHY (SEEG) STIMULATION SUGGESTS RECORDED INTRACRANIAL SIGNALS AND CORTICO-CORTICAL EVOKED POTENTIALS (CCEPS) ARE OFTEN ARTEFACTUAL ECHOES OF EACH OTHER

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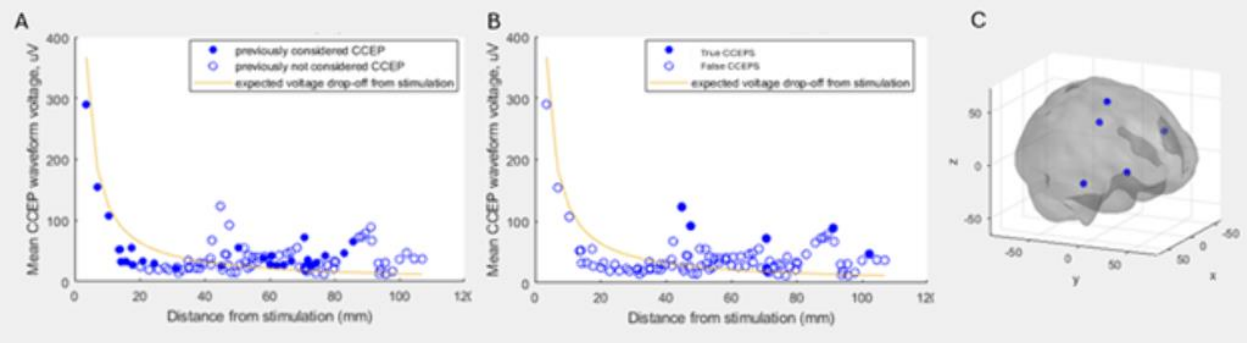
Introduction: Patients who are candidates for epilepsy surgery often undergo intracranial monitoring with Stereoelectroencephalography (SEEG) if non-invasive monitoring is of insufficient value for seizure-onset zone (SOZ) localization. Patients occasionally undergo cortico-cortical evoked potentials (CCEP) mapping with SEEG investigations as well, which allows for mapping effective connectivity and functional relationships between different regions of the brain. However, it remains unclear the exact distance that SEEG electrodes are able to record from, which limits optimization of SEEG implantation strategies.

Methods: We carried out low voltage stimulation (100 uA-500uA) recordings in nine patients undergoing SEEG for epilepsy surgery. Specifically, two adjacent contacts served as the bipolar stimulation channel, whereas all other implanted contacts served as recording channels. The locations of each contact were determined in three-dimensional patient space, and voltage attenuation models were built and validated.

Results: The attenuation in recorded voltages over distances followed a $1/r^2$ drop off with a high degree of correlation ($R^2 > 0.8$). The limit of SEEG detection was set as a signal-to-noise ratio of three, which allowed for the building of a detection limit model, based on the input parameters of system noise and input voltage of interest (Equation 1). When evaluating the model on an average interictal discharge, this corresponded to a detection limit of 28 mm. The expected drop-off in voltage was then used to identify the expected voltage drop-off from the CCEP stimulation sites. In addition, the expected drop-off in voltage from the remaining CCEP candidates had their own voltage drop off modeled as well (Figure 2). The drop-off analysis suggested that across all patients and stimulation trials, up to 90% of previously considered “true” CCEPs, were in fact artefactual echoes of each other and not true CCEPs. Furthermore, around four percent of previously “false” CCEPs, were in fact true CCEPs. Equation 1. Distance_mm = sqrt((3.57*Voltage of Interest_uV) + 71700)/(Noise_uV)) Figure 1.



Conclusions: A model was built which allows for determining the maximum distance a SEEG electrode can placed away from an intra-cranial voltage source of interest. The model suggests that the number of true-CCEPs in the literature is likely being significantly over-reported.

Keywords: recording distance, SEEG, Cortico-Cortical Evoked Potentials

O010 / #235

Topic: *AS02. Epilepsy*

INTERICTAL ELECTROPHYSIOLOGY OF CHRONIC RECORDINGS IN EPILEPSY PATIENTS WITH THALAMIC AND BITEMPORAL RESPONSIVE NEUROSTIMULATION.

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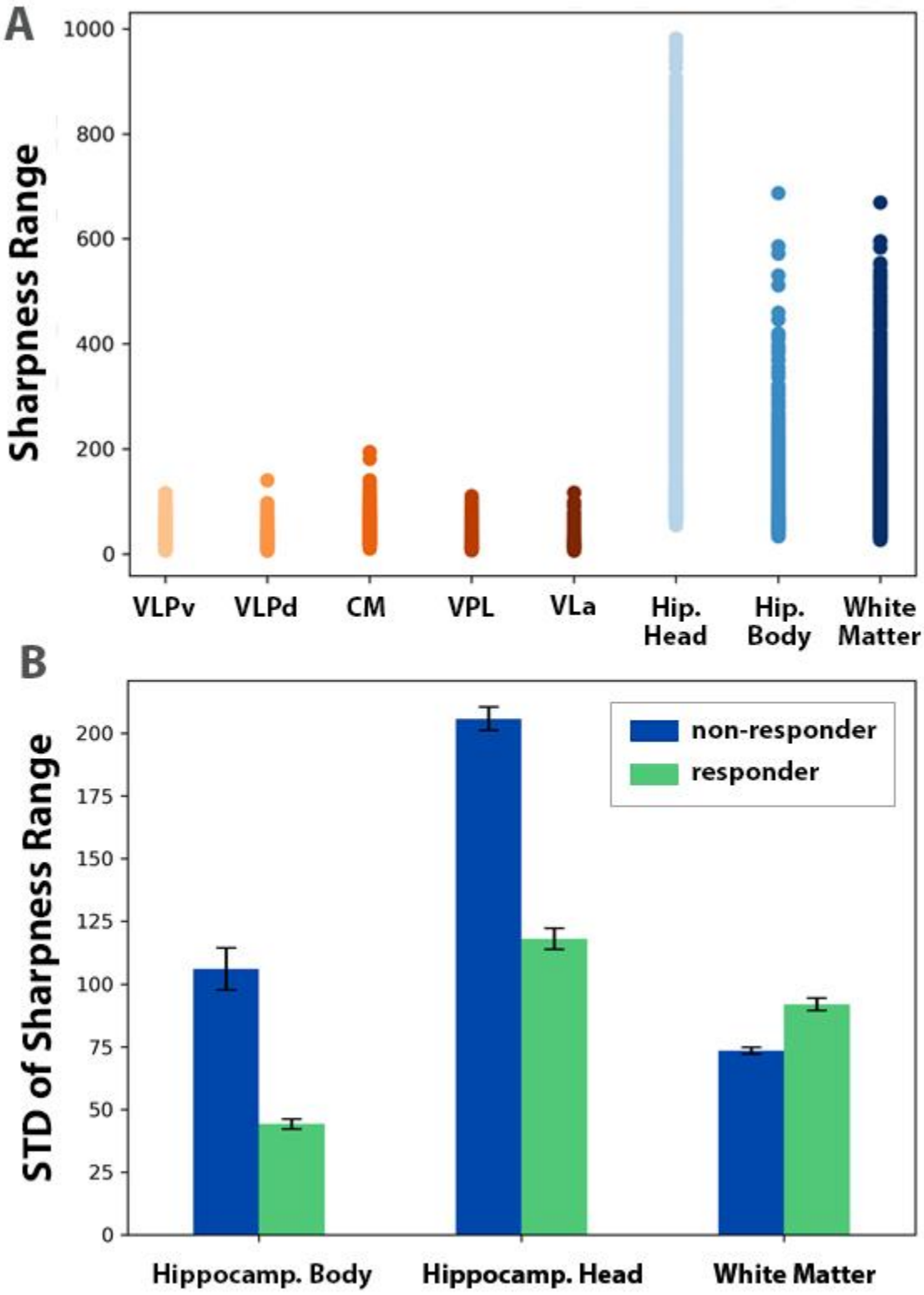
Introduction: The responsive neurostimulation system (RNS) for epilepsy can be programmed to record intracranial EEG at scheduled times throughout the day. These recordings capture neural activity that might be useful for understanding the electrophysiology of the targeted anatomical structures as well as RNS treatment effects. Sinusoidal and non-sinusoidal spectral features of interictal recordings were estimated in order to characterize the electrophysiology of subdivisions of the thalamus and hippocampus. Patient-reported outcomes were used to examine the relationship between anatomical location of interictal features and response to RNS.

Methods: Interictal recordings were obtained and identified using BRAINStim and iESPNet. The py_neuromodulation toolbox was used to estimate Fast Fourier Transform (FFT) and Sharpwave features (non-sinusoidal waveform characteristics) of recordings from patients implanted with RNS in the thalamus (n = 9) and the hippocampus (n = 6). Electrodes were reconstructed in MNI space and contacts labeled using the THOMAS and Allen Brain atlases. Permutation tests identified significant differences in feature means and standard deviations (STD) across anatomical labels. The relationship between interictal features and responder status (defined by patient-reported change in quality of life) was examined for bitemporal patients.

Results: There was a significant difference in the STD of Sharpwave features across labels ($p < .025$); STDs were higher for bitemporal contacts than thalamic contacts (for example see scatterplot in Figure Panel A: thalamic contacts = orange, bitemporal = blue). There was no significant difference for FFT. For bitemporal patients there was an interaction between responder status and label where the STD of Sharpwave features was significantly higher for non-responders than responders for contacts implanted in the body and head of hippocampus ($p < .025$) but not the white matter of the forebrain (for example see barplot in Figure Panel B: non-responders = blue, responders =

green).



Conclusions: Interictal recordings provide an opportunity for understanding the electrophysiology of anatomical structures targeted by RNS. Non-sinusoidal waveform features provide unique information for understanding differences in physiology across different anatomical structures. Future work will integrate information about changes in outcomes and stimulation over time to examine whether interictal features can characterize the impact of RNS on pathological physiology.

Keyword: epilepsy, neurostimulation, electrophysiology

O011 / #144

Topic: *AS08. Stereotactic Procedures*

IN-SITU FLUORESCENCE GUIDED TUMOR BIOPSIES – A REPORT FROM 40+ CASES

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Introduction: Brain tumor biopsies can be associated with inconclusive results and hemorrhage which may increase the number of trajectories and thus prolong surgery. An investigational optical-probe-system (FluoRa, Linköping University) has been used to provide spectroscopic fluorescence in-situ feedback before tissue sampling. The aim is to present the first 40+ optical biopsy procedures.

Methods: This study included 44 patients (age:18-80; women:15; EPN-2015-138-32, EPM-2020-01404) with radiologically suspected high-grade tumors. MRI were used for trajectory and target planning with StealthStation (Medtronic Inc., USA) or Leksell Stereotactic System (LSS, Elekta Instrument AB, Sweden). An oral dose of 5-ALA (Gliolan, Medac GmbH, Germany) was administered before anesthesia. For 20 patients a forward-looking optical probe adapted to LSS was used. It allowed simultaneous measurement and trajectory creation prior to insertion of the biopsy needle[1]. In 24 patients (3 with LSS[2]) the probe was fitted to the outer cannula of the biopsy kits which were modified with a small opening at the tip. Fluorescence, perfusion, and gray-whiteness were measured in millimeter steps along the respective trajectories and displayed in real-time during surgery. When 5-ALA-induced fluorescence peaks were registered in the vicinity of the target, the inner cannula of the biopsy needle replaced the probe, tissue sampled and sent for analysis. The surgery was closed following intraoperative pathology assessment. References: 1) Richter J et al., Oper Neurosurg., 2021; 2) Wårdell K et al., Oper Neurosurg., 2023

Results: Fluorescence was seen in 40 patients. Final CNS WHO 2021 diagnosis were: glioblastoma (n=32), glioma grade 2 (n=1), astrocytoma (n=2), lymphoma (n=7), and non-tumor (n=2). Measurement through the biopsy needle resulted in fewer trajectories (25 in 24 patients) compared to the two-step insertion (28 in 20 patients). Measurement time (5-10 min.) depended on the trajectory length. Pathology response time varied between 18-75 min. per trajectory with an average of 47 min.

Conclusions: In conclusion, with an optical probe fitted into the biopsy kit the number of trajectories were reduced and thus surgical time, as the fluorescence spectra guided in identifying malignant tissue. Multicentre studies are required to validate the method in a larger cohort, and to verify the full potential of the optical system.

Keyword: biopsy, fiberoptics, navigation

O012 / #528

Topic: *AS03. Pain*

BRAIN GRAY MATTER SIGNATURES OF CHRONIC FACIAL PAIN IN MULTIPLE SCLEROSIS

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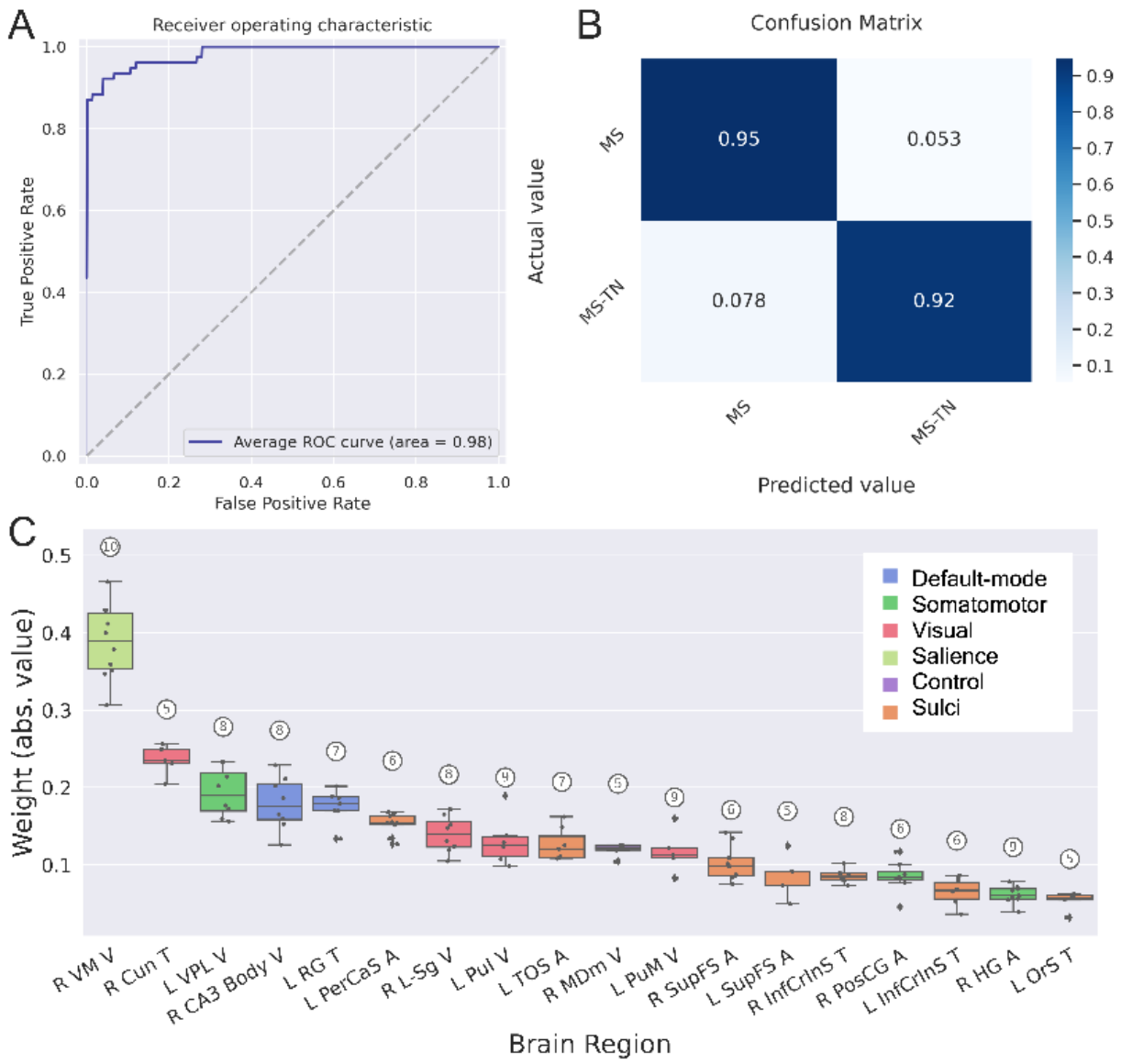
Introduction: Patients with multiple sclerosis (MS) have a twenty-fold greater risk of developing trigeminal neuralgia (TN), a severe form of facial neuropathic pain[1]. In patients who developed TN secondarily to MS (MS-TN), objective neural signatures of pain remain elusive. Previous research suggests that gray matter abnormalities may be crucial indicators of pain, prompting the investigation of their role in the TN pain experienced by MS patients for the first time[2]. Chronic pain in MS is significantly understudied and may be difficult to investigate, particularly in those with advanced stages of disease, impaired cognition or limited ability of verbal expression. Research in this area is critical for patient care, advocacy and improved patient quality of life. In this work we use machine learning (ML) methods to examine differences between the gray matter of MS and MS-TN patients.

Methods: We analyzed T1-weighted MR imaging data from 75 MS and 77 MS-TN patients, matched by age, sex, and MS duration. We processed imaging data using Freesurfer 7 and extracted cortical and subcortical gray matter metrics [4]. Using a support vector machine classifier, we trained a machine learning model to predict presence of TN pain in MS patients using their imaging metrics alone.

Results: Our classifier distinguished between MS and MS-TN imaging metrics on average achieving 99% of training and 93.4% testing accuracy (A, B). Structures within visual, attentional, somatomotor, and default-mode networks (hippocampus, thalamic subnuclei, occipital cortex and postcentral gyrus) were identified as significant imaging predictors of TN pain in MS (C). Figure 1 displays model performance and important predictors of TN pain in

MS



Conclusions: We were able to accurately distinguish between MS and MS-TN using ML analysis, which pointed towards several key imaging predictors of TN pain in MS patients. Our results emphasize the multifaceted nature of pain and pave the way towards using imaging to assess and understand pain disorders with greater objectivity.

Keywords: chronic pain, Machine Learning, Neuroimaging

O013 / #338

Topic: *AS03. Pain*

CAUSE OF RECURRENCE OF TRIGEMINAL NEURALGIA AFTER PREVIOUS SUCCESSFUL MICROVASCULAR DECOMPRESSION: TEFLON GRANULOMA UNDER THE MICROSCOPE

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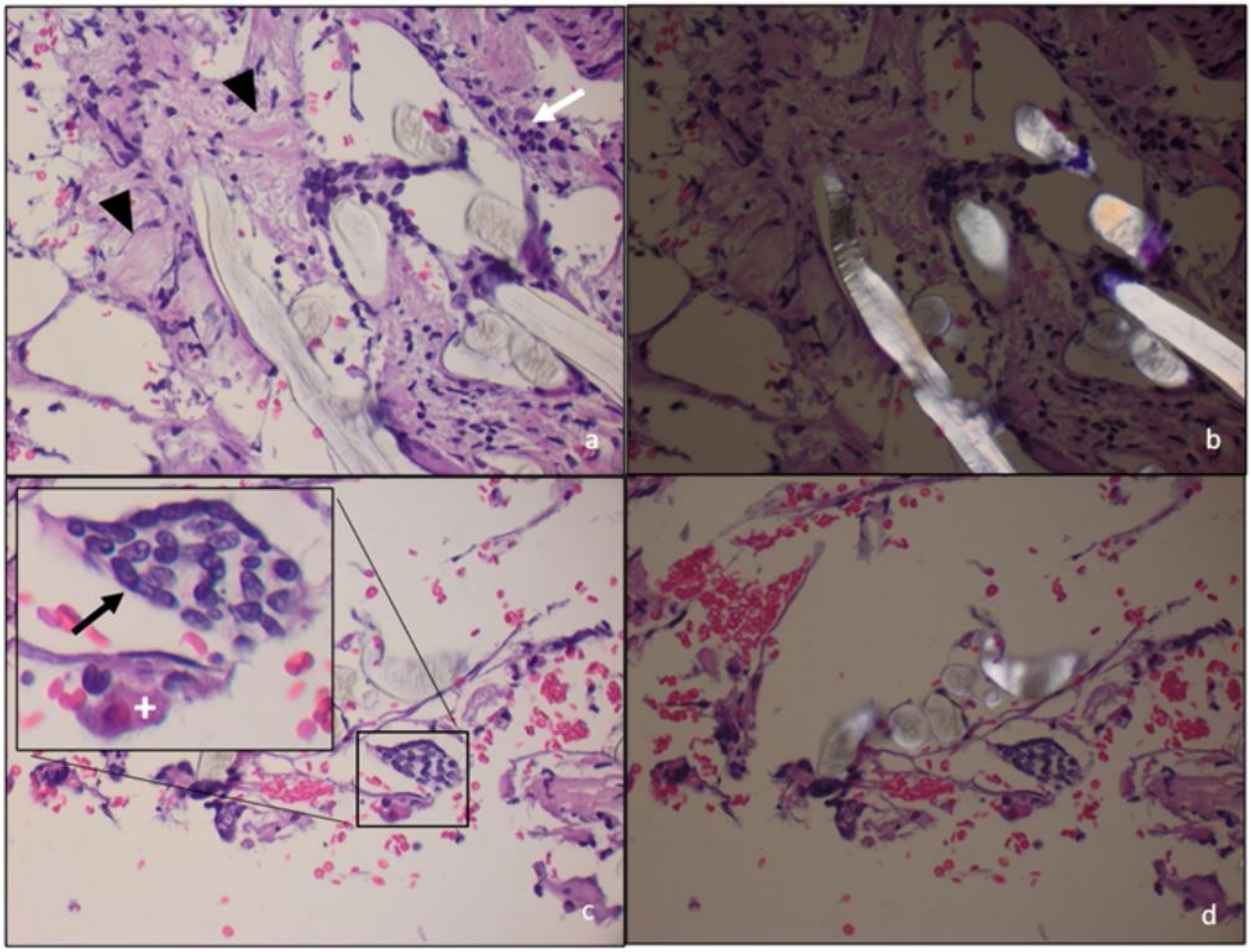
Introduction: Teflon granuloma is one of the possible causes of recurrence in patients with trigeminal neuralgia who underwent successful microvascular decompression. Its incidence is variable and the pathophysiology and mechanisms for recurrence are poorly defined. In this study, we aim to characterize the histological features of Teflon granulomas and to correlate their occurrence with clinical and intraoperative findings.

Methods: Clinical and histological data of 13 out of 30 patients with recurrent trigeminal neuralgia who underwent posterior fossa re-exploration over a period spanning from 2005 to 2023 was collected and analyzed.

Results: The mean time for recurrence was 24 months after the first microvascular decompression. In 6 cases the distribution of pain had progressed to an adjacent area, mostly from V2 to V2 and V3. All samples showed scar tissue and birefringent Teflon filaments were observed, which were embedded between enlarged and collagenous fibers. The full configuration of foreign body granulomas with Teflon-adherent giant cells and discrete lymphocytic infiltrates was evident in 10/13 cases. Siderophages were found in 4/13 cases. Microcalcifications occurred in 5/13 cases. Notably, the presence of macrophages and siderophages correlates with a longer time to recurrence, suggesting a persistent inflammatory

reaction.



Conclusions: This study highlights different histopathological findings over time, their importance in the pathophysiological of the Teflon granuloma, and possible risk factors that should be addressed when performing MVD for the first time.

Keywords: teflon granuloma, pain, trigeminal neuralgia

O014 / #366

Topic: *AS03. Pain*

A CLINICAL TRIAL TO INVESTIGATE NEUROMODULATION OF THE INSULA FOR CHRONIC NEUROPATHIC PAIN

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Introduction: The insula has been identified as a key component of pain processing in laboratory and imaging studies in both animals and humans. We have preliminary evidence that neuromodulation of the anterior insula increases the heat pain threshold in humans.

Methods: A two-staged clinical trial was designed to comprehensively investigate the insula as a target for neuromodulation to manage chronic neuropathic pain. Twelve subjects with severe, refractory, chronic neuropathic pain will be enrolled. Phase 1 involves stereotactic implantation of multi-contact depth electrodes longitudinally into the bilateral insula. Brain mapping will be performed over one week with continuous intracranial EEG and heart rate monitoring. Clinical pain ratings, quantitative sensory testing, and laser evoked potentials will be used to measure nociceptive responses to stimulation of each of the insular gyri. Subjects who respond to insular stimulation in at least one gyrus during the mapping phase will advanced to phase 2 for DBS implantation and a randomized, sham-stimulation controlled trial.

Results: Four subjects have been implanted with intracerebral depth electrodes into the bilateral insular cortex. No safety events occurred with surgery. Afterdischarges were evoked during brain mapping with higher currents. One subject with thalamic pain and morbid obesity expired 3 months after surgery from pulmonary insufficiency. All subjects were deemed ‘responders’ during the trial phase, based on heat pain threshold responses to anterior insula stimulation that exceeded the a priori defined minimum increase of 2°C.

Conclusions: Stimulation of the insula is well tolerated in the hospital setting. Acute nociceptive responses to electrical stimulation of the anterior insula have been consistently observed. The effects of chronic neuromodulation using DBS for pain relief remains under observation.

Keywords: Neuromodulation, Neuropathic pain, insula

O015 / #421

Topic: *AS03. Pain*

FMRI CORRELATES OF EFFICACIOUS PERIPHERAL NERVE FIELD STIMULATION IN FACIAL PAIN

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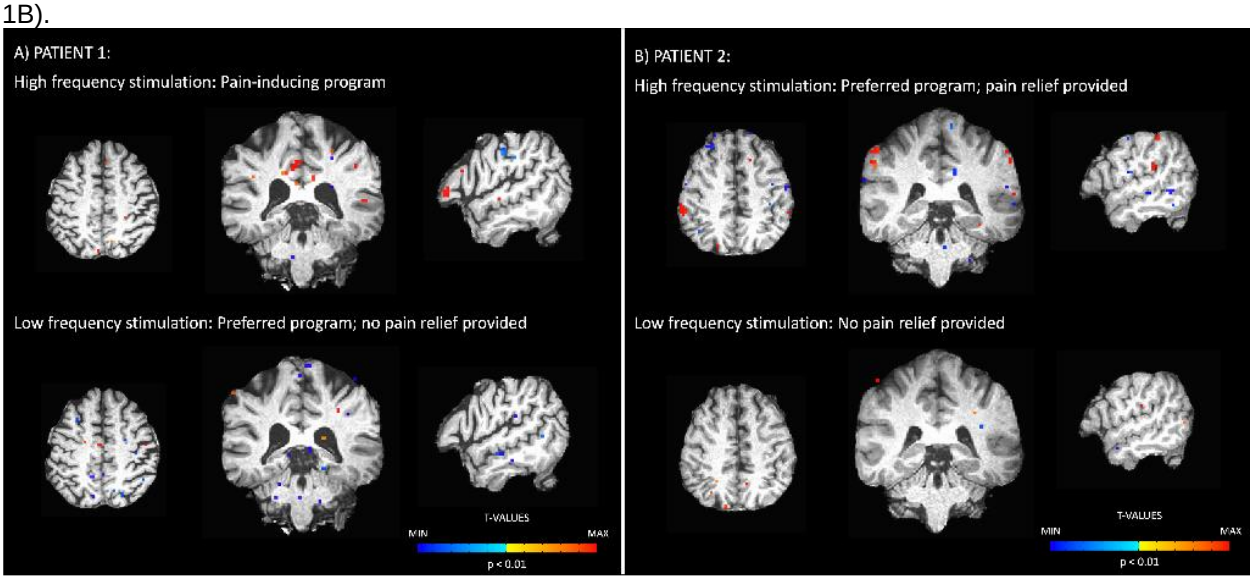
Introduction: Peripheral nerve field stimulation (PNFS) is a subcutaneous minimally-invasive treatment directed at the trigeminal nerve for refractory trigeminal pain. The central nervous response patterns to PNFS in trigeminal pain, if present, require clarification. This study aims to investigate variations in individual stimulation-related functional response patterns during active PNFS through the use of fMRI.

Methods: Two patients with trigeminal neuropathic pain who underwent PNFS surgery were recruited. Patient 1 was a non-responder (+0% points of relief on Numeric Rating Scale (NRS) from baseline to 1 year) and Patient 2 was a responder (+100% points of relief on NRS from baseline to 3 months). 3 Tesla fMRI was acquired with a 30-second PNFS-ON/OFF cycling block design paradigm on clinically optimized high (1 kHz, intensity = 50% paresthesia threshold, pulse width 180 µs) or low-frequency (30-40 Hz, intensity = tolerable paresthesia-inducing, pulse width 60-90 µs) stimulation settings. Following image preprocessing, BOLD response t-maps were generated from the difference between the ON and OFF states for each patient.

Results: BOLD response changes in orbitofrontal cortex, posterior cingulate and motor cortex were observed with high-frequency stimulation in Patient 1, while low-frequency stimulation did not induce any changes (Figure 1A). Bilateral somatosensory cortex corresponding to face region showed significant increase in BOLD response during high-frequency paresthesia-free stimulation in Patient 2 ($p < 0.01$). No change in BOLD signal was identified during low-frequency stimulation (Figure 1B).



Conclusions: Functional response to PNFS may depend on the efficacy of stimulation and stimulation parameters. In addition to these two showcased patients, the study will include more participants, and their findings will be presented during the congress.

Keywords: fMRI, peripheral nerve field stimulation, trigeminal neuralgia

O016 / #377

Topic: *AS03. Pain*

REVISITING CANCER PAIN WITH FOCUSED ULTRASOUND MESENCEPHALOTOMY

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Introduction: Historically, stereotactic mesencephalotomy was developed as a 'supraspinal' cordotomy for cancer and neuropathic pain. Early experience suggested good initial effectiveness, but the procedure was never widely adopted because of the associated morbidity with midbrain lesioning. Contemporary image-guided lesioning could make this a feasible pain procedure, especially for today where there is an opioid crisis and successful pain surgeries are limited.

Methods: A clinical trial is designed to treat six subjects with severe, refractory pain from head and neck cancer with unilateral MRI-guided focused ultrasound mesencephalotomy. The primary outcome is safety, but efficacy will also be assessed with measurements of pain intensity and the affective components of pain. Imaging includes MR tractography of the spinothalamic tract.

Results: Five subjects have been treated. The technology was precise in creating a discrete mid brain lesion. Each subject has experienced pain relief to a different degree. Two had profound pain relief and two others were very transient. Morbidity has been minimal with transient oculomotor disturbance (1), brief agitation (1), and mild numbness (2).

Conclusions: Stereotactic mesencephalotomy is a modern, image-guided, lesioning technique that may be effective for cancer pain.

Keywords: mesencephalotomy, cancer pain, focused ultrasound

O017 / #249

Topic: *AS01. Movement Disorders*

THETA-BURST DEEP BRAIN STIMULATION OF THE BILATERAL SUBTHALAMIC NUCLEI RESULTS IN COGNITIVE IMPROVEMENTS AND NETWORK ACTIVATION CHANGES UNDER FUNCTIONAL MRI

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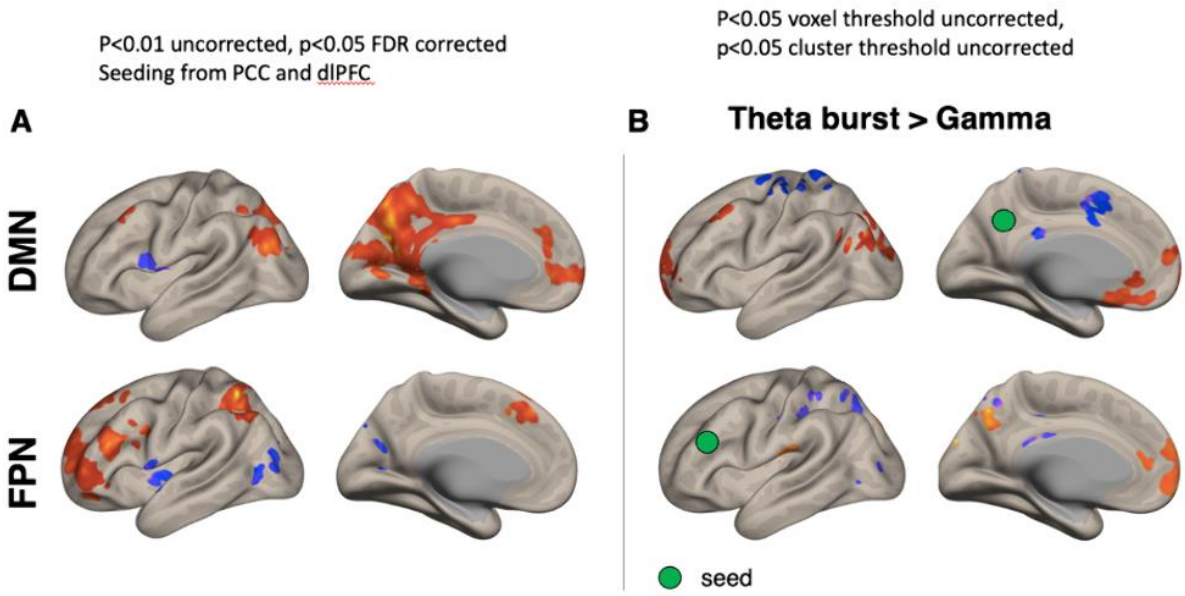
Introduction: Parkinson's disease (PD) is the second most prevalent neurodegenerative disorder worldwide. Gamma frequency (130-180Hz) deep brain stimulation (DBS) is effective in treating motor but not cognitive symptoms of PD. Our group has previously demonstrated theta frequency (5-10Hz) DBS improves cognitive functions in PD. By overlaying theta and gamma frequencies ("theta-burst DBS") control of both facets of PD symptomatology may be achieved. Here, we assess changes in motor and verbal fluency, and utilize fMRI to characterize changes functional connectivity (FC) in the default mode (DMN) and frontoparietal (FPN) networks.

Methods: Four patients with bilateral subthalamic nucleus (STN) DBS electrodes underwent T1 anatomic scans, followed by resting-state fMRI under gamma frequency and theta-burst DBS. By seeding the DMN with the posterior cingulate cortex and the FPN with the dorsolateral prefrontal cortex, seed-to-voxel analyses were conducted to identify network changes. An additional two patients underwent 1-hour theta-burst treatment with verbal fluency and UPDRS-III assessed at baseline and the conclusion of treatment.

Results: The DMN and FPN could be identified across both stimulation conditions (Fig1A). The PCC showed significant positive connectivity to other DMN regions including the anterior cingulate cortex, ventromedial prefrontal cortex (vmPFC), and inferior parietal lobe. The dlPFC exhibited positive connectivity to nearby lateral PFC regions as well as the superior parietal lobe. Comparing network connectivity between stimulation conditions (Fig1B), the DMN exhibited greater connectivity of the PCC with the vmPFC and OFC, and sparsely decreased connectivity with the paracentral lobules during theta burst DBS as compared to gamma DBS. The dlPFC of the FPN exhibited increased FC with medial PFC and parietal cortex, as well as decreased FC with the superior parietal lobe under theta-burst DBS. Clinicometric testing demonstrated increases in verbal fluency in the theta-burst compared to the gamma DBS condition (mean +3.5 words/minute, n=2). UPDRS-III scores improved by 5 and 2 points under the theta-burst condition in both

patients.



Conclusions: Overall, STN theta-burst DBS resulted in improvements in verbal fluency and motor symptoms with significant changes in DMN and FPN FC under theta-burst as compared to standard gamma therapy. Future work will examine whether network changes relate to improvements in cognition.

Keywords: Parkinson's disease, Theta burst, Functional connectivity

O018 / #37

Topic: *AS01. Movement Disorders*

THE EFFICACY OF BILATERAL DBS WITH DOUBLE TARGETING VIM AND PSA FOR TREATMENT OF RARE TREMOR SYNDROMES

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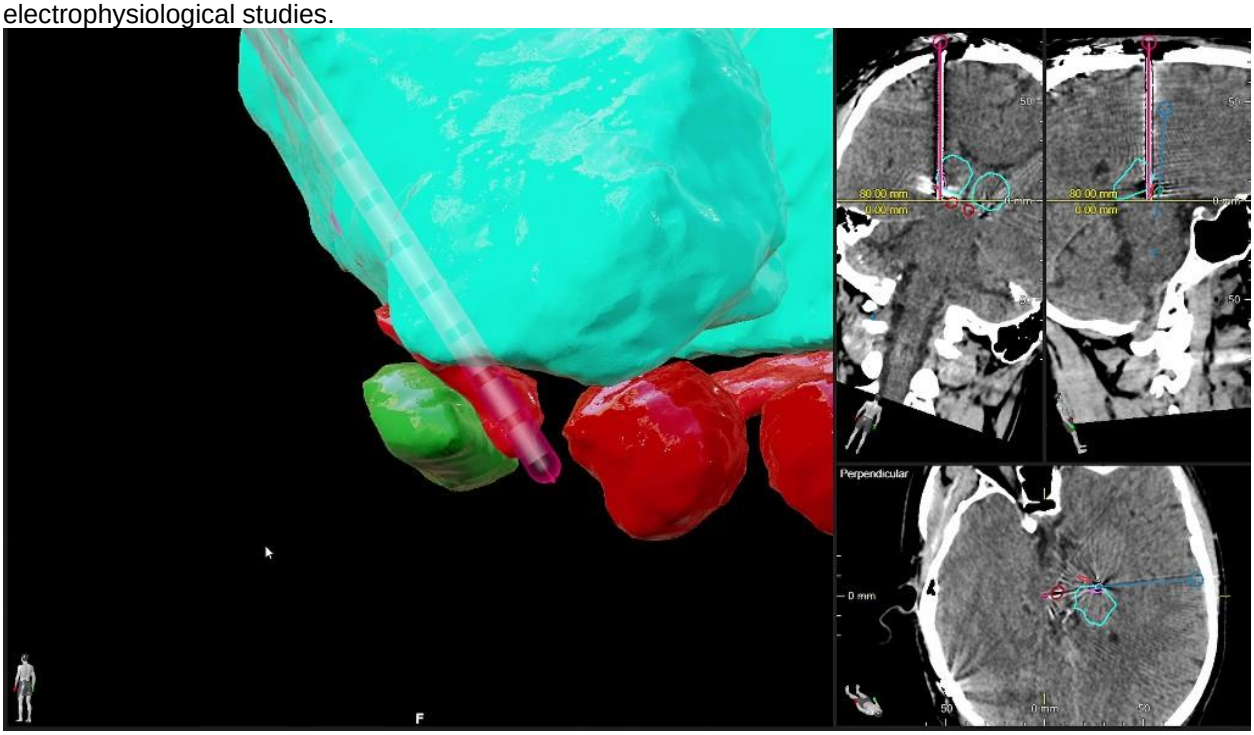
Introduction: Tremorous movements can affect the head, neck, upper and lower extremities of which pathophysiology remains uncertain. When sufficient relief cannot be achieved with pharmacological treatment, Deep Brain Stimulation (DBS) has proven effective for ET (Essential Tremor) and Parkinson's Disease tremor. VIM (Ventromedial Nucleus) has been the main target for tremor DBS surgery but unfortunately, there is a scarcity of data regarding the effect of Vim DBS on rare tremor syndromes. PSA (Posterior Subthalamic Area), a newer target for DBS surgery lies in the proximity of Vim, it is possible to align the electrode to place electrode contacts in both targets. Double targeting of the VIM and PSA is a rather recent practice, allowing us to stimulate both nuclei simultaneously, or separately.

Methods: Between 2019 and 2023, 22 patients with rare tremor syndromes were treated with bilateral DBS of the VIM and PSA. This case series consisted of 7 isolated head tremor, 1 hepatic encephalopathic tremor due to Abernethy syndrome, two voice tremor, 4 dystonic tremor, and eight Holmes tremor (two multiple sclerosis, two cerebellar insult, and four posttraumatic) patients. Patients' preoperative and 12-month postoperative tremor scores were compared, and the optimum VIM and PSA stimulation areas were investigated.

Results: The Tremor Rating Scale (TRS) was used for evaluation, on which higher scores indicate greater tremor. In this sample, there was a significant reduction in the mean TRS score from 3.70 (±0.57) to 0.45 (±0.68) after 12 months of DBS. Specific outcomes for different indications were observed and each patient experienced significant relief of affected body parts which indicates a global tremor reduction.

Conclusions: The literature on DBS for rare tremors is limited. Dual stimulation targeting of the VIM and PSA appears to produce promising improvements on the outcomes reported in the existing literature on VIM-only DBS. The proximity of the VIM and PSA allows for flexible electrode placement, contributing to the potential success of the dual-target approach. We also discuss the theoretical advantages of targeting the PSA based on the distribution of tremor circuits, emphasizing the need for further research and

electrophysiological studies.



Keywords: Tremor Surgery, Double Targeting, VIM/ PSA

O019 / #40

Topic: *AS01. Movement Disorders*

OPTIMAL FOCUSED ULTRASOUND LESION LOCATION IN ESSENTIAL TREMOR

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Introduction: MR-guided focused ultrasound (MRgFUS) thalamotomy is an effective treatment for medically refractory essential tremor (ET). However, there is no established or standard method for targeting. Here, we investigate ablation sites associated with optimal tremor control and those associated with side effects based on the analysis of 200 lesion cases. We also investigate potential tracts associated with optimal tremor outcomes and side effects based on normative connectomes.

Methods: Clinical outcomes including Fahn-Tolosa-Marin (FTM) tremor scores and side effects (including weakness, sensory deficits, dysarthria, dysgeusia, and gait imbalance) were collected prospectively at post-procedural timepoints of one day (except dysgeusia), three months, and one year. Lesions were manually segmented on thin-cut T2 axial images acquired the day after surgery using a pre-defined semi-automated workflow. Lesion segmentations were mapped to standard MNI space and used to derive probabilistic maps and tracts associated with symptom improvement and side effects.

Results: The average tremor reduction at one year was 86.0%. A specific subregion within the ventral intermediate nucleus (Vim) and lesioning of the cerebellothalamic tract (CTT) associated with optimal tremor improvements. Frequency of side effects was highest on post-procedural day one, and gradually improved over time. Weakness was associated with lesions extending laterally into the corticospinal tract (CST), sensory deficits and dysgeusia with posterior lesions and medial lemniscal fibers. Dysgeusia associated with fibers corresponding to the trigeminothalamic tract whereas gait imbalance with ventrolateral lesions and fibers corresponding to the CTT and CST. Dysarthria was associated with superomedial lesions. In summary, we identified an optimal location that is associated with maximal tremor improvements without side effects.

Conclusions: Our results identify an optimal target area for tremor control and sites of avoidance associated with specific side effects. Efficacy of this location was confirmed by test-retest cases that underwent two MRgFUS procedures and may help refine future targeting.

Keywords: focused ultrasound, essential tremor, thalamotomy

O020 / #137

Topic: *AS01. Movement Disorders*

FOCUSED ULTRASOUND PALLIDOTHALAMIC TRACTOTOMY IN CERVICAL DYSTONIA: A PILOT STUDY

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Introduction: Focused ultrasound (FUS) ablation has been reported to be an effective and less invasive procedure for the treatment of essential tremor and Parkinson's disease (PD). Due to the anatomical characteristics of the GPi, which is located relatively lateral to the center of the brain, the energy required to reach 50 degrees during FUS pallidotomy was nearly twice that of FUS thalamotomy. On the other hand, the PTT is located 6-12 mm from the midline, closer to the center than the thalamic Vim nucleus and GPi, and is feasible target for FUS induced temperature elevation. We designed this study because we believe that the PTT is an effective target for the treatment of cervical dystonia using FUS. This study is the first clinical trial of FUS treatment for cervical dystonia.

Methods: This was a prospective, open-label, non-controlled pilot study. The primary outcome was defined as a change in the score for the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) from baseline to 6 months after FUS pallidothalamic tractotomy. The secondary outcomes included a change in the neck scale for the Burke-Fahn-Marsden Dystonia Rating Scale (BFMDRS), mood scales including Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), Apathy Evaluating Scale (AES) and adverse events. Patients were assessed for TWSTRS, BFMDRS and adverse events at baseline, 1 week, 1 month, 3 months, and 6 months after treatment. BDI, BAI and AES were assessed at baseline and 6 months after treatment.

Results: Ten patients were enrolled in this study. The mean age of onset of dystonia was 51.6±10.2 years, and the mean disease duration was 9.2±6.1 years. The TWSTRS at 6 months (29.9±16.0, range: 3-55) was significantly improved by 43.4% ($p<0.001$) from baseline. The BFMDRS-Neck scales at 6 months (4.2±2.8) were significantly improved by 38.2% ($p<0.001$) from baseline. The BDI, BAI and AES at 6 months were improved by 30.3%, 26.2% and 15.7%, respectively from baseline. Reduced hand dexterity in three patients and weight gain in two patients were confirmed at the last evaluation.

Conclusions: This study suggests that FUS pallidothalamic tractotomy may be an effective treatment option for patients with cervical dystonia.

Keywords: focused ultrasound, dystonia, pallidothalamic tract

O021 / #355

Topic: *AS01. Movement Disorders*

ROLE OF SERUM INFLAMMATORY MARKERS IN THERAPEUTIC RESPONSE AFTER DBS FOR PARKINSON'S DISEASE

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Introduction: Deep brain stimulation (DBS) is a well-established therapy for Parkinson's Disease (PD) aimed at motor symptom relief and decreasing medication burden. PD is associated with a pro-inflammatory state characterized by elevated peripheral inflammatory markers in select patients. However, the impact of these markers on DBS outcomes remains unclear.

Methods: We included 22 patients who underwent bilateral subthalamic nucleus (STN) DBS at Mount Sinai. Unified Parkinson's Disease Rating Scale—part III (UPDRS-III) motor ratings and levodopa-equivalent daily dose (LEDD) were collected pre- and postoperatively. Baseline motor assessments were performed in the ON and OFF state. Postoperative motor assessments were done in the ON stimulation, OFF medication state. Serum inflammatory markers collected within 3 months of surgery included hsCRP, homocysteine, omega 6/3 ratio, TNF-α, IL-6, IL-1β, myeloperoxidase (MPO), and trimethylamine N-oxide (TMAO). In addition to numeric values, inflammatory markers were categorized as "normal" or "abnormal" based on elevation. Mann-Whitney U tests and Pearson correlation were used to ascertain relationships between inflammatory markers and therapeutic response.

Results: 40.9% of patients discontinued medication after STN-DBS. LEDD was significantly reduced postoperatively (Mean: 1190.3 vs. 412.5, $p < 0.01$), while post-op UPDRS-III reduction approached significance (Mean: 13 vs. 11, $p = 0.08$). Homocysteine showed significant correlation with preoperative OFF scores ($r= 0.47$, $p = 0.04$). Patients with elevated homocysteine had significantly lower post-op LEDD reduction compared to patients with normal homocysteine (Mean: 650.0 vs. 1276.8, $p < 0.01$). Accordingly, homocysteine levels were correlated negatively with LEDD reduction ($r = -0.50$, $p = 0.03$). No association between other inflammatory markers and LEDD reduction, UPDRS-III reduction, or ability to move off medication were observed.

Conclusions: Our analysis identified a significant association between preoperative homocysteine levels and both higher baseline UPDRS-III scores and reduced postoperative LEDD reduction following STN-DBS for PD. These findings suggest that elevated homocysteine may impact the clinical efficacy of STN-DBS, particularly in terms of medication reduction. Our data support the potential utility of assessing metabolic and inflammatory profiles, specifically homocysteine levels, during preoperative evaluation to enhance STN-DBS outcomes. Further research is warranted to explore metabolic modulation as a strategy to optimize STN-DBS therapeutic response.

Keyword: Deep Brain Stimulation

O022 / #488

Topic: *AS01. Movement Disorders*

EVALUATION OF BILATERAL VIM RADIOSURGERY IN PATIENTS WITH A SEVERE ESSENTIAL TREMOR : A PROPSECTIVE TRIAL. PREFERRED FORMAT

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Introduction: Safety efficacy of unilateral VIM Gamma Knife Radiosurgery (VIM GK) has been well demonstrated for Essential tremor (ET). The safety-efficacy of bilateral VIMGK has never been assessed strictly. We conducted a prospective and objective assessed of the changes in cognitive functions (primary criteria), speech, balance in addition to the evaluation of the impact activities of daily living.

Methods: Were included 33 patients presenting with a severe ET previously treated by VIM GK on the dominant side at least 12 months before. Quantitative assessment before, at 6 & 12 months was including neuropsychological testing (MMS, apathy Starkstein scale, Stroop, verbal fluences, similitudes), evaluation of the voice, writing, walk gait (Kinematic gait analysis), posture (AMTI force platform), tremor severity (FTMS) ADL (Bain Scale) and MRI. Assessment was perform independently from the neurosurgical team. The results were followed and reviewed by an international independent surveillance committee. Patients acted as their own controls.

Results: All the 33 patients have completed the study (19 male 14 female, 32 right VIM and 1 left). Only one adverse event (expected) was observed (hemi-proprioceptive ataxia & dysarthria due to hyper-response 11 months after VIM GK). The mean delay between the first and the second GK was 28,7 months. The cognitive functions was altered in none of the patients. The evaluation of speech walk gait and posture have shown no worsening. In term of efficacy at 1 year the severity score was improved of 58,5%, the disability score of 84,8% and the functional impact score of 68,6%. Only 4 patients failed to respond but for the 29 remaining the mean improvement was of 74,4% improvement of the tremor on the treated upper limb. No side effect related to the bilaterality of the VIM GKS was found in spite of the independent meticulous prospective assessment.

Conclusions: This is the first prospective trial assessing the safety efficacy of bilateral VIM GK. This trial is demonstrating the excellent safety efficacy of VIM GK of the contralateral side in a subgroup of selected candidates previously treated by VIM GK at least 1 year before with a good response of the first side operated.

Keywords: gait, balance, tremor

O023 / #535

Topic: *AS04. Psychiatric Disorders*

THE SCENT OF STIMULATION: OLFACTORY PHENOMENA INDUCED BY DEEP BRAIN STIMULATION

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Introduction: Deep brain stimulation (DBS) is an effective therapy for treatment-resistant obsessive compulsive disorder (trOCD), achieving a success rate of 66%. Here, we document instances of phantosmia observed during programming sessions in patients receiving DBS targeting the Bed Nucleus of the Stria Terminalis (BNST) and/or the ventral capsule/ventral striatum (VC/VS). The occurrence of phantosmia and similar sensory experiences in patients undergoing DBS remains sparsely documented, which compelled us to explore and delineate potential underlying mechanisms.

Methods: We conducted a review of intraoperative and subsequent programming records of twenty-three patients who received DBS for trOCD between 2018 and 2024 at Baylor College of Medicine. We systematically interviewed this subset of patients during programming visits or phone calls to obtain insights into these olfactory phenomena. The stimulation settings that precipitated olfactory phenomena were recorded from the programming documentation.

Results: Five patients reported transient phantosmia during intraoperative and/or follow-up programming sessions. Patient 1 experienced a smell of “organic chemistry lab” during bilateral stimulation of BNST either after increasing amplitude or when stimulation ceased briefly. Patient 2 described a “burning cinnamon” smell under multiple stimulation settings applied to the bilateral BNST, triggered by increases in either pulse width or amplitude. Patient 3 experienced a “medical gas” smell when stimulation ceased briefly. Patient 4 described a “bad smell” with stimulation of the right VC/VS, triggered by an increase in amplitude. Patient 5 experienced an unspecified smell when switching contacts. The described experiences were consistent across episodes and ceased shortly after onset following parameter

changes.

Patient No.	Diagnosis	Description of smell	Contact settings eliciting findings	Target Site	Triggers
1	trOCD + Tourette/dystonia	Organic chemistry lab	Bilateral: C+,1-	Bilat BNST	Increase in amplitude. Stim off briefly
2	trOCD	Burning cinnamon	Bilateral: 1+, 0- Bilateral: C+, 0- Bilateral: C+, 0-, 1- Bilateral: C+, 0-	Bilat BNST	Increase in amplitude or pulse width
3	trOCD	Medical gas	N.A	Bilat BNST	Stim off briefly
4	trOCD	Bad smell	R: C+, 1-	L BNST R VC/VS	Increase in amplitude
5	trOCD + Tourette	Unclear	bilateral: C+, 1-	Bilat VC/VS	Change in contacts from (C+, 2-) to (C+, 1-)

Table 1: Summary of Patient Characteristics, Phantosmia, and DBS Settings for Individuals Reporting Olfactory Experiences During Programming Sessions

Conclusions: The BNST and VC/VS are anatomically proximal to the anterior fascicle of the anterior commissure. We hypothesize that stimulation of these fibers, or a change in stimulation, could facilitate signal transmission to the contralateral olfactory bulb. The transient effects observed here bear resemblance to the paresthesias encountered during programming modifications in patients subjected to subthalamic nucleus DBS. This study documents the emergence of phantosmia as a side effect arising from stimulation adjustments and elucidates the mechanism through which DBS modulates extensive neural networks. It underscores the necessity for further investigative efforts in this domain.

Keywords: OCD, DBS, Olfactory

O024 / #514

Topic: *AS08. Stereotactic Procedures*

SURGICAL COMPLICATIONS IN SUBTHALAMIC NUCLEUS DEEP BRAIN STIMULATION FOR PARKINSON'S DISEASE: EXPERIENCE IN 800 PATIENTS

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Introduction: We present our surgical complications during 25 years of DBS of the subthalamic nucleus (STN) for Parkinson's Disease (PD) resulting in neurological deficit or additional surgery.

Methods: We conducted a retrospective chart review of all PD patients who received STN DBS in our DBS center between 1998 and 2023. Outcome measurements were complications resulting in neurological deficit or additional surgery. Potential risk factors (number of micro-electrode recording tracks, hypertension, age, sex, anesthesia method) for symptomatic intracerebral hemorrhage (ICH) were analyzed. Furthermore, lead fixation techniques were compared.

Results: Eight hundred PD patients (507 men, 293 women) received unilateral (n=11) or bilateral (n=789) implantation of STN electrodes. Neurological deficit due to ICH, edema, delirium, or infarction was seen in 8.4% of the patients (7.4% transient, 1.0% permanent). Twenty-two patients (2.8%) had a symptomatic ICH following STN DBS, for which we did not find any risk factors, and five had permanent sequelae due to ICH (0.6%). Of all patients, 18.4% required additional surgery, which proportion was reduced from 27% in the first 300 cases to 13% in the last 500 cases, due to a surgical learning curve and technical advances. The infection rate was 3.5%, which decreased from 5.3% in the first 300 cases to 2.2% in the last 500 cases. The use of a lead anchoring device led to significantly fewer lead migrations than miniplate fixation.

Conclusions: STN DBS leads to permanent neurological deficit in a small number of patients (1.0%), but a substantial proportion needs some additional surgical procedure after the first DBS system implantation. The risk of revision surgery was reduced over time but remained significant. These findings need to be discussed with the patient in the preoperative informed consent process in addition to the expected health benefit.

Keywords: Complications, Parkinson's disease, Deep Brain Stimulation

O025 / #61

Topic: *AS01. Movement Disorders*

CORTICOSUBTHALAMIC DECOUPLING IN PARKINSON'S DISEASE DURING TURNING FREEZE: INSIGHTS INTO NEURAL MECHANISMS

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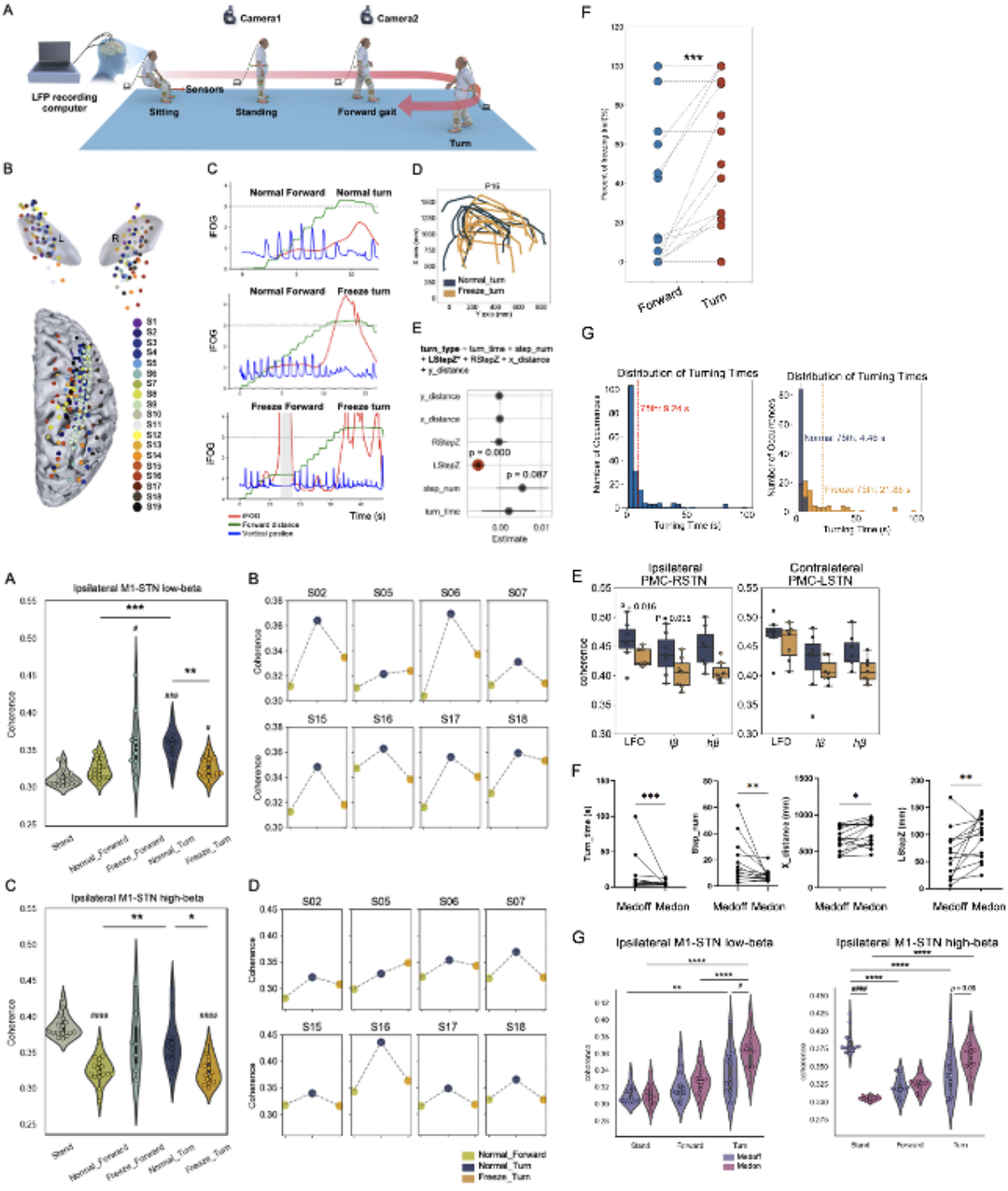
Introduction: Freezing of gait in Parkinson's Disease is a common yet challenging postural and gait disorder. Early stages of freezing of gait often manifest during turning. These abnormalities are associated with corticosubthalamic dysfunction. We aimed to reveal the characteristics of cortico-subthalamic activity in PD patients during different motor statuses.

Methods: We simultaneously recorded potentials in the primary motor cortex (M1) and premotor cortex (PMC) using subdural electrocorticography (ECoG), as well as bilateral STN local field potentials (LFPs) through deep brain stimulation electrodes in 19 freely-walking Parkinson’s disease patients. Gait freezing was synchronously captured using optoelectronic motion-tracking systems under conditions of on/off-medication and with/without dual-tasking.

Results: Compared to straight walking, beta coherence (coh) between M1 and STN significantly increased during normal turning, while there was a trend of increased low-frequency oscillation (LFO) coherence between PMC and STN. Two seconds before turning, LFO coherence between PMC and STN significantly increased. During freezing of gait (FOG) episodes compared to normal turning, beta coherence between M1 and STN significantly decreased, and beta coherence between PMC and STN significantly decreased. Levodopa medication significantly improved FOG during turning, increasing beta coherence between M1 and STN during turning, but had no significant effect on beta coherence between M1 and STN during straight walking.

Conclusions: Normal turning requires higher functional connectivity to be completed, and there is widespread cortical-STN decoupling during FOG episodes. Levodopa medication can improve FOG during turning by increasing functional connectivity between the cortex and STN during turning. This study highlights the critical role of cortical-STN connectivity in the control of turning movements in Parkinson's disease and underscores the potential of targeted interventions, such as levodopa

medication, to modulate neural circuits and alleviate symptoms of freezing of gait.



Keywords: freezing of gait, Parkinson's disease, corticosubthalamic connectivity

O026 / #75

Topic: *AS01. Movement Disorders*

REAL-WORLD OUTCOMES WITH DIRECTIONAL DEEP BRAIN STIMULATION (DBS) SYSTEMS: AWAKE VERSUS ASLEEP LEAD PLACEMENT

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Introduction: Conducting Deep Brain Stimulation (DBS) procedures with patients asleep (i.e., under general anesthesia) has becoming increasingly popular due to patient preference, programming flexibility with directional leads, and advances in imaging technology. Previous work assessing those undergoing awake versus asleep DBS procedures has demonstrated no difference in cognition, mood, and/or behavioral adverse effects. Here, we compare real-world outcomes of Parkinson's disease (PD) patients using DBS systems based on patients being awake or asleep during lead placement procedures.

Methods: This is a prospective, on-label, multicenter, international real-world evaluation of subjects who received multiple-source, constant-current directional DBS systems (Boston Scientific) for treatment of PD. Based on sites' standard-of-care and preferred technique, DBS procedures were performed with subjects awake or asleep during lead placement. Subjects were followed up to 3-years post-implantation and quality-of-life and PD motor symptoms was evaluated. Endpoints evaluated at baseline and study follow-ups included Unified Parkinson's disease Rating Scale (UPDRS), MDS-UPDRS III (converted), Parkinson's disease Questionnaire (PDQ-39), and Global Impression of Change.

Results: Of 633 implanted patients in the study, 173 patients (mean age = 61.4±8.3 years, 68% male) were asleep during lead placement and 460 (mean age= 60.6±8.5 years, 66% male) were awake. Improvement in quality-of-life as assessed by PDQ-39 was noted in both groups with the asleep group reporting a 5.3-point improvement (n=111) and awake group reporting a 4.2-point improvement (n=356) at 1-year. Similarly, a 19.1- and 21.5-point improvement in converted MDS-UPDRS III scores (meds off) was noted in asleep and awake groups, respectively. Additional and updated data collected since last analysis will be provided.

Conclusions: Preliminary results show that motor function related, and quality-of-life outcomes show little to no difference between groups who received leads during DBS procedures whether awake versus asleep (i.e., under general anesthesia). Asleep DBS procedures have potential to shorten total time taken for DBS procedures.

Keyword: Deep Brain Stimulation, DBS, Parkinson's disease

O027 / #200

Topic: *AS04. Psychiatric Disorders*

STRUCTURAL CONNECTIVITY OF NUCLEUS BASALIS MEYNERT DEEP BRAIN STIMULATION IN ALZHEIMER'S DISEASE PATIENTS

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Introduction: The degeneration of the nucleus basalis Meynert (nbM) has been linked to dementia-related disorders like Alzheimer's disease (AD). Since the nbM neuronal loss is not homogeneous and its projections differ depending on the different anatomical divisions within the nbM, we aimed to analyze the network profiles based on the stimulation site and clinical outcome in AD patients that underwent deep brain stimulation (DBS) surgery.

Methods: We analyzed the data of 11 AD patients that underwent nbM DBS surgery. Clinical data was obtained before surgery and 6, 12 and 18 months postoperatively, which included the Mini-Mental Status Test (MMST) and Alzheimer's Disease Assessment Scale Cognitive Behavior Section (ADAS-cog). For the connectivity analysis, the nbM was segmented following its histological subdivision into anterior, intermediate and posterior as well as medial and lateral for both hemispheres. After this, we calculated the volume of tissue activated and tractography analysis using a normative connectome.

Results: The majority of fibers were located in the intermediate-lateral (IL) subdivision with 43%, followed by the anterior with 10% and the posterior with 4%. For the anterior region, 39% of the fibers projected to the orbitofrontal cortex (OFC), 27% to the dorsolateral prefrontal cortex (DL-PFC), 20% to the temporal region (TR), and 7% to dorsomedial PFC (DM-PFC). For the posterior region, 10% of the fibers projected to OFC, 7% to the DL-PFC, 15% to the TR, and 5% to DM-PFC. For the IL, 33% of the fibers projected to the DL-PFC, 27% to the OFC, 33% to the TR, and 9% to DM-PFC. Here, the majority of fibers projected to the fornix and hippocampus. After 18 months, anterior bilateral regions showed a significant clinical negative correlation, while posterior bilateral regions showed a significant positive correlation meaning a slower cognitive deterioration.

Conclusions: DBS of the nbM posterior regions showed a positive correlation associated with a better cognitive outcome. IL stimulation showed a higher connectivity to DL-PFC, DM-PFC and OFC areas simultaneously when compared to anterior and posterior regions. The fornix that has also been used as a DBS target for AD, could be modulated with nbM DBS.

Keywords: Nucleus basalis Meynert, Alzheimer's disease, DBS

O028 / #242

Topic: *AS11. Basic Science or Technology Development*

REVEALING THE FUNCTIONAL AND PHYSIOLOGICAL PROPERTIES OF HUMAN SINGLE NEURONS IN A TEMPORAL CORTICAL MICROCIRCUIT USING NEUROPIXELS

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Introduction: Most of our knowledge of local microcircuits in the brain in vivo comes from studies conducted in animal models, mostly due to lack of access to high-resolution neural recording technologies for human neuroscience. Recent significant technological advances in brain recordings and demonstration of the feasibility of high-density intracranial electrode technologies such as Neuropixels has opened up a new frontier for human neuroscience (Paulk et al. 2022; Chung et al. 2022). For our study, we intended to set up the first-ever Neuropixels recordings at our site, and focused on recording from a temporal cortical microcircuit. We intended to characterize the physiological responses of single neurons and local field potentials within the microcircuit.

Methods: For this study, we recruited patients undergoing elective anterior temporal lobectomies for epilepsy management. During the surgery, we performed Neuropixels recordings in the temporal microcircuit while the patient was under general anesthesia. We conducted recordings of spontaneous neuronal activity and in response to a sequence of auditory stimuli. We aligned the electrode probe perpendicular to the cortical surface in order to record neuronal activity from across the laminar compartments. The probe was stabilized for recordings using a combination of a microdrive and a ROSA robot, to mitigate the impact of brain tissue movements on the neuronal activity.

Results: We observed that the brain motion-induced drift was minimal, which was corrected using the most recent version of the Dredge correction algorithms for both the action potential and local field potential data. Using Kilosort 2.5 for spike sorting followed with curation using pre-determined quality metrics, we isolated 80 single units and 101 multiunits. We also found that a significant percentage of units are responsive to the auditory stimuli (36/181 units, $p<0.01$, binomial test) as well as to whether the auditory stimulus was an oddball sound (28/181 units, $p<0.01$, binomial test).

Conclusions: Our study is the first one to demonstrate single-unit responses to auditory oddball stimuli in the human brain, especially during general anesthesia. Ongoing work is determining the properties and relationships of the local field potentials, neuronal population activity, and single neuron activity across layers within and across tasks.

Keywords: hippocampus, neuropixels, microcircuit

O029 / #410

Topic: *AS04. Psychiatric Disorders*

CHARACTERIZING A BRAIN NETWORK ASSOCIATED WITH ANTI-DEPRESSANT EFFECTS FROM RESTING-STATE FUNCTIONAL MRI AFTER DEEP BRAIN STIMULATION OF THE MEDIAL FOREBRAIN BUNDLE FOR TREATMENT RESISTANT DEPRESSION

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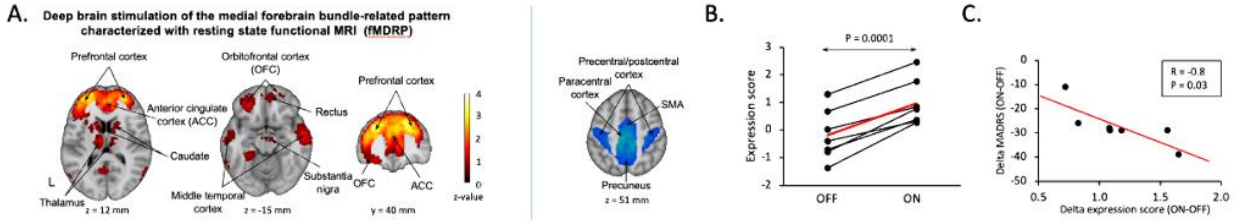
Introduction: Deep Brain Stimulation of the Superolateral branch of the Medial Forebrain Bundle (MFB-DBS) has been shown to have rapid long-lasting efficacy for (TRD). However, the topography of brain network changes associated with anti-depressant effects remain unclear.

Methods: rs-fMRI (1.5 T) was acquired in the OFF & ON stimulation conditions in 7 patients with TRD. A significant functional pattern associated with MFB-DBS was identified using an ICA-based algorithm(Vo CerCor 2023). Stimulation-mediated chnages in expression of this network were correlated with anti-depressant effects after MFB-DBS

Results: A mean decrease of 27.7 points (SEM+/-3.2) in MADRS ratings were seen after 12 months of MFB-DBS, with 6/7 patients classified as responders (> 50% decrease). rs-fMRI based network termed fMFB_DBSRP was characterized by significant changes in the superior, middle and orbitofrontal cortices(OFC), anterior cingulate(ACC), caudate and thalamus (Fig1). Opposite changes were seen in the sensorimotor cortex, SMA and precuneus (Fig1). Treatment-induced changes in network expression were seen in all patients (p=0.0001) and significantly correlated with the magnitude of changes in the MADRS ratings(R=-0.8, P = 0.03, Pearson correlation).



Conclusions: MFB-DBS produces significant therapeutic effects that are likely mediated via a distinct functional brain network. While prospective validation in an indepedent cohort is needed, preliminary results suggest expression of this netwrok has the potential to serve as an imaging biomarker for treatment efficacy.

Keywords: Deep Brain Stimulation, Brain Network, Refractory Major Depression

O030 / #114

Topic: *AS04. Psychiatric Disorders*

DEEP BRAIN STIMULATION TIME-SPECIFICALLY ENHANCED SYNCHRONIZATION WITHIN BNST-NAC CIRCUIT IN TREATMENT-RESISTANT DEPRESSION

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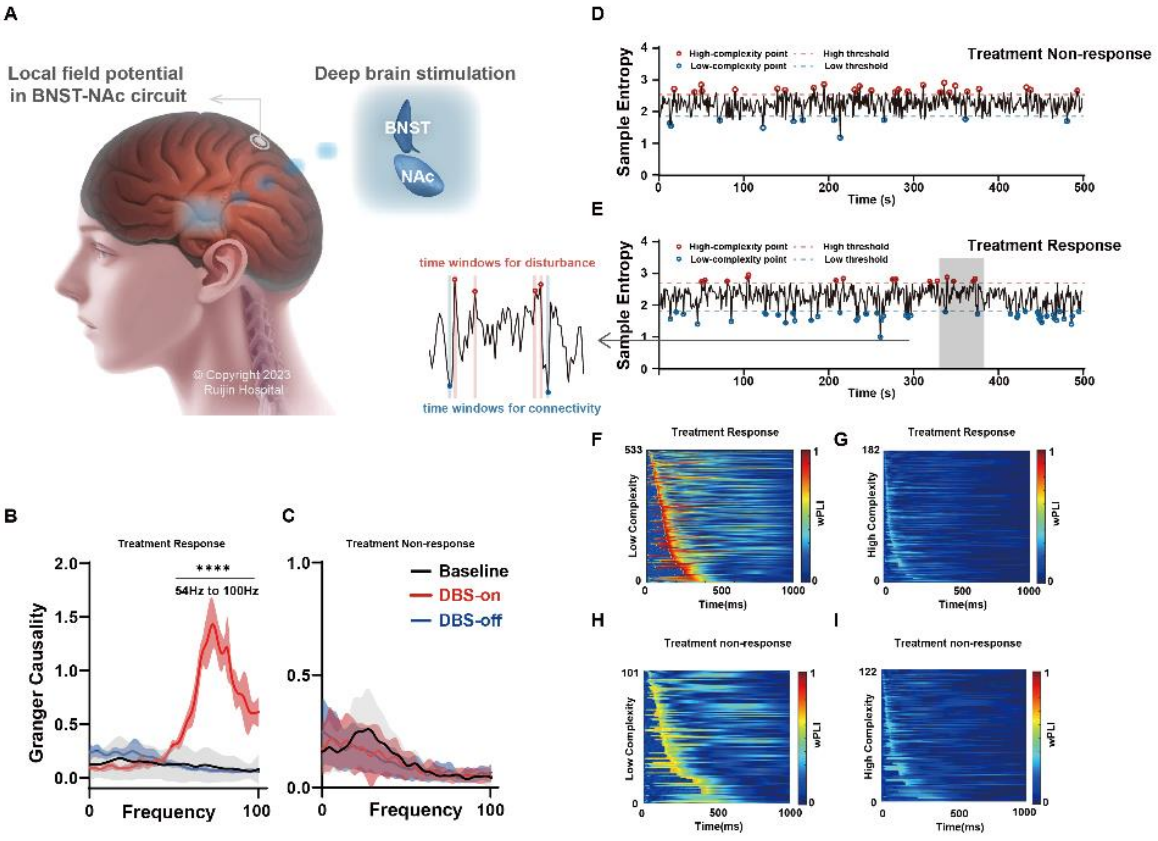
Introduction: Deep brain stimulation (DBS) has emerged as a promising therapeutic approach to treating patients with treatment-resistant depression (TRD). However, the underlying mechanisms through which DBS exerts its therapeutic effects are not yet fully understood. Previous studies have provided robust evidence indicating the crucial involvement of the bed nucleus of the stria terminalis (BNST) and the nucleus accumbens (NAc) neural circuitry in the processing of negative emotions. In this study, we analyzed local field potentials (LFP) and explored functional connectivity in the circuit of the BNST and NAc to assess mechanisms underlying the therapeutic effect of DBS.



Methods: A total of 18 patients diagnosed with TRD were recruited. Synchronous implantation of intracranial DBS electrodes was performed in the BNST and NAc. LFPs were recorded using the implanted electrodes. Participants' baseline symptom assessments and LFP recordings were conducted post surgically. Following a 6-month DBS treatment, reassessment and recording was conducted.

Patients were categorized into two groups based on achieving at least a 50% remission rate on the clinical scales. Differences in the LFP characteristics and functional connectivity of the BNST-NAc circuit were explored before and after DBS treatment and between the two groups.

Results: After 6 months of DBS treatment, the majority of subjects (13/18) showed significant improvements in depressive symptoms (improvement > 50% on Hamilton depression scale, which we defined as the response group). Compared to the non-response group, the response group showed significantly modulated oscillatory gamma activity in BNST and theta in NAc, which had strong correlations with TRD symptoms. Also, the enhancement of unidirectional functional connectivity of BNST-NAc circuit was exclusively observed, as measured by Granger causality. Phase-amplitude coupling (PAC) in the circuit also supported the findings, and the strength of PAC was correlated with TRD symptoms. Finally, we found that BNST-NAc functional connectivity enhancement is specific to low-complexity time windows, which may be related to the modulatory effects of DBS.

Conclusions: The modulation of DBS-induced functional connectivity is specific to a transient time window of low complexity, suggesting that one of the mechanisms through which DBS exerts its therapeutic effects may be to entrain disordered neuron populations.

Keywords: Deep Brain Stimulation, treatment resistant disorder, the bed nucleus of the stria terminalis

O031 / #74

Topic: *AS04. Psychiatric Disorders*

REAL-WORLD DATA ON DEEP BRAIN STIMULATION FOR OBSESSIVE COMPULSIVE DISORDER: LEVERAGING A GLOBAL DEVICE REGISTRY TO EXAMINE SAFETY OUTCOMES AND SUCCESS METRICS

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Introduction: Severe treatment-refractory obsessive-compulsive disorder (OCD) is a neuropsychiatric disorder involving repetitive thoughts and behaviors that interfere with daily life, which can be unmanageable with psychotherapy and medication alone. Deep Brain Stimulation (DBS) for treatment-refractory OCD has been a treatment option in Europe and the United States since 2009. Research over the past 2.5 decades has demonstrated the safety and efficacy of DBS for treatment-refractory OCD. Scientific guidelines support DBS for severe treatment-refractory OCD, stating that the potential benefits outweigh the potential risks. The objective of this analysis is to contribute to scientific knowledge by reviewing safety and efficacy outcomes of DBS for OCD from a global, real-world device registry.

Methods: The Product Surveillance Registry (PSR) is a device registry that enrolls patients undergoing DBS. Patients are consented and followed prospectively from implant through therapy life cycle. This analysis includes 52 implanted patients with OCD enrolled in the PSR from July 2012 through October 2023. To determine efficacy, we calculated the mean change in the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) from baseline to 6/12 month follow up. To determine safety, we reviewed serious adverse events (SAEs) and device events.

Results: The mean (SD) follow-up duration was 42.4 (29.7) months. During this time, 9 SAEs occurred in 8 (15.4%) patients (Table 1). A total of 121 neurostimulators, 106 leads and 98 extensions were recorded. Twelve device events occurred in 8 (15.4%) patients (Table 2). Four components (1 extension, 1 lead, and 2 neurostimulators) had a product performance event which resulted in clinical actions. Fifty percent (20/40) of the therapy-naïve patients had Y-BOCS data at both baseline and 6/12 months. A significant mean reduction of 10.95 points was observed between the two timepoints ($p<0.001$), with 50.0% and 15.0% of the patients achieving a full or partial response, respectively.

Table 1. Serious Adverse Events

Serious Adverse Event [a, b]	Event Counts	Events Per 100 Patient Years	Patients with Event (%) N=52 [c]
Bipolar Disorder	1	0.54	1 (1.92%)
Device Extrusion	1	0.54	1 (1.92%)
Medical Device Site Infection	1	0.54	1 (1.92%)
Suicidal Ideation[d]	2	1.09	2 (3.85%)
Suicide Attempt[e]	2	1.09	2 (3.85%)
Therapeutic Product Ineffective	2	1.09	2 (3.85%)
Total	**9**	**4.90**	**8 (15.38%)**

[a] Medical Dictionary for Regulatory Activities (MedDRA) Lower-Level Term or Medtronic's coding system term for events that do not exist in the MedDRA dictionary.
[b] In cases where the Clinical Events Committee (CEC) has adjudicated seriousness differently from the site, the CEC adjudication is used in this report for analysis purposes.
[c] The total number of patients with events may not represent the sum of all rows, as a patient may have experienced more than one type of event.
[d] One of the patients reported suicidal ideation and previous suicide attempt and the other patient reported "unknown" for both suicidal ideation and previous attempt prior to DBS therapy
[e] Both patients reported a suicide attempt prior to DBS therapy

Table 2. Device Events

Device Event [a]	Event Counts	Events Per 100 Patient Years	Patients with Event (%) N=52 [b]
Device Breakage	1	0.54	1 (1.92%)
Device Image Display Error	1	0.54	1 (1.92%)
Device Malfunction	2	1.09	2 (3.85%)
Device Placement at Incorrect Location	1	0.54	1 (1.92%)
High Impedance	4	2.18	3 (5.77%)
Lead Migration/Dislodgement	1	0.54	1 (1.92%)
Low Impedance	1	0.54	1 (1.92%)
Neurostimulator Migration	1	0.54	1 (1.92%)
Total	**12**	**6.54**	**8 (15.38%)**

[a] Medical Dictionary for Regulatory Activities (MedDRA) Lower-Level Term or Medtronic's coding system term for events that do not exist in the MedDRA dictionary.
[b] The total number of patients with events may not represent the sum of all rows, as a patient may have experienced more than one type of event.

Conclusions: Our research demonstrates that DBS for treatment-resistant OCD is an effective therapy in a real-world population, with 65% of patients reporting a full or partial response to treatment. The SAEs and device events reported in our cohort suggest that DBS has an acceptable safety profile for this hard-to-treat population.

Keywords: Device Registry, Deep Brain Stimulation, Obsessive Compulsive Disorder

O032 / #170

Topic: *AS04. Psychiatric Disorders*

RECONCILING A COMMON PATHWAY CONCEPT FOR DEEP BRAIN STIMULATION IN THE CASE OF OBSESSIVE-COMPULSIVE DISORDER

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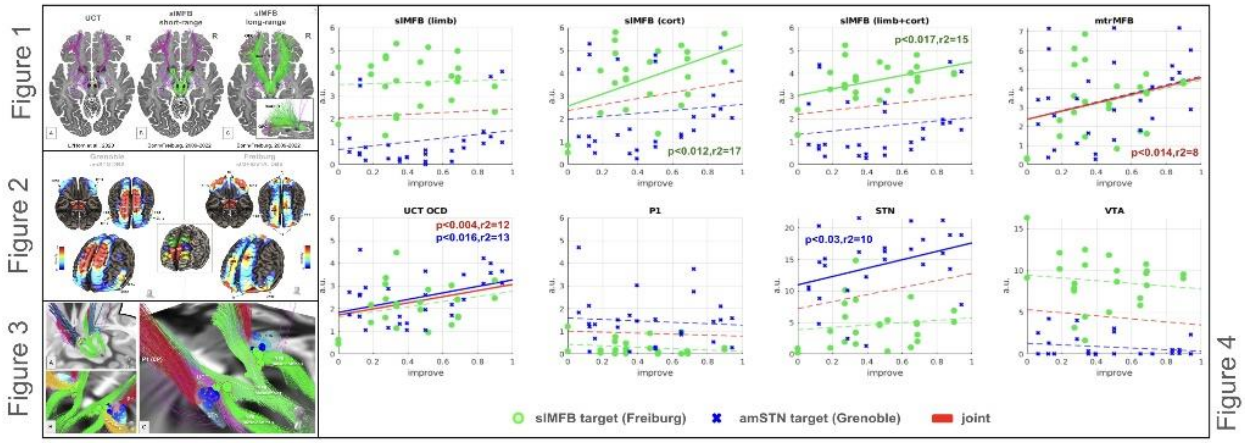
Introduction: Deep Brain Stimulation (DBS) in distinct brain regions is a therapeutic option for treatment resistant obsessive-compulsive disorder (OCD). The OCD network consists of different sub-networks with homeostatic functions, altered under disease and modifiable with DBS. Connectomic analyses of DBS data sets have defined fiber selections explaining anti-OCD efficacy (1). In search for an optimal DBS target, a centrally located, ramified fiber structure interconnecting several OCD sub-networks might serve as a likely candidate structure for a common pathway.

Methods: Analysis of data from 26 OCD patients with DBS (14 anteromedial subthalamic nucleus (amSTN), Grenoble; 12 superolateral medial forebrain bundle (slMFB), Freiburg). Yale-Brown Obsessive Compulsive Scale (Y-BOCS) improvement 24 months post surgery served as outcome parameter. Structural proximity and outcome were correlated using individual volumes of activated tissue for STN, ventral tegmental area, frontopontine tract, slMFB, unified connectomic tract target (UCT, based on atlases or established connectomes). Connectomes were inspected for structural similarities. Normative connectome data from the HCP cohort served to investigate cortical fiber penetration. Sub-network conjugations were evaluated as peak levels.

Results: According to the analysis (Figure 1-2) the UCT likely represents a lateral fiber selection of the slMFB. Sub-network conjugations project amongst other regions onto the dorsomedial prefrontal cortex (Brodmann‘s area 8 & 9, Figure 2). Both target regions (Figure 3) proved efficacious for OCD. Freiburg pre-DBS Y-BOCS was 34.33 ± 4.37, mean 24 months - improvement 41% ± 27%. The Grenoble cohort showed preoperative Y-BOCS 33.36 ± 3.54, mean 24 months - improvement 46% ± 29%. Whereas DBS of amSTN and slMFB typically address different OCD sub-networks, deep amSTN DBS can also address slMFB (Figure 4).

Conclusions: Conclusion: The slMFB is a dispersed fiber pathway which encompasses all OCD sub-networks, therefore qualifying as a common DBS target when stimulated in the diencephalic mesencephalic junction. Brodman area 8 emerges as a key conjugation/hub between OCD sub-networks.



REFERENCES 1. Li N, Baldermann et al. Nature Communications. 2020 Jun 23;11(1):1–12.

Keywords: unified connectomic tract target, slMFB DBS, TR-OCD

O033 / #212

Topic: *AS04. Psychiatric Disorders*

OBSESSIVE-RELATED ACTIVITY MODULATION IN OCD PATIENTS DURING NUCLEUS ACCUMBENS/ ANTERIOR LIMB OF THE INTERNAL CAPSULE STIMULATION

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Introduction: Deep brain stimulation (DBS) is an established therapy for psychiatric disorders with therapy resistant conditions, such as obsessive-compulsive disorder (OCD). Although it is generally recognized that the phenomenology of OCD symptoms is rooted in hyperactivity of the prefrontal cortex, the precise neural correlates of obsessions and compulsions are still poorly understood, as are the neurophysiological effects of DBS in OCD. Our aim was to uncover electrophysiological markers of OCD during a paradigm of symptom provocation.

Methods: We recorded bipolar local field potential (LFP) data from implanted leads in six patients with OCD who underwent Nucleus accumbens/ Anterior Limb of the Internal Capsule (Nac/ALIC) DBS, using the Percept PC system. Recordings were performed under a confrontation test condition in which patients were shown patient-adapted pictures with negative-, positive- and neutral-obsession-related content. Afterwards, patients were asked to rate if the picture provoked OCD symptoms and their emotional arousal (from 1 to 5) and the valence (from 1 to 5 – negative vs positive). This paradigm was conducted during active DBS. Afterwards, OCD-related spectral power LFP was calculated.

Results: Our study showed increase in low-frequency power (2-6 Hz) after stimulus onset (i.e., picture) compared to baseline starting, which lasted around 1000 ms. This low power changes is visible for both conditions (negative- and positive obsession-related pictures) and both hemispheres ($p<0.05$). Nevertheless, the effect is more pronounced for the left hemisphere compared to the right hemisphere. Moreover, there is a difference between symptom-provoking vs symptom-provoking event-related low frequency power only in the left hemisphere, with more increased power for symptomatic negative-obsession-related content pictures.

Conclusions: The present study is the first to report postoperative LFP data acquired with the fully-implanted DBS system Percept PC in Nac/ALIC DBS for OCD patients. Our findings suggest that an increase in low-frequency activity of a broad area in the Nac/ALIC in patients with OCD may contribute to generation of obsessions and possibly eventually the compulsion and anxiety phenomenology. Increased low-frequency activity before the onset of a compulsion might function as an electrophysiological marker for closed-loop DBS for OCD.

Keywords: OCD, DBS, Brain sensing

O034 / #216

Topic: *AS04. Psychiatric Disorders*

DEEP BRAIN STIMULATION IN THE TREATMENT OF SEVERE PSYCHIATRIC DISORDERS: LONG-TERM DATA ON SUICIDALITY

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Introduction: This study presents the findings of a longitudinal follow-up on suicidality outcomes among patients who underwent Deep Brain Stimulation (DBS) for treatment-resistant obsessive-compulsive disorder (OCD) and major depressive disorder (MDD). Suicidal ideation and feelings of weariness toward life are common and distressing symptoms among individuals suffering from these psychiatric conditions. DBS has emerged as an intervention for treatment-resistant cases, offering hope for improved quality of life and reduced symptom severity.

Methods: We analyzed item 10 in the Montgomery-Asberg Depression Rating Scale (MADRS) and the suicide risk assessment before DBS surgery and up to five years post-surgery in 17 patients. Item 10 in MADRS evaluates weariness of life, suicidal thoughts, and intentions. Twelve patients had undergone DBS for OCD and five for MDD. There were nine females and eight males; the average age at surgery was 40 years, and comorbidities included anorexia nervosa, attention-deficit hyperactivity disorder, bipolar disorder type II, autism, and generalized anxiety disorder.

Results: The results showed a meaningful reduction in scoring for weariness of life or suicidal thoughts after DBS. Before surgery, 76% of patients reported feelings of weariness toward life or suicidal thoughts compared to 35% at one-year follow-up. At two-year follow-ups, the number was 12%; at three years, 27%; and at four and five-year follow-ups, 12%. Before surgery, seven patients had a history of several suicide attempts, and one had one previous attempt. During the five-year follow-up, only one patient had several suicide attempts following social stressors during the first year after surgery, there were no suicide attempts at the following follow-ups. The rest of the group reported no suicidal attempts during the five-year follow-up.

Conclusions: These findings underscore the potential of DBS surgery as a therapeutic option for reducing suicidality in patients with treatment-resistant OCD and MDD. Patients who qualify for DBS for psychiatric indications often have an increased suicide risk due to the severity of the disorder and treatment-resistant symptoms. Therefore, it is important to have ongoing psychiatric monitoring and support following DBS surgery to optimize outcomes. Further research is warranted to elucidate appropriate rehabilitation post-DBS surgery and to identify strategies for enhancing long-term efficacy and patient well-being.

Keywords: suicidality, Depression, obsessive-compulsive disorder

O035 / #496

Topic: *AS06. Radiosurgery*

TREATMENT OF TRIGEMINAL NEURALGIA WITH RADIOSURGERY IN THE NEW ZAP-X DEVICE: THE SWISS EXPERIENCE, 2021-2024

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Introduction: The ZAP-X radiosurgical device has been in use at the Swiss Neuro Radiosurgery Center in Zurich since 2021 for the treatment of trigeminal neuralgia (TN).

Methods: From September 2021 to January 2024, 35 patients with TN were treated with the ZAP-X device. The original radiation dose of 70 Gy at the 80% isodose was reduced to 60 Gy at the 80% isodose from September 2023 onward to avoid side effects. All patients underwent close clinical follow-up.

Results: 25 of the 35 patients had idiopathic TN (ITN); 10 had TN of other types (multiple sclerosis, 7; solitary pons lesion, 1; "atypical TN", 2). 19 of the ITN patients were treated up to August 2023; 2 had had previous radiosurgery treatment and 2 did not come for follow-up. For the group of 15 ITN patients analyzed here, there were follow-up periods of 2 to 15 months. All 15 experienced relief of their TN pain (2 partial, 13 complete), and 9 were no longer taking medication for TN at the time of their last follow-up. The median latency to full pain relief was 3.9 months. These improvements came at the expense of moderate or severe sensory deficits in 5 of the 15 patients (2 moderate, 3 severe). All 3 patients with severe deficits, and one with a moderate deficit, also suffered from dysesthesia. From September 2023, a further 6 ITN patients were treated with the lower dose of 60 Gy at the 80% isodose. Their preclinical follow-up data at the time of submission of this abstract suggest effective pain relief with a lower risk of severe sensory loss and dysesthesia.

Conclusions: Radiosurgery with the ZAP-X device is effective against trigeminal neuralgia. The radiation dose must be chosen to minimize the risk of dysesthesia.

Keywords: radiosurgery, trigeminal neuralgia

O036 / #298

Topic: *AS06. Radiosurgery*

SEIZURE OUTCOMES AFTER GKRS FOR LARGE VOLUME AVMS

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Introduction: Treatment of large AVMs associated with epileptic seizures are difficult, as it should result not only in AVM obliteration but also in seizure improvement.

Methods: We analyzed the results of Gamma Knife radiosurgery (GKRS) for large AVMs associated with seizures and treated at our Radiosurgical department over 10 years from 2013. 30 patients with neurological follow-up were selected from the database and their clinical, neurological and radiological data were summarized. The Spetzler-Martin grade was 3 for 6 AVMs, 4 for 19 AVMs and 5 for 5 AVMs. As additional treatment, 18 patients underwent AVM embolization before GKRS, 4 – after GKRS and 8 patients were treated only with GKRS. Volume-staged GKRS were done for 19 patients: 2 stages for 9 AVMs, 3 stages for 8 AVMs and 4 stages for 1 and 5 stages for 1. The time interval between radiosurgical stages was 1 year. The prescribed irradiation volume for radiosurgery varied from 1.3 to 5.2 cm^3. The marginal dose was between 20 to 24 Gy, prescribed at 50% isodose. After GKRS patients underwent regular radiological (MRI and CA) and neurological follow-ups. The mean follow-up time after GKRS was 90 months (median 93, from 35 to 128 months).

Results: Among patients who had embolization before GKRS: 11 patients achieved seizure-free status after GKRS and 5 of them were no longer required AEDs; 5 patients achieved a decrease in seizure frequency following GKRS and 2 of them were free from AEDs; 2 patients had seizure-free status for 4 and 8 years after GKRS, but then seizures re-appeared following ischemic stroke and severe stress. Among 4 patients who underwent embolization after GKRS, 2 achieved seizure-free status without AEDs and 2 had no improvement in seizures with AEDs. Among patients who received only GKRS, 5 patients were seizure-free (3 without AEDs), 2 patients had a decrease in seizure frequency (one without AEDs) and 1 had no improvement in seizure status.

Conclusions: Gamma Knife radiosurgery offered an improvement in seizure status, associated with large AVMs and thus may be considered a favorable treatment strategy, even performed in a volume-staged mode.

Keywords: AVM, Epilepsy, radiosurgery

O037 / #483

Topic: *AS08. Stereotactic Procedures*

VIM LESIONS IN RADIOSURGERY AND FOCUSED ULTRASOUND: ASSESSMENT OF THE ACCURACY OF TWO TARGETING MODELS BASED ON MACHINE LEARNING.

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Introduction: Targeting the ventro-intermediate nucleus (VIM) remains a challenge for lesioning techniques such as radiosurgery (RS) or MR-guided focused ultrasound (MRgFUS). Are the lesioning targets equivalent to those used in DBS? To evaluate the ideal target locations, we examined the localization of lesions in the ventro-intermediate nucleus (VIM) in successfully treated tremor patients (considered our gold standard) and compared it with predictions generated by machine learning.

Methods: A specific prediction model of the VIM target in RS was generated from a database of patients successfully treated in Marseille using support vector machine regression. A second specific prediction model of DBS active contact placement in the VIM developed by RebrAIn® was used. External validation of these two models was performed by selecting two new series of patients after effective left VIM lesion. Twelve patients successfully treated with RS in Marseille (France) and 15 patients successfully treated with MRgFUS in Pampelona (Spain) were selected to Ievaluate the accuracy of two targets : the target obtained by the DBS algorithme and the target obtained using the newly developed RS model. Both targets were compared in terms of lesion center position and lesion diameter.

Results: The mean distance between the RS model target and the center of the RS lesion was 1.8±0.47 mm and between the DBS model target and the center of the RS lesion was 3.4±1.05 mm for a mean RS lesion diameter of 5.28±1.01 mm. The mean distance between the RS model target and the center of the MRgFUS lesion was 1.37mm ±0.3mm, and between the DBS model target and the center of the MRgFUS lesion was in the same range as in RS patients, with an MRgFUS lesion diameter of 4.9±1.3mm. All RS model targets are within the lesion for both RS and MRgFUS patient series. The DBS model targets are more medial (x-axis) and inferior (z-axis) than the RS model.

Conclusions: The more medial and inferior location of the DBS prediction model highlights the fact that the learning process takes into account patients who have greatly improved by selecting the deeper active contact of leads that are closest to the PSA.

Keywords: targeting, radiosurgery, focused ultrasound

O038 / #362

Topic: *AS08. Stereotactic Procedures*

PROBABILISTIC MAPPING OF LESION LOCATIONS IN BILATERAL FOCUSED ULTRASOUND THALAMOTOMIES

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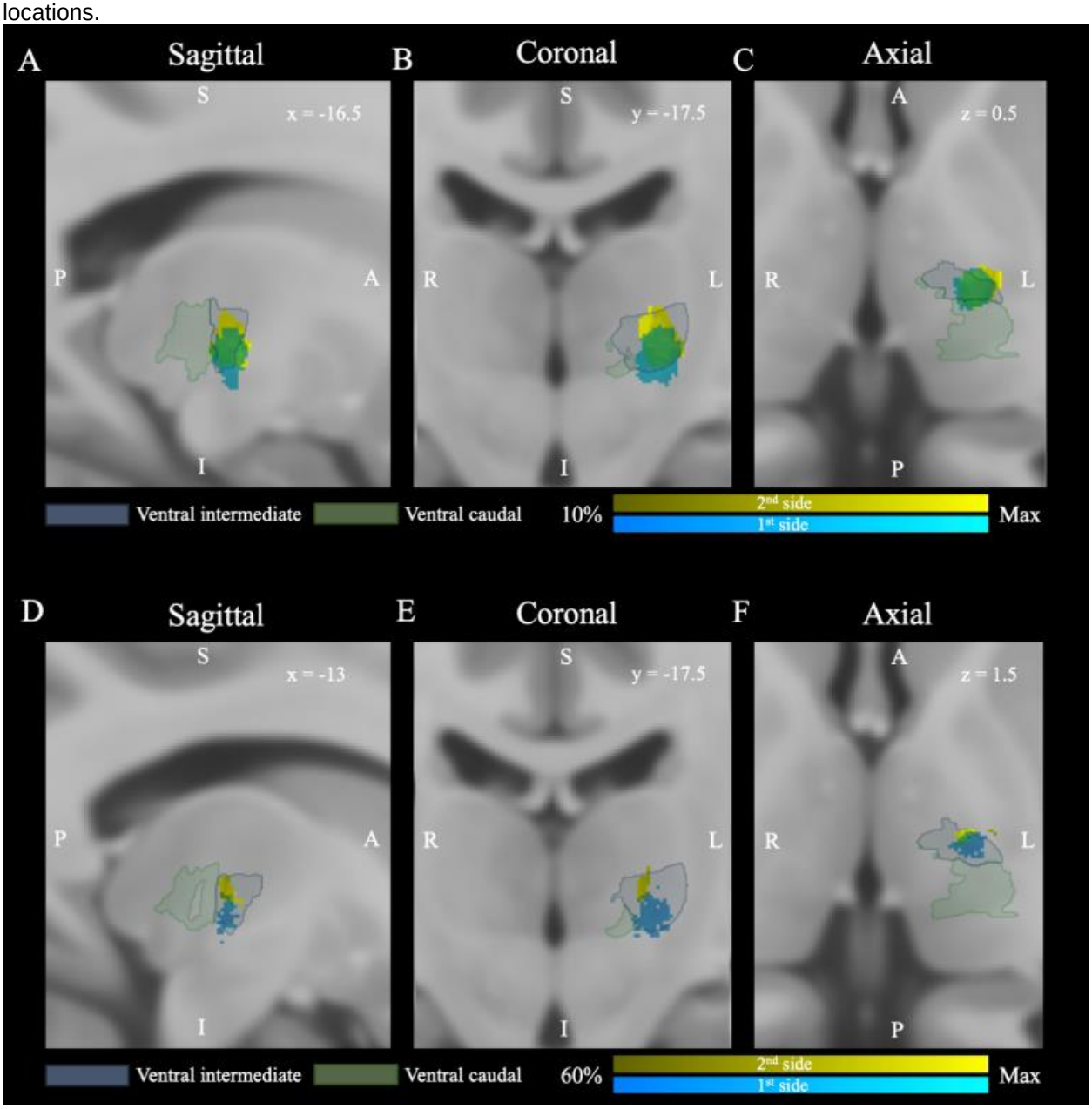
Introduction: Bilateral focused ultrasound thalamotomies for essential tremor (ET) patients have gained regulatory approval in various countries, marking a recent addition to neurosurgeon's arsenal. Nevertheless, the need for symmetrical lesioning to achieve an optimal outcome requires further clarification. The potential necessity of asymmetrical lesioning, aimed at preventing the exacerbation of complications from initial surgeries, raises uncertainty about its impact on clinical efficacy. The aim of this study is to evaluate lesion symmetry in a bilateral thalamotomy ET cohort, identifying and comparing spatial lesion locations with the highest clinical efficacy in both hemispheres to assess the potential requirement for symmetrical lesioning.

Methods: The CRST sub-scores for both sides at baselines and latest follow-up were reviewed. Lesions from the day-zero MRI of each surgery were segmented, and probabilistic maps of efficacy, as per literature methods[1], were generated. All right-sided lesions were flipped to left for visualization. All patients received initial treatment for their dominant hands, with intentional placement of second lesions 1mm superior to the first-side.

Results: Nineteen ET patients who underwent bilateral thalamotomies, with an average follow-up of 21±13 months after 2ndsurgery, were identified. Mean scores on the dominant side improved from 19.8±1.7 to 7.5±3.3, reflecting a 61% improvement, while non-dominant scores improved from 20.3±4.4 to 9.4±5.5, showing a 52% improvement. Thresholded probabilistic maps, showing a minimum 10% improvement, confirm the spatial superiority of lesions from the second surgery over the first, supporting the intentional asymmetrical lesioning. Thresholding at a 60% improvement revealed that the 'sweet spots' were dispersed along the length of the VIM near the VC junction, occupying distinct spatial

locations.



Conclusions: Non-overlapping sweet spots suggest the presence of multiple sweet spots within VIM rather than a single spot, supporting a "sweet tract" hypothesis. Symmetrical lesioning is not imperative for high efficacy in second-side surgeries; instead, emphasis is placed on accurate lesion placement. The study will be updated with complication maps during the congress.

Keywords: magnetic resonance guided focused ultrasound, essential tremor, probabilistic mapping

O039 / #318

Topic: *AS01. Movement Disorders*

NON-SELECTIVE LUMBOSACRAL VENTRAL-DORSAL RHIZOTOMY FOR MANAGEMENT OF LOWER-LIMB HYPERTONIA IN NON-AMBULATORY CHILDREN WITH CEREBRAL PALSY

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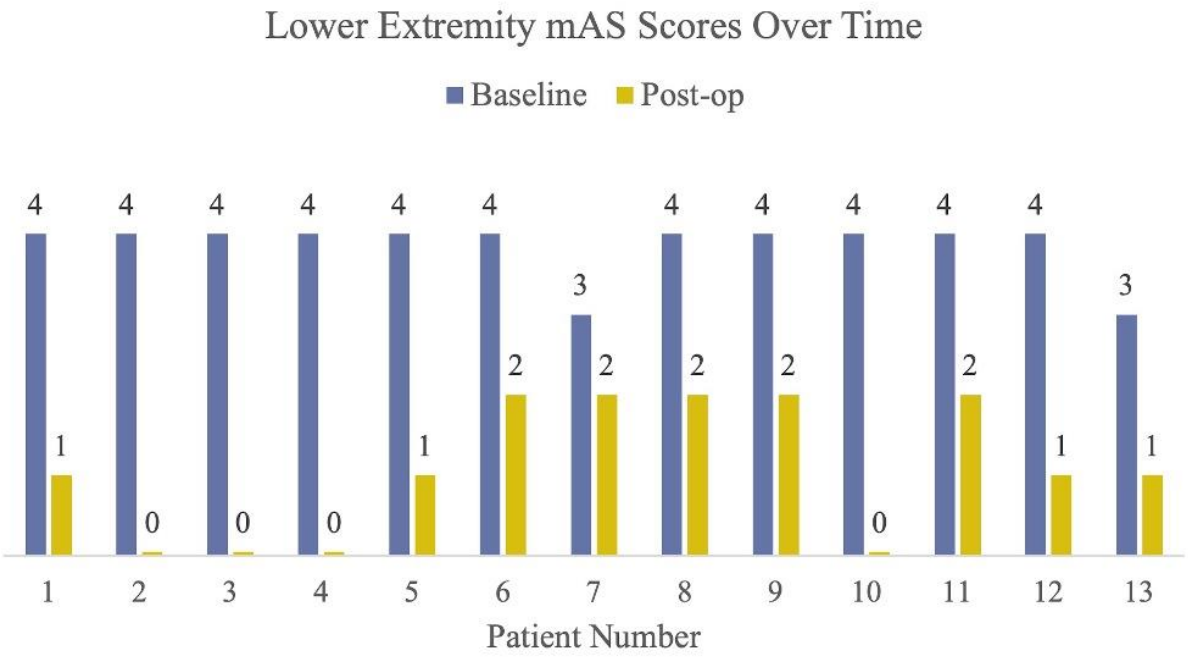
Introduction: Children with cerebral palsy (CP) often suffer from medically refractory hypertonia, for which there are surgical therapies including neuromodulation and rhizotomy. Traditional surgical treatment for medically refractory mixed hypertonia or dystonia includes intrathecal baclofen pumps (ITBP) and selective dorsal rhizotomy (SDR). A non-selective lumbosacral VDR (ventral and dorsal roots lesioned by 80-90%) has the potential to address the limitations of traditional surgical treatment options. We identified a cohort to highlight our institutional safety and efficacy using non-selective lumbosacral VDR for palliative tone management in non-ambulatory patients with highly involved CP.

Methods: Retrospective analysis was performed for patients that underwent lumbosacral VDR between 2022-2023. Demographic factors, clinical variables, and operative characteristics were collected.

Results: Fourteen patients (7 female) were included. All patients underwent a T12-L2 osteoplastic laminoplasty and bilateral L1-S1 VDR. Nine patients had quadriplegic mixed hypertonia, four patients had quadriplegic spasticity, and one patient had generalized secondary dystonia. Following VDR, there was a significant decrease in both the lower extremity modified Ashworth scale (mAS), mean difference (MD) -2.77 ± 1.0 ($p < 0.001$) and upper extremity mAS, MD -0.71 ± 0.76 ($p = 0.02$), postoperatively with average follow-up of three months. In the patient with generalized dystonia, the lower extremity Barry Albright Dystonia Scale (BADS) score decreased from 8 to 0 and the overall score decreased from 32 to 13. All parents noted improvement in caregiving provisions, particularly with positioning, transfers and changing. Mean daily enteral baclofen dose decreased from 47 mg preoperatively to 24.5 mg ($p<0.001$) postoperatively. Three patients developed wound dehiscence, two of which had concurrent

infections.



Conclusions: Lumbosacral VDR is safe, effective for tone control, and can provide quality of life improvements in patients with medically refractory lower-limb mixed hypertonia. Lumbosacral VDR can be considered for palliative tone control in non-ambulatory patients with more involved CP. Larger studies with longer follow-up are necessary to further determine safety and long-term benefits in these patients.

Keywords: Cerebral Palsy, Lumbar Rhizotomy, Lower Limb Hypertonia

O040 / #195

Topic: *AS01. Movement Disorders*

INVESTIGATION OF GUSTATORY PATHWAYS USING PROBABILISTIC TRACTOGRAPHY: IMPLICATIONS FOR MR-GUIDED FOCUSED ULTRASOUND

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Introduction: Taste disturbances have been increasingly recognized as a side effect following MR-guided focused ultrasound (MRgFUS) treatment of the ventral intermediate nucleus (VIM) for essential tremor and tremor-dominant Parkinson's disease. Given the impact of taste disturbances on patients' quality of life, addressing this issue has become a pressing concern. However, our understanding of how gustatory pathways traverse the thalamus and which regions are involved at the thalamic level remains incomplete. To address this knowledge gap, we conducted tractography of gustatory pathways using probabilistic tractography.

Methods: We leveraged data from 20 individuals sourced from the Human Connectome Project database. We created the tractography using diffusion-weighted images with MRtrix3. The medial lemniscus (ML) was delineated using the Regions of interest (ROIs) in the dorsal brainstem, entire thalamus, and postcentral gyrus, followed by the pyramidal tract (PT) using ROIs in the cerebral peduncle, posterior limb of the internal capsule, and precentral gyrus. Subsequently, gustatory tracts were delineated using the ROIs that were placed in a sphere with a 3-mm diameter, of which the center is at coordinates 3mm medial from the intersection between the anterior edge of the ML and the inner edge of the PT (Sphere ROI), the dorsal brainstem, Brodmann area 43. Additionally, the dentato-rubro-thalamic tract (DRTT) was delineated using the Sphere ROI, dentate nucleus, red nucleus, and precentral gyrus.

Results: The results indicated successful delineation of the ML, PT, gustatory tract, and DRTT in all 20 subjects. Across all participants, a total of 564 gustatory tracts (14.1 per patient) were identified, anteromedial to the ML and posteromedial to the DRTT in the anterior commissure – posterior commissure plane

(Figure).

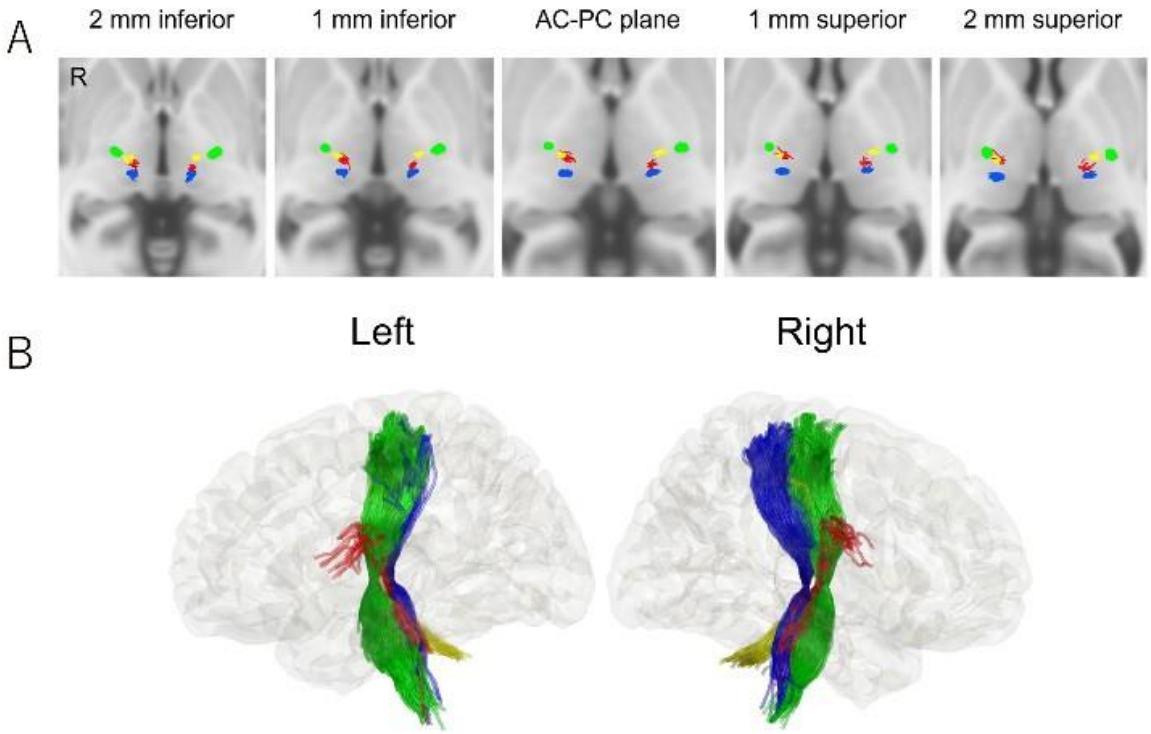

Figure. Spatial Relationship of Tractography in Axial Images.

(A) Axial images show the spatial relationships of the gustatory tract, medial lemniscus (ML), pyramidal tract (PT), and dentato-rubro-thalamic tract (DRTT) in 2 mm inferior, 1 mm inferior, in, 1 mm superior, and 2 mm superior to the Anterior Commissure - Posterior Commissure (AC-PC) plane. The gustatory tract is represented in red, ML in blue, PT in green, and DRTT in yellow. R: right. (B) A three-dimensional brain image.

Conclusions: Our findings suggest that gustatory pathways are predominantly located anteromedial to the ML and posteromedial to the DRTT at the thalamic level. These insights highlight the importance for clinicians performing MRgFUS on the VIM to consider the gustatory pathways when selecting treatment targets.

Keywords: MR guided Focused ultrasound, essential tremor, dysgeusia

O041 / #530

Topic: *AS02. Epilepsy*

RADIOSURGICAL CORPUS CALLOSOTOMY FOR INTRACTABLE EPILEPSY: RETROSPECTIVE LONG-TERM SAFETY AND EFFICACY ASSESSMENT IN 19 PATIENTS AN REVIEW OF THE LITERATURE

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Introduction: Some patients suffering from intractable epileptic seizures, particularly drop attacks (DAs), are nonremediable by curative techniques. Palliative procedure carries a significant rate of surgical and neurological complications. Objective: To propose evaluation of safety and efficacy of Gamma Knife corpus callosotomy (GK-CC) as an alternative to microsurgical corpus callosotomy.

Methods: This study included retrospective analysis of 19 patients who underwent GK-CC between 2005 and 2017.

Results: Of the 19 patients, 13 (68%) had improvement in seizure control and 6 had no significant improvement. Of the 13/19 (68%) with improvement in seizures, 3 (16%) became completely seizure-free, 2 (11%) became free of DA and generalized tonic-clonic but with residual other seizures, 3 (16%) became free of DA only, and 5 (26%) had >50% reduction in frequency of all seizure types. In the 6 (31%) patients with no appreciable improvement, there were residual untreated commissural fibers and incomplete callosotomy rather than failure of Gamma Knife to disconnect. Seven patients showed a transient mild complication (37% of patients, 33% of the procedures). No permanent complication or neurological consequence was observed during the clinical and radiological workup with a mean of 89 (42-181) months, except 1 patient who had no improvement of epilepsy and then aggravation of the pre-existing cognitive and walking difficulties (Lennox-Gastaut). The median time of improvement after GK-CC was 3 (1-6) months.

Conclusions: Gamma Knife callosotomy is safe and accurate with comparable efficacy to open callosotomy in this cohort of patients with intractable epilepsy suffering from severe drop attacks.

Keywords: Epilepsy, stereotactic, radiosurgery

O042 / #243

Topic: *AS02. Epilepsy*

NEUROPHYSIOLOGIC FEATURES OF CENTROMEDIAN NUCLEUS SUBREGIONS TO GUIDE SURGICAL TARGETING

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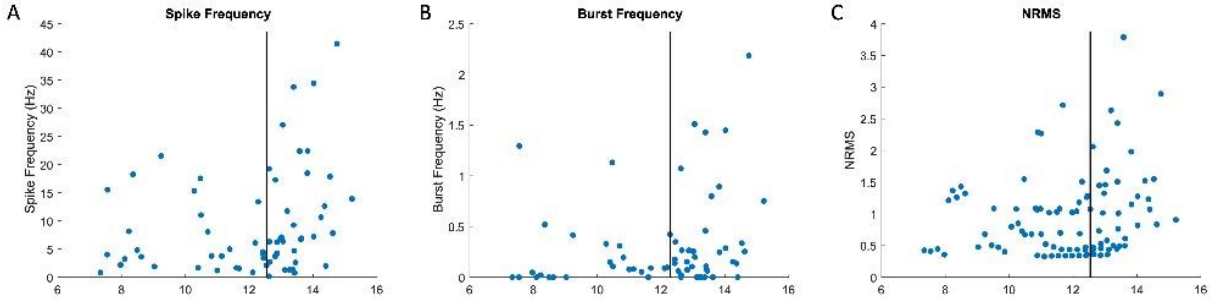
Introduction: Neuromodulation of the centromedian (CM) nucleus of the thalamus has shown promise in treating epilepsy. Limited data suggest greater seizure reduction with lateral, parvocellular CM stimulation. The lack of established imaging features and distinct electrophysiological markers for targeting this nucleus remains a challenge. Our study analyzes single-cell microelectrode recordings (MER) to identify unique electrophysiological characteristics of the CM.

Methods: Intraoperative MER were recorded from 5 patients (9 hemispheres) undergoing deep brain stimulation or responsive neurostimulation of CM for generalized (4 patients) or multifocal (1 patient) epilepsy. Two cases were performed awake, and 3 under general anesthesia. Recording locations were determined through coregistration of preoperative MRI, postoperative CT, and the Morel histologic atlas. CM was divided into a medial portion overlapping with the CM segmentation from the THOMAS radiographic atlas and a lateral portion found lateral to the THOMAS CM. Spike and burst rates and normalized root mean square (NRMS) were characterized at recording depths.

Results: Neuronal activity was observed in 319 of 481 recording depths. Bursting was observed in 172 recording locations. CM exhibited a mean spiking rate of 9.2 Hz (±9). The mean bursting rate in CM was 0.31 Hz (±0.45). In the CM there was a mean of 6 spikes per burst and a burst duration of 18.1 ms. There were no significant differences between medial and lateral CM for spiking (Wilcoxon rank-sum test, p=0.08) and bursting rates (p=0.17) (Fig. 1A, Fig. 1B). Mean firing rate (15.7 Hz; p=0.0007) and bursting rate (0.68 Hz; p=0.001) were significantly higher in the ventral lateral (VL) nucleus compared to the CM. Mean NRMS was lower in the CM (0.97) than non-CM thalamus (1.20) (Wilcoxon rank-sum test, p=0.0002), specifically VL (NRMS of 1.17, p=0.001). The NRMS of the lateral CM (40 recordings) was significantly higher than medial CM (58 recordings) for all cases (Wilcoxon rank-sum test, p=0.03) (Fig. 1C). This effect appeared to depend on anesthetic state (awake cases: p=0.02; asleep cases: p=0.38).



Conclusions: CM is characterized by distinct electrophysiological features which differ from other thalamic nuclei and vary within the CM itself. Further investigation of these features may guide neuromodulation to optimize therapeutic effect.

Keywords: Epilepsy, Deep Brain Stimulation, Centromedian nucleus

O043 / #237

Topic: *AS08. Stereotactic Procedures*

ADOPTION AND ACCESSIBILITY OF LASER INTERSTITIAL THERMAL THERAPY (LITT) IN THE UNITED STATES: A NATIONWIDE INPATIENT SAMPLE ANALYSIS

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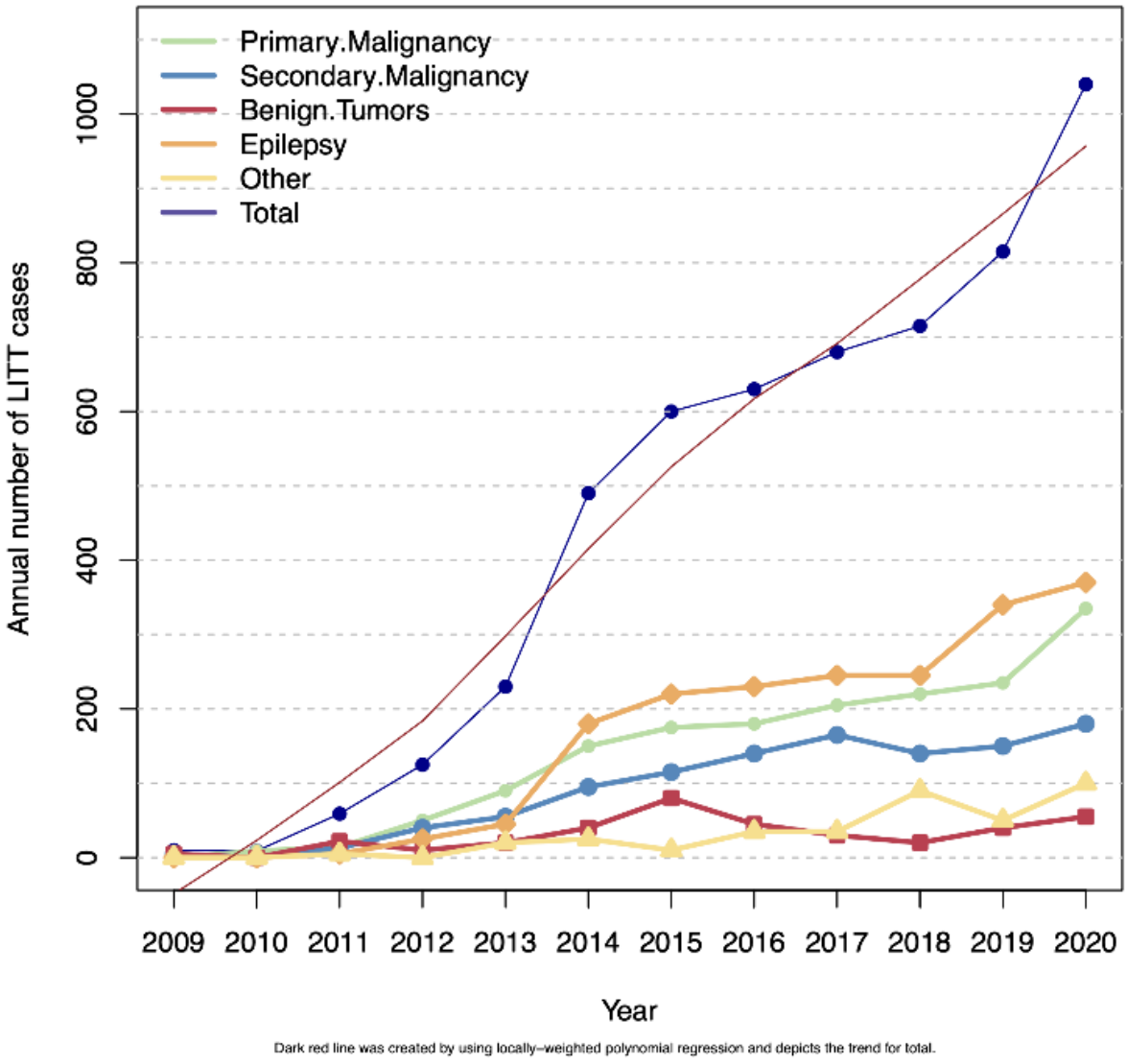
Introduction: Laser Interstitial Thermal Therapy (LITT) is a minimally invasive stereotactic procedure wherein an optical fiber is guided through brain to administer laser light for ablative purposes. The evolution of adoption trends for this relatively novel technique across various indications over years remains inadequately documented. Furthermore, the accessibility of this treatment for all demographic groups and the potential existence of any disparities require further clarification. This study aims to conduct a comprehensive analysis of LITT utilization across multiple indications, seeking to enhance understanding of the factors contributing to disparities in access.

Methods: The analysis of surgical volume and procedure trends based on indication, utilizing pertinent ICD codes, was conducted using the U.S.-based "National Inpatient Sample" database. Predictors of LITT utilization were examined through a logistic regression model.

Results: Our analysis of 5,403 LITT discharges from 2009 to 2020 unveiled that the predominant indications were epilepsy (35.2%), primary malignant neoplasm (PMN) (30.7%), and secondary malignant neoplasm (SMN) (20.3%). Notably, there is an upward trend in both the overall number of LITT procedures and the figures for the three primary indications. Negative predictors for LITT utilization encompassed an age increase for epilepsy and SMN, as well as male sex for epilepsy and PMN. Across all cohorts, African American status emerged as a consistent negative predictor. Private insurance was identified as a positive indicator in epilepsy, while other indications exhibited no influence based on payer status. Factors such as patient location and median income in the patient's zip code did not demonstrate an impact. Conversely, large-sized hospitals, urban-teaching status, and governmental hospital status were identified as positive indicators for the use of

LITT.



Conclusions: Demographic and socioeconomic-based discrepancies in LITT utilization are apparent. While racial disparities persist across all primary indications, other imbalances, such as age, sex, and insurance status, are specifically pertinent in certain indications.

Keywords: trend, laser interstitial thermal therapy, disparity

O044 / #360

Topic: *AS02. Epilepsy*

SUBCORTICAL AROUSAL STRUCTURES DEMONSTRATE VIGILANCE DEPENDENT CONNECTIVITY DIFFERENCES IN FOCAL EPILEPSY

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Introduction: Epilepsy affects nearly 1% of the global population and focal epilepsy can have widespread effects outside of seizures, including decreased attention, executive function, and concentration. These neurocognitive can greatly affect the quality of life for many patients. Neuromodulation of subcortical networks has demonstrated preliminary success in the restoration of consciousness for consciousness-impairing seizures and similar strategies may aid in improving neurocognitive functioning in patients with focal epilepsy. It is hypothesized in the Extended Network Inhibition Hypothesis that subcortical-to-neocortical networks contribute to these neurocognitive deficits, but prior studies have been confounded by arousal level, termed vigilance. Thus, we sought to analyze subcortical networks while controlling for vigilance state to identify neuromodulation targets for neurocognition in focal epilepsy.

Methods: 20-minutes of resting-state functional MRI (fMRI) data were obtained for 46 age-matched patients with focal epilepsy and healthy controls. These data were parcellated into subcortical and cortical regions with the Harvard-Oxford atlas and a patient-specific atlas of nucleus basalis of Meynert (NBM), a key subcortical nucleus. Functional connectivity was computed between all regions using a sliding window technique with a 2-minute length and 2-second stride. Degree, a network measure of the number of connections of a brain region, was used to assess connectivity of subcortical arousal structures. Vigilance was computed using an fMRI based template for all windows, with high and low vigilance windows selected for analysis.

Results: We found that degree of the ipsilateral NBM was increased in the high vigilance state in patients (paired t-test, p=0.007), but not for controls (p=0.301, Fig. 1A-B), perhaps representing decreased activating output from subcortical arousal structures. Furthermore, the NBM degree is lower in patients than controls in the low vigilance state (p=0.005), but not in the high vigilance state (p=0.150, Fig. 1C-D). This may indicate that patients have decreased activation of subcortical structures at baseline which may

contribute to long-term neurocognitive deficits.

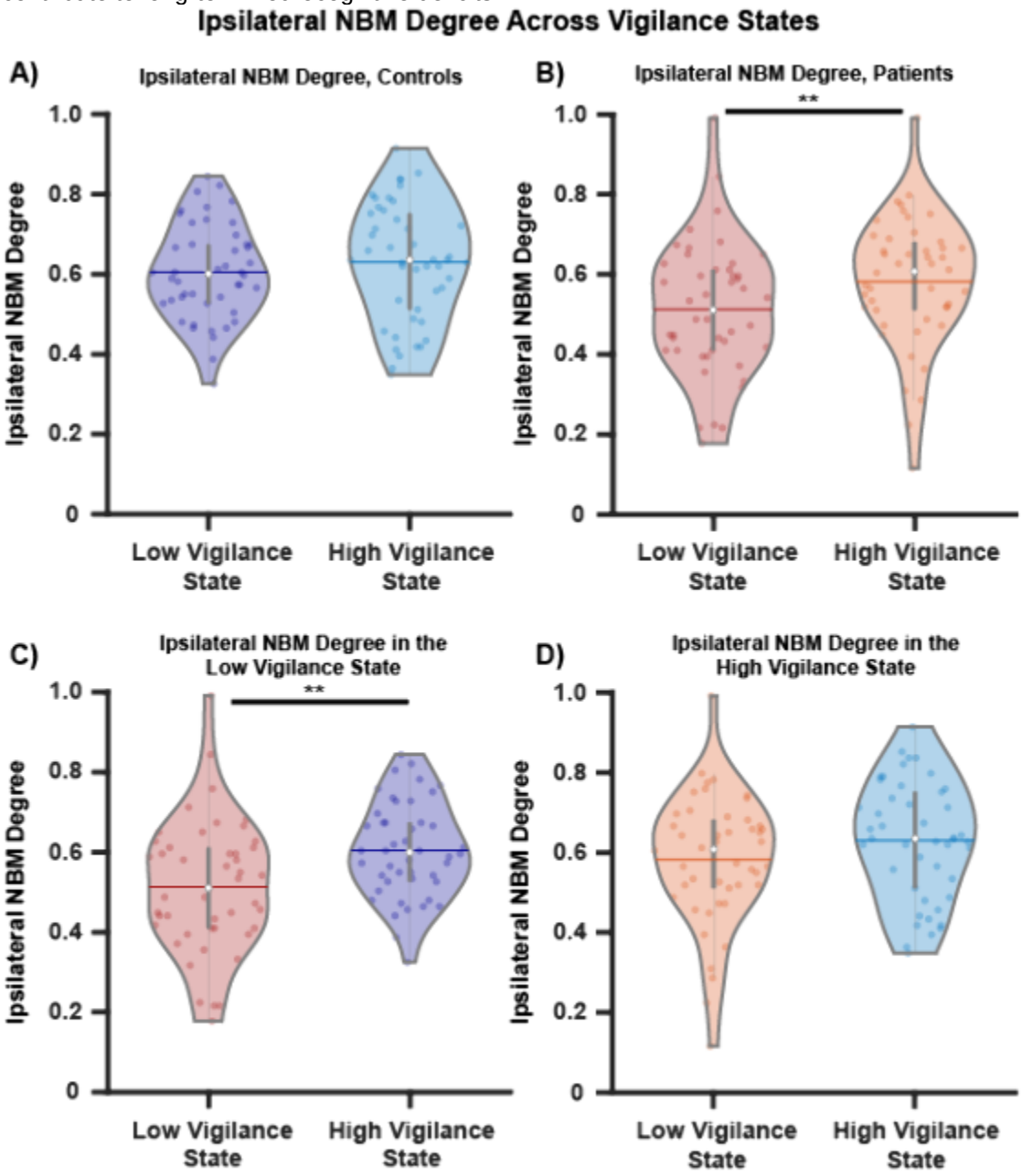

Fig. 1: Patients with focal epilepsy demonstrate less widespread connectivity with the NBM in the low vigilance state. Data from 46 patients and 46 age-matched controls are shown. Ipsilateral NBM degree is shown between vigilance states in the top row, with controls displayed on the left (A) and patients displayed on the right (B). Ipsilateral NBM degree between patients and controls is shown in the bottom row, with the low vigilance state depicted on the left (C) and the high vigilance state depicted on the right (D). Controls did not have a change in ipsilateral NBM degree betweeen low and high vigilance states wheras patients had higher degree in the high vigilance state. Furthermore, patients and controls did not have different degree in the high vigilance state, but did in the low vigilance state. Groups were compaired with paired t-tests and a Bonferroni-Holm procedure was performed for multiple comparisons. *p<0.05, **p<0.01, ***p<0.001.

Conclusions: Impaired neurocognition can be devastating to patients with epilepsy and neuromodulation of subcortical networks may help these patients. We found that subcortical networks are disrupted in patients during low vigilance states. Such work may lead to identification of targets for neuromodulation to improve neurocognitive deficits.

Keywords: Epilepsy, Network Neuroscience, connectomics

O045 / #39

Topic: *AS08. Stereotactic Procedures*

A POSTERIOR APPROACH FOR COMBINED TARGETING OF THE CENTROMEDIAN NUCLEUS AND PULVINAR FOR RESPONSIVE NEUROSTIMULATION

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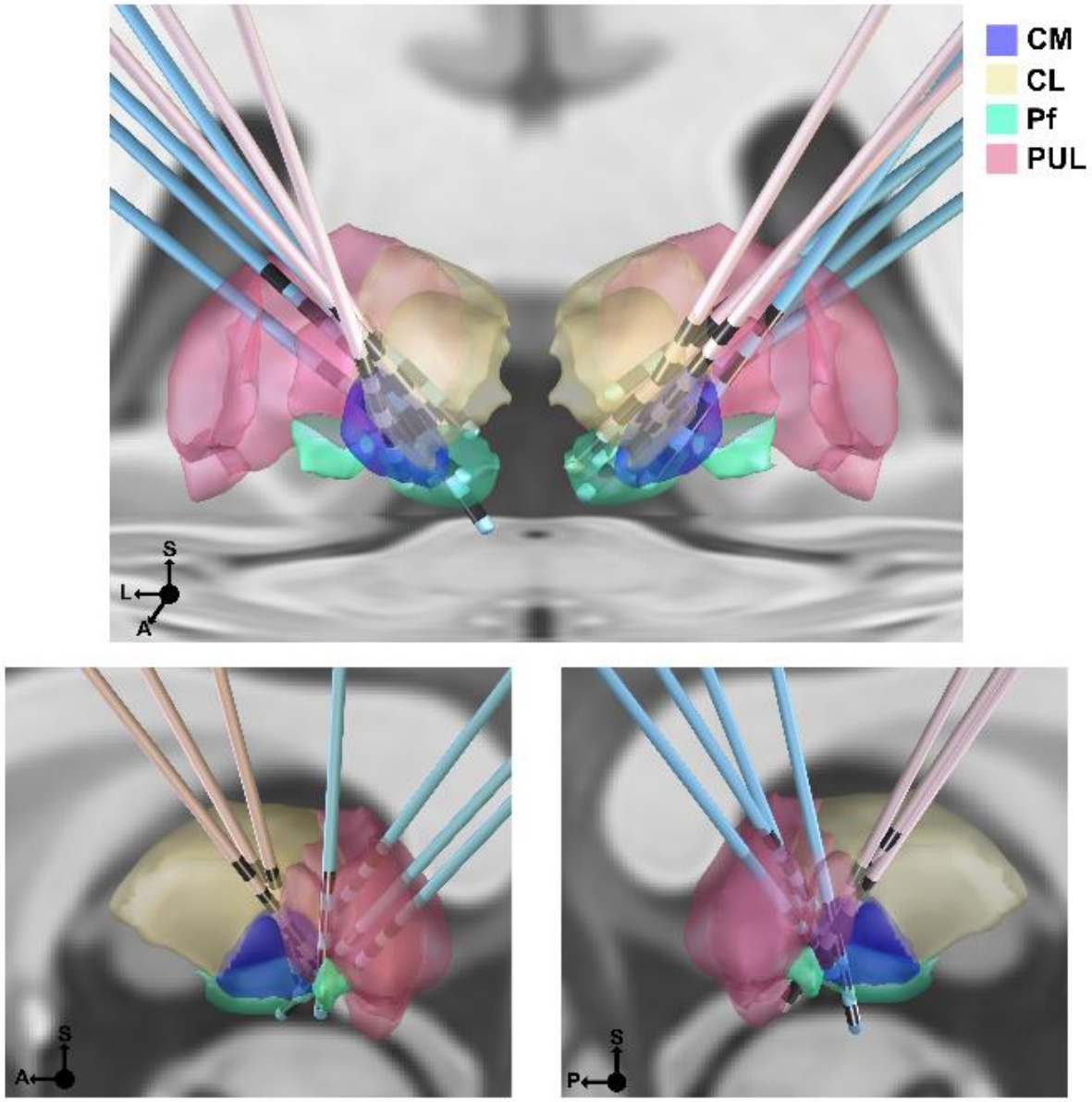
Introduction: Responsive neurostimulation (RNS) has demonstrated efficacy in seizure control in patients with drug-resistant epilepsy (DRE). Several thalamic nuclei including the anterior nucleus (ANT), centromedian (CM), and pulvinar (PUL) have been implicated in epilepsy and targeted for neuromodulation. Here, we report and demonstrate efficacy of a novel posterior targeting approach to the CM.

Methods: We retrospectively collected clinical and imaging data from 7 patients (8 total CM leads) who were implanted with at least one posterior trajectory CM lead, and 4 patients (6 total CM leads) who were implanted with at least one standard trajectory CM lead. Mean follow-up was 10.4 months (range 8-13, SD 1.5) and 11.25 months (range 10-12, SD 0.8) in the posterior trajectory and anterior trajectory groups, respectively. Lead localizations were performed in LeadDBS and the Morel atlas was utilized to determine individual contact positions relative to thalamic nuclei. Seizure outcome at most recent follow-up was collected. A two-sample t-test was used for statistical analysis.

Results: Patients in the posterior trajectory group had a mean of 65.2% (range 0-100%, SD 35.4) seizure reduction, while the anterior trajectory group had a mean of 48.1% (range 0-100%, SD 42.7), and were not statistically significantly different ($p = 0.53$). Contact localizations showed that at contacts from patients in the posterior trajectory group were within the CM and/or PUL. No contacts from the anterior trajectory group were in the PUL. There was seizure detection in leads with contacts in CM and

PUL.



Conclusions: A posterior trajectory approach to the CM allows for a single lead with contacts in both CM and PUL. Additionally, we demonstrate in this small cohort that this targeting approach is feasible and effective in DRE, providing an alternative in cases where the conventional anterior approach is infeasible or where dual pulvinar and CM coverage is desired.

Keywords: responsive neurostimulation, centromedian, Epilepsy

O046 / #86

Topic: *AS11. Basic Science or Technology Development*

USING STEREOTACTIC ELECTROENCEPHALOGRAPHY TO DECODE AN IMPLICIT MODEL OF OTHER PEOPLE'S VISUAL ATTENTION AS A 'BEAM' OF MOTION

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Introduction: Accurately perceiving the attention, intention, and beliefs of another person underpins fluent social functioning and high social-emotional intelligence. A critical component of social cognition is understanding what another person is paying attention to. A traditional view in psychology is that people track attention by tracking others' gaze. In contrast, recent studies showed that the brain builds a much richer model of others' attention, involving the simplified construct of 'beams' of implied motion travelling from social agents toward attended objects (Guterstam & Graziano 2020 Prog Neurobiol). Using neuroimaging based on hemodynamic markers of brain activity (fMRI), this implied agent-to-object motion signal could be significantly decoded from the temporoparietal junction (TPJ) (Guterstam et al 2020a PNAS). However, the direct electrophysiological correlates of this internal 'fluid-flow' model of attention remain unexplored.

Methods: To address this issue, human neurosurgical patients with implanted intracranial stereoelectroencephalography (sEEG) electrodes were exposed to multiple short trials consisting of either low-level visual motion (going left or right) or static images of faces gazing left or right, while their brain activity were recorded.

Results: We found that a classifier, trained to discriminate the direction of visual motion, significantly decoded gaze direction in static images depicting a sighted face (56.7-66.7%, p-values <0.01-0.04), but not a blindfolded one (40.0%-50.0%, p-values 0.44-0.99), based on grid-wide high-gamma activity. The decoding was specific to electrodes in mesial temporal structures (amygdala, hippocampus and entorhinal cortex) and in the TPJ; cortical regions with key roles in spatial reasoning and social cognition.

Conclusions: These results demonstrate, for the first time, a link between the visual motion system and social brain mechanisms at an electrophysiological level. They extend previous fMRI findings by showing that mesial temporal structures work in concert with the TPJ to encode gaze as implied motion, where, speculatively, mesial temporal structural provides the spatial framework to a social representation of other agents in the TPJ. This model may be a fundamental aspect of social cognition that allows us to intuitively link social agents with the objects of their attention, with potential implications for disorders associated with impaired social ability (such as autism).

Keywords: STEREOTACTIC ELECTROENCEPHALOGRAPHY, ATTENTION

O047 / #465

Topic: *AS04. Psychiatric Disorders*

DEEP BRAIN STIMULATION OF THE VENTRAL CAPSULE AND VENTRAL STRIATUM DRIVES APPROACH BEHAVIOR AND HIGH BETA POWER IN VENTROLATERAL PREFRONTAL CORTEX

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Introduction: Deep Brain Stimulation (DBS) of the ventral capsule and ventral striatum (VC/VS) is an effective therapy for treatment resistant obsessive-compulsive disorder (trOCD). While clinical improvement occurs over months, elevated mood and energy can occur shortly after stimulation initiation. Acute changes, which we term “approach behaviors”, include increased engagement and talkativeness. We investigated the relationship between changes in stimulation amplitude, spectral power in the ventrolateral prefrontal cortex (vlPFC), and speech rate to quantify a biomarker of approach behavior.

Methods: A patient with trOCD was implanted with bilateral VC/VS DBS leads and subdural electrodes adjacent to orbitofrontal cortex (OFC) and vlPFC. On days 0, 10, 25, and 67 of therapy, we recorded audio/video in experiments with blocks of low and high amplitude stimulation; a control recording was conducted on day 171, with constant amplitude across blocks where the patient spoke or remained silent upon instruction. Recordings were synchronized to neural activity via stimulation artifact injection. Speech rate was calculated from audio. Power in a high beta frequency biomarker (31±1.5Hz; determined via inspection of power spectra) was computed using time-resolved parametrization to remove the 1/f component. Statistical comparisons of power or speech rate computed during periods of high or low amplitude stimulation were conducted using 2 sample Students t-test.

Results: Speech rate ($p<10^{-2}$, Hedge’s $g>0.3$) and high beta power ($p<10^{-4}$, Hedge’s $g>0.3$) in the left (all four experiments) and right vlPFC (first three experiments) were significantly higher during high than during low amplitude stimulation. Left vlPFC power correlated significantly with speech rate in all four experiments ($p<0.05$, mean $R^2=0.0252$), while right vlPFC power correlated in the first two ($p<0.05$, mean $R^2=0.0137$). Notably, at 10 weeks the patient's Young's Mania Rating Score rose to 4, uncharacterstic for individuals without history of bipolar disorder. In the control, vlPFC power did not change significantly between speech and silence, nor did it correlate significantly with speech rate, suggesting stimulation amplitude is a key driver of the observed talkativeness

phenomenon.

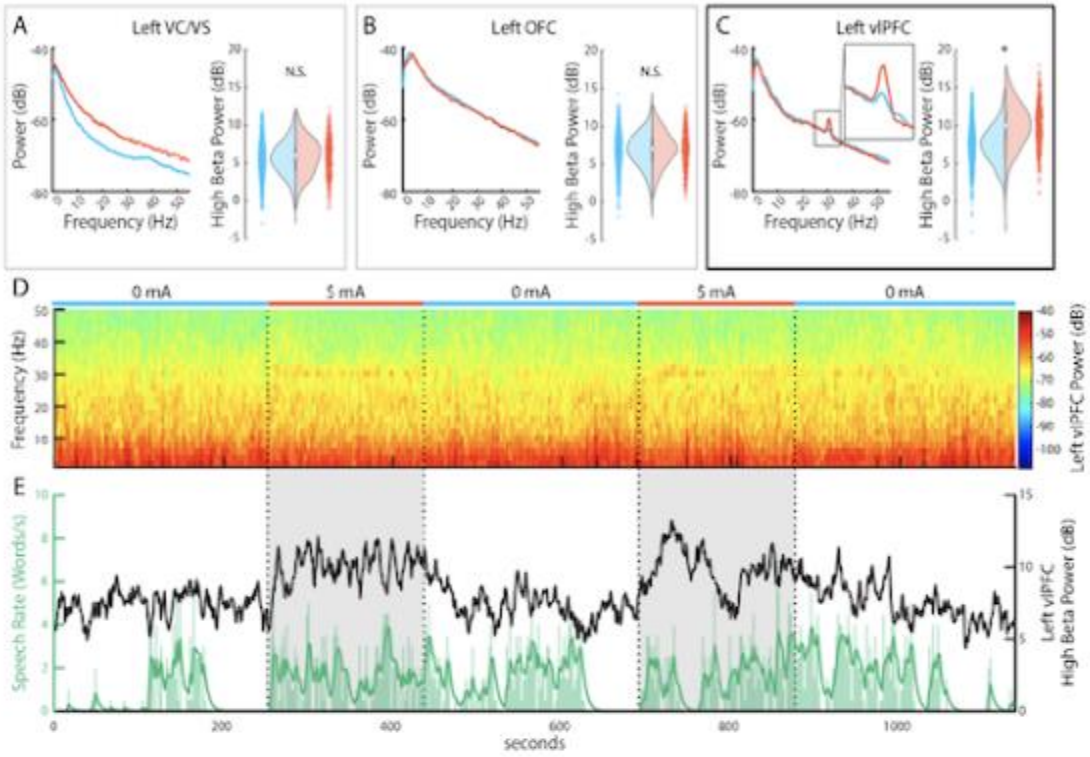

Figure 1. High beta power in vlPFC increases with speech rate during DBS. (A) Power spectral density plots showing average activity during DBS on (red; DBS frequency: 150.6 Hz, DBS amplitude: 5 mA, DBS pulse width: 180 us) and off (blue) period in the left VS, **(B)** OFC, and **(C)** vlPFC. Violin plots in **A-C** show 1/f-corrected high beta power distributions in the DBS on (red) and off (blue) conditions. Left vlPFC shows a significant difference in high beta power between DBS on and off. **(D)** Time-frequency decomposition of left vlPFC power shows the high beta power increase in response to bilateral VC/VS DBS. DBS amplitude is indicated by the blue (0 mA) and red (5 mA) lines above the spectrogram. **(E)** Speech rate (green; words per second) and high beta power in the left vlPFC (black). All data shown in this figure were collected during the amplitude modulation experiment conducted on the same day as DBS activation (Day 0 after DBS).

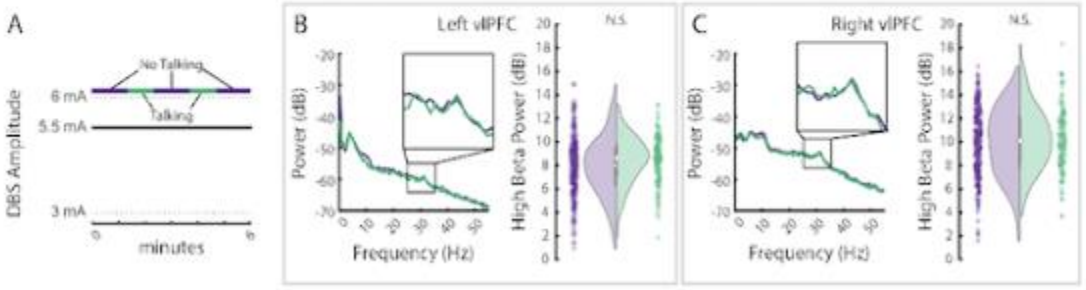

Figure 2. vlPFC high beta power is not modulated by the simple presence vs. absence of speech. (A) Experimental paradigm showing bilateral constant DBS throughout the experiment with speech (green) and no-speech (purple) conditions. **(B, C)** PSD plots showing average activity during the speech (green) and no speech (purple) conditions in the **(B)** left and **(C)** right vlPFC. Violin plots show high beta power distributions in the speech (green) and no speech (purple) periods.

Conclusions: Our results suggest vlPFC high beta power is a biomarker for approach behaviors associated with VC/VS DBS. These results are consistent with prior findings in patients with bipolar disorder.

Keywords: psychiatry, biomarker, DBS

O048 / #427

Topic: *AS03. Pain*

ALTERED VENTRAL TEGMENTAL AREA CONNECTIVITY IN CLASSICAL TRIGEMINAL NEURALGIA

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Introduction: Increasing evidence suggests that the reward network is linked to pain sensitization in trigeminal neuralgia (TN) via disruptions of mesocortical and mesolimbic circuits. This study aimed to identify resting-state functional connectivity (rsFC) and topological reorganization of the brain's functional networks in classical TN (CTN). We hypothesized an association between anxiety and depression in CTN patients and alterations of ventral tegmental area (VTA) based rsFC.

Methods: Resting-state functional magnetic resonance imaging scans from 27 CTN patients and 39 healthy controls (HCs) were analyzed. A seed-based analysis with the VTA was performed to explore rsFC alterations. Graph theory was applied to analyze topological properties of brain functional networks including global and nodal metrics. Associations between anxiety (Anxiety Sensitivity Index; ASI) and depression severity (Beck Depression Inventory; BDI) and measures of VTA-based rsFC were further analyzed.

Results: Compared to HCs, CTN patients had significantly decreased VTA-based rsFC linked to the left dorsolateral prefrontal cortex (PFC), which serves as a major component of the mesolimbic circuit. We also observed increased rsFC between the VTA and the right pre- and post- central gyri in CTN patients. Graph theory analysis demonstrated notable differences between groups in clustering coefficient in the salience and default mode networks. At the nodal level, several nodes with abnormal betweenness-centrality were detected in CTN patients, including the VTA, bilateral parahippocampal gyri, bilateral inferior temporal gyri, and left insula. These indicate there are less nearby nodes of the VTA that are highly used during pain sensitization, and suggest decreased activity of the VTA in CTN. Significantly changed VTA-based rsFC did not correlate with anxiety or depression, as measured by ASI and BDI.

Conclusions: A pattern of functional disconnection of the VTA in CTN points to abnormal rsFC and effective connectivity of this region, which echoes our previous study of structural affective circuitry in CTN. The VTA can project to cortical motor fields via the posterior ventrolateral thalamic nucleus of the PFC bundle, which may be dysfunctional in CTN. Overall, this investigation augments the current understanding of CTN's pathophysiology and lays groundwork for the development of innovative therapeutic modalities.

Keywords: classical trigeminal neuralgia, Functional connectivity, ventral tegmental area

O049 / #433

Topic: *AS02. Epilepsy*

DEEP BRAIN STIMULATION OF THE ANTERIOR NUCLEUS OF THE THALAMUS FOR INTRACTABLE EPILEPSY: RESULTS OF THE FRANCE STUDY, A RANDOMIZED , OPEN LABEL, CONTROLLED TRIAL.

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Introduction: Deep brain stimulation (DBS) of the anterior nucleus of the thalamus (AN) has been used to treat patients with severe drug-resistant epilepsy, and showed good results in unblinded pilot studies and one randomized study. We aimed to specifically assess the efficacy of DBS compared to the best medical treatment (BMT) in patients for whom all previous treatments including VNS had failed.

Methods: In this randomized, unblinded, controlled trial (NCT02076698), 62 patients aged 15-60 years with severe, medically refractory focal or multifocal epilepsy were included from 14 hospital centers. Patients were randomized to the DBS or BMT group. Patients in the DBS group received bilateral 3389 leads into the AN. Patients in both groups were followed up for 12 months, and the number of seizures at baseline (3 months before surgery) was compared to the number recorded during the last three months of follow-up (months 10-12). The primary endpoint was an effect of bilateral AN-DBS on severe seizures at 12 months compared to BMT (50% reduction in severe monthly seizures). At 12 months, patients in the BMT group could cross over to the DBS group. Follow-up was continued for a further 12 months. We assessed safety in all patients who were enrolled.

Results: Between January 2014 and January 2016, we randomised 61 patients, 59 were analyzed . At 12 months, 44,83 of patients reached 50 % median reduction of severe seizure in DBS group and 26,67 in BMT group (p=0,14). DBS resulted in a median 44% decrease in the frequency of severe seizures,versus 6% for BMT (p=0,09). Compared to baseline, median changes of severe seizures reached significance for DBS group at 12 (44,44%, p< 0,0001) and 24 months (46,95%, p< 0,001). A similar effect at 1 year (35%, p< 0,0001) was observed for patients from the BMT group who opted for delayed DBS implantation. 6 serious AE occurred: 1 death from each group before surgery, 1 infection, 1 herpes simplex virus reactivation, 1 asymptomatic intracranial hemorrhage,1 migration of a lead. No increase in depressive symptoms nor memory impairment was observed.

Conclusions: Continuous AN-DBS stimulation tended to be more efficient against severe seizures than BMT including VNS.

Keywords: Deep Brain Stimulation, ANTERIOR THALAMIC NUCLEUS, Epilepsy

O050 / #440

Topic: *AS01. Movement Disorders*

EVOKED RESONANT NEURAL ACTIVITY IN THE BASAL GANGLIA OF AWAKE AND ASLEEP PARKINSON DISEASE PATIENTS

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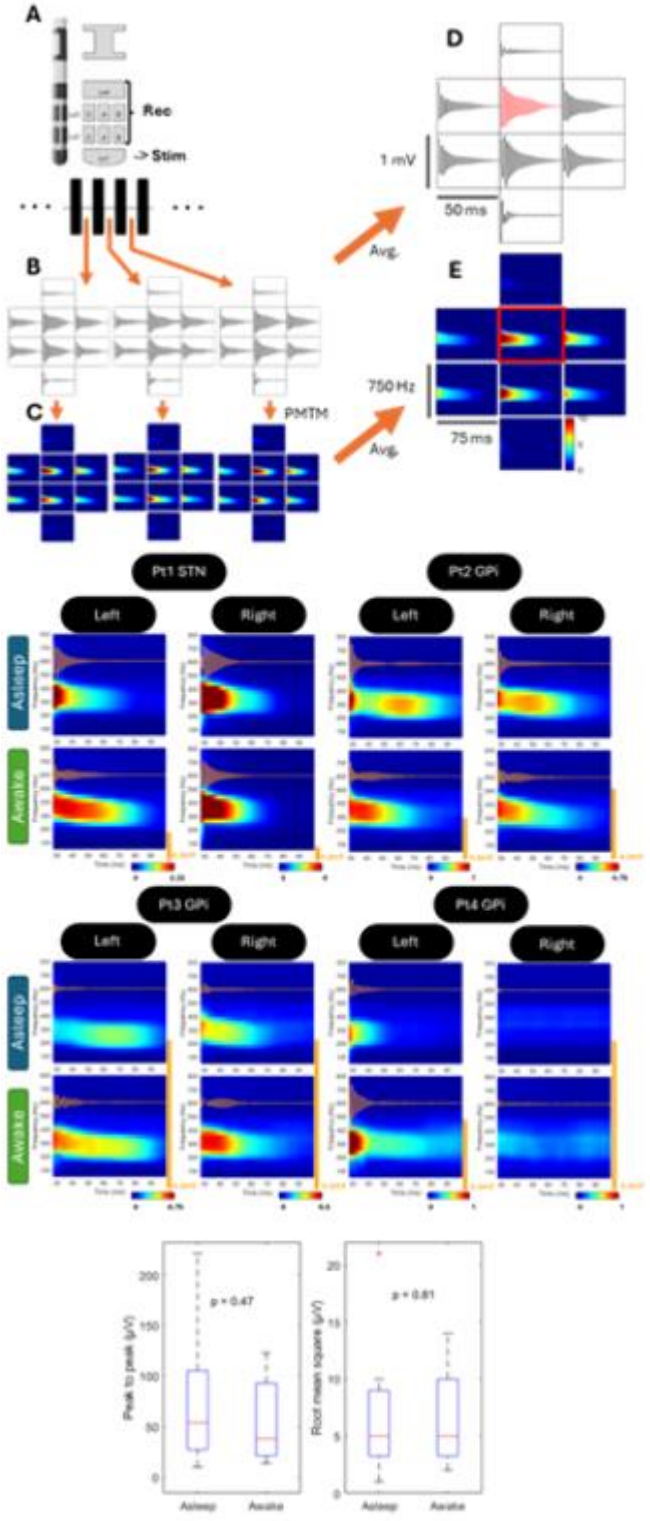
Introduction: Beta (13-30Hz) and High-Frequency-Oscillations (HFO, 200-400Hz), and their coupling, recorded from local field potentials (LFP) serve as established biomarkers for Parkinson's disease (PD). During deep brain stimulation (DBS) surgery, electrophysiological recordings from the implanted electrodes are used to localize the subthalamic nucleus (STN) and globus pallidus interna (GPi) and predict optimal clinical contacts. Exaggerated beta activity, indicative of a pathological state, is suppressed by dopaminergic medication or DBS. However, recent studies suggest that pharmacological therapy can alter brain dynamics, challenging the use of these biomarkers. Evoked Resonance Neural Activity (ERNA) emerges as a new PD biomarker, characterized by a resonant response after stimulation which dampens over time. Contacts with the largest ERNA amplitude in STN and GPi have been correlated with optimal chronic therapeutic DBS contacts. However, Limited data exists on ERNA in sedated subjects during DBS surgery. In this abstract, we demonstrate ERNA as a larger-amplitude biomarker compared to traditional beta and HFO, remaining detectable in a sedated state, potentially helping DBS electrode placement during asleep surgery.

Methods: Four patients (1 STN, 3 GPi) undergoing bilateral DBS surgery were tested intraoperatively in asleep and awake states. Stimulation at 130 Hz, 3mA, was delivered through the bottom contact of the chronic electrodes while recording LFPs at 15 kHz. Stimulation occurred in bursts of 20 pulses, followed by a 200-millisecond gap, where ERNA may be present. Time-frequency maps (TFM) for each gap were created and averaged.

Results: The figure illustrates findings in sedated and awake states, showing ERNA extending for 40 to 70 milliseconds in the time-domain. TFM reveals ERNA extends close to 100 milliseconds after

stimulation ends. Statistical tests indicate no significant difference between asleep and awake states in



the largest ERNA contact.

Conclusions: Utilizing ERNA facilitates electrophysiological mapping of PD target structures, offering potential optimization for DBS electrode placement in both awake and asleep patients.

Keywords: Subthalamic Nucleus (STN), Globus Pallidus internus (GPi), Evoked Resonant Neural Activity (ERNA), Sedated ERNA, Awake ERNA, Beta, High Frequency Oscillations (HFO)

O051 / #511

Topic: *AS04. Psychiatric Disorders*

DEEP BRAIN STIMULATION FOR DEPRESSION - A NOVEL CLINICAL TRIAL HARNESSING PERCEPT RECORDINGS TO UNCOVER CLOSED-LOOP BIOMARKERS

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Introduction: Recent high-impact publications have positioned deep brain stimulation (DBS) for depression at the forefront of revolutionary breakthroughs, poised to secure regulatory approval and significantly alter the course of this challenging disease. Here, we present a groundbreaking study featuring a large, well-characterized cohort of treatment-resistant depression (TRD) patients treated with tractography-informed subcallosal cingulate (SCC) DBS. Utilizing the innovative Percept device, we collected a vast and diverse dataset of naturalistic local field potential (LFP) data, correlated it with mood tracking, and employed machine learning to develop a closed-loop stimulation biomarker.

Methods: Twelve patients underwent tractography-informed SCC-DBS, with mood tracking biweekly. LFPs were recorded using LFP-streaming, patient-triggered event logs, and longitudinal narrowband recording. Machine learning algorithms were employed to develop patient-specific and group-level mood classifiers. A generative causal explainer (GCE) aided in dimensionality reduction and identified spectral-discriminative components in LFP signals capable of distinguishing between 'depressed' and 'neutral/happy' moods. 3-tesla diffusion weighted imaging and resting-state fMRI were used to uncover structural/functional correlates underlying neurophysiology spectral electrophysiologic markers.

Results: Seven out of twelve patients achieved responder status, with a mean reduction in Hamilton Depression Rating Scale (HAMD) score of 52%. At the individual level, LFP data differentiated between 'sick' and 'stable' states with an AUC of 0.88±0.06, slightly lower at the group level (AUC: 0.84±0.07). Increased beta signal amplitude was most associated with symptomatic improvement. Quantitative diffusion tensor imaging (DTI) correlated four tracts to modulation of alpha and beta oscillatory power. Brain-wide connectomic profiling revealed that the strength of cingulate structural connectivity to the volume of tissue activated significant correlated with degree of beta modulation.

Conclusions: Conclusion: This original clinical trial data demonstrates the efficacy and long-term stability of response to SCC-DBS using a prospective DTI-targeting method. Long-term natural LFP recording, combined with explainable artificial intelligence (XAI), enabled accurate mood detection, highlighting a biomarker for future closed-loop stimulation techniques. Brain-wide connectomic modeling showcased increased beta-spectral augmentation in patients with greater engagement of the cingulum bundle, underscoring its role in conveying crucial limbic oscillatory information.

Keywords: subcallosal cingulate, Deep Brain Stimulation, dti

O052 / #19

Topic: *AS01. Movement Disorders*

GENERALIZED SLEEP DECODING WITH BASAL GANGLIA SIGNALS IN MULTIPLE MOVEMENT DISORDERS

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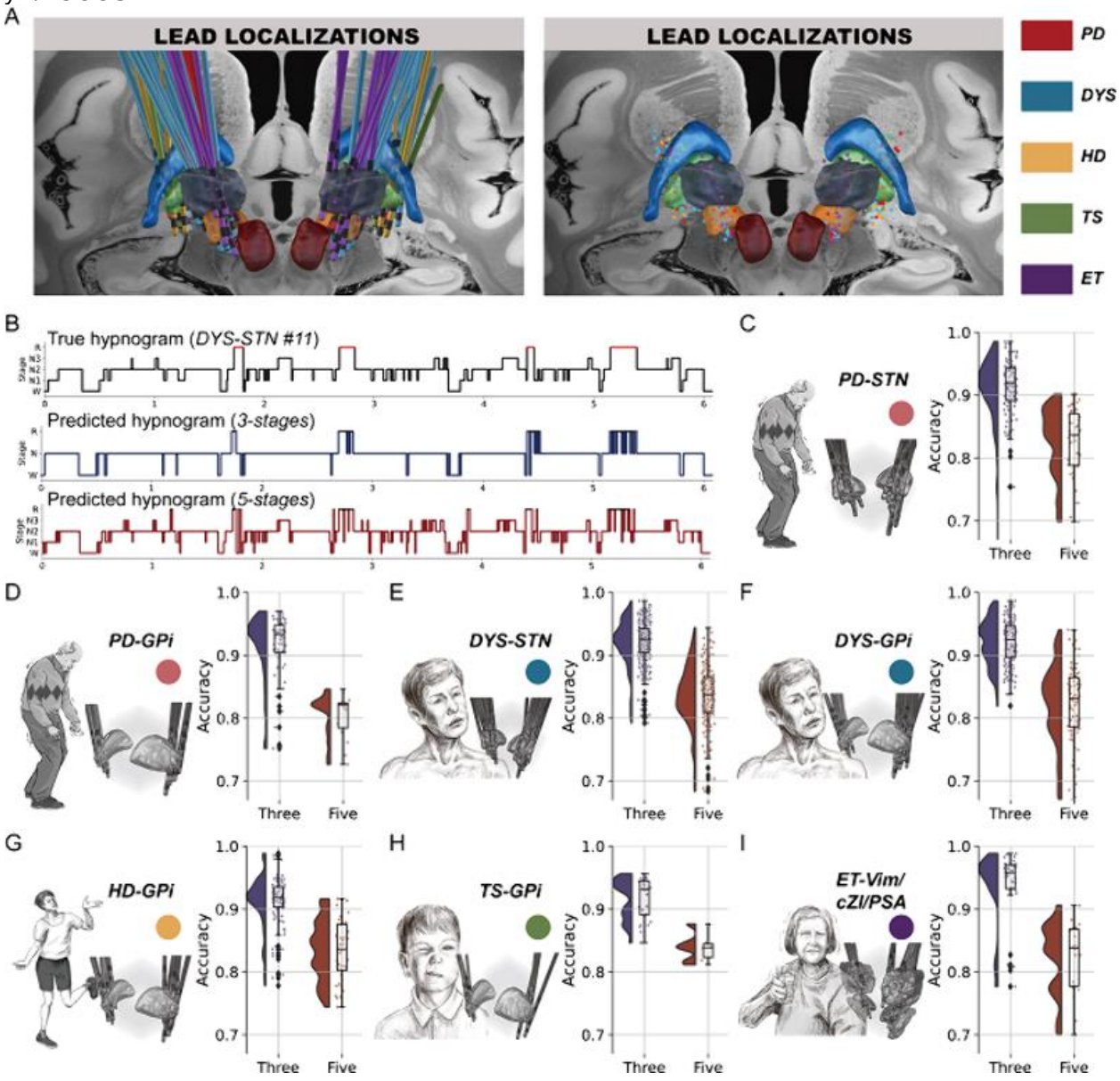
Introduction: Sleep disturbances profoundly affect quality of life in individuals with neurological disorders. Closed-loop deep brain stimulation (DBS) holds promise for alleviating sleep symptoms, yet, one key to a successful therapy lacking is that this technique necessitates automated sleep stage decoding from intracranial signals. Previous works including ours have attempted to decode sleep stages based on basal ganglia local field potentials (LFPs) recorded from DBS electrodes in an individualized manner. However, this approach requires cumbersome polysomnography (PSG) -based sleep labelling for each new patient, which would not be tractable or scaleable in clinical practice.

Methods: We leveraged overnight data from 141 patients with movement disorders (Parkinson's disease, Essential Tremor, Dystonia, Essential Tremor, Huntington's disease and Tourette's syndrome) in whom synchronized polysomnograms and basal ganglia local field potentials were recorded, to develop a generalized, plug-and-play, multi-class, sleep specific decoder – BGOOSE (acronym for the basal ganglia oscillation-based model for sleep stage estimation).

Results: This generalized model achieved 80% accuracy in sleep stage decoding across patients and across disease conditions, even in the presence of recordings from different basal ganglia targets. We also investigated the role of additional electrocorticography (ECoG) in sleep decoding and proposed an optimal decoding map, which was shown robustly to facilitate channel selection for optimal model performances. Finally, BGOOSE was validated in two out-of-cohort datasets recorded at different postoperative time points and using different DBS devices. The full BGOOSE model is freely available at https://github.com/zixiao-

yin/BGOOSE.



Conclusions: Our results provide direct basis for the implementation of sleep-aware algorithms in clinical deep brain stimulation. By encompassing the most common movement disorders and most frequently used DBS targets, this breadth of applicability represents a significant clinical translational potential to tackle sleep disturbance in brain disorders through sleep stage-specific neuromodulation.

Keywords: local field potentials, adaptive deep brain stimulation, sleep stage decoding

O053 / #69

Topic: *AS01. Movement Disorders*

ROLE OF MODULATION OF THE DESCENDING PATHWAY IN PATIENTS WITH CERVICAL DYSTONIA WITH GPI-DBS: A TRACTOGRAPHY STUDY

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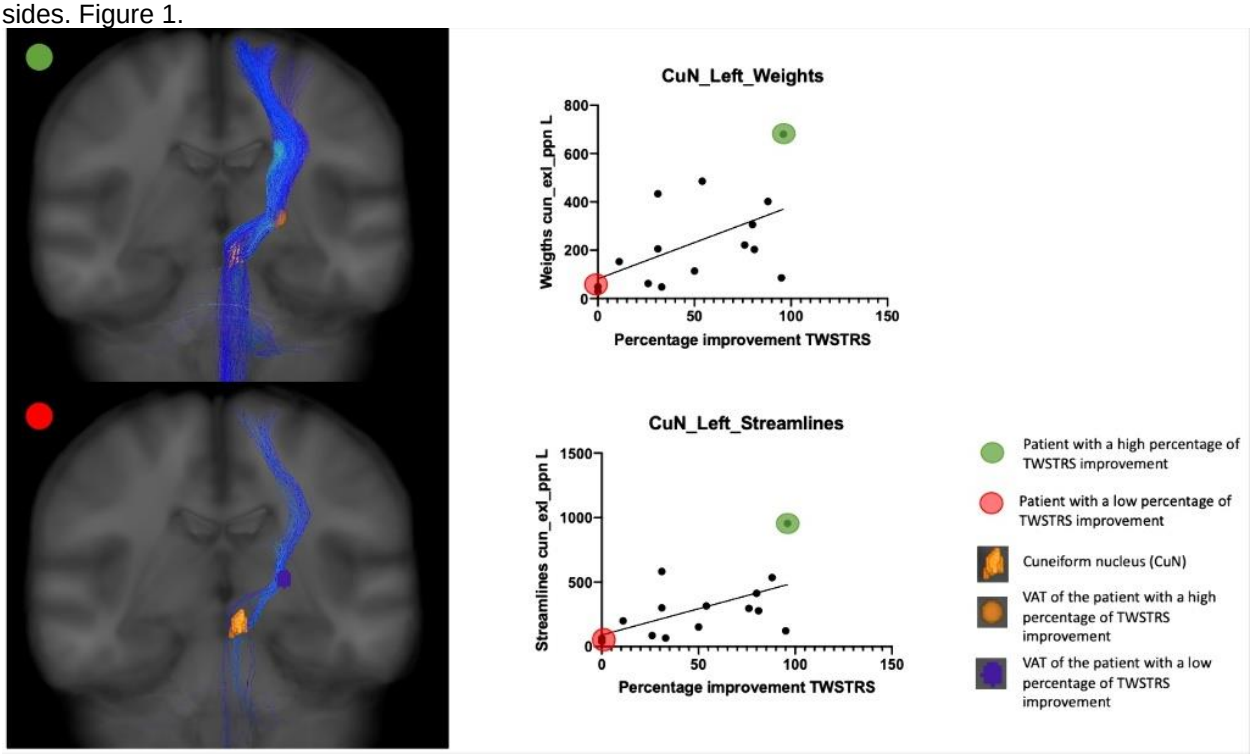
Introduction: Patients with severe cervical dystonia could benefit from Deep Brain Stimulation (DBS) of the internal Globus Pallidus (GPi). However, individual clinical results are sometimes disappointing. Moreover, the mechanisms underlying the effect of GPi-DBS are not understood. One hypothesis involved the modulation of the ascending pallido-thalamo-cortical pathway. The implication of the descending pathway including the Mesencephalic Locomotor Region (MLR) that comprises the pedunculopontine (PPN) and cuneiform nucleus (CuN), has been recently suggest. Here, we collected data from a retrospective series of cervical dystonic patients with GPi-DBS and search for correlation between clinical outcome and streamlines included in each Volume of Activated Tissue (VAT) generated by DBS usual settings, from ascending or descending pathways using a quantitative probabilistic tractography template.

Methods: Between 2015 and 2021, 15 cervical dystonic patients with GPi-DBS operated in Montpellier and Paris were included. Clinical outcomes were assessed before and 1-year after surgery using the Toronto Western Spasmodic Torticolis Rating Scale (TWSTRS). For each patient, we localized precisely therapeutic contacts and modelized the VAT. Each patient specific brain anatomy was registered to a normative template of diffusion-weighted imaging (MRtrix). The connectivity between each VAT and the thalamus (centromedian and ventrolateral nucleus) and the MLR (PPN and CuN) was quantified.

Results: The median TWSTRS severity score reduced significantly from 18.7±4.1 to 10±7 after 1-year of GPI-DBS (p=0,0003). We found a positive significant correlation between the motor improvement and the number of streamlines from the left MLR included in the VAT (p=0.046; R^2= 0.272). More specifically, we found a positive significant correlation between motor improvement and the number and weight of streamlines from the left CuN (excluding streamlines from the left PPN) (p=0.031; R^2= 0.312) (Figure 1). We did not find any correlation between the TWSTRS scores and streamlines from the thalamus for both

sides. Figure 1.



Conclusions: Patients with cervical dystonia that improved the best after GPi DBS exhibited a higher rate of streamlines included in the VAT, that come from the left MLR and especially the left CuN. This result highlights the involvement of descending pathways in the control of axial muscle tone that could be modulate by GPi-DBS.

Keywords: tractography, cuneiform nucleus, Deep Brain Stimulation

O054 / #96

Topic: *AS01. Movement Disorders*

PROSPECTIVE OBSERVATIONAL STUDY OF ADAPTIVE DEEP BRAIN STIMULATION FOR ADVANCED PARKINSON'S DISEASE IN OSAKA, JAPAN: REPORT OF 13 CASES OVER 1 YEAR

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Introduction: Patients with Parkinson's disease (PD) often encounter fluctuating motor symptoms and dyskinesia, leading to the exploration of adaptive deep brain stimulation (aDBS), a closed-loop system adjusting stimulation intensity. In Japan, the approval of a deep brain stimulator utilizing aDBS by measuring local field potentials allows for its long-term clinical application. This presentation provides a one-year progress report on a prospective observational study of aDBS at our hospital.

Methods: Between August 2021 and August 2022, thirteen PD patients, with subthalamic nucleus electrodes for over six months and utilizing Medtronic's Percept PC stimulator, were included. Shifting from conventional stimulation (cDBS) to aDBS, clinical symptoms were assessed using PDQ39 and MDS-UPDRS before, six months after, and one year after aDBS introduction. UPDRS Part 3 was evaluated in four states: stimulation on/off, drug on/off.

Results: Three subjects reverted to conventional deep brain stimulation (cDBS) due to exacerbated dyskinesia, and one subject was excluded from analysis. Among the nine subjects utilizing adaptive deep brain stimulation (aDBS), UPDRS Part 3 scores demonstrated improvement from cDBS (mean 34.0, SD 8.2) to 32.0 (9.2) at 6 months and 27.7 (7.0) at 1 year post-aDBS under the stimulus-on/drug-off condition. While not achieving statistical significance, this improvement is noteworthy. The baseline UPDRS Part 4 score (6.6±2.1) exhibited minimal changes at 6 months (6.4±2.9) and returned to baseline levels at 1 year (6.6±2.1). PDQ-39 scores at baseline (47.8±19.5) demonstrated slight variations at 6 months (50.0±33.5) and 1 year (51.4±32.7) without reaching statistical significance.

Conclusions: The results indicate that aDBS shows promise in improving motor function as much as or more than cDBS. This study's outcomes serve as a foundation for future randomized control studies comparing aDBS with cDBS. The ongoing prospective observational nature of this research enhances the understanding of aDBS efficacy in the long-term management of PD symptoms.

Keywords: prospective observational study, Parkinson's disease, adaptive deep brain stimulation

O055 / #130

Topic: *AS01. Movement Disorders*

OPTIMAL STIMULATION SITES OF GPI-DBS AND STN-DBS TREATING IDIOPATHIC CRANIOCERVICAL DYSTONIA: INSIGHTS FROM MNI COORDINATES, ELECTRIC FIELDS AND PROBABILISTIC STIMULATION MAPS

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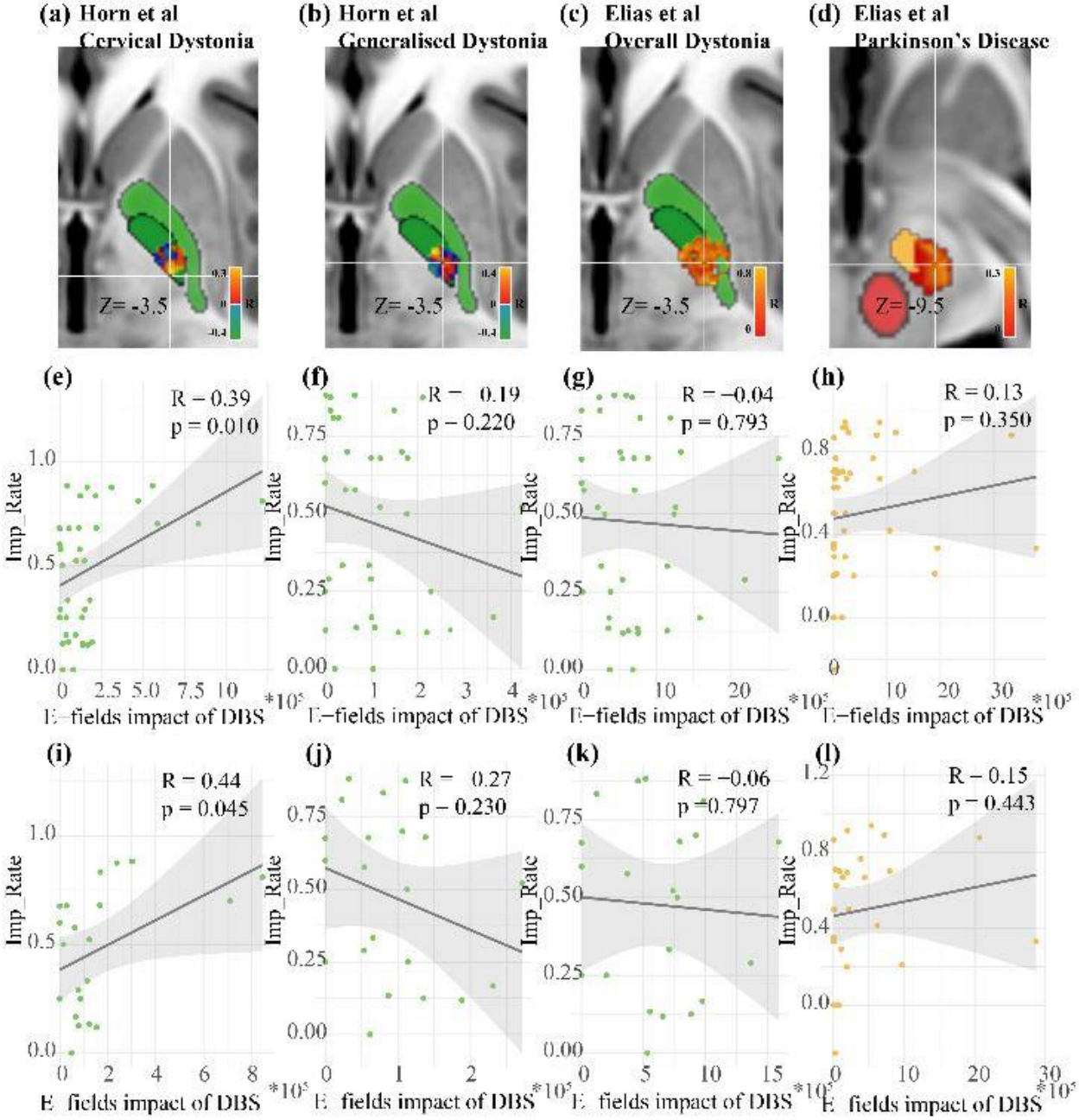
Introduction: Deep Brain Stimulation (DBS) has emerged as a promising treatment for idiopathic craniocervical dystonia (iCCD), but optimal stimulation sites remain unclear. Recently, the local-level analysis has gained traction, considering individual electrode placement and stimulation parameters to improve postoperative efficacy. The primary objective of this study is to pinpoint optimal sites for DBS in iCCD patients by integrating clinical data, electrode localization, and Electrode fields (E-fields) modeling within globus pallidus internus (GPi) and subthalamic nucleus (STN).

Methods: 48 iCCD Patients underwent bilateral DBS were included (21 GPi-DBS, 27 STN-DBS). Univariate and multivariate regression was employed to assess the influence of clinical characteristics. Advanced normalization and pre-construction tools were utilized for precise electrode localization. MNI coordinates, E-fields impact, and probabilistic stimulation maps (PSMs) were employed to identify optimal stimulation sites, and validate previously identified PSMs.

Results: GPi-DBS and STN-DBS both significantly improved motor symptoms of iCCD patients, with no significant difference between them. Optimal stimulation sites were identified in the posterior ventrolateral GPi and dorsolateral STN. Furthermore, the study revealed that stimulation impacts on STN and sensorimotor regions were significantly correlated to postoperative efficacy, whereas similar correlations were absent for GPi impacts. PSMs analysis reinforced the specificity of optimal sites, affirming the distinct correlation of the anti-cervical dystonia "sweet spot" with GPi-DBS efficacy of

iCCD.



Conclusions: Both GPi-DBS and STN-DBS are effective for iCCD. We highlight the importance of tailoring electrode placement to specific body regions and disease characteristics, reinforcing the significance of personalized treatment strategies.

Keywords: Idiopathic craniocervical dystonia, Deep Brain Stimulation, Optimal simulation sites

O056 / #135

Topic: *AS01. Movement Disorders*

PROSPECTIVE, MULTICENTER, INTERNATIONAL REGISTRY OF DEEP BRAIN STIMULATION FOR DYSTONIA: SUB-ANALYSIS OF CERVICAL DYSTONIA PATIENTS

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Introduction: In patients with cervical (focal) versus generalized dystonia, optimal DBS target sites (within pallidothalamic loop) are thought to diverge and be specific for particular connections. DBS devices equipped with capabilities such as directionality and Multiple Independent Current Control (MICC) may enable improved outcomes. This registry seeks to assess/report real-world outcomes of patients with either inherited, idiopathic, or acquired dystonia implanted with a Multiple Independent Current Control (MICC)-based directional Deep Brain Stimulation (DBS) systems."

Methods: This is a sub-analysis of patients with focal (cervical) dystonia only or cervical dystonia in context of segmental or generalized dystonia derived from a prospective, multicenter, international dystonia registry (NCT02686125). Participants receive an MICC-based, directional DBS system (Boston Scientific). Patients are followed up to 3-years (post-implant). Study assessments collect the following: TWSTRS, quality-of-life, overall satisfaction, and adverse events.

Results: A total of 50-patients (mean age 56.1-years, 62% females) with focal (cervical) dystonia only, and 95-patients (mean 43.6-years, 58% females) with cervical dystonia in context of segmental or generalized dystonia have been evaluated to date. In the cervical only cohort, a 20-point improvement in overall TWSTRS score (baseline: 42.4) was noted at 6-months (n=35) and sustained up to 1-year (23.1-point improvement, n=30). In those with cervical dystonia in context of segmental or generalized dystonia, an 8.3-point and 7.8-point improvement in overall TWSTRS scores (baseline: 35.1) was noted at 6-(n=62) and 12-months (n=48), respectively. The percentage of those who reported significant improvement as compared with Baseline (Global Impression of Change) at 12-months follow-up was the following: 91% of patients with cervical only and 82% of patients with cervical and other involved regions. Additional results, per on-going data collection and analysis, will be presented.

Conclusions: This registry represents the first comprehensive, large-scale collection of real-world outcomes associated with dystonia patients implanted with a directional, MICC-based DBS system. Preliminary results demonstrate significant improvement in patients with cervical dystonia (alone or in context of segmental or generalized dystonia) following DBS.

Keyword: Deep Brain Stimulation, DBS, dystonia, cervical dystonia

O057 / #168

Topic: *AS01. Movement Disorders*

LOCAL FIELD POTENTIAL AND PROGRAMMING CHARACTERISTICS OF ADAPTIVE DEEP BRAIN STIMULATION FOR PARKINSON'S DISEASE FROM A REAL-WORLD REGISTRY IN JAPAN

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Introduction: Adaptive deep brain stimulation (aDBS), leveraging local field potentials (LFP) as a control signal for stimulation modulation, is an emerging development to treating patients with Parkinson's disease (PD). Here we captured aDBS programming and control signal characteristics in a real-world, multisite sample of patients with PD receiving DBS.

Methods: A total 109 patients (mean age: 63.4 years; sex: 45 males (41.3%); 86 DBS therapy naïve) were registered in the aDBS Japan registry. LFP peaks were identified from automated algorithms in the frequency range of 8-30 Hz and are analyzed in the 91 hemispheres of the 47 patients with bilateral subthalamic nucleus (STN) recordings from JSON files in January 2023 (Three hemispheres did not have omnidirectional LFP recordings).

Results: STN LFP peaks were detected in 73/91 hemispheres (80.2%), where 42 hemispheres (57.5%) had peaks in the beta range (13-30 Hz). Peak power and frequency were a median of 1.66 [interquartile range: 1.20-2.30] uVp and 14.65 [10.74-19.53] Hz, respectively. aDBS, of either mode (single-threshold (ST) or dual-threshold (DT)), was activated on a median of 53 [24-108] and 41 [15-155] days after device implant for DBS therapy naïve (51/86 patients, 59.3%) and replacement patients (7/23 patients, 30.4%). Overall, the most prevalent aDBS mode selected at first aDBS activation was DT (54/58 patients, 93.1%).

Conclusions: We report programming and LFP characteristics from a large, real-world sample of patients receiving DBS for PD. This analysis reports 80% of hemispheres contained a peak which, on average, fell within the beta range. Additionally, aDBS was used in 53% (58/109) of patients with the majority of patients configured to DT mode. Together, this data provides early evidence for the real-world use and feasibility of implementing aDBS for PD.

Keywords: Adaptive DBS, Real World Registry, Parkinson's disease

O058 / #293

Topic: *AS04. Psychiatric Disorders*

THALAMOCORTICAL FUNCTIONAL CONNECTIVITY PATTERNS IN TOURETTE SYNDROME: INSIGHTS FROM EEG AND LFP RECORDINGS

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Introduction: The pathophysiology of Tourette syndrome (TS) is not yet completely understood. Studies have shown abnormal connectivity patterns in the cortico-striatal-thalamic-cortical (CSTC) loops. Deep brain stimulation (DBS) is an effective therapy option for patients with treatment refractory TS. The mechanism of action of DBS is still not fully understood, however there is a growing consensus that DBS modulates CSTC circuits. DBS also offers the unique opportunity to record local field potentials (LFPs) from the targeted area. Combining LFP-recordings with scalp recordings facilitates the investigation of functional connectivity patterns within the CSTC loops. The objective of our study was to assess functional connectivity patterns in terms of spatiality and spectrality and their association with symptom severity and dynamics during tics in TS patients.

Methods: We analyzed 6 TS patients treated with DBS, who received bilateral electrodes in the centromedial nucleus/nucleus ventrooralis (CM/Voi). Data was recorded at rest and during the Real-Time Urge Monitoring task. EEG was recorded using the extended 10-20 system, and simultaneously bilateral LFPs were recorded using Percept™ PC. Clinical improvement of the patients was measured using the YGTSS, PUTS was used to assess premonitory urges prior to tics.

Results: During resting state significant thalamo-cortical phase synchronization was found within the alpha frequency range (8-15 Hz). The maximum PSI in the alpha frequency band was identified at Fz (PSI: 0.23 ± 0.05; $t_{(11)} = 3.23$; $p = 0.014$). We observed a negative correlation between averaged thalamo-frontal alpha phase synchronization and tic/urge severity ($n = 6$; YGTSS: Spearman's Rho = -0.89; $p = 0.023$; PUTS: Spearman's Rho = -0.89; $p = 0.024$). Further, we observed fluctuations of decreased thalamo-frontal alpha phase synchronization, with significant PSI reductions at the beginning and middle of the 2-second pre-tic time window, along with another reduction within 300 ms just before tic onset.

Conclusions: Our findings revealed a spatially and spectrally distinct oscillatory network, connecting thalamus and particularly frontal regions in the alpha band. We found a negative correlation between connectivity within this network and TS symptom severity. Additionally, we showed that thalamo-frontal alpha connectivity decreased just before tic onset, suggesting its involvement in tic generation.

Keywords: Functional connectivity, LFP, Tourette syndrome

O059 / #385

Topic: *AS04. Psychiatric Disorders*

AGGRESSIVENESS PATIENTS WITH BILATERAL HYPOTHALAMIC DEEP BRAIN STIMULATION. LONG TERM FOLLOW UP WITH MOAS AND QUALITY OF LIFE SCORE.

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Introduction: Deep brain stimulation for severe refractory and chronic aggressiveness has been a topic of much debate in the neurofunctional field. Bilateral hypothalamic deep brain stimulation is one of the most desperate,,humanitarian and definitive treatment options. We present long-term follow-up patients treated with same multidisciplinary team that maintained acceptable results in the management of aggressive symptoms.

Methods: 23 patients. 9 being female, mean age 27.5 years (SD = 9.3). Pre-surgery, patients aggression across verbal, property, self, and physical categories, mean MOAS scores 2.04, 3.65, 3.39, and 3.39,respectively, total mean score of 31.39. After DBS surgery, significant reductions aggression levels, evidenced by decreased mean scores of 0.48, 0.48, 0.61, and 0.57 for verbal, property, self, physical aggression, respectively, resulting in reduced mean total MOAS score of 3.57. Statistical analyses,paired t-tests Wilcoxon signed-rank tests, confirmed significant reductions ($p < 0.001$) in aggressionpost-surgery, (Cohen's d). Quality of life assessments, pre- and post-surgery, were conducted using the MOAS scale and revealed notable findings.

Results: Pre-surgery, patients reported moderate levels of mobility, personal care, and usual activities, with significant pain, anxiety, and depression, reflected in an average total score of 18.96. Post-surgery,patients exhibited improvements across all domains, with significant increases in mobility ($t(22) = 4.61, p < 0.001$), personal care ($t(22) = 3.23$, $p = 0.004$), and usual activities ($t(22) = 2.89$, $p = 0.008$), and decreased pain ($t(22) = -3.37$, $p = 0.003$) and psychological distress ($t(22) = -2.21$, $p = 0.037$). Thetotal mean score post-surgery was 11.39, indicating a statistically significant improvement in quality oflife ($t(22) = 5.28$, $p < 0.001$). Patients reported better health conditions post-surgery (mean = 70.22,SD = 26.56), reflecting a significant improvement ($t(22) = 6.19$, $p < 0.001$). The comparison between MOAS scores and quality of life before and after surgery highlights the multifaceted benefits of DBS. It not only mitigates aggression but also enhances various aspects of patients' lives, including mobility, pain management, and psychological well-being.

Conclusions: These findings underscore the potential of DBS as an effective therapeutic intervention for aggressive patients, offering substantial improvements in both aggression levels and overall quality of life post-surgery.

Keywords: Deep Brain Stimulation, aggressiveness, hypothalamus

O060 / #537

Topic: *AS04. Psychiatric Disorders*

ESTABLISHMENT OF A MULTIDISCIPLINARY OCD CLINIC: INITIAL 6-YEAR EXPERIENCE

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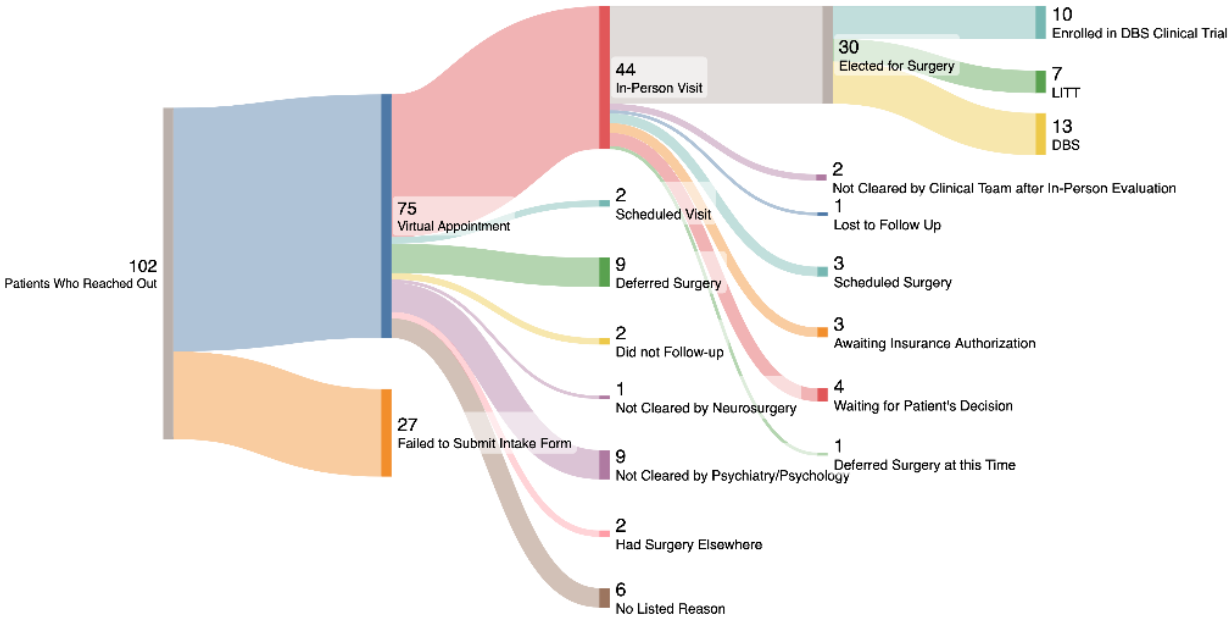
Introduction: OCD affects 2-3% of the U.S. population, with 10-20% being treatment resistant. Our institution has established a multidisciplinary clinic offering neurosurgical interventions (DBS and LITT) for these treatment-resistant OCD (trOCD) patients. Here we describe the establishment and operational challenges of a clinic dedicated to evaluating and treating trOCD patients.

Methods: We evaluated 102 patients from 2018 to 2023 and retrospectively identified key transition points in their evaluation that ruled them in or out for surgical consideration.

Results:



Among the 102 patients who reached out to our clinic, 75 patients participated in a virtual visit with the clinical team, 44 patients came for an in-person evaluation, and 30 patients underwent surgery. Key points of attrition include not returning intake forms after initially reaching out (27/102, 26.45%) or not proceeding to an in-person visit (31/75, 41.3%). The most common reasons to not have an in-person visit were failing to be cleared by the psychology and psychiatry teams (9/31, 29.03%), usually due to inadequate behavioral therapy or pharmacotherapy prerequisites (5/9, 55.56%). Of the patients who successfully underwent surgery, most underwent DBS (23/30, 76.67%), while fewer had LITT (7/30, 23.33%). A fraction of DBS surgeries were through a clinical trial (10/23, 43.48%). Non-trial patients who underwent surgery either had commercial insurance (15/20, 75.00%), Medicare (4/20, 20.00%), or self-paid (1/20, 5.00%). Initial surgical denial was common (9/20, 45.00%), often due to commercial insurance non-approval (8/9, 88.89%). LITT was initially denied more frequently (5/9, 55.56%) than DBS (4/9, 44.44%).

Conclusions: Multi-disciplinary experience is crucial for the evaluation and ultimate management of trOCD patients. Attrition during evaluation is common, and clinical teams must be prepared to screen several patients for every one that proceeds to surgery. Insurance denials remain a major impediment to access to therapy despite mounting evidence for the safety and efficacy of these procedures. With a high incidence of insurance denials, future clinics need to establish a comprehensive support system that includes dedicated insurance liaisons to minimize patient attrition. As evidence supporting wider use of these safe and effective therapies mounts, demand for these procedures may increase, requiring an increasing number of institutions to embrace this process.

Keywords: OCD, DBS, Clinic

O061 / #331

Topic: *AS04. Psychiatric Disorders*

PATIENT-SPECIFIC STRUCTURAL CONNECTIVITY OF NAC/ALIC AND AMSTN IN OCD PATIENTS TREATED WITH DBS

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Introduction: DBS of the anterior limb of the internal capsule(ALIC), Nucleus Accumbens(NAC), and anteromedial subthalamic nucleus(amSTN) are recognized targets for treating treatment-resistant obsessive-compulsive disorder(OCD). The Frontopontine-corticothalamic(Fp-Ct) networks involve anatomic regions of the common pathway described by Dr Horn for symptom relief in OCD. This study aims to delineate the white matter pathways of Fp-Ct networks using patient-specific structural connectivity data from OCD patients who have undergone DBS.

Methods: In our study, we analyzed structural and diffusion MRI data from 20 OCD patients (10 females, average age: 42.9 ± 9 years, baseline Y-BOCS: 30 ± 6) treated with DBS at the University of Cologne. Utilizing MRTRIX3 software, we generated 40 hemisphere-specific tractograms using probabilistic tractography with single-shell, three-tissue-constrained spherical deconvolution. We initiated 10 million tracts at the white matter-grey matter boundaries, later refining to 1 million streamlines and then editing the tracts that crossed the NAC/ALIC and amSTN white matter regions. Employing HCP842_tractography parcellation, we constructed structural connectivity matrices based on streamline counts, fractional anisotropy (FA), and mean diffusivity (MD) for the Fp-Ct networks with NAC/ALIC and amSTN.

Results: Significant differences were observed in both hemispheres for structural connectivity of Fp-CT tracts from NAC/ALIC and amSTN ($p < 0.001$), with respective percentages of NAC/ALIC(R=20.4%;L=20.6%) and amSTN(R=64.3%;L=64.7%). The FA also showed significant differences, indicating fiber coherence for NAC/ALIC(R=0.33±0.04;L=0.34±0.04) and amSTN(R=0.48±0.05;L=0.48±0.05) in both hemispheres ($p<0.001$). However, MD showed no significant differences, in NAC/ALIC, and amSTN(R=0.76±0.04;L=0.76±0.07) suggesting similar cell density in both regions.
Fig1

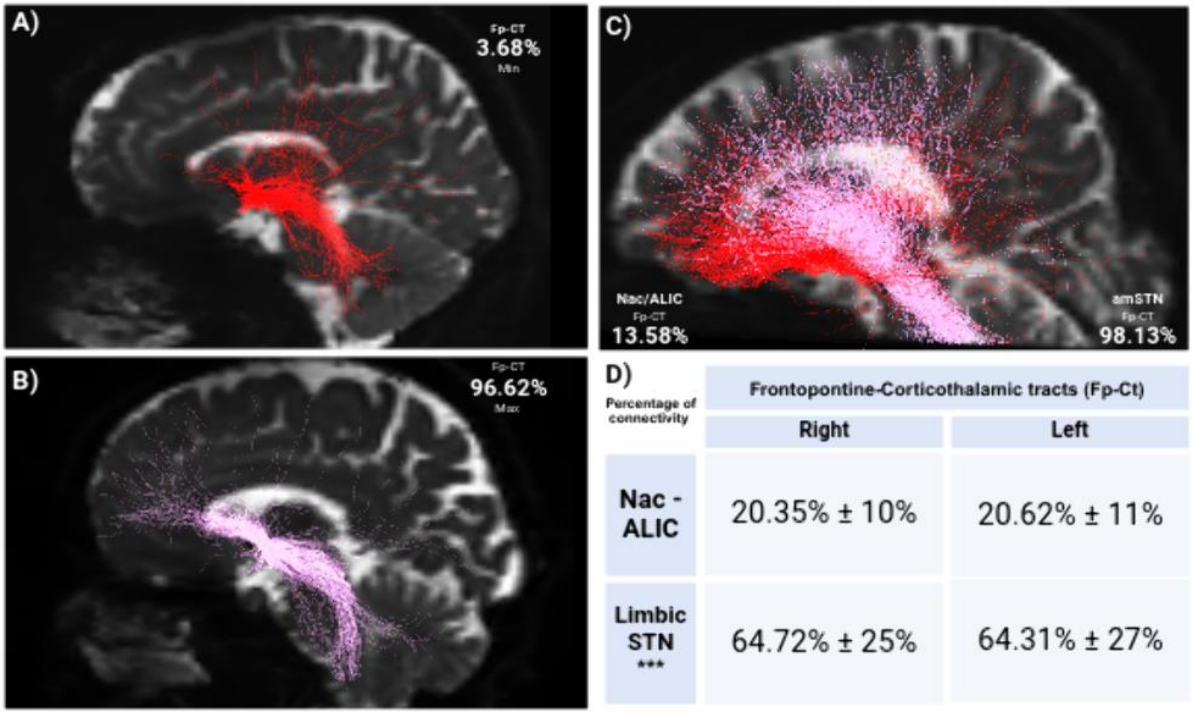

Fig 1 illustrates probabilistic tractography of Frontopontine-Corticothalamic (Fp-Ct) tracts: A) minimum, B) maximum percentage of structural connectivity (%conn) in a white matter region; C) NAC/ALIC and amSTN streamlines for one OCD patient; D) average, standard deviations of %conn (n=20) for each hemisphere. ***p<0.001 indicates statistical significance.

Conclusions: Structural connectivity analysis between NAC/ALIC, amSTN, and Fp-CT tracts reveals crucial links between the frontal cortex, midbrain, and brainstem for OCD DBS, with FA indicating superior coherence in NAC/ALIC fibers towards the frontal area. Despite uniform MD values suggesting consistent cell density, these findings could enhance stereotactic-targeting precision and early diagnosis in treatment-resistant OCD by leveraging microstructural characteristics like FA and MD as biomarkers.

Keywords: structural connectivity, probabilistic tractography, obsessive-compulsive disorder DBS

O062 / #328

Topic: *AS04. Psychiatric Disorders*

LONG-TERM FOLLOW-UP IN TOURETTE SYNDROME PATIENTS TREATED WITH DEEP BRAIN STIMULATION

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Introduction: Tourette syndrome (TS) is a chronic neuropsychiatric disorder that presents with a combination of vocal and motor tics. Since 1999, deep brain stimulation (DBS) can be considered a therapeutic option for patients with treatment-refractory TS. The aim of this study is to evaluate long-term (>5 years) follow-up in TS patient treated with DBS.

Methods: We retrospectively assessed all TS patients treated with DBS within a 10-year time period between 2009 and 2019. Demographic data, stimulation parameters, response of tics to chronic DBS and quality of life were evaluated. Clinical outcome was assessed using self-assessment and clinician-rated scales (i.e.YGTSS).

Results: A total of 22 TS patients (5 female, 17 male) were included in this study. One patient received GPi DBS, while the remaining patients received thalamic DBS, predominantly in the centromedian nucleus/nucleus ventro-oralis internus (CM/Voi). The average age at the time of the initial implantation was 31.9 years (SD +/- 10.7). Twenty-one patients (95%) were available for follow-up. The mean time interval since the initial implantation was 9.9 years (SD +/- 3.0). Seventeen (81%) patients were responders with active stimulation. Three patients turned off the stimulation. Here, one patient did not benefit, one patient's tics improved significantly even without stimulation and one patient's vocal tics disappeared completely, while motor tics showed little response to stimulation. In one patient who benefited from the stimulation, the complete DBS system was explanted due to an infection. In the self-assessment outcome, symptoms improved on average by 73% under stimulation compared to the preoperative condition, while the premonitory urge improved by 57% and the quality of life improved by 77%. YGTSS scores were available in eight patients at long-term follow-up. The average YGTSS score was 76.6 points (SD +/- 17.0) preoperatively, 39.5 points (SD +/- 24.6) after 12 months, and 24.0 points (SD +/- 15.0) in the long-term follow-up. In five patients, complications leading to surgical revisions were documented.

Conclusions: DBS for TS patients remains a highly effective therapy over many years after the implantation with a further tendency for improvement in the long-term.

Keywords: clinical outcome, Tourette syndrome, DBS

O063 / #222

Topic: *AS04. Psychiatric Disorders*

PALLIDAL DEEP BRAIN STIMULATION WITH ANTERIOR CAPSULOTOMY FOR COMORBID TOURETTE'S SYNDROME AND OBSESSIVE-COMPULSIVE DISORDER

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Introduction: Deep brain stimulation (DBS) of the globus pallidus interna (GPi) has been shown to improve motor symptoms in patients with severe medically refractory Tourette's syndrome (TS). However, the treatment options and efficacies for patients with TS comorbid obsessive-compulsive disorder (OCD) remain to be further explored.

Methods: A retrospective consecutive cohorts of patients with TS and OCD who underwent GPi-DBS combined with anterior limbs of the internal capsule (ALIC) lesionectomy (combined group) and GPi-DBS only (DBS only group) between January 2017 and August 2022 were included. The YGTSS, Y-BOCS, GTS-QOL, HAMD, HAMA, MoCA, and MMSE were used to evaluate and compare the outcomes at 3, 6, 12 months, and the last follow-up after surgery. Linear regression analysis was used to identify factors influencing surgical prognosis.

Results: A total of 12 patients were included, 10 males and 2 females, with at least 12 months' follow-ups. There were 6 patients in each group, and there were no significant differences in baseline characteristics between the two groups (all $P > 0.05$). Postoperative scores on the YGTSS, Y-BOCS, GTS-QOL, HAMD, HAMA were significantly improved compared with preoperative scores at all time points (all $P < 0.05$), and there was a trend of further improvement with increasing follow-up duration in both of groups. Postoperative MoCA and MMSE scores did not significantly differ from preoperative scores (all $P > 0.05$). The combined group showed significantly greater improvement on the Y-BOCS score at 12 months postoperatively compared with the DBS only group ($P = 0.005$). Linear regression analysis showed that lower age at surgery was a positive influencing factor for the improvement rate of YGTSS scores in the DBS only group ($\beta = 0.859$), while lower age at symptom onset was a positive influencing factor for the improvement rate of Y-BOCS scores in the combined group ($\beta = 0.835$).

Conclusions: GPi-DBS combined with ALIC lesionectomy may have potential for better efficacy in treating obsessive-compulsive symptoms. Attention should be paid to TS comorbid with psychiatric symptoms, and comprehensive preoperative evaluation should be conducted to select an appropriate treatment strategy, thereby improving quality of life.

Keywords: obsessive-compulsive disorder, Deep Brain Stimulation, Tourette's syndrome

O064 / #272

Topic: *AS05. Neuro Restoration or Injury*

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

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Introduction: 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.

Methods: 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.

Results: 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.

Conclusions: 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: disorders of consciousness, DBS, CMpf

O065 / #225

Topic: *AS08. Stereotactic Procedures*

COST VARIANCES IN STEREOTACTIC TECHNIQUE FOR DEEP BRAIN STIMULATION SURGERY: AN OVERVIEW OF SURGICAL METHODS AND COST CONSIDERATIONS

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Introduction: Deep Brain Stimulation (DBS) is a promising therapeutic intervention for neurological and psychiatric disorders with expanding indications. However, the cost implications of employing various advanced technologies in stereotactic and functional neurosurgery have yet to be demonstrated, and its widespread adoption faces challenges related to cost considerations. In this study, we assess the cost disparities and specific factors driving expenses across multiple stereotactic approaches in movement disorder and epilepsy surgery, aiming to identify potential cost-saving measures to inform clinical decision-making in this field.

Methods: Cost data from 2012-2023 was retrospectively accessed using the Value Driven Outcomes (VDO) tool developed by the University of Utah. Patients who underwent bilateral DBS surgery (without same-day internal pulse generator implantation) were included in the study. Four distinct surgical approaches to DBS implantation were categorized based on the type of frame and intraoperative imaging used. Techniques included 1) frame with C-arm fluoroscopy, 2) frame with intraoperative CT, 3) robotic stereotaxy with intraoperative CT, and 4) frameless with intraoperative MRI. Costs were reported as a percentage of the total cost for the frame with C-arm method. Univariate and multivariate analyses were performed.

Results: 209 encounters met the inclusion criteria. The median and interquartile ranges of each subcategory were calculated as a percentage of established reference. The median cost percentages are as follows: frame with intraoperative CT 129.8%; robotic stereotaxy with intraoperative CT: 124.9%; and frameless with intraoperative MRI: 233.9%. Significant differences were noted in the total cost category among all groups, except for the costs associated with the intraoperative CT methods ($p = 1.00$). The MRI-based method demonstrated notably higher costs across imaging and supply expenses, with considerable variability within each cost category, found to be attributable to fiscal year and procedure time.

Conclusions: The intraoperative MRI-based method showed significantly elevated costs regarding imaging and supply categories, attributed to increased time spent in the operating room. The frame with C-arm, frame with intraoperative CT, and robotic stereotaxy methods showed no significant differences in imaging expenses. Further evaluation of data including technical accuracy, revision and readmission rates, and other postoperative outcomes needs to be assessed to effectively evaluate the most cost-effective approach.

Keywords: Deep Brain Stimulation, stereotactic surgery, Cost analysis

O066 / #218

Topic: *AS09. Gene Therapy and Neuronal Transplant*

DIRECT DELIVERY OF A REPAIR CELL THERAPY FOR INVESTIGATING DISEASE MODIFICATION IN PARKINSON'S DISEASE

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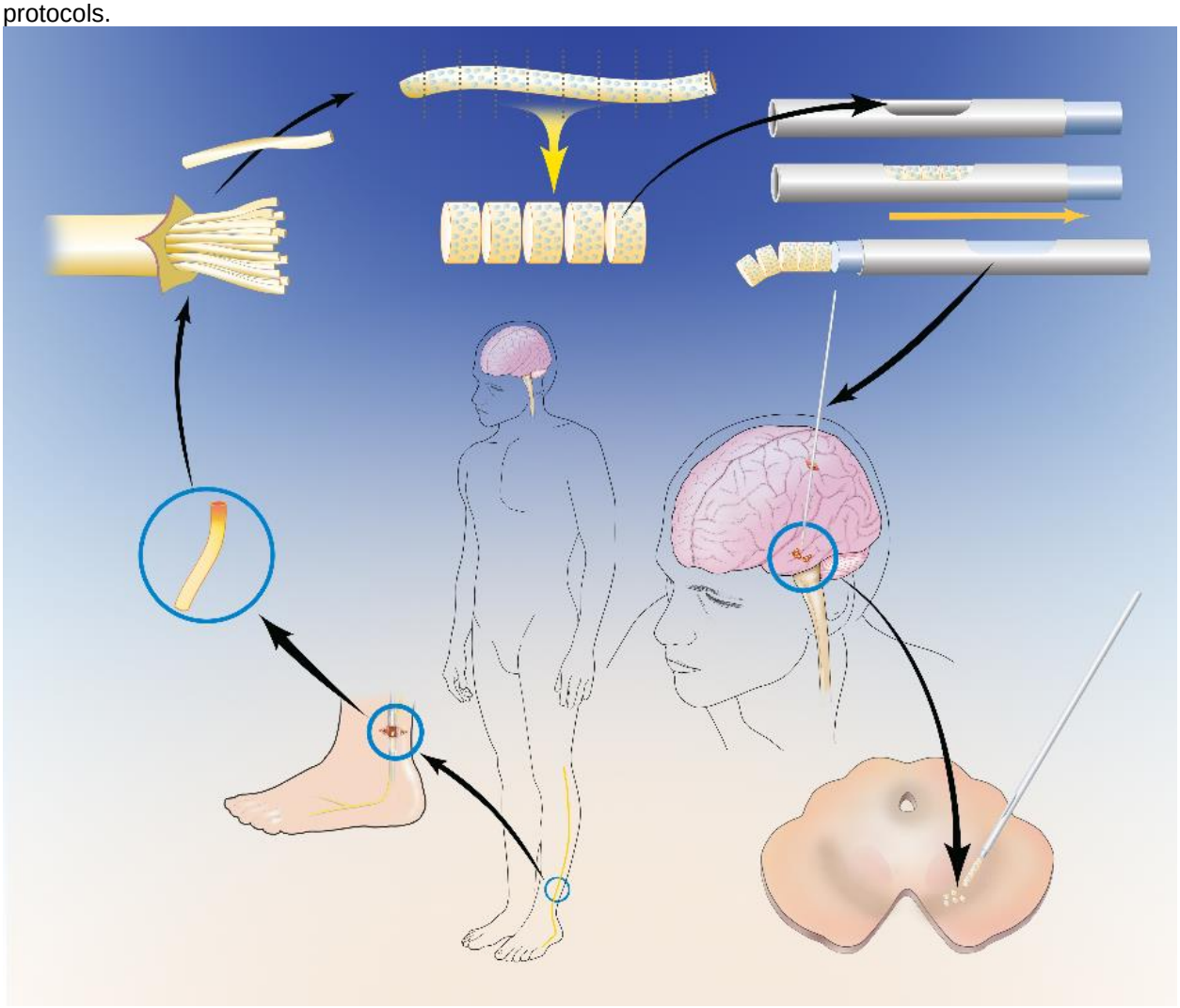
Introduction: Our approach to neuro-restoration and disease modification in Parkinson's disease (PD) involves the direct delivery of repair cell tissue to the substantia nigra (SN). Previous phase I clinical trials have met primary endpoints of safety and feasibility and continue to show promise in clinically meaningful metrics of disease modification of motor symptoms at 2 years. These trials required 2 surgeries staged two weeks apart. We present in-progress findings of a potential next-generation clinical trial designed to investigate the safety and feasibility of a one-stage procedure.

Methods: This trial utilizes the Deep Brain Stimulation (DBS) Plus clinical trial platform and is designed to enroll 10 participants with idiopathic PD, who consented to DBS, are between the ages of 40 and 75 without PD dementia, and are able to participate in the post-operative study visits for 1 year. The major difference between this study and our previous studies is that all surgical components of DBS placement and delivery of cell repair tissue, autologous peripheral nerve tissue (APNT), are performed in one setting (figure 1). The primary outcome is safety and feasibility of delivering the APNT to the SN bilaterally in a single surgical setting. The secondary outcome relates to clinical data, motor, non-motor, and cognitive, for comparison to previous results with staged

protocols.



Results: To date, we have enrolled 9 participants. After enrolling, one participant dropped out for personal reasons. The other 8 (all male by chance, average age 64 (51-69)) went on to have the DBS Plus procedure. Baseline UPDRS motor scores were 37.8 (stdev 9.0) in the practical OFF medication state (12 hours) and 22.3 (stdev 11.2) in the ON state. All 8 received successful DBS placement and bilateral implantation of APNT to the SN. One participant had mild dysarthria immediately following surgery which fully resolved.

Conclusions: This work continues to demonstrate the overall safety and feasibility of the direct delivery of repair cell tissue to the SN highlighting the success of the DBS surgical platform. The results of the clinical data, if consistent or better than that of the staged procedure, will strongly support the use of non-staged protocols for future phase III trials.

Keywords: Neurorestoration, Parkinson's, Clinical, Parkinson's disease, transplant

O067 / #396

Topic: *AS09. Gene Therapy and Neuronal Transplant*

REPARATIVE CELLS FROM PERIPHERAL NERVE TISSUE SURVIVE AFTER IMPLANTATION TO THE SUBSTANTIA NIGRA IN PATIENTS WITH PARKINSON'S DISEASE

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Introduction: Over the last 10 years we have been conducting a series of safety and feasibility clinical trials exploring the ability of cells from peripheral nerve tissue (PNT) to provide cell-survival factors to the substantia nigra in patients with Parkinson's disease. Recently, we have had former participants arrive at autopsy. While we have previously reported clinical outcomes from these open-label studies, we can now begin to examine the histopathology of these cell implants.

Methods: We obtained written informed consent from all participants prior to the start of study procedures and for brain donation. Participants received unilateral autologous PNT (sural nerve) implantation to the substantia nigra as part of their enrollment in a clinical trial examining the disease-modifying capability of PNT. Following brain donation, the brain was fixed in paraformaldehyde and immunostaining for performed for PNT-identifying factors, alpha-synuclein, and tyrosine hydroxylase.

Results: We obtained brain donations from five participants (4 males/1 female) with a mean age of 69 years and an average of 6 years with the PNT graft (range: 3 years to 10 years). All participants died from unrelated causes. We have not observed abnormal tissue changes in any of the brains. We have previously reported findings on two participants (Colvett et al. 2023). Because the PNT is not treated prior to implantation, neuroimaging has not been possible. However, we have identified the PNT graft in the substantia nigra in the donated brains. Preliminary analyses indicate increased dendritic arborization in the ipsilateral substantia nigra compared to the contralateral substantia nigra. Analyses of the tissues are continuing.

Conclusions: Cells from PNT grafts survive for years following implantation to the CNS. The PNT grafts have not resulted in adverse events. The continued safety profile of this procedure warrants further examination supported by in-depth analyses of the graft and host responses.

Keywords: Histopathology, Cell Therapy, Parkinson's disease

O068 / #113

Topic: *AS10. Novel Therapies*

SURGERY AT THE CROSSROADS OF BRAIN FUNCTIONS: NEUROMODULATION OF FOREL H FIELD ON MOVEMENT, PSYCHIATRIC AND EPILEPTIC DISORDERS

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Introduction: The fields of Forel (FF) is a region in which various nerve fibers, including the pallidothalamic tract (PTT), course and is located caudal to the thalamus, surrounded medially by the mamillothalamic tract, laterally by the subthalamic nucleus (STN), and anteriorly by the red nucleus(RN). The ventral tegmental area (VTA), nucleus accumbens (NAcc), and prefrontal cortex (PFC) are essential for experiencing pleasure and initiating motivated behaviour. The VTA, NAcc, and PFC are connected through the medial forebrain bundle (MFB). The MFB, effective for obsessive compulsive disorders (OCD) and depression, passes through the FF. Neuromodulation of FF has been reported to improve epilepsy as well as movement disorders, including Parkinson’s disease and dystonia, and is noteworthy in that it is possible to neuromodulate multifunctional neural networks simultaneously.

Methods: Based on 264 patients treated by FF surgery (radiofrequency ablation, deep brain stimulation, and focused ultrasound ablation) at Tokyo Women’s Medical University, we examined the possible candidates for neuromodulation at FF. The usefulness of FF surgery will also be discussed.

Results: In our experience, improvements were observed in movement disorders such as Parkinson's disease, dystonia, myoclonus dystonia, hereditary dystonia, drug-induced dyskinesia, Huntington's chorea, and chorea-achantocytosis. Improvement was also observed in intractable epilepsy and OCD. Treatment-resistant depression and OCD have also been reported with DBS for MFB. The effect of FF surgery on movement disorders was thought to be due to the PTT from the GPi to the thalamus. The effect of FF surgery on OCD was considered to be due to the MFB, considering the results of tractography analysis. Other literatures have also reported improvement in depression with MFB-DBS. Improvement of refractory epilepsy was thought to be due to PTT and/or nigro-thalamic tract. Tardive dyskinesia with comorbid psychiatric and movement disorders may be a good indication for FF surgery.

Conclusions: This study strongly suggests that PTT in FF is as effective as GPI for movement disorders. When considering focused ultrasound therapy, PTT is very close to the center of the brain compared to GPI, making it easier to obtain a temperature increase with FUS. In FUS therapy, PTT is an effective candidate as an alternative target to GPI.

Keywords: Forel's field, medial forebrain bundle, Epilepsy

Flash Presentations

FP001 / #25

Topic: *AS02. Epilepsy*

HIGH VALUE EPILEPSY CARE IN THE UNITED STATES: PREDICTORS OF INCREASED COSTS AND COMPLICATIONS FROM THE NATIONAL INPATIENT SAMPLE DATABASE 2016-2019

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Introduction: For patients with medically refractory epilepsy newer minimally invasive techniques such as Laser Interstitial Thermal Therapy (LITT) have been developed in recent years. This study aims to characterize trends in the utilization of surgical resection versus LITT to treat medically refractory epilepsy, characterize complications, and understand the cost of this innovative technique to the public.

Methods: The National Inpatient Sample (NIS) database was queried from 2016 to 2019 for all patients admitted with a diagnosis of medically refractory epilepsy. Patient demographics, hospital length of stay, complications, and costs were tabulated for all patients who underwent LITT or surgical resection within these cohorts.

Results: A total of 6,019 patients were included, 223 underwent LITT procedures while 5,796 underwent resection. Compared to resection, LITT had a lower length of stay (2.0 days vs. 10.4 days, $p<0.001$), lower costs ($39,000 vs $57,000), and slightly lower complication rate (1.8% vs. 3.8%, $p<0.001$). Significant predictors of increased patient charges included diabetes (OR 1.7, CI 1.44-2.19), infection (OR 5.12, CI 2.73-9.58), and hemorrhage (OR 2.95, CI 2.04-4.12). Procedures performed at non-teaching hospitals had 1.54 greater odds (CI 1.02-2.33) of resulting in a complication compared to teaching hospitals. Insurance status did significantly differ ($p=0.001$) between those receiving LITT (23.3% Medicare; 25.6% Medicaid; 44.4% Private insurance; 6.7 Other) and those undergoing resection (35.3% Medicare; 22.5% Medicaid; 34.7% Private Insurance; 7.5% other).

Conclusions: LITT has a lower length of hospital stay, lower complication rate, and overall lower cost to the patient than surgical techniques for treatment of medically refractory epilepsy.

Keywords: Epilepsy, LITT, Neuromodulation

FP002 / #31

Topic: *AS02. Epilepsy*

LIMITING LEFT ANTERIOR TEMPORAL LOBECTOMIES WITHIN 3.5 CENTIMETERS FROM THE TEMPORAL TIP DOES NOT PREVENT PICTURE NAMING DECLINE

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Introduction: Recent voxel lesion symptom mapping (VLSM) studies have identified a critical region assimilated to the basal temporal language area (BTLA) located 3.4 to 6.1 cm from the temporal pole. Its resection during left temporal lobe epilepsy surgery led to postoperative decline in picture naming. However, post-operative anomia has been reported after classic left temporal lobectomy which rarely extends so posteriorly. The aim of the present study was to confront patients' post-operative picture naming outcome with their precise surgical cavities in light of the recent findings from VLSM studies.

Methods: In this monocentric retrospective study, we analyzed picture naming outcome and the surgical cavities of 34 patients who underwent surgery for left temporal lobe epilepsy. We confronted the cohort's surgical cavities with the critical regions identified by VLSM studies as the BTLA.

Results: The surgical cavities of patients were anterior to the critical regions for picture naming identified by VLSM studies in the literature. Eight out of 11 patients presenting a post-operative lexical access decline at 18 months had a posterior limit of lesioned voxels that did not reach the critical region identified by VLSM studies. Only 3 out of 11 patients with a post-operative picture naming decline had surgical cavities reaching these critical regions. Conversely, 3 out of 23 patients with a stable or improved post-operative picture naming had surgical cavities reaching these critical regions.

Conclusions: Keeping a surgical cavity anterior to the limits identified by recent VLSM studies does not protect patients from post-operative picture naming decline. Interindividual antero-posterior variability of the BTLA could complete the explanation offered by VLSM.

Keywords: BTLA (basal temporal language area), VLSM (voxel lesion symptom mapping), picture naming

FP003 / #372

Topic: *AS02. Epilepsy*

BILATERAL CENTROMEDIAN THALAMIC NUCLEI DEEP BRAIN STIMULATION FOR EPILEPSY IN CHILDREN AND ADULTS, A SINGLE CENTER EXPERIENCE IN COLOMBIA, SOUTH AMERICA.

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Introduction: Deep brain stimulation (DBS) of the anterior thalamic nucleus has been approved for drug-resistant epilepsies (DRE), and this study aims to report the safety and clinical efficacy of centromedian (CM) thalamic nucleus DBS for treating patients with DRE

Methods: A retrospective review and questionnaire assessment of 28 consecutive patients who underwent CM-DBS for epilepsy at a single center from 2017 to 2023 were conducted, comparing seizure frequency and severity before and after DBS while describing surgical complications. Non-parametric analyses were employed to evaluate the impact of surgical intervention, revealing a significant reduction in epileptic seizures post-surgery.

Results: The mean age of patients was 35.7 ± 15.3 years, with a median follow-up time of 26.42 months. The population was heterogeneous, with various types of epilepsy represented. Fifty-seven percent of patients experienced a ≥50% reduction in total seizure frequency, with a remarkable 95.56% reduction in epileptic seizures after surgery. Seizure frequency decreased significantly from 441.5 ± 110 seizures per month before surgery to 20.14 ± 10.93 after surgery (p=0.002), and seizure-free days increased from 10.29 ± 3.5 to 67.03 ± 35.9 (p=0.009) across all patients. Eighty-five percent of patients saw a decrease in seizure intensity and duration, with no increased effect over time observed. Three patients (10.7%) developed device-related infections requiring surgical intervention, with no permanent neurological deficits observed, and three deaths occurred unrelated to DBS.

Conclusions: In conclusion, in a heterogeneous population of children and adults with generalized, multifocal, and poorly localized DRE, bilateral CM-DBS proves to be an effective and safe therapy, offering promising outcomes in the management of drug-resistant epilepsy.

Keywords: Epilepsy, centromedian, Deep Brain Stimulation

FP004 / #11

Topic: *AS02. Epilepsy*

MICROENDOSCOPIC TRANSVENTRICULAR DEEP BRAIN STIMULATION OF THE ANTERIOR NUCLEUS OF THE THALAMUS AS A SAFE TREATMENT IN INTRACTABLE EPILEPSY

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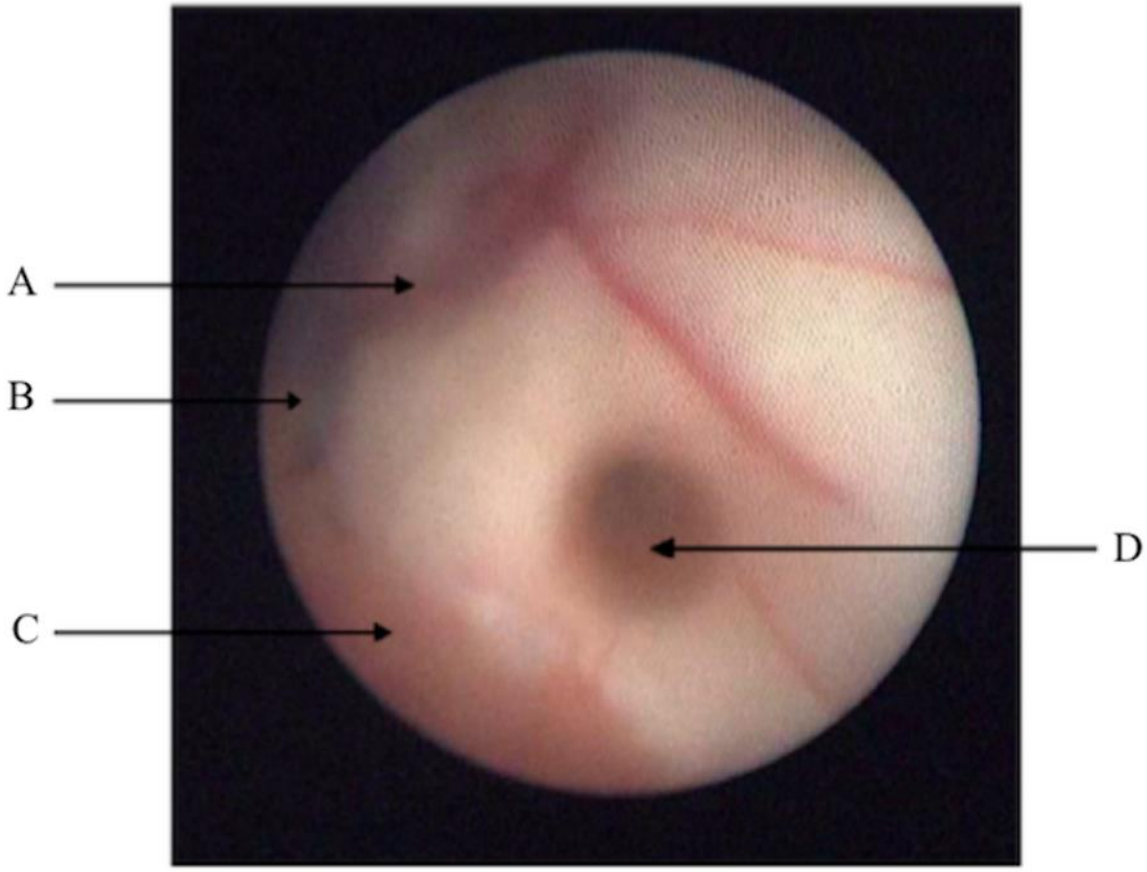
Introduction: Deep brain stimulation (DBS) of the anterior nucleus of the thalamus (ANT) is proposed for patients with severe intractable epilepsy. However, the transventricular approach increases the risk of bleeding due to the anatomy around the entry point in the thalamus. In the SANTE trial, a bleeding frequency of 4.5% was reported. To mitigate this complication, we employed a transventricular microendoscopic technique.

Methods: We conducted a retrospective study involving nine adult patients treated surgically for refractory epilepsy between 2010 and 2019 by DBS of the anterior nucleus of the thalamus. The surgical procedure involved a transcortical-transventricular puncture using a 1mm diameter micro-endoscope inserted through a guide cannula into the frontal horn of the lateral ventricle. This reached the calculated point within the ventricle before removing the stylet and using the rigid micro-endoscope. We performed only one penetration into the brain through the cannula while inserting both the micro-endoscope and the lead.

Results: Endoscopy provided direct visual control of the lead's entry point into the thalamus through the ventricle, avoiding ependymal vessels (Figure 1). No hemorrhages were recorded, and accuracy was systematically checked by intraoperative stereotactic MRI. At 1 year, we observed an 88.9% improvement rate in responders and an 87.5% improvement rate at 2 years. A significant decrease in the global seizure count per month was observed one year after DBS (68.1%; P = 0.013), leading to an overall improvement in quality of life. No major adverse effects were recorded during the follow-up. ANT DBS exhibited a notable significant effect by reducing the number of generalized seizures. Figure 1. Peroperative endoscopic view of the entry point in the thalamus. A. Thalamo-striated vein, B. Anterior septal vein, C. Choroid plexus, D. View of the entry point of a removed lead (due to a fracture) before re-implantation at the same

location



Conclusions: Our goal was to achieve better ANT/lead collimation using a vertical transventricular approach under microendoscopic monitoring. This technique enhanced the procedure's safety and improved targeting accuracy.

Keywords: Endoscopy, Deep Brain Stimulation, Epilepsy

FP005 / #58

Topic: *AS02. Epilepsy*

DIRECT TARGETING OF THE CENTROMEDIAN NUCLEUS

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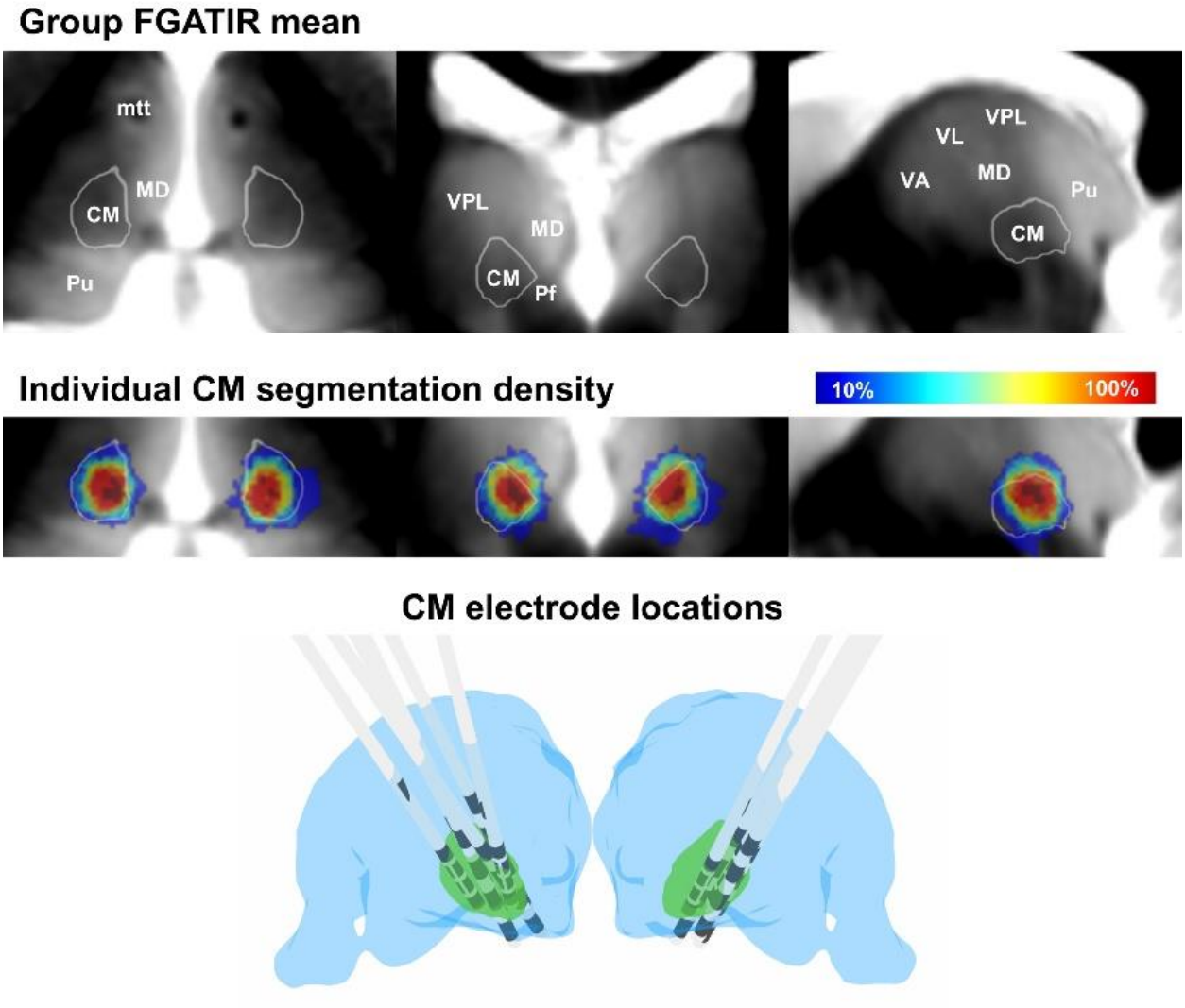
Introduction: Stimulation of the thalamic centromedian nucleus (CM) is an emerging therapy for focal and generalized epilepsy. Historically, CM has been targeted indirectly due to difficulty visualizing CM on conventional MRI sequences. Fast gray matter acquisition T1 inversion recovery (FGATIR) is a clinical MRI sequence used to visualize subcortical structures based on relative gray matter content. Recent optimization of the FGATIR sequence utilizing deep learning reconstruction has resulted in substantial improvement in signal-to-noise ratio.

Methods: Optimized FGATIR sequences were acquired in 10 patients with epilepsy in advance of thalamic deep brain stimulator (DBS) or responsive neurostimulator (RNS) implantation. CM was identified as the relatively hypointense region lateral to the mediodorsal and parafascicular nuclei and anterior to the pulvinar. Individual FGATIR acquisitions and manual CM segmentations were normalized to MNI space for group analysis and compared to the Morel atlas of the thalamus.

Results: CM visualization was significantly improved on optimized FGATIR relative to traditional FGATIR. The medial and posterior borders of CM demonstrated greatest contrast with neighboring thalamic nuclei and were identified with the highest accuracy and precision. Lower contrast was noted at the anterior and lateral borders with sensorimotor thalamus and the superior border with the internal medullary lamina. Six patients underwent FGATIR-guided placement of bilateral CM DBS or RNS leads. Postoperative atlas comparison revealed that all electrodes traversed CM, with a median of 2.5 contacts (range 1-3) in CM for DBS and 1.5 (range 1-2) for

RNS.



Conclusions: FGATIR is a useful and readily available sequence for accurate targeting of CM. Further improvements in CM neuromodulation may come from combining FGATIR, specialized MRI sequences, and emerging data regarding the optimal stimulation target within CM.

Keywords: Epilepsy, Neuromodulation, thalamus

FP006 / #223

Topic: *AS02. Epilepsy*

LESIONECTOMY FOR STRUCTURE INSULAR REFRACTORY EPILEPSY

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Introduction: Insular epilepsy (IE) is characterised by a low response for antiseizure treatment. Meanwhile, surgical treatment of insular lesions is considered challenging due to their deep location and the proximity to functional important areas. The aim of this study is to analyze the results of insular lesionectomy using a transsylvian approach in patients with IE.

Methods: A retrospective study enrolled 12 adult patients with focal structural insular epilepsy, aged between 24 and 69 years (mean age: 43.1 years). All patients underwent insular lesionectomy at the Romodanov neurosurgery institute. The duration of epilepsy ranged from 6 months to 6 years (mean: 2.2 years), with 9 patients (75.0%) experiencing daily seizures. Lesions were located in the non-dominant hemisphere in 7 cases (58.3%) and in the dominant hemisphere in 5 cases (41.7%). Microsurgical insular lesionectomy was performed using a transsylvian approach. CT angiography was conducted for visualization of the arterial insular supply in all cases before surgery. Neuromonitoring was performed during the operation in 6 cases (50%). Postoperative long-term follow-up ranged from 2.5 to 5.5 years (mean: 4.2 years). All patients were evaluated at one year, and 10 patients (83.3%) were evaluated at two years after the operation.

Results: n 9 patients (75.0%), total resection of the insular lesion was achieved, while in 3 cases (25.0%), only subtotal resection was possible due to involvement of eloquent areas. 10 patients (83.3%) suffered from glial/glioneural tumours (grades I-III), while 2 patients (16.7%) had non-neoplastic lesions. Two years after surgery, 7 patients (58.3%) became seizure-free, rare short auras (Engel 2) were observed in 2 (16.7%) cases, and relatively positive results were obtained in the remaining 3 cases (25.0%). Postoperative neurological complications occurred in 4 patients (33.3%), with motor deficits being the most common (in three cases) and dysphasia occurring in one case. Among these complications permanent neurological deficits occurred after 2 surgeries (16.7%).

Conclusions: Insular lesionectomy via the transsylvian approach is a safe intervention, that provides a high rate of satisfactory seizure relief in well-selected patients. The use of neuromonitoring allows for the enlargement of the resection volume and reduces the risk of developing permanent neurological deficits

Keywords: lesionectomy, transsylvian approach, insular epilepsy

FP007 / #437

Topic: *AS07. Tumor*

DIFFUSE MIDLINE GLIOMA MAP TO A COMMON BRAIN NETWORK ASSOCIATED WITH TUMOUR PROGRESSION AND OVERALL SURVIVAL

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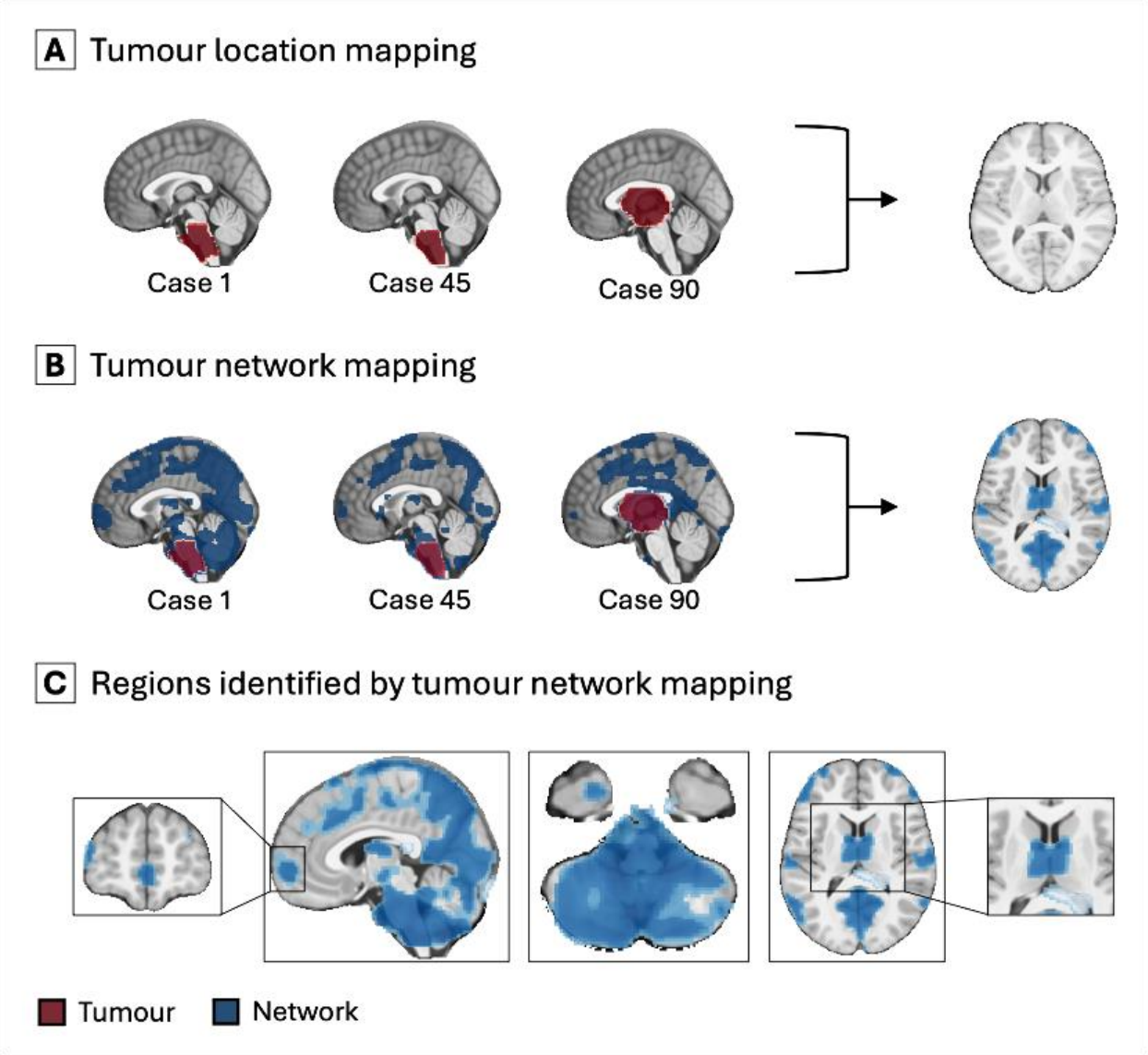
Introduction: Gliomas are known to form bidirectional, functional synapses with otherwise healthy neurons: increasing neuronal excitability and driving tumour growth. The prognostic significance of this phenomenon does, however, remain unknown.

Methods: This study used tumour location and tumour network mapping to identify brain networks associated with tumour progression and overall survival (OS) in 90 children with diffuse midline glioma, H3K27-altered (DMG). Tumours were segmented on volumetric magnetic resonance imaging and mapped to a standard template. Brain networks functionally connected to each tumour were computed using normative resting-state paediatric functional magnetic resonance imaging (n=525).

Results: Median OS in the discovery cohort was 9.5 months (interquartile range 7.0-14.5 months). Comparison of tumour location in short-term (<18 months; n=75) and long-term (>18 months; n=15) survivors of DMG identified an area of maximal anatomic overlap associated with short-term survival in the mid-pontine tegmentum and corticospinal tracts (89%; $P<0.05$). Tumour location alone was, however, not associated with OS ($P=0.347$). We, therefore, seeded tumour-to-brain resting-state functional connectivity maps from this tegmental a priori region-of-interest, identifying a specific brain network associated with short-term survival - defined by functional connectivity to the medial prefrontal cortex, thalami, and cerebellum ($P<0.0005$) - and significantly different from the seven canonical resting-state networks (Figure). High and low tumour connectivity to this network was associated with short-term and long-term OS, respectively, using both univariate ($P=0.013$) and multivariate models controlling for treatment and tumour volume ($P=0.016$). Subset analysis of longitudinal neuroimaging in children within one month of death (n=21) showed tumour progression mapped to this same functional network and exhibited a dominant (left) hemispheric predominance ($P<0.05$), underpinned by increased tumour connectivity to the right ($P=0.0270$) rather than left ($P=0.1802$) corticospinal tract, and associated with OS ($P=0.02$). Finally, the prognostic significance of tumour-to-network functional connectivity was replicated both in an independent multicentre validation cohort (n=80) and using diffusion-weighted magnetic resonance

imaging.



Conclusions: We map DMG to a unified and prognostically important functional network, further establishing DMG as a circuit disorder. Interventions aiming to modulate this network may inform future treatment strategies for affected individuals.

Keywords: Diffuse midline glioma, Lesion network mapping

FP008 / #207

Topic: *AS07. Tumor*

FIBER OPTICAL GUIDANCE IN NEURONAVIGATED BRAIN TUMOR NEEDLE BIOPSIES LINKED TO NEUROPATHOLOGICAL ANALYSIS AND POSTOPERATIVE IMAGING

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Introduction: Brain tumor needle biopsies provide tissue samples for neuropathological analysis and oncological treatment planning. The procedure is at risk of non-diagnostic or biased sampling (5-25%) and hemorrhage (3-59.8%, upper bound including asymptomatic). To minimize these risks, optical techniques have been proposed. One approach is to estimate tissue fluorescence and microvascular blood flow (perfusion) in situ along the trajectory before the tissue is sampled. This study aimed to evaluate an investigational fiber optical system integrated into the neuronavigated biopsy procedure. Further, the optical results were compared with in-depth neuropathological analysis and findings on postoperative imaging.

Methods: A probe-based optical measurement system was integrated into the neuronavigated biopsy procedure (StealthStation, Medtronic Inc, USA) in 20 patients (range 18-80, 7 females, EPM 2020-01404). Through a forward-looking probe fitted into the outer cannula of a modified biopsy needle (Medtronic Inc, USA) real-time measurements provide estimates of tissue perfusion, gray-whiteness, and 5-ALA-induced protoporphyrin IX (PpIX)-accumulation. After surgery, an in-depth evaluation of the tissue samples was made by a senior neuropathologist. This included morphological and molecular analyses. The optical findings were then compared to the neuropathological assessment and findings on postoperative imaging (magnetic resonance imaging, MRI, or computed tomography), i.e., hemorrhage and final biopsy position.

Results: PpIX-fluorescence was found in the biopsy region of 16 patients including 13 gliomas (12 glioblastomas, one astrocytoma) and three lymphomas. Ki67-indices for positive fluorescence response were 15-99%. A negative fluorescence response was found for two gliomas (one glioma grade 2, one glioblastoma) with a Ki67-index of 6%. The two remaining samples were non-diagnostic, showed no PpIX-fluorescence and postoperative imaging confirmed the biopsy location to be outside the radiological definition of tumor. Increased perfusion was found in nine patients corresponding to cortical, tumorous, and tentorium regions on MRI. On postoperative imaging, nine patients showed asymptomatic bleeding, and one symptomatic.

Conclusions: In conclusion, fiber optical measurements provide real-time feedback on tissue during surgery before sampling and can be integrated into the neuronavigated needle biopsy procedure. Perfusion values can indicate an increased risk of hemorrhage along the trajectory. In line with the literature, most gliomas and lymphomas show positive fluorescence response.

Keywords: brain tumor, neuropathology, fluorescence spectrosopy

FP009 / #76

Topic: *AS03. Pain*

SURGICAL TREATMENT OF GLOSSOPHARYNGEAL NEURALGIA; SURGICAL OUTCOME OF MICROVASCULAR DECOMPRESSION USING TRANSPOSITION TECHNIQUES TO ACHIEVE 'OFF THE ROOT ENTRY ZONE'

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Introduction: Glossopharyngeal neuralgia often needs to be treated with microvascular decompression (MVD) surgery, since it stands as the sole curative therapeutic intervention for this debilitating pain. This retrospective study investigates the outcomes of MVD procedures aimed at alleviating neuralgia by targeting the "off the Root Entry Zone (REZ)" without resorting to rhizotomy.

Methods: Data from 83 MVD procedures performed in 82 patients between 1996 and early 2023 were retrospectively analyzed, with a focus on transposition techniques used during surgery. Patient demographics, preoperative imaging findings, intraoperative details, and postoperative outcomes were collected and reviewed. Follow-up evaluations tracked neuralgia progression post-surgery, including recurrent symptoms or complications. Cases of failed initial MVD procedures undergoing revision MVD or Gamma Knife Radiosurgery as secondary interventions.

Results: Among the 83 MVD procedures analyzed, 80 (96.39%) resulted in patients achieving pain-free status post-surgery. The posterior inferior cerebellar artery (PICA) was frequently implicated as the culprit vessel compressing the glossopharyngeal nerve. In more than half of the cases, compression was observed not only at the glossopharyngeal nerve REZ but also at the vagus nerve REZ. Secondary interventions, including revision MVD and Gamma Knife Radiosurgery, yielded varying degrees of success in cases of initial MVD failure. Minimal temporary complications were reported, with no permanent adverse effects or mortality observed.

Conclusions: MVD utilizing transposition techniques is a safe and effective treatment modality for GN that achieves 'off the Root Entry Zone', resulting high rates of pain relief with minimal recurrence and complications.

Keywords: Microvascular decompression, Glossopharyngeal neuralgia, Transposition technique

FP010 / #333

Topic: *AS03. Pain*

NEUROMODULATION IN NEUROPATHIC FACIAL PAIN

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Introduction: Medically intractable neuropathic facial pain is a debilitating disease. According to the 3rd Edition of International Classification of Headache Disorders, it may stem from conditions such as multiple sclerosis or mass effect, and can also be linked to post-traumatic or post-herpetic nerve injuries. Gasserian ganglion stimulation can serve as an effective method for reducing neuropathic facial pain.

Methods: 13 patients suffering from medically intractable neuropathic facial pain participated in this study. Pain origins were classified as postherpetic (n=3), postraumatic (3), iatrogenic (5), and unknown (2) origin. Each patient was implanted with a custom made Medtronic 3-contact anchored, curved lead, under light sedation and intraoperative trial stimulation. The leads were carefully placed through the oval foramen using flouroscopy, lead extension has been tunneled and externalized on the neck. Each patient underwent up to a 3-week-long postoperative testing period using an external neurostimulator to assess the efficacy of stimulation. VAS scores were obtained three times a day, with stimulation parameters adjusted accordingly.

Results: 11 of the 13 patients completed the trial period successfully. Mean age was 53.84±14.24 years, with a gender distribution of 8 female and 5 male patients. On average, symptoms had been present for 8.69±10.15 years. Mean preoperative VAS 9.15±0.9 decreased to 2.64±1.5 within the first two weeks of testing on an external neurostimulator. At least three months after surgery VAS scores remained relatively low with a mean of 2.5±2.27. Stimulation amplitude and pulse width varied within the whole group.

Conclusions: While Gasserian ganglion stimulation shows promise as a reliable therapeutic approach for medically intractable neuropathic facial pain, its precise mechanism remains to be unveiled. Given the necessity for highly individualized stimulation parameters, a trial period of up to three weeks is recommended before the implantation of the Internal Pulse Generator (IPG) to establish tailored therapeutic settings effectively. The method outlined demonstrates consistent reduction of neuropathic facial pain within the observed patient cohort. However, enrolling additional patients is imperative to identify specific parameters that can be fine-tuned for various indications, ultimately establishing a disease-specific guideline for programming.

Keywords: Neuromodulation, Gasserian ganglion, Neuropathic Facial Pain

FP011 / #41

Topic: *AS03. Pain*

WEIGHT TRENDS FOLLOWING SPINAL CORD STIMULATION THERAPY FOR CHRONIC PAIN

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Introduction: Spinal cord stimulation (SCS) therapy is an effective treatment for chronic pain, particularly in conditions like post-laminectomy syndrome and complex regional pain syndrome (CRPS). Rare case reports described significant weight loss in patients that underwent dorsal columns SCS therapy for chronic pain. Recently, neuromodulation for obesity has become a novel field for research.

Methods: We conducted a retrospective chart review of 342 patients treated with SCS or dorsal root ganglion (DRG) stimulators at our institution between 2010-2023. Patients had weight recorded before SCS implantation, and at least once within 12 months post-operatively. We also conducted interviews with 28 patients who experienced significant weight loss or had revision procedures due to weight loss.

Results: We found that 105/342 patients (30.7%) experienced weight loss of at least 5% within a year of implantation, and 32/105 (30.5%) experienced weight loss of >10%. A multivariable regression analysis revealed a modest increase in the likelihood of weight loss among patients with CRPS (Odds Ratio=1.17, 95% CI [1.04, 1.30], p=0.0069) and in those who achieved pain relief following implantation (OR=1.22, 95% CI [1.05,1.40], p=0.0079). Of the 28 patients with significant weight loss who were interviewed, 12 (43%) could not explain the reasons for their weight loss, while 8 (29%) reported decreased

Table 2.

	Any weight loss		Significant weight loss	
Multivariable analysis	Odds ratio	P value	Odds ratio	P value
Diagnosis of CRPS	1.17 [1.04, 1.30]	0.0069*	1.11 [1.01,1.22]	.0319*
Pain relief	1.22 [1.05,1.40]	0.0079*	1.14 [1.02,1.28]	.0233*

Tabel 2: Multivariable linear regression analysis of the prediction of any weight loss (>5%) or significant weight loss (>10%) by either the type of pain (CRPS vs Post-laminectomy syndrome) or pain outcomes (pain relief vs no pain relief). CRPS-complex regional pain syndrome. Both compared to control as logistic regression. * p<0.05

appetite.

Conclusions: Our findings suggest that SCS therapy may impact weight. Further studies are needed to investigate the potential role of SCS in neuromodulation for obesity.

Keywords: pain, Neuromodulation, scs

FP012 / #16

Topic: *AS03. Pain*

THE IMPORTANCE OF SOMATOTOPY TO ACHIEVE CLINICAL BENEFIT IN MOTOR CORTEX STIMULATION FOR PAIN RELIEF

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Introduction: The aim of this study was to search the relationship between the anatomical location and the eventual analgesic effect of each contact.

Methods: 22 patients (14 men and 8 women) suffering from central and / or peripheral neuropathic pain were implanted with stimulation of the precentral cortex. The implantation of the electrodes was performed using intraoperative: 1) Anatomical identification by Neuronavigation with 3D MRI, 2) Somesthetic evoqued potentials monitoring to check the potential reverse over the central sulcus, 3)Electrical stimulations through the dura to identify the motor responses and its somatotopy. In order to locate postoperatively the electrodes, a 3D-CT was performed in each case and fused with the preoperative MRI. The clinical analgesic effects of cortical stimulation were collected on a regular basis (VAS reduction > 50%, drugs consumption). Data were analyzed to search a correlation between the anatomical position of contacts and analgesic effects.

Results: Post implantation analgesic effects were obtained in 18 (81.81 %) patients out of 22. The analgesic effect was companied with reduction of the drugs consumption in 15 patients (68.18 %). The post-operative 3D CT analysis shows a correspondence between the effective contacts localization and the motor cerebral cortex somatotopy in the patients with post-operative good analgesic effects. No correspondence was found between the contacts localization and the motor cerebral cortex somatotopy in the 4 patients with no analgesic effects. In three out of these four patients, analgesic effects were obtained after a new surgery allowing a replacement of the electrode position over the motor cortex somatotopy corresponding to the painful area.

Conclusions: This study shows the correlation between position of the contact over the precentral cortex and the analgesia obtained when the somatotopy of the stimulated cortex correspond to the painful area.

Keywords: Motor cortex stimulation, Cerebral cortex somatotopy, Neuropathic pain

FP013 / #330

Topic: *AS03. Pain*

THREE-DIMENSIONAL MORPHOLOGY OF THE TRIGEMINAL NERVE: EXPLORING DEFORMITIES AND THEIR ROLE IN TRIGEMINAL NEURALGIA PATHOGENESIS

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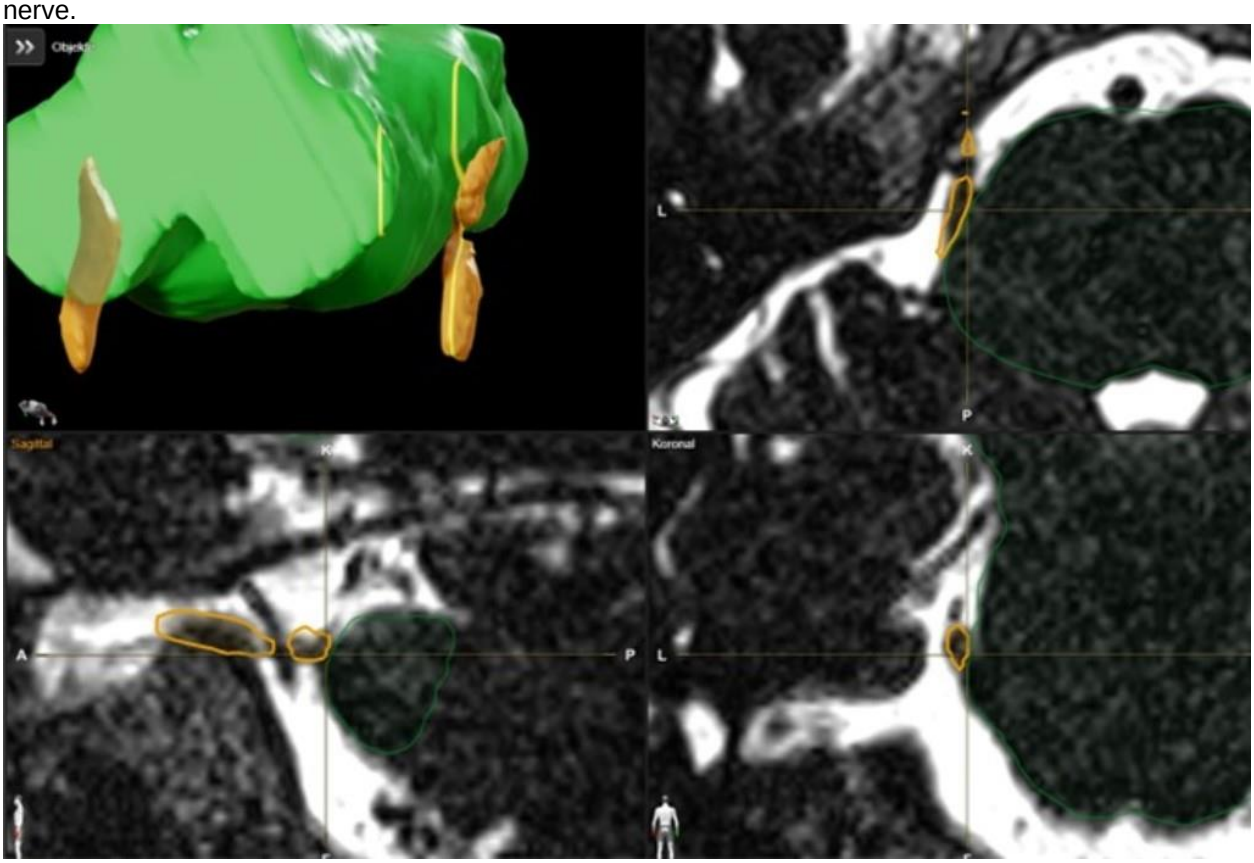
Introduction: Neurovascular conflict (NVC) is the most common cause of trigeminal neuralgia, which paved the way for the success of microvascular decompression. Although the link between severe neurovascular conflict and trigeminal neuralgia is well-established, there exists a gap in understanding the qualitative aspects of trigeminal nerve distortion. Utilizing advanced imaging technology, this study explores the three-dimensional (3D) morphology of trigeminal nerves in trigeminal neuralgia patients, aiming to correlate deformities with the side and distribution of pain.

Methods: Patients with trigeminal neuralgia and high-resolution magnetic resonance imaging (MRI) utilizing 3D constructive interference in steady state (CISS) were selected. Blinded evaluations of MRI scans were conducted, and trigeminal nerves were meticulously segmented using Brainlab Elements Software. The study involved 41 patients with trigeminal neuralgia, and parameters such as length, volume, and impressions in axial, sagittal, and coronal planes were blindly analyzed for each nerve.

Results: The average age at the time of MRI was 58 years, with a mean pain duration of 4 years. Continuous pain was observed in 9 patients, 4 patients had concomitant multiple sclerosis, and 9 patients presented with preoperative hypaesthesia. The mean slice thickness of scans was 0.5 mm (range 0.3-0.7). Painful sides exhibited severe coronal impressions in 17%, moderate in 22%, and mild in 44% of patients, while non-painful sides had 17% moderate, and 51% mild impressions. Sagittal impression was present in 56% of nerves on the painful side and in 39% of the nerves on the non-painful side. Coronal and sagittal deformities were associated with side and distribution of pain. More deformities were associated with the side of pain. Adhesions contributed to the sagittal and axial impression of the trigeminal

nerve.



Conclusions: This study establishes that deformities in both coronal and sagittal planes of the trigeminal nerve are associated factors in the pathogenesis of trigeminal neuralgia. Understanding these morphological nuances contributes to comprehending the disorder and may aid in refining treatment approaches.

Keywords: trigeminal neuralgia, pain, Microvascular decompression

FP014 / #190

Topic: *AS03. Pain*

DEEP BRAIN STIMULATION AND MOTOR CORTEX STIMULATION IN THE TREATMENT OF CHRONIC INTRACTABLE NEUROPATHIC PAIN

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Introduction: Chronic neuropathic pain poses a significant therapeutic challenge, often resistant to pharmacological and conservative approaches. Functional neurosurgery, including deep brain stimulation (DBS) and motor cortex stimulation (MCS), has been explored for refractory cases. This study presents four cases of pharmaco-resistant neuropathic pain treated subsequently with both thalamic DBS and MCS, aiming to analyze the combined approach and strategies for patients unresponsive to single brain stimulation methods

Methods: This monocentric retrospective study includes patients with refractory chronic neuropathic pain treated at the Department of Neurosurgery in Hannover between December 2007 and December 2022. Patients underwent in different instances bifocal implantation of DBS electrodes in the CM–Pf and the VPL or the VPM and epidural placement of a quadripolar paddle lead for MCS. Preoperative assessments included imaging, pain evaluation, and cognitive assessments. Inclusion criteria involved medically refractory chronic neuropathic pain with a defined lesion, while exclusion criteria included specific pain scores and comorbidities.

Results: Four patients, two men and two women (average age: 37 years), underwent combined DBS and MCS treatment. Two of them (cases 1 & 2) had first a trial of MCS and upon insufficient response had DBS electrodes implanted. The remaining two patients (cases 3 and 4) had first DBS electrode implantation with temporary pain relief and afterwards underwent MCS test stimulation. The mean pain duration was 8.2 years. Follow-up (mean: 68.8 months) showed variable improvements in VAS pain scores, with two patients achieving ≥50% improvement in average pain at last follow up. Secondary surgeries were performed in two patients. One patient experienced a seizure during the MCS test phase, leading to discontinuation. The study presents an illustrative case demonstrating the first report of a synergistic effect from simultaneous stimulation of CM-Pf DBS and MCS.

Conclusions: This study presents a combined approach of thalamic DBS and MCS for pharmaco-resistant neuropathic pain. Results varied among patients, emphasizing the need for individualized treatment strategies. The discussion underscores the challenges and considerations in choosing between DBS and MCS, advocating for a prudent approach and future prospective trials to refine treatment strategies for patients unresponsive to initial brain stimulation.

Keywords: Motor cortex stimulation, Deep Brain Stimulation, Neuropathic pain

FP015 / #274

Topic: *AS03. Pain*

IMPLANTABLE PULSE GENERATOR SITE PAIN FOLLOWING SPINAL CORD STIMULATION: A CASE-CONTROL STUDY OF FACTORS

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Introduction: Implantable pulse generator (IPG) site pain is a relatively common complication of spinal cord stimulator (SCS) implantation that often warrants revision. While consideration of bony anatomy, seating position and clothing may help reduce the incidence of IPG site pain, the optimal IPG site remains unclear. Additionally, there are a paucity of data on factors predisposing to IPG-site pain. In this study we aimed to investigate factors associated with IPG-site pain following spinal cord stimulation.

Methods: A Current Procedural Terminology (CPT) code-based search was performed to identify patients undergoing IPG placement, revision, replacement or removal for SCS (codes 63685 and 63688) between 01/01/2000 - 02/28/2021. A chart review was performed to identify cases with IPG-site pain. Demographics, medical, and surgical data were collected and compared to age and gender matched controls.

Results: Of 911 patients that underwent IPG surgery, 30 cases underwent a revision, replacement, or removal for IPG-site pain. There were a higher proportion of females (76%) in the cases group compared to the total 911 patients (52%). Compared to matched controls, a higher proportion of cases had previous spine surgery. There were no differences in body mass index, pain etiology, duration of pain, duration of opioid use, psychiatric comorbidities, substance abuse, financial compensation, laminectomy versus percutaneous, IPG location or laterality.

Conclusions: Contrary to our hypotheses, we found no association between IPG-site pain and low BMI, or implanted location. Previous spine surgery may be predictive of IPG-site pain, but no associations with other demographic, socioeconomic, or medical factors were observed. Further work is needed to investigate factors associated with IPG-site pain in order to identify strategies to reduce the incidence.

Keywords: internal pulse generator, pain, Spinal Cord Stimulation

FP016 / #27

Topic: *AS03. Pain*

PERIPHERAL NERVE STIMULATION WITH A WIRELESS DEVICE IN CHRONIC POST-TRAUMATIC PAIN MANAGEMENT

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Introduction: Up to 30% of the population suffers from chronic pain. A significant number of patients develop pharmacoresistance, which reduces the quality of life. One of the rapidly developing pain management modalities is Neuromodulation. Peripheral nerve stimulation (PNS) is a less popular technology compared to epidural spinal cord stimulation due to the technical difficulties of devices implantation (including the need to implant an IPG in a parts of the body with limited subcutaneous space), as well as the high risks of postoperative complications. The introduction of wireless stimulation systems into clinical practice, and the development of minimally invasive PNS leads implantation technology using ultrasound guidance increase interest in the PNS technique.

Methods: We would like to present 3 clinical observations of PNS in patients with post-traumatic neuropathic pain. The selection of patients for PNS was carried out by a multidisciplinary team.

Results: According to the results of stimulation trial, two patients showed a significant regression of pain (50-60%), which persisted after implantation of a permanent wireless stimulation device for 6 months (Fig 1; Tab 1). In one patient, pain regression was insufficient; the patient refrained from permanent stimulation device implantation (Tab

1).

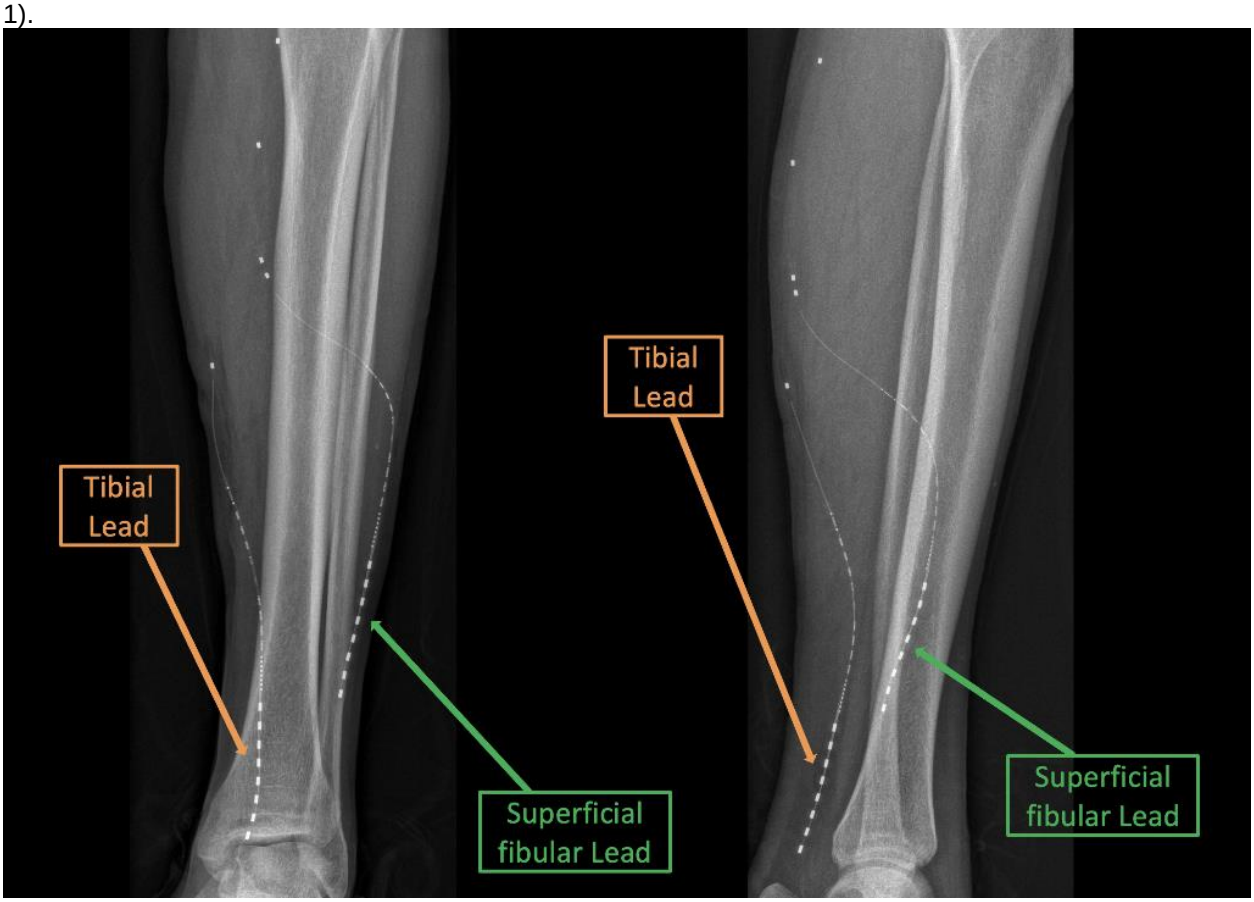

Table 1

	Pain area	Stimulated nerve (Lead location)	Trial results (pain regression) Stimulation modality	Permanent PNS Results (1 month) Stimulation modality	Permanent PNS Results (6 months) Stimulation modality
Pat 1	Left shoulder	Suprascapular nerve + PNfS	30-40% (Tonic)	-	-
Pat 2	Left forearm and wrist	Median + Superficial Radial	50-60% (Tonic; HF)	50-60% (HF)	60-70% (HF; Surge/Burst)
Pat 3	Right lower leg and ankle	Tibial + Superficial Peroneal	50-60% (Tonic; HF)	50-60% (HF)	40-50% (HF; Surge/Burst)

Conclusions: Technological modifications of PNS devices, and the widespread use of intraoperative ultrasound guidance in lead implantation process can significantly improve the quality of treatment of pharmacoresistant pain. For a more reliable assessment of the effectiveness and safety of wireless PNS devices, further clinical studies are required, as well as evaluation of the PNS long term outcomes.

Keywords: PNS, Wireless device, Surge/Burst

FP017 / #131

Topic: *AS01. Movement Disorders*

POTENTIAL FOR STEREOTACTIC TARGETS IN HUNTINGTON'S DISEASE: DISTINCT CLINICAL PROFILES ASSOCIATED WITH UNIQUE FUNCTIONAL CONNECTIVITY SIGNATURES

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Introduction: Huntington's disease (HD) was the first-ever disorder treated by stereotactic functional neurosurgery. However, attempts to modulate affected frontostriatal circuits via brain-graft injections and deep brain stimulation have yielded inconsistent results. While HD is characterized as a movement disorder, there is great heterogeneity in the severity and progression of motor, cognitive, and psychiatric decline. As such, this study aims to explore clinical profiles in HD, as well as the underlying alterations in cortico-striatal circuits that may serve as targets for future stereotactic interventions.

Methods: Thirty-eight HD gene expansion carriers (25 female) underwent extensive clinical assessment of motor, cognitive, and psychiatric domains as well as multimodal structural and functional MRI. Principal component analysis was first applied to assessment scores to examine clinical profiles in HD. The resulting principal components were subsequently entered into separate multivariate linear regression models together with three basal ganglia seeds (caudate nucleus, putamen, nucleus accumbens) to analyze their corresponding whole-brain functional connectivity maps. Finally, factor loadings for each individual were regressed against basal ganglia gray matter volumes.

Results: Principal component analysis identified two main clinical profiles in HD. The first was defined by motor-cognitive symptoms, while the second demonstrated psychiatric disturbances. Functional connectivity maps revealed specific neural signatures associated with each profile. Specifically, more severe motor-cognitive symptoms were related with decreased connectivity in executive and sensorimotor networks, and, interestingly, increased connectivity between the ventral nucleus accumbens and executive networks (Figure 1). Meanwhile, the psychiatric profile exemplified a link between more severe psychiatric disturbances and decreased connectivity in limbic networks. Lastly, basal ganglia atrophy was related with motor-cognitive
symptoms.

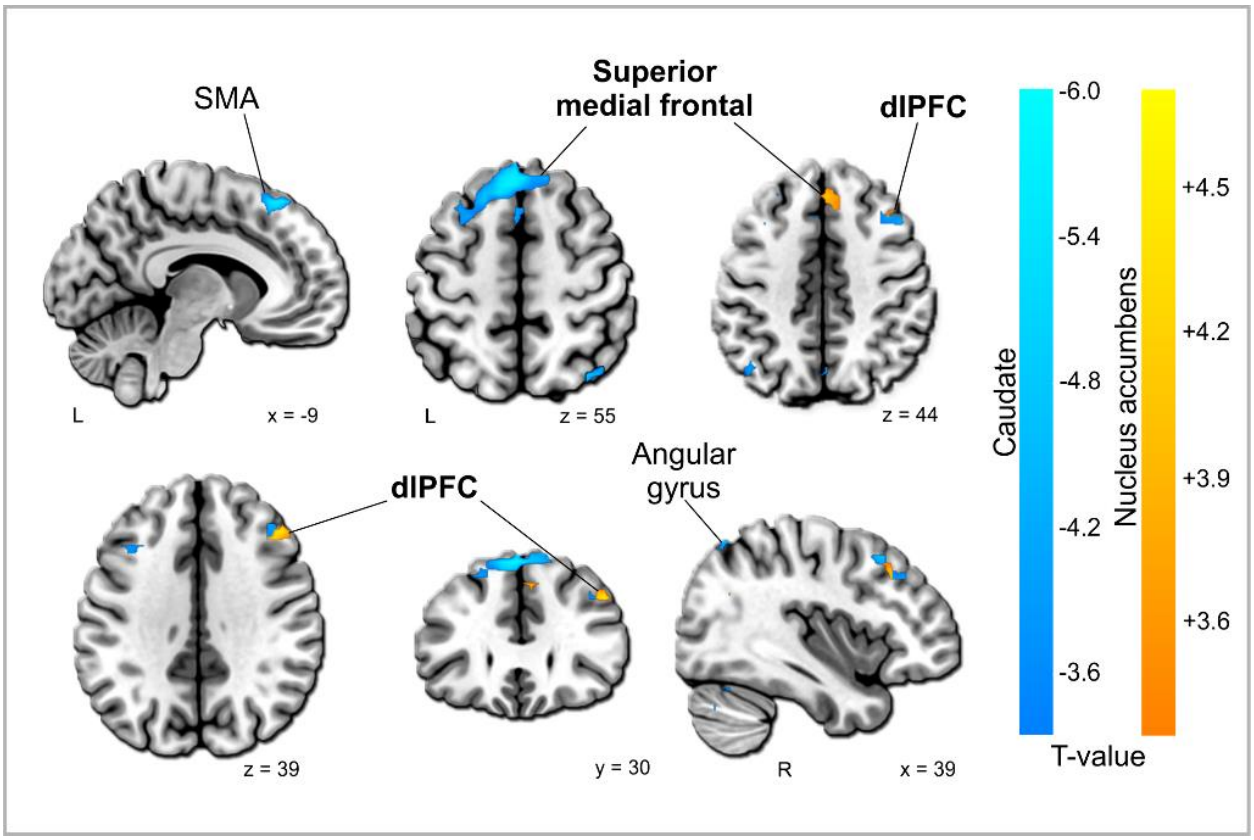

Figure 1. Functional connectivity maps of the motor-cognitive profile for basal ganglia seeds. Maps shown at the whole-brain level.

Conclusions: The present work underscores that clinical heterogeneity in HD may be delineated by distinct clinical profiles of patients defined by predominantly motor-cognitive or psychiatric disturbances, each with its own unique underlying functional and structural brain alterations. Ultimately, these distinct neural signatures may provide a basis for the selection of patients that may be more likely to benefit from stereotactic intervention, such as the stimulation or potentiation of nodes within disrupted or compensatory networks.

Keywords: Huntington's disease, fMRI, basal ganglia

FP018 / #308

Topic: *AS01. Movement Disorders*

FREQUENCY-SPECIFIC MODULATION OF CORTICAL ACTIVITY ACROSS ANTERIOR-POSTERIOR SENSORIMOTOR CORTICAL REGIONS DURING LOSS OF CONSCIOUSNESS.

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Introduction: The investigation of consciousness, especially through loss of consciousness (LOC), can reveal important insights into brain mechanisms regulating arousal and awareness. While much research is focused on understanding the specific frequency bands that are modulated with LOC, we aimed to investigate spatial patterns of spectral changes underlying LOC. We hypothesize that during LOC, there is a distinct, region-specific modulation of cortical dynamics, characterized by a spatial gradient in frequency-specific activity across the cortex. Given the concept of “anteriorization of alpha” with LOC, we hypothesized greater modulation of alpha-band oscillations more anteriorly. This modulation reflects a systematic shift from lower to higher frequency bands from anterior to posterior cortical regions, suggesting a structured, frequency-based pattern of brain activity alteration with LOC.

Methods: We employed a detailed analysis of electrophysiological data in 2 different consciousness states after propofol injection (Baseline and Loss of Consciousness) derived from electrocorticography (ECoG) recordings in nine Parkinson's disease patients during deep brain stimulator (DBS) implantation surgery.

Results: We found a significant increase in normalized power during Loss of Consciousness (LOC) across all frequencies across sensory (S1, S2), primary motor (M1), and premotor (PM1, PM2) cortices. The power ratio (relative change in power) between LOC and baseline showed a consistent spatial pattern: anterior regions, including PM, predominantly exhibited maximal modulation in lower frequency bands (e.g., Theta), while posterior regions, such as S1 and S2, showed maximal modulation in higher frequency bands (e.g., high beta and gamma). This pattern supports our hypothesis of a structured, frequency-based modulation of cortical activity in response to LOC.

Conclusions: The findings confirm our hypothesis, demonstrating a distinctive spatial gradient of frequency-specific modulation of brain activity that significantly varies from anterior to posterior regions. The observed pattern suggests region-specific modulation of cortical dynamics in response to LOC, underscoring interactions between spatial location and frequency-specific brain activity in the regulation of consciousness.

Keywords: Loss of Consciousness, Cortical Activity, Deep Brain Stimulation

FP019 / #325

Topic: *AS01. Movement Disorders*

CERVICOTHORACIC VENTRAL-DORSAL RHIZOTOMY FOR TREATMENT OF BRACHIAL HYPERTONIA IN CEREBRAL PALSY

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Introduction: Cervicothoracic ventral-dorsal rhizotomy (VDR) is a potential treatment of medically refractory hypertonia in children who are not candidates for intrathecal baclofen, particularly in cases of severe upper limb hypertonia with limited to no function. Lumbar rhizotomy are commonly performed, however there are limited data in the treatment of pediatric hypertonia with cervicothoracic VDR. A longitudinal cohort was identified to highlight our institutional safety and efficacy using cervicothoracic VDR for the treatment of hypertonia.

Methods: Retrospective data analysis was performed for children that underwent non-selective cervicothoracic VDR between 2022-2023. Non-modifiable risk factors, clinical variables, and operative characteristics were collected.

Results: 6 patients (3 female) were included. Four patients underwent a bilateral C6-T1 VDR, one patient underwent a left C7-T1 VDR, and another underwent a left C6-T1 VDR. Three patients had quadriplegic mixed hypertonia, one patient had quadriplegic spasticity, one patient had triplegic mixed hypertonia, and one patient had mixed hemiplegic hypertonia. The mean difference of proximal upper extremity modified Ashworth scale (mAS) was -1.4 ± 0.55 ($p = 0.002$), and -2.2 ± 0.45 ($p < 0.001$) for the distal upper extremity. Both patients with independence noted quality of life improvements as well as increased ease with dressing and orthotics fits. Caregivers for the remaining four patients noted improvements in caregiving provision, mainly in dressing, orthotics fit, and ease when transferring.

Conclusions: Cervicothoracic VDR is safe, provides tone control and quality of life improvements. Cervicothoracic VDR is appropriate when ITB is impractical; it can be considered as a first-line surgical option in medically refractory brachial hypertonia patients with CP. Larger multicenter studies with longer follow-up are necessary to further determine safety along with long-term functional benefits in these patients.

Keywords: Cerebral Palsy, Brachial Hypertonia, Rhizotomy

FP020 / #368

Topic: *AS01. Movement Disorders*

EFFECTIVENESS OF VIM DBS FOR HEAD TREMOR IN ESSENTIAL TREMOR PATIENTS: A SINGLE-CENTER EXPERIENCE

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Introduction: Deep Brain Stimulation (DBS), particularly targeting the ventral intermediate nucleus (VIM), has demonstrated significant efficacy in mitigating tremors affecting the arms and hands in patients with essential tremor (ET). However, the effectiveness of DBS in alleviating head tremors within this population remains relatively unexplored, along with the associated influencing factors. Herein, we present findings from a single-center experience.

Methods: We conducted a retrospective chart review of patients diagnosed with ET who underwent unilateral or bilateral VIM DBS procedures at the Center for Neurological Restoration (CNR) within the Cleveland Clinic between January 2020 and December 2023. Patients without a confirmed diagnosis of ET or those presenting with concurrent diagnoses of ET and Parkinson's disease (PD) were excluded from the study. Head tremor severity was assessed using the Fahn-Tolosa-Marin (FTM) Tremor Rating Scale preoperatively and at the first visit after three months postoperatively, with concurrent recording of stimulation parameters. A positive response was defined as an improvement of at least 1 point in a sub-item of the FTM scale. Statistical analyses were employed to evaluate group differences, including students' t-tests and chi-square tests.

Results: Among the 150 patients who underwent VIM DBS, 48 patients with ET met the inclusion criteria for our study by having the two time-point scales and DBS parameters available. The mean age was 68.0±7.5 years, with a disease duration of 24.0±15.0 years. The average preoperative resting head tremor severity was 1.2±0.7, while postural head tremor severity was 1.11±0.77. The average time for postoperative FTM visits was 4.3±5.1 months. Eighty-five percent of patients exhibited a positive response to treatment. For responders, the average amplitude and frequency were 1.9±0.7 mA and 138.8±13.5 Hz, respectively, compared to 1.7±0.7 mA and 135.4±16.4 Hz for non-responders (p-value =0.602, and 0.474, respectively).

Conclusions: Our preliminary findings suggest that VIM DBS shows promising efficacy in managing head tremors in patients with ET. However, a more extensive review is ongoing to comprehensively analyze factors associated with treatment response and to validate these results.

Keywords: VIM DBS, essential tremor, Head tremors

FP021 / #429

Topic: *AS01. Movement Disorders*

OPTIMAL STIMULATION SITES, STRUCTURAL AND FUNCTIONAL CONNECTOME OF STN-DBS FOR THE TREATMENT OF REM SLEEP BEHAVIOR DISORDER IN PARKINSON'S DISEASE

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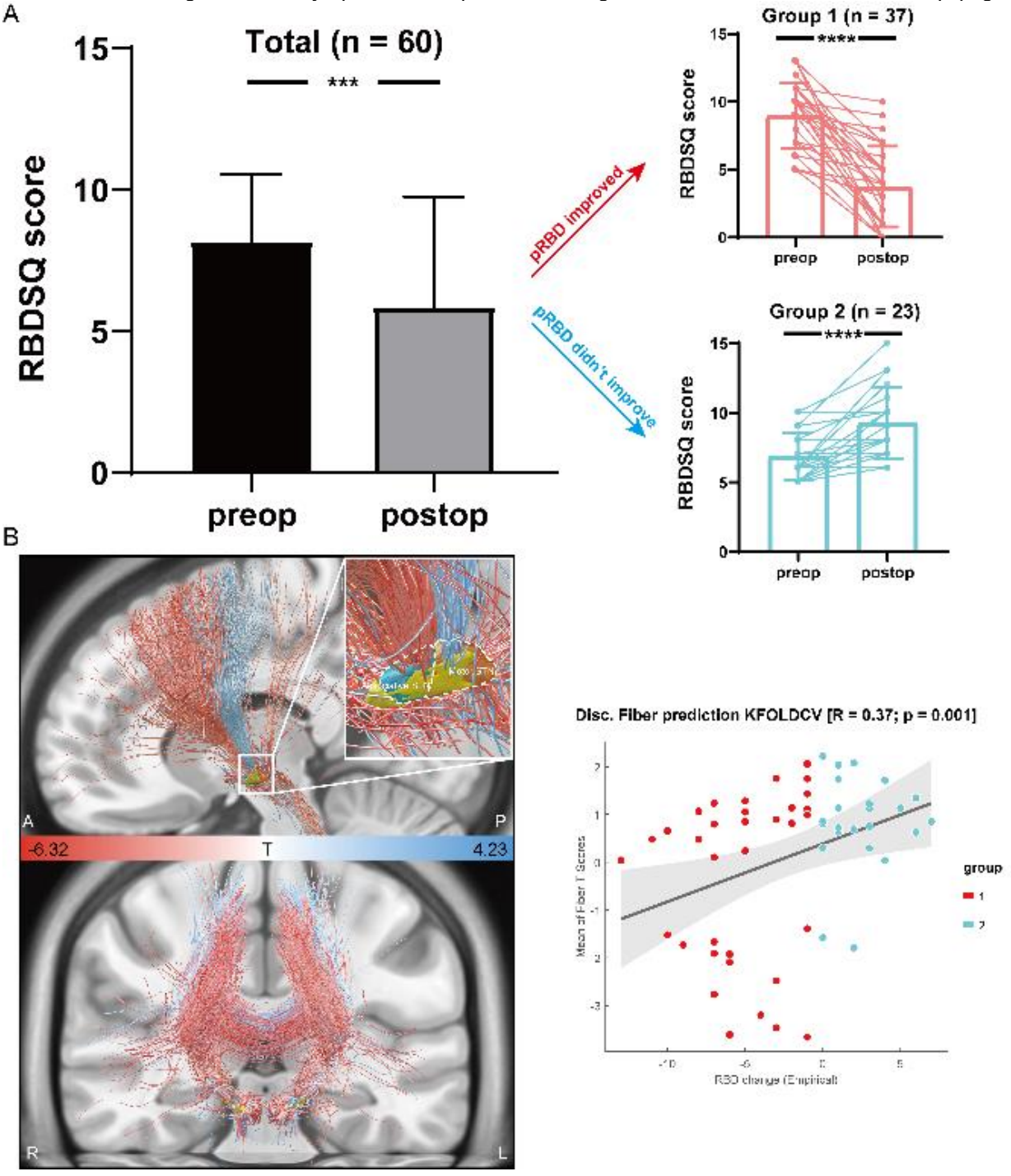
Introduction: As many as 60% of patients with Parkinson's disease (PD) have rapid eye movement (REM) sleep behavior disorder (RBD), a parasomnia characterized by lack of muscle atonia and the presence of complicated motor behaviors. This disorder has the potential to cause harm to the patient as well as to bed companions. Subthalamic nucleus (STN)–deep brain stimulation (DBS) in PD patients affects not just focused target areas but also diffuse brain networks. The effect of this network modulation on nonmotor DBS effects is not fully understood. By concentrating on the sleep domain, the authors comprehensively determined the influence of electrode location and related structural/functional connections on changes in RBD symptoms, as indicated by the RBD screening questionnaire (RBDSQ), after STN-DBS, which has been reported to ameliorate, deteriorate, or remain constant.

Methods: A total of 60 PD patients with RBD at baseline (preoperative RBDSQ score ≥ 5) were included in this retrospective study. Preoperative and postoperative RBD symptoms were documented. The volumes of tissue activated (VTAs) were assessed on the basis of individual electrode reconstructions and merged with normative connectome data to identify probabilistic stimulation map and structural/functional connections associated with VTAs. The entire cohort was used to construct predictive models that explained changes in RBD symptoms, as well as to perform cross-validations.

Results: RBD symptoms significantly improved after bilateral STN-DBS (ΔRBDSQ score −2.32 ± 4.59, $p = 0.0002$). However, patients responded differently to DBS surgery (Fig A). Structural/functional connectivity was associated with RBD symptom changes during STN-DBS. Prefrontal connection was related with improved RBD symptoms, whereas sensorimotor connectivity was associated with

deterioration; changes in RBD symptoms were predicted using an ideal structural connection map (Fig B).



Conclusions: Recovery of RBD symptoms was predicted on the basis of the fibers connecting the STN electrode to prefrontal regions. These findings implied that the placement of STN-DBS leads influences the fibers to prefrontal regions and may be used to enhance treatment of RBD symptoms; however, further prospective studies are needed to validate these findings.

Keywords: Parkinson's disease, REM sleep behavior disorder, STN-DBS

FP022 / #489

Topic: *AS01. Movement Disorders*

COMPARISON OF DENTATO-RUBRO-THALAMIC TRACTOGRAPHY METHODS BASED ON THE ANATOMY OF THE RUBRAL WING

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Introduction: Precise localization of the dentato-rubro-thalamic (DRT) tract can facilitate anatomical targeting in MRI-guided high-intensity focused ultrasound (HIFU) thalamotomy and thalamic deep brain stimulation (DBS) for tremor. The anatomical segment of DRT fibers adjacent to the Ventral Intermediate Nucleus of the Thalamus (VIM), referred to as the rubral wing (RW), may be directly visualized on the fast gray matter acquisition T1 inversion recovery (FGATIR). We compared reproducibility, lesion overlap and clinical outcomes when reconstructing the DRT tract using a novel anatomically-defined RW region of interest (ROI), DRT-RW, to an existing tractography method based on the posterior subthalamic area ROI (DRT-PSA).

Methods: We reviewed data of 23 patients with either essential tremor (n=18) or tremor-predominant Parkinson's disease (n=5) that underwent HIFU thalamotomy, targeting the VIM. DRT-tractography, ipsilateral to the lesion, was created based on either DRT-PSA or DRT-RW. Volume sections of each tract were created and Dice similarity coefficients (DSC) were used to measure spatial overlap between the 2 tractographies. Post-HIFU lesion size and location (on post-operative T2 MRI) was correlated with tremor outcomes and side-effects for both DRT-tractography methods and the RW itself.

Results: DRT-PSA passed through the RW and DRT-RW intersected with the ROIs of the DRT-PSA in all 23 cases. A higher percentage of the RW was ablated in patients that achieved tremor control (19±6%) versus those without tremor relief (7±6%, p=0.017). In patients with tremor control 6-months post-op (n=12), those with side-effects (n=6) had larger percentages of their tracts ablated in comparison to those without side-effects in both DRT-PSA (44.82±12.10% vs 24.25±11.29%, p=0.025) and DRT-RW (35.42±13.22% vs 21.74±8.64%, p=0.03).

Conclusions: Tractography of the dentato-rubro-thalamic tract could be reconstructed by direct anatomical visualization of the RW on FGATIR-MRI. Anatomical planning is expected to be quicker, more reproducible and less operator-dependent.

Keywords: tractography, rubral wing, tremor

FP023 / #121

Topic: *AS01. Movement Disorders*

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

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Introduction: Assessing tremor severity to determine the optimal electrode position in DBS surgery traditionally relies on subjective visual observation. Numerous quantitative methods have been suggested. However, many of these necessitate the use of additional sensors or require patients to carry or handle smartphones, presenting significant drawbacks. In this study, we introduce an innovative application specifically designed for quantifying action tremor. Notably, our method utilizes a digital pen with a touch screen tablet device, offering a more practical solution for tremor evaluation during surgery.

Methods: 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.

Results: 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).

Conclusions: 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: Digital Pen, Real-time Monitoring, Tremor Evaluation

FP024 / #128

Topic: *AS01. Movement Disorders*

REAL-WORLD CLINICAL AND SAFETY OUTCOMES FROM A PROSPECTIVE, MULTICENTER DEEP BRAIN STIMULATION REGISTRY OF ESSENTIAL TREMOR PATIENTS

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Introduction: Large, multicenter patient outcome registries are an important source from which to collect realworld evidence (RWE). Ventral intermediate nucleus (Vim) Deep Brain Stimulation (DBS) is an increasingly recommended therapeutic approach in properly selected candidates to manage Essential Tremor (ET). This clinical evaluation will help provide RWE in patients implanted with a DBS system for ET. Here, we evaluate on-going registry outcomes derived from patients implanted with directional Deep Brain Stimulation systems with Multiple Independent Current Control (MICC) technology for treatment of Essential Tremor.

Methods: In this prospective, on-label, multi-center, international DBS registry, enrolled patients are implanted with a directional MICC-based DBS system (Vercise, Boston Scientific). Patients are followed up to 3-years where ET symptoms and overall improvement in quality of life are evaluated. Clinical endpoint evaluated at baseline and during study follow-up timepoints include Fahn-Tolosa-Marin Rating Scale (FTMTRS), the Essential Tremor Rating Assessment Scale (TETRAS), Quality of Life in Essential Tremor Questionnaire (QUEST), and Global Impression of change. Adverse events are also being collected.

Results: from this ongoing, prospective, multicenter, international outcomes study demonstrate significant improvement in ET related symptoms and quality of life up to 12-month follow-up. A total of 50 subjects (27 males, mean age= 65.3 years, mean disease duration = 19.5 years) received DBS. At the 12-month follow-up, a mean 8.9-hours reduction in tremor was noted (self-reported, QUESD in a typical day. Additionally, regarding tremor severity, no subject reported marked disability while 82.6% reported mild disability (FTMTRS), and subjects saw a 63.7% mean-improvement in activities of daily living (TETRAS) at 12-months compared to baseline. No lead breakages/fractures were reported. Additional clinical and safety outcomes derived from on-going data collection and analysis will be reported.

Conclusions: Results from this ongoing, prospective, multicenter, international real-world outcomes study using multiple-source constant-current Directional DBS Systems for the treatment of Essential Tremor continue to demonstrate positive outcomes out to 12-months follow-up.

Keyword: Deep Brain Stimulation, DBS, Essential Tremor

FP025 / #193

Topic: *AS04. Psychiatric Disorders*

DEEP BRAIN STIMULATION OF THE LIMBIC-MOTOR INTERFACE NETWORK FOR TOURETTE SYNDROME

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Introduction: DBS is an effective treatment for refractory Tourette syndrome (TS). Several targets have been reported, but there is still controversy about the networks involved. Here we aimed to identify the basal ganglia–thalamo-cortical networks associated with tic and obsessive-compulsive behavior (OCB) improvement. To investigate the network interface between two main targets used for TS

Methods: Retrospective analysis of 21 patients treated with pallidal and thalamic DBS. Tics and OCB scores were recorded before and after DBS. We performed the analysis in standard space and calculated the volume of tissue activated with last follow-up settings to obtain areas of maximal improvement ("sweetspots") for the both targets. Tractography showed the white-matter pathways associated with maximal tic and OCB improvement.

Results: Ten patients treated with pallidal-DBS and 11 patients treated with thalamic-DBS were included. Responder rates were 80% in the pallidal and 64% in the thalamic target. Sweetspots for tics and OCB clustered in several areas across the basal ganglia and thalamus. Tic reduction in the pallidal target mapped to a limbic pallidothalamic network and in the thalamic target to the premotor thalamocortical network. Putting these two networks together will form the main output of the so-called limbic-motor interface network. On the other hand, OCB reduction mapped a dorsomedial prefrontal cortex/dorsal anterior cingulate (dmPFC/dACC) network.

Conclusions: We demonstrated the involvement of the limbic-motor interface network through the ventral pallidofugal pathway during effective DBS for TS in 2 different tagets. OCB redution was associated with the additional involvement of dmPFC/dACC connections passing dorsal to the head of the globus pallidus pars externa on its way to the thalamus and midbrain.

Keywords: Tourette syndrome, tractography, Deep Brain Stimulation

FP026 / #296

Topic: *AS04. Psychiatric Disorders*

NON-INVASIVE MR-GUIDED FOCUSED ULTRASOUND FOR ANOREXIA NERVOSA

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Introduction: Anorexia nervosa (AN) is one of the most challenging psychiatric disorders to treat. The poor clinical outcomes warrant novel treatments for AN, especially in severe and persistent cases. Radiofrequency ablation and deep brain stimulation have been reported, and have significant efficacy in patients with anorexia nervosa. As a non-invasive treatment, MR-guided Focused ultrasound (MRgFUS) has more therapeutic advantages and a wider treatment window for patients with decompensated signs.

Methods: Three female patients diagnosed with refractory AN who underwent MR-guided bilateral anterior capsule focused ultrasound ablation completed this 1-year follow-up study. Outcomes included body mass index (BMI) and results from a series of psychiatric scales (for obsessive, depressive, and anxious symptoms) that were implemented at baseline, and 1 mo, 3mo, 6 mo and 1 yr after MRgFUS treatment. The study was approved by the hospital's ethics committee.

Results: Compared to pretreatment baseline, BMI increased significantly at 3-mo and 1-yr follow-ups. Compared to pretreatment scores, psychiatric scale scores were significantly improved at 1-mo post-treatment, and continued to remain low at the 1-yr follow-ups. In addition, Montreal Cognitive Assessment (MoCA) scores were in the normal range during the follow-up. There were no short- and long-term complications during the follow-up period.

Conclusions: MR-guided bilateral anterior capsule focused ultrasound ablation enabled patients with refractory AN to normalize their weight, especially those in life-threatening conditions. As a non-invasive, highly safe treatment, it is the best option for patients with anorexia who are decompensated with Liver and kidney and having coagulopathy.

Keywords: anorexia nervosa, MRI-guided Focused ultrasound, anterior internal capsule

FP027 / #93

Topic: *AS04. Psychiatric Disorders*

ECOG SIGNATURE-INFORMED CORTICAL STIMULATION SUPPRESSES HALLUCINATION-LIKE BEHAVIORS IN A PSYCHOSIS MONKEY MODEL

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Introduction: Auditory hallucinations are a prevalent symptom of schizophrenia. Previous studies have suggested that transcranial electrical stimulation may be effective in treating refractory auditory hallucinations, but individual response heterogeneity has hindered the clinical outcome.

Methods: To identify symptom-specific neural markers and optimize electrical stimulation, we used methamphetamine-induced psychosis rhesus monkeys exhibiting repetitive hallucination-like actions and recorded cortical activity with intracranial electrocorticography. Afterward, cortical brain regions associated with aberrant behaviors in the macaque were identified, and high-frequency electrical stimulation was applied via the cortical electrodes. The improvement in the abnormal behaviors were then quantified.

Results: We found a significantly elevated beta-band power in the primary auditory cortex (A1) accompanying monkey's hallucination-like behaviors. Notably, we also found similar local field potential elevation in the supra-marginal gyrus (Wernicke's area) of a schizophrenia patient during electrical stimulation-induced auditory verbal hallucinations. Furthermore, a high-frequency electrical stimulation centered around A1 resulted in a sustained suppression of the elevated beta-band power and methamphetamine-induced hallucination-like behaviors in rhesus monkeys.

Conclusions: These findings suggest a potential of cortical high-frequency electrical stimulation in the treatment of refractory auditory hallucinations in psychosis patients.

Keywords: electrical stimulation, auditory hallucinations, non-human primate

FP028 / #232

Topic: *AS04. Psychiatric Disorders*

STIMULATION SITES AND NETWORKS PREDICTS CLINICAL OUTCOMES OF ANTERIOR MEDIAL GLOBUS PALLIDUS DEEP BRAIN STIMULATION FOR TOURETTE SYNDROME

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Introduction: Deep brain stimulation is a therapeutic option for treatment-resistant Tourette syndrome. However, selection of the best target location and setting stimulation parameters is challenging. This study aimed to examine the efficacy of deep brain stimulation targeting the anteromedial globus pallidus internus based on image analysis.

Methods: A single-institute cohort of patients who underwent deep brain stimulation for the globus pallidus internus was included in this study. Deep brain stimulation image analysis was performed using the 'Lead-DBS' Software. The 'Lead-Group' was used for group analysis. The volume of activated tissue was measured, and its correlation with clinical improvement was examined. Structural connectivity analysis using fiber filtering and functional connectivity analysis with connectivity mapping were correlated with clinical improvement.

Results: Thirty-four patients were evaluated. The mean follow-up period was 46.7 months. The total Yale Global Tic Severity Scale score showed approximately 35.9% (range, -2.5% to 74%) improvement after the last follow-up. Image analysis results indicated that the anterior, medial, and ventral targets were more responsive to symptom improvement. The volume of activated tissue and electric fields correlate with symptom improvement in patients with Tourette syndrome. The fiber filtering results revealed structural areas related to clinical benefits. Functional connectivity mapping predicted good prognostic effects related to associative networks.

Conclusions: Tourette syndrome deep brain stimulation of the anteromedial globus pallidus internus was more effective in the anterior, medial, and ventral portions of the globus pallidus internus. Connectivity analysis of related networks may also be a useful prognostic indicator of clinical outcomes.

Keywords: Globus pallidus interna, Tourette syndrome, Deep Brain Stimulation

FP029 / #423

Topic: *AS04. Psychiatric Disorders*

EVALUATION OF MULTIDISCIPLINARY AUTHORSHIP IN THE LITERATURE ON THE ETHICS OF DBS FOR NEUROPSYCHIATRIC DISORDERS

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Introduction: Deep brain stimulation (DBS) was first implemented three decades ago for Parkinson's Disease. In the last two decades, publications commenting on the ethics of DBS have accelerated. As investigations of DBS for neuropsychiatric disorders continue to emerge, we sought to identify and critically appraise the existing literature addressing the ethics thereof.

Methods: Embase, MEDLINE, APA PsycInfo, and SCOPUS electronic databases were systematically queried. Papers, conference abstracts, and commentaries addressing the topic of ethics and DBS were identified. From these, results addressing the ethics of DBS for neuropsychiatric were included and reviewed.

Results: Embase yielded 143 results; MEDLINE, 38; PsycINFO, 21; and SCOPUS, 16. From these, eleven results (3 conference abstracts, 8 papers) were identified as directly addressing the ethics of DBS for neuropsychiatric disorders and were reviewed. Only five (45%) results included a neurosurgeon as a co-author. Of the 34 total authors, 8 authors (24%) were neurosurgeons; the remaining authors were professors or trainees in neurology, psychiatry, ethics, philosophy, neurosciences, or anatomy. Inclusion of a multidisciplinary team was a common theme among all publications. Other recurring qualitative themes discussed included ethics oversight committees, conflicts of interest with industry, proxy consent in adolescent cases, impact on suicidality in the case of mood disorders, data privacy with the emergence of adaptive technologies, and heterogeneity across clinical studies.

Conclusions: Less than 25% of the literature addressing the ethics of DBS for neuropsychiatric disorders includes a neurosurgeon as a co-author. The call for multidisciplinary teams in practice should be reflected in authorship.

Keywords: ethics, DBS, psychiatry

FP030 / #466

Topic: *AS04. Psychiatric Disorders*

ASSESSING COGNITIVE CONTROL WITH VC/VS DBS IN OCD: INSIGHTS FROM INTRAOPERATIVE STIMULATION DURING AWAKE DBS

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Introduction: Deep Brain Stimulation (DBS) has emerged as a promising therapy for movement and psychiatric disorders, but its effects on cognition need further exploration. Frontostriatal circuits, critical for action control, are influenced by DBS in the subthalamic nucleus (STN) and globus pallidus internus (GPi) for movement disorders. However, the cognitive impacts of striatal stimulation in neuropsychiatric disease, specifically ventral capsule/ventral striatum (Vc/Vs) DBS, remain relatively unexplored. This study examines Vc/Vs DBS's effects on inhibitory control in an OCD patient using the Simon Task during surgery. The Simon Task evaluates the suppression of behavioral impulses towards goal-directed actions, relevant to OCD's pathology.

Methods: A modified version of the Simon Task, with a 70% non-conflict and 30% conflict trial ratio to increase task difficulty, was administered to assess inhibitory control. The task was performed at baseline with stimulation off (patient had a prior Vc/Vs DBS) and was stimulated intraoperatively at eight locations (10mm and 2mm above the target across anterior and posterior channels of both hemispheres) in a patient with OCD. Delivery was performed via the semi-macroelectrode contacts (~1000Ω) which were being used to provide a more effective mapping, which in turn would serve to maximize stimulation efficacy. Stimulation parameters were set at 90ms pulse width, 130Hz frequency, and 5mA intensity.

Results: Our findings reveal an increase in the Simon effect, measured in milliseconds, relative to the baseline during stimulation in both superficial and deep regions of Vc/Vs. The increase was more pronounced in the left hemisphere (50%) compared to the right hemisphere (21%), indicating a lateralized effect of DBS on the ability to selectively inhibit action impulses.

Conclusions: This study presents an investigation of the inhibitory control performance in the context of intraoperative Vc/Vs DBS, uncovering significant changes to inhibitory control. The results suggest that DBS stimulation, especially in the left hemisphere, can impact cognitive processes involved in inhibitory control. This could, in the future, contribute to the optimization of DBS protocols for neurological and psychiatric conditions and highlights the need for further research. Our study highlights the impact of neuromodulation in the ventral striatum and underscores the importance of cognitive assessment in understanding DBS outcomes.

Keywords: Obsessive Compulsive Disorder, Deep Brain Stimulation, Inhibitory Control

FP031 / #336

Topic: *AS04. Psychiatric Disorders*

SELF-REPORTED HEALTH AND ANXIETY BEFORE AND AFTER DEEP BRAIN STIMULATION IN PATIENTS WITH OBSESSIVE-COMPULSIVE DISORDER – A TWO-YEAR FOLLOW-UP

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Introduction: Severe and treatment-resistant obsessive-compulsive disorder (OCD) may be treated with deep brain stimulation (DBS) to achieve a reduction in OCD symptoms with the ultimate aim of improved overall health and daily function. Our objective is to present preliminary data on patients' self-reported general health and anxiety, before surgery, and up to two years after surgery, in patients who received DBS for severe OCD.

Methods: Twelve participants with OCD were enrolled in a clinical trial on DBS in the bed nucleus of stria terminalis (BNST) and were evaluated with the EuroQOL five dimensions questionnaire (EQ-5D). Outcome measures were the EQ-5D VAS scale where patients assess their health status on a scale graded from 0 to 100 (0 equals worst possible health and 100 equals best possible health) and the EQ-5D anxiety item graded as none, intermediate, or severe anxiety. The assessment was performed before surgery and six, twelve, and 24 months after surgery. Paired t-test or Wilcoxon signed-rank test was used to analyze group differences.

Results: Overall the patients had increased scores on the EQ-5D VAS scale and reduced anxiety scores after surgery as compared to before surgery. The mean age at surgery was 39.2 years (standard deviation [SD] 15.5). Mean EQ-5D VAS scores measured pre-surgery 35.9 (SD 22.2), six months post-surgery 48.7 (SD 19.5), one year 56.9 (SD 11.6), and two years post-surgery 54.4 (SD 21.0). The difference between EQ-5D VAS before surgery and after two years was not statistically significant (t= -1.81, p-value = 0.11). For the anxiety item of the EQ-5D, seven patients (89%) reported severe anxiety before surgery. After two years, only two patients (22%) reported severe anxiety (Z=-2.33, p-value = 0.020).

Conclusions: EQ-5D self-reported health scores slightly increased two years after DBS compared to pre-surgery, but the difference was not statistically significant while anxiety showed a significant decrease two years after DBS. These preliminary data show that the self-assessment EQ-5D scale may be used as a tool to follow up on patients' well-being after DBS in OCD and longer follow-up periods are warranted.

Keywords: Deep Brain Stimulation, Bed nucleus of the stria terminalis, obsessive-compulsive disorder

FP032 / #533

Topic: *AS04. Psychiatric Disorders*

COMBINING NON-SURGICAL AND SURGICAL TREATMENT MODALITIES IN AN INTRACTABLE OCD EGYPTIAN COHORT AND FIRST COHORT IN ARAB WORLD

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Introduction: The combination of conventional treatment modalities (including rTMS) and psychosurgery procedures , could offer a new hope for patients suffering from treatment –resistant and intractable OCD. The authors' aim was to introduce psychosurgery as a "long-awaited-for" refuge for treatment-refractory psychiatric patients in egypt. It is to be noted that the world-wide prevalence of OCD is 2-3% , but the prevalence "could" be higher in eastern countries including Egypt due to cultural causes , namely that religious rituals could offer a fertile land and a ready nucleus for the development of pathological OCD rituals.

Methods: Among inclusion criteria for patients in our cohort :OCD as a primary diagnosis, more than 4 years of treatment with conventional methods,
and relapse of symptoms occurred while the patient is on regular ttt and compliant to treatment. Then psychosurgery, cingulotomy and capsulotomy were done and patients were evaluated both pre and post operative, using OCD scales and tests. We also evaluated the efficacy of non-surgical modalities (including pharmacotherapy, rTMS and psychotherapy, post operatively in comparison to their efficacy preoperatively.

Results: Accepted safety and efficacy of surgery with notable clinical improvement of the patients in our cohort , as assessed by YBOCS scale among others (up to 90%). It was noticed that the response to non surgical modalities increased after surgery in comparison to before surgery.

Conclusions: More awareness is required to be spread among Egyptian psychiatrists and in the mental health field in Egypt, about the possible benefits of surgery for treatment of refractory OCD patients as well as psychiatric patients in general.Surgery could improve the cost-effect ratio of non-surgical options.

Keywords: Obssessive Compulsive Disorder, Psychaitry, surgery

FP033 / #157

Topic: *AS06. Radiosurgery*

GLOMUS JUGULARE TUMORS TREATMENT BY GAMMA KNIFE RADIOSURGERY: A SINGLE CENTER STUDY

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Introduction: Glomus jugular tumors are benign vascular tumors and surgical resection is almost impossible. We have treated these tumors with Gamma knife radiosurgery and share our experience.

Methods: This study was conducted at the Neurospinal and Cancer Care Institute, Karachi from January 2010 to May 2020. Thirty-four patients with glomus jugulare tumors treated with gamma knife radiosurgery were included in the study. The comprehensive clinical and demographic characteristics of all patients were collected through a manually designed questionnaire. Computed tomography, digital subtraction angiography, and magnetic resonance imaging were used to make the diagnosis. Data was incorporated and analyzed by SPSS version 26.

Results: A total of 34 patients were included in the study of which 16(47%) were males and 18(53%) were females with first follow-up after 6 months up to two years of clinical and radiological follow-up. The mean age of the patients was 42.5±13.5 with a minimum age of 20 years and maximum age of 65 years. The KPS scale was 2.09±0.45 and the volume of the tumor was 33.8±22.5 cm3. The improvement was shown in 27 patients of which 14 were males and 13 were females showing insignificance post radiation change. Of all 34 patients, the outcome was recorded as 3(9%) for excellent, 22(64%) for good, 6(17%) for fair and 3(9%) were poor results.

Conclusions: Gamma Knife radiosurgery is a safe and effective primary therapy and salvage therapy for newly diagnosed and recurrent cases of glomus jugulare and tympanicum tumors. It offers a low-risk-benefit treatment option with stable long-term tumor control rates and minimal side effects. Treatment at an early stage before tumors reach large sizes potentially reduces post-treatment complications.

Keywords: Glomus Tumor, gamma knife, stereotactic radiosurgery

FP034 / #215

Topic: *AS06. Radiosurgery*

FRAMELESS RADIOSURGICAL THALAMOTOMY TO TREAT TREMOR

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Introduction: Considerable positive experience in functional radiosurgery has been reported since Leksell's first results in 1951, and today, the most recent guidelines define radiosurgery as a viable modality to treat tremor. On the other hand, radiosurgery for functional purposes is usually performed using Gamma Knife, while the frameless procedures are poorly investigated. The aim of the present study is to investigate the role of frameless radiosurgery for tremor.

Methods: Between 2014 and 2023, we treated 11 patients because of an invalidating tremor by using a Cyberknife frameless radiosurgical device according to two prospective, dose escalation protocols. Two patients were excluded from the present analysis, one because of an enrolment error (wrong diagnosis) and one because he/she refused regular follow-up. The radiological (MRI based) appearance of the thalamotomy, as well as the clinical efficacy and the toxicity, were investigated.

Results: The patients included in this study underwent 75 Gy (two patients), 80 Gy (one patient), 90 Gy (three patients), 100 Gy (two patients) and 110 Gy (one patient) treatments respectively. A circular 5 mm collimator was always used. The treatment targets were always identified as the VIM or the VoA-VoP nuclei. None of the patients who received a dose lower than 90 Gy developed the radiological signs of thalamotomy nor clinical effects. Patients who had a 90 Gy dose or higher, developed the typical cockade like lesion at the planned point. No clinical effects were observed without the radiological appearance of thalamotomy. The latency between the treatment and the effect ranged between 6 and 23 months. One patient developed a clinical relevant radiation necrosis six months post-radiosurgery. No others toxicities were registered.

Conclusions: The present is an exploratory dose escalation study protocol investigating frameless radiosurgical thalamotomy. Despite the study being limited by the low number of enrolled patients, the results support the frameless thalamotomy as a possible treatment modality to treat the tremor in selected patients. A minimum dose of 90Gy to the 100% isodose line appears to be sufficient to produce a clinical effect but with a long latency. Increasing the dose from 90Gy to 110Gy reduces the latency period without increased toxicity rate.

Keyword: tremor, radiosurgery, frameless

FP035 / #463

Topic: *AS06. Radiosurgery*

STEREOTACTIC RADIOSURGERY FOR NONCAVERNOUS SINUS DURAL ARTERIOVENOUS FISTULAS: TREATMENT OUTCOMES AND THEIR PREDICTORS

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Introduction: Stereotactic radiosurgery (SRS) has emerged as a safe and effective treatment modality for dural arteriovenous fistulas (dAVFs), particularly cavernous sinus (CS) dAVFs. However, the long-term outcomes of non-CS dAVFs are not well known. This study aimed to evaluate the efficacy and safety of SRS for non-CS dAVFs and to investigate the risk factors for incomplete obliteration.

Methods: Between 2007 and 2020, 65 non-CS dAVFs in 63 patients were treated using SRS at a single institution. Demographic characteristics, initial clinical presentations, clinical outcomes, and radiological findings were retrospectively reviewed. The procedure-related complications were assessed. Radiological outcomes were evaluated as complete obliteration, incomplete obliteration, and angiographic worsening, whereas clinical outcomes were evaluated for symptom recovery.

Results: Complete recovery of symptoms was achieved in 32 patients (32/63, 50.8%) and incomplete recovery was achieved in 10 patients (10/63, 15.9%), while 4 patients showed no change (n = 3) or worsening (n = 1). Complete and incomplete obliterations were achieved in 41 (63.1%) and in 18 (27.7%) lesions. At a median follow-up of 17 months, the overall complete obliteration rate was 63.1%, and the cumulative obliteration rates were 24.6%, 60.0%, 70.0%, and 74.3% at 12, 24, 36, and 48 months, respectively. Six patients underwent retreatment due to angiographic worsening; in 5 of these patients, recruitment of arterial feeders was newly observed in the adjacent sinus, which was not treated in the initial SRS. In the multivariate analysis, high-flow shunt and venous ectasia were associated with incomplete obliteration. No adverse events occurred after SRS.

Conclusions: The obliteration rates of non-CS dAVFs were variable according to the location. The TS-SS-JB location was associated with complete obliteration. No adverse radiation events were observed. The presence of cortical venous drainage itself was not associated with incomplete obliteration; however, highflow shunts and venous ectasia were predictors of incomplete obliteration. SRS is safe and effective for non-CS dAVFs without high-flow shunts or venous ectasia.

Keywords: noncavernous sinus, stereotactic radiosurgery, dural arteriovenous fistula

FP036 / #472

Topic: *AS06. Radiosurgery*

HYPOFRACTIONATED GAMMA KNIFE ICON RADIOSURGERY FOR PERIOPTIC MENINGIOMAS: PRELIMINARY EXPERIENCE IN A GROUP OF MORE THAN 100 PATIENTS.

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Introduction: Perioptic meningiomas (cavernous sinus, anterior clinoid and tuberculum sella), defined as those that are less than 3 mm from the optic apparatus, present a treatment challenge when using stereotactic radiosurgery. Achieving tumor control must be carefully weighed against the potential for radiation-induced optic neuropathy (RION), as both tumor advancement and RION carry the risk of causing clinical deterioration. Single-fraction radiosurgery has been considered the gold standard therapy for small brain lesions, but hypofractionation offers an option to treat tumors close to critical structures.

Methods: Between September 2017 and December 2022, 102 patients (81 female and 21 male) with a mean age of 61 years (35-84) underwent hypofractionated Gamma Knife radiosurgery for perioptic skull base meningioma. In 6 patients, we treated multiple meningiomas for a total of 116 tumors. The average tumor volume was 6.55 ml (0.47-20.64), and the median was 5.76 ml. All the patients were treated with the thermoplastic mask and the Cone Beam CT (CBCT) stereotactic system. In most cases, we performed a 5-fraction treatment, with a marginal dose of 25 Gy (5 Gy/fraction); in only 16 patients, we performed a 3-day treatment with a marginal dose of 21 Gy (7 Gy/fraction).

Results: We have the radiological follow-up for 85 patients; the clinical follow-up is available in 80. The median radiological follow-up was 35 months, while the median clinical follow-up was 34 months. Tumor control was achieved in 99% of cases (19% reduction, 80% stability of the volume). Most patients had stable clinical symptoms, while we observed an improvement in initial symptoms in 8 patients (10 %). 3 of the symptomatic patients at onset reported a worsening of the symptoms (3.7%). None of the asymptomatic patients became symptomatic.

Conclusions: Our preliminary experience with hypofractionated Gamma Knife Icon proved to be effective and safe in the treatment of patients with perioptic tumors.

Keywords: perioptic meningiomas, Gamma Knife Icon, hypofractionated radiosurgery

FP037 / #476

Topic: *AS06. Radiosurgery*

EFFICACY AND SAFETY OF STEREOTACTIC RADIOSURGERY VERSUS ENDOVASCULAR TREATMENT FOR SYMPTOMATIC CAVERNOUS SINUS DURAL ARTERIOVENOUS FISTULA WITHOUT OPHTHALMOLOGICAL EMERGENCY: A SINGLE-CENTER 10-YEAR EXPERIENCE

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Introduction: Stereotactic radiosurgery (SRS) is emerging as a treatment option for cavernous sinus dural arteriovenous fistula (CS dAVF). It is less invasive and has a lower complication rate than conventional surgeries. However, little is known regarding the advantages and limitations of SRS compared to those of endovascular treatment (EVT). The aim of this study was to compare the efficacy and safety between EVT and SRS for treatment of CS dAVF.

Methods: Over a 10 years, a total of 86 consecutive patients diagnosed with CS dAVF were treated with EVT or SRS. No neurological deficit due to ICH or seizure was noted in any of the patients. Ultimately, 70 patients (EVT 33, SRS 37) were included in this study. Demographic characteristics, initial clinical presentations, clinical outcomes, and radiological findings were retrospectively reviewed and compared. Procedure-related complications were assessed after the treatments.

Results: The patients' baseline characteristics and angiographic features of CS dAVF were not significantly different between the EVT and SRS groups. Conjunctival symptoms were more frequently noted in the EVT than in the SRS group (69.7% vs 40.5%, p = 0.015). After EVT, initial complete obliteration was achieved in 20 cases (60.6%). Complete obliteration was achieved at 6 months in 86.4% of cases with EVT and in 77.8% of those treated with SRS, and at 12 months in 86.4% cases with EVT and in 94.4% of those treated with SRS. Worsening of symptoms developed at 1 month in 24.2% of cases with EVT and in 5.4% of those treated with SRS (p = 0.038); at 6 months in 22.6% of cases with EVT and in 10.8% of those treated with SRS; and at 12 months in 30.0% of cases with EVT and in 13.5% of those treated with SRS (p = 0.099). Procedure-related morbidity and mortality occurred more frequently in the EVT than in the SRS group (27.3% vs 8.1%, p = 0.034).

Conclusions: Both EVT and SRS were effective for the treatment of CS dAVF without ophthalmological emergency. However, procedure-related morbidity and mortality was less frequent in SRS than in EVT, and consequently SRS may be more advantageous in terms of safety.

Keywords: stereotactic radiosurgery, endovascular treatment, dural arteriovenous fistula

FP038 / #133

Topic: *AS02. Epilepsy*

RADIOFREQUENCY ABLATION OF THE CENTROMEDIAN NUCLEUS IN THE TREATMENT OF REFRACTORY STATUS EPILEPTICUS

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Introduction: In a pilot study conducted previously in six patients with generalized and multifocal epilepsy secondarily refractory to drugs, in whom radiofrequency ablation (RFA) of both centromedian nuclei was performed, a significant decrease in seizure rate was observed. On this basis, we decided to apply this novel procedure in patients with refractory status epilepticus (RSE).

Methods: Here, we describe two cases of RSE in which bilateral radiofrequency ablation of the CMN was performed due to the lack of response to conventional pharmacological treatment in intensive care.

Results: Immediately after the procedure, we observed total remission of status epilepticus in both cases, allowing the removal of mechanical ventilatory support and discharge from the intensive care unit. No sequelae were observed in the neurological status of both patients. At 3 and 5 months of follow-up, patients report an overall decrease in the rate of generalized seizures compared to previous status epilepticus.

Conclusions: Radiofrequency ablation of the centromedian thalamic nucleus is a safe and effective method of treating RSE. In both cases reported here, an immediate clinical response was observed with remission of status epilepticus without relapses at 3 and 5 months of follow-up.

Keywords: Radiofrequency lesion, Refractory status epilepticus, Centromedian nucleus

FP039 / #304

Topic: *AS06. Radiosurgery*

IMMUNOTHERAPY IMPROVES LOCAL CONTROL FOR LARGE (>4CC IN VOLUME) LUNG CANCER BRAIN METASTASES COMPARED TO RADIOSURGERY ALONE

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Introduction: Stereotactic radiosurgery (SRS) is a key pillar of treatment for patients with brain metastases (BM). However, rates of local control are worse for patients with large BMs despite advances in SRS. To this end, immune checkpoint inhibitors (ICIs) may provide synergistic effects when implemented alongside SRS, which may improve tumor local control. However, this paradigm has not been investigated for large BMs. We demonstrate our single-center, retrospective experience with SRS with and without ICI for the treatment of patients having lung and breast cancer BM greater than 4cc in volume.

Methods: Patients who received SRS therapy for the treatment of lung cancer BMs greater than 4cc in volume at Northwell Health between January 2017 and June 2023 were retrospectively identified. Local failure events (LF) and utilization of immunotherapy agents were identified and collected. Rate of local control was compared between the subgroup receiving SRS+ICI compared to SRS alone.

Results: A total of 155 large lung BMs (in 120 patients) greater than 4cc were identified. Of these, 17 patients (22 BMs) received SRS+ICI. There was no significant difference in the median BM volume (10.8cc for SRS only, 10.9cc for SRS+ICI; p=0.225) between subgroups. There was a significant difference in local control rate between SRS only and SRS+ICI (HR for SRS+ICI: 0.178; p=0.032). Six- and 12-month for LF rates were 6.1% and 8.7% for SRS only, and there were no LF events for patients receiving SRS+ICI.

Conclusions: We present one of the few studies demonstrating clinical outcomes for SRS+ICI for patients with large lung BMs. ICI provided alongside SRS yields improved rates of local control compared to SRS only. Further investigation will identify optimal timing of ICI therapy relative to SRS and elucidate the molecular mechanisms underlying this synergy.

Keywords: radiosurgery, brain metastasis

FP040 / #442

Topic: *AS10. Novel Therapies*

ARE WE BARKING THE WRONG TREE: A NOVEL WAY OF PROGRAMMING THE DBS IMPLANTABLE PULSE GENERATOR

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Introduction: The evolution of Deep Brain Stimulation (DBS) technology, featuring multi-parametric adjustments and directional leads, has significantly enhanced therapeutic outcomes while also increasing the complexity of programming. This study compares conventional Standard of Care (SOC) programming, which relies on clinical assessment and image-guided programming, with a novel Stimulation-Induced Side-Effect (SISE)-guided programming, which leverages the occurrence of side effects to refine the determination of the stimulation contact point.

Methods: SOC programming is used for all the patients at our center. SISE-guided programming was offered to the patients who failed or had suboptimal responses. SISE-guided programming determines the threshold current that elicits side effects to estimate the DBS lead's anatomical positioning for precise current steering. We present three cases of Parkinson’s disease patients who benefitted from the SISE-guided programming. All patients had undergone DBS using directional lead and Boston Scientific (USA) implantable pulse generator.

Results: The stimulation level with SISE-guided programming was maintained the same for three leads, moved ventrally by 0.5 contact points for two leads and dorsally by 0.6 contact points for one lead relative to SOC programming. SISE-guided adjustments resulted in an average increase in current amplitude of 1.7 mA (range: 0.5 mA - 2.1 mA). Furthermore, the current direction was altered from posterior to medial for two leads and from posterior to lateral for one lead, with adjustments not exceeding 90 degrees. Notably, in two additional instances, the current direction was changed from a circumferential spread to a more focused posteromedial and posterolateral distribution. This precision programming enhanced symptom control in two patients with tremors and one with bradykinesia and freezing gait.

Conclusions: Selecting optimal contact points, current direction, and amplitude is challenging when using SOC programming, especially considering the STN's small size and the VTA's spherical shape. SISE offered a larger margin of safety, which otherwise would not have been realized in SOC-based programming. This provided enhanced clinical benefits without any undue side effects. SISE-guided programming emerges as an alternative approach.

Keywords: Side effects, Programming, Deep Brain Stimulation

FP041 / #513

Topic: *AS02. Epilepsy*

COMPARISON OF INTRAOPERATIVE ELECTROCORTICOGRAPHY USING HIGH-FREQUENCY OSCILLATIONS OR SPIKES IN TAILORED RESECTIONS FOR EPILEPSY SURGERY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Intraoperative electrocorticography (ECoG) is utilized in tailoring resections for epilepsy surgery. Spikes and high-frequency oscillations (HFOs) are considered potential biomarkers of epileptogenicity. This study aims to evaluate the efficacy of utilizing either spikes or HFOs to guide surgical decision making in epilepsy surgery.

Methods: Embase, Scopus, and PubMed databases were systematically searched from inception to September 2023 for articles utilizing intraoperative ECoG with spikes or HFOs as biomarkers for surgical planning. Articles were included with at least 10 patients and ≥12-month follow-up. PRISMA 2020 guidelines were followed. The primary outcome was seizure freedom at the last follow-up. A random-effects model was used to calculate pooled effect sizes. Heterogeneity was assessed using the Cochran Q test and the I^2 index. We calculated the pooled, weighted proportion of patients with Engel 1 post-surgical outcomes. We then conducted separate analyses to calculate the pooled Odds ratio (OR) of patients with temporal vs. extra-temporal lesions who achieved Engel 1 using a binary random-effects model. The meta-analysis was performed using the OpenMeta [Analyst] software.

Results: A total of 22 studies were included. Patients who underwent surgery using spikes rather than HFO had greater success at achieving postoperative Engel 1 outcome (pooled effect size (PES) 0.73, P value < 0.001 and 0.67, P value=0.178, respectively). Finally, increased Engel 1 outcomes were achieved in temporal resections utilizing spikes (OR= 6.42, p= 0.729) or HFO markers (OR=17.38, p < 0.001), with HFO markers demonstrating notably higher significance.

Conclusions: Patients who underwent surgery using spikes as a marker for epileptogenicity had greater success in achieving Engel 1 outcomes compared to those utilizing HFOs. Notably, tailored resections using spikes or HFOs demonstrated higher rates of Engel 1 outcomes in temporal resections (as compared to extra-temporal), suggesting a possible greater effectiveness of these intraoperative markers within this subgroup. These findings highlight the importance of lesion location when using intraoperative electrocorticography to tailor surgical resections. Prospective studies with larger samples and standardized methods are needed to validate our findings and guide evidence-based decisions in epilepsy surgery.

Keywords: high-frequency oscillations, Spikes, Epilepsy

FP042 / #82

Topic: *AS02. Epilepsy*

DIRECT MRI GUIDED MULTIPLEX RADIOFREQUENCY THERMAL ABLATION AS AN ALTERNATIVE TO LASER INTERSTITIAL THERMAL THERAPY FOR MEDIAL TEMPORAL LOBE EPILEPSY

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Introduction: Despite increasing international adoption among epilepsy centers, stereotactic MRI-thermometry-guided laser interstitial thermal therapy (LITT) for appropriately selected epilepsy patients is not consistently available. In the USA, inconsistent availability has resulted in part from health insurance providers that classify LITT as “investigational” and continue to deny preauthorization of this elective procedure. We present two cases in which patients with medial temporal lobe epilepsy—one with SEEG-proven left MTLE and the other with right mesial temporal sclerosis—were recommended to undergo LITT by a multidisciplinary team, but an insurance provider consistently refused preauthorization, prompting use of alternative radiofrequency thermal ablation (RFA).

Methods: We utilized direct MRI guidance frames and two sequential ablation trajectories with a commercially available RFA probe (with 1.6 mm diameter x 10 mm exposed ablation tip) to perform empirical RFA of the hippocampus, amygdala, and entorhinal cortex without thermometry under general anesthesia. In each case, the hippocampus and amygdala were targeted with the first trajectory, and the subiculum and entorhinal cortex were targeted with a second slightly more inferior trajectory. A disposable MRI guidance frame was used to perform stereotaxy, and intraprocedural MRI was used to confirm device placement, evaluate lesions, and plan sequential steps of the multiplex ablation procedure. Post-ablation volume of Cases 1 and 2 were calculated using 3D-slicer and compared to the volume of two analogous cases of medial temporal lobe LITT, each performed with a single trajectory, as well as previously published mean volumes of analogous cases performed with LITT.

Results: In each patient, two parallel, confluent, ~12-14-mm-diameter ablation trajectories were completed. This yielded post-ablation imaging results and ablation volumes comparable to a single LITT trajectory, without complication. Patients were seizure-free at last follow-ups of >1 year and >2 month

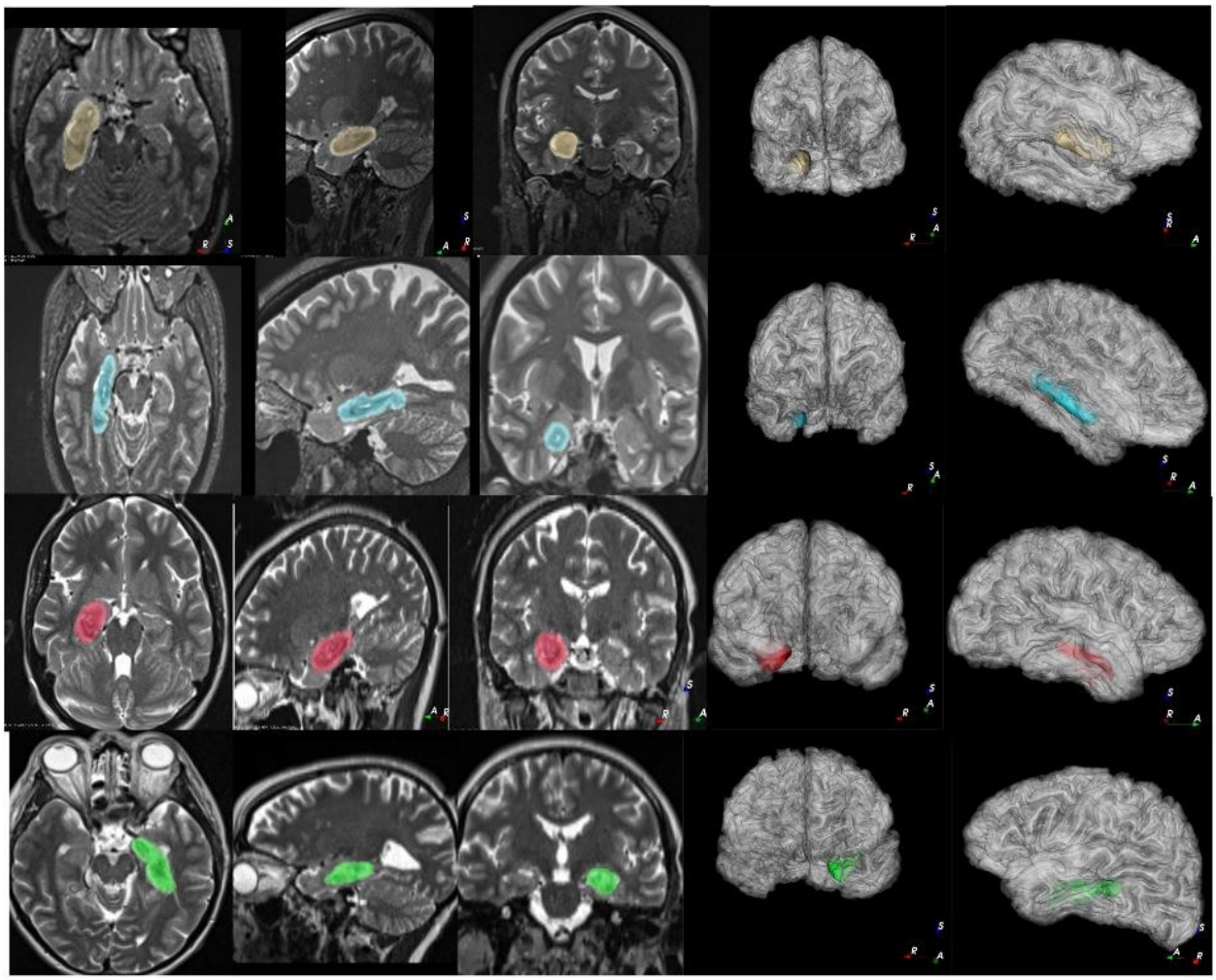

Figure 1: Ablation comparison of LITT and RFA. MTL-LITT MTS (Yellow), MTL-RFA MTS (Blue), MTL-LITT MRI negative (Red), and MTL-RFA MRI negative (Green).

Surgery Type	Ablation volume (cm3)
MTL-RFA MRI negative	7.1
MTL-RFA MTS	4.8
MTL-LITT MRI negative	8.9
MTL-LITT MTS	7.5
MTL-LITT (Mean from Kerezoudis et al., 2020)	5.4

Conclusions: With appropriate stereotactic control and experience, RFA provides a widely available alternative to both LITT and open epilepsy surgery.

Keywords: Radiofrequency, Medial Temporal Lobe Epilepsy

FP043 / #88

Topic: *AS02. Epilepsy*

RESTING-STATE EEG MICROSTATE FEATURES ARE POTENTIAL BIOMARKERS OF REFRACTORY TEMPORAL LOBE EPILEPSY

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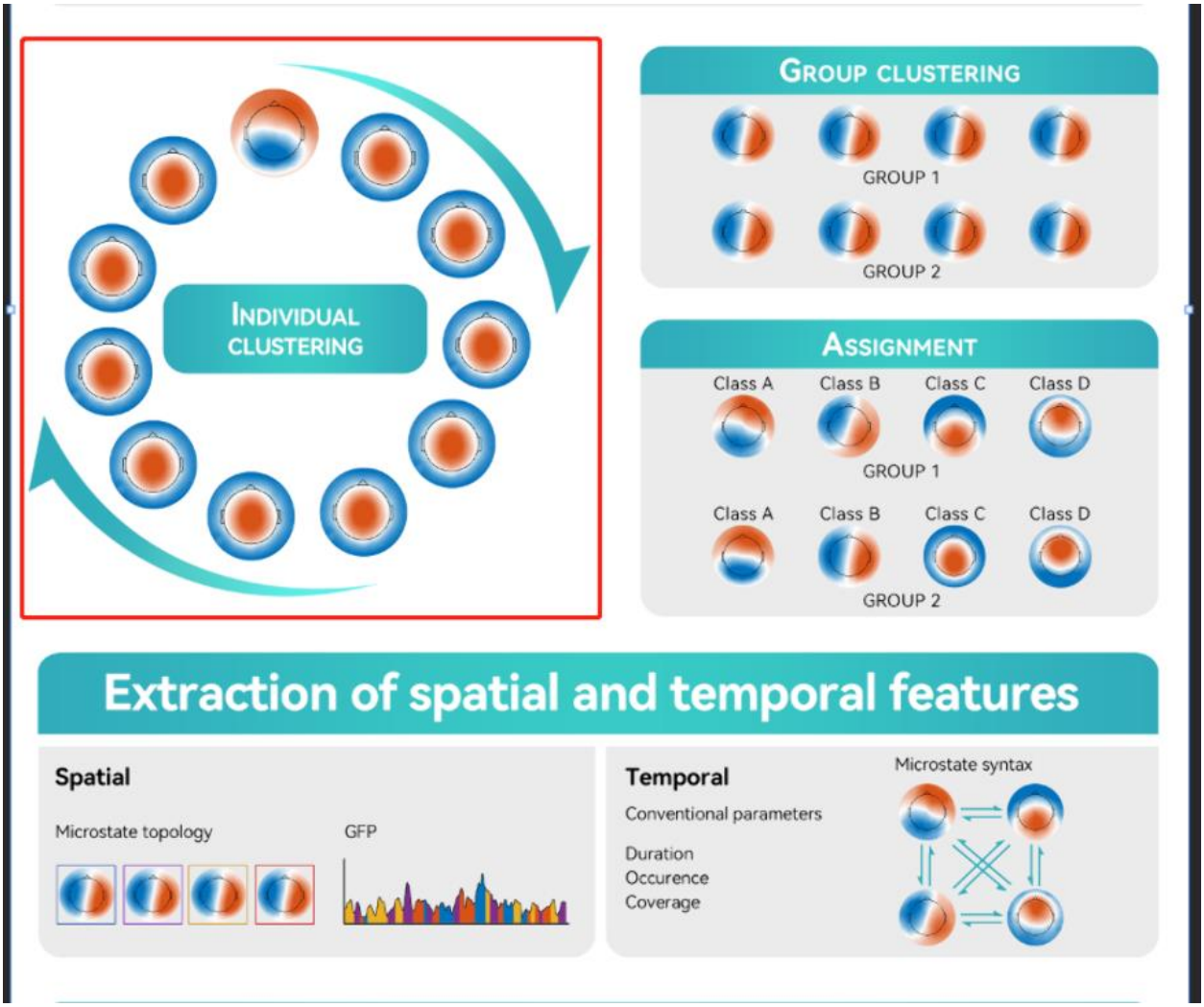
Introduction: Although surgical treatment for refractory temporal lobe epilepsy (TLE) is readily available, the disease remains largely unknown and the outcomes remain suboptimal. A contemporary view defines epilepsy as a network disorder derived from diseased dynamical networks. Resting-state EEG microstates have notable spatiotemporal features that demonstrate the dynamics of whole-brain networks and may provide information on clinical features in TLE. In this study, we extensively explored the dynamics of microstates panorama in TLE during the resting-state periods.

Methods: Microstate analyses were based on 256-channel scalp EEG in 67 refractory TLE patients and 30 healthy controls (HCs). We propose a novel framework for EEG microstate spatial-temporal dynamics (EEG-MiSTD) analysis based on machine learning method. Among the patient group, 11 pairwise clinical features were identified. Four dominant microstate classes A-D with their spatial and temporal measures were computed for between-group comparisons. We applied topographic analysis of variance (TANOVA) and global field power (GFP) contrast analysis to explore spatial features, multiple independent t-tests, Pearson's correlation and decision forest-based machine learning methods to explore temporal

features.



Results: With only 100 seconds of resting-state EEG, spatial measures of all microstate classes significantly differentiated TLE from HCs, and favorable from poor prognosis. Temporal measures of all microstate classes showed a consistent trend of increasing Duration and decreasing Occurrence in TLE. Specifically we found Coverage decreased in class A whereas increased in class D prominently, and Syntax altered significantly in these two classes, suggesting major alterations in corresponding networks. Moreover, we observed wide association of microstate spatiotemporal measures and various clinical features in TLE.

Conclusions: Microstate temporal and spatial features are found to be widely related to clinical parameters of TLE, which help support that TLE is a network disease. The analysis found overall neural protractions reflected by microstate temporal measures and spatial alterations across all four classes in TLE compared to HCs. Spatial rather than temporal microstate features showed promise in predicting surgical outcomes in TLE patients before surgery. Microstate features hold potential as biomarkers of refractory TLE, even in the absence of IEDs in non-invasive EEG, and may be useful to improve diagnosis and guide surgical treatment of TLE.

Keywords: temporal lobe epilepsy, EEG microstate, biomarker

FP044 / #233

Topic: *AS02. Epilepsy*

MAGNETIC RESONANCE IMAGING GUIDED LASER INTERSTITIAL THERMAL THERAPY (MRIGLITT) FOR INSULAR EPILEPSY IN PEDIATRIC PATIENTS: A SINGLE-CENTER EXPERIENCE

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Introduction: Magnetic Resonance Imaging-Guided Laser Interstitial Thermal Therapy (MRIgLITT) has emerged as a safe and effective treatment for focal epilepsy, particularly in cases involving deep-seated lesions such as insular epilepsy.

Methods: We have prospectively collected data on cases treated with MRIgLITT in our Pediatric Epilepsy Surgery Unit since 2016. This study presents our experience in treating insular epilepsy using this technology.

Results: In our series, we performed four MRIgLITT procedures for insular lesions causing epilepsy. The patients included two boys and two girls aged between 7 and 17 years (average age: 12 years). Three lesions were located on the right hemisphere and one on the left. Prior to laser ablation, we conducted brain biopsies along the same trajectory in all cases. Pathological analysis revealed three cases of focal cortical dysplasias and one of pleomorphic xanthoastrocytoma. The average accuracy at the target point during MRIgLITT was 1.21mm. Three patients have been seizure-free since treatment, while the fourth has shown significant improvement in seizure frequency and severity. Follow-up duration ranged from 1 month to 3 years, with an average of 1.6 years.

Conclusions: Our experience suggests that MRIgLITT is a safe and effective treatment for insular lesions causing epilepsy in pediatric patients. The ability to obtain pathology prior to laser ablation during the same procedure adds to its clinical utility. Although further follow-up is warranted, MRIgLITT has emerged as the preferred option for managing focal insular lesions contributing to epilepsy.

Keywords: insular epilepsy, Pediatric Epilepsy Surgery, MRIgLITT

FP045 / #375

Topic: *AS02. Epilepsy*

FOCAL IMPAIRED AWARENESS SEIZURES AND DEEP SLEEP DEMONSTRATE SIMILAR NETWORK MOTIFS

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Introduction: Epilepsy affects nearly 1% of the global population with focal epilepsy being the most common type. Seizures can drastically impact patients' lives, but the loss of consciousness in focal impaired awareness seizures (FIAS) and focal to bilateral tonic clonic (FBTCS) seizures can be particularly devastating. Neuromodulation may aid in preservation of consciousness in epilepsy, but it is not well understood what networks to target. It is hypothesized that studying network motifs during periods of decreased consciousness, such as deep sleep, may aid in neuromodulation strategies to preserve consciousness. Thus, we sought to analyze network motifs during seizures and deep sleep.

Methods: Stereotactic electroencephalography (SEEG) recordings of 78 patients with continuous video monitoring were obtained. For each patient, all FAS, FIAS, and FBTCS were analyzed with. Seizure types were designated through behavioral changes observed on video monitoring, resulting in 192 FAS, 170 FIAS, and 104 FBTCS. Bandpower and connectivity were computed in the delta(1-4Hz) and gamma(31-80Hz) frequency bands in the ipsilateral/contralateral mesial temporal, lateral temporal, and frontoparietal association cortex (FPAC).

Results: In the ipsilateral FPAC, it was observed that delta bandpower increased in consciousness impairing seizures and in deep sleep. The gamma bandpower of the ipsilateral FPAC only increases for FBTCS and doesn't change across sleep states, perhaps representing the generalization of seizure activity observed in FBTCS. Delta band segregation of the FPAC was increased for both FIAS and for deep sleep, suggesting that the ipsilateral FPAC both FIAS and deep sleep is isolated from the rest of the brain (Fig.1A-B). Furthermore, gamma band segregation of the FPAC was decreased for FIAS and for

deep sleep, suggesting that brain state is more integrated in high frequency bands (Fig.1C-D).

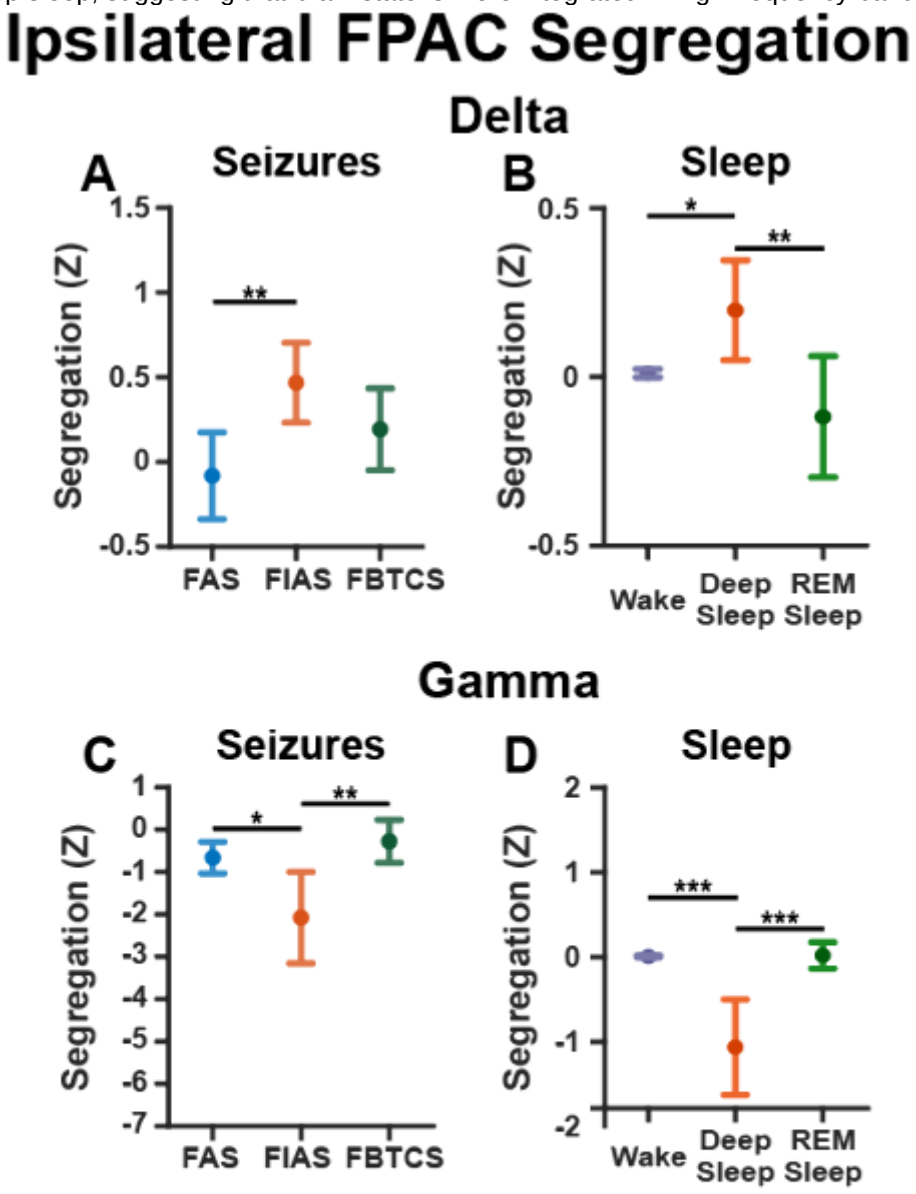

Fig. 1: Network changes in FIAS are similar to those seen in deep sleep. Delta band (1-4Hz) segregation is significantly different across seizure types ($p = 0.008$, One-way ANOVA) with FIAS significantly increased compared to FAS in a post-hoc multiple comparison (A). Delta band segregation is also significantly different across sleep stages ($p=0.002$) with deep sleep significantly increased compared to both REM and awake states (B). Gamma band (31-80Hz) segregation is significantly different between seizure types ($p=0.002$) with FIAS significantly decreased compared to FAS and FBTCS (C). Gamma band segregation is significantly different between sleep stages ($p<0.001$) with deep sleep significantly decreased compared to REM and awake states (D). Means are displayed in solid circles and 95% confidence intervals of the mean are displayed with the error bars. Post-hoc multicomparisons were performed with 2 sample t-tests, *p<0.05, **p<0.01, ***p<0.001.

Conclusions: Impaired consciousness seizures are a major source of morbidity for patients with epilepsy and the network changes during these seizures is not well understood. We found that the network state during deep sleep resembled FIAS ictally and FBTCS post-ictally, suggesting that there may be a

common factor between deep sleep and consciousness-impairing seizures. Further study of the common networks between sleep and impaired consciousness seizure may improve neuromodulation to preserve consciousness in epilepsy.

Keywords: Epilepsy, consciousness-impairing seizures, sleep

FP046 / #279

Topic: *AS02. Epilepsy*

MICROELECTRODE RECORDINGS DURING ANT DBS FOR MEDICALLY REFRACTORY EPILEPSY

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Introduction: Anterior nucleus of the thalamus (ANT) deep brain stimulation (DBS) has emerged as an effective treatment for medically refractory epilepsy, boasting response rates exceeding 50%. However, precise electrode placement within ANT remains challenging. While magnetic resonance imaging (MRI) is conventionally employed for direct targeting, its limitations prompt exploration of alternative methods. Microelectrode recording (MER) during surgery provides real-time neuronal information, yet its utility in delineating ANT boundaries and understanding neuronal characteristics is underexplored.

Methods: This study analyzes data from 7 patients (11 sides) undergoing MER during ANT DBS for refractory epilepsy. Employing a transventricular approach under general anesthesia, recording trajectories averaged 8.6 mm (right) and 7.9 mm (left). A total of 80 neurons were analyzed, with final electrode locations determined through postoperative imaging. Neurons were classified into probable ANT (0-4 mm) and probable dorsomedial (DM) (4-8 mm) based on assumed electrode locations. Spike sorting utilized the template matching method, and firing rate (FR) and burst rate (BR) were calculated, with LTS bursts detected using specific criteria.

Results: Comparing neuronal characteristics, the median FR of probable ANT was 3.851, and probable DM was 4.939. The median BR of probable ANT was 0.482, and probable DM was 0.881, demonstrating a statistically significant difference (p=0.012). Real-time MER during ANT DBS surgery proved valuable for confirming thalamic electrode placement.

Conclusions: Despite similar firing rates, ANT and DM neurons exhibit divergent burst rates. This study suggests that utilizing MER during ANT DBS provides crucial insights for intraoperative targeting, enhancing the precision of electrode placement. The findings underscore the significance of real-time neuronal information in optimizing the therapeutic impact of ANT DBS for refractory epilepsy.

Keywords: DBS, Epilepsy, MER

FP047 / #504

Topic: *AS08. Stereotactic Procedures*

COMPARATIVE ANALYSIS OF MACHINE LEARNING ALGORITHMS FOR CENTROMEDIAN (CM) NUCLEUS TARGETING USING T1W MRI

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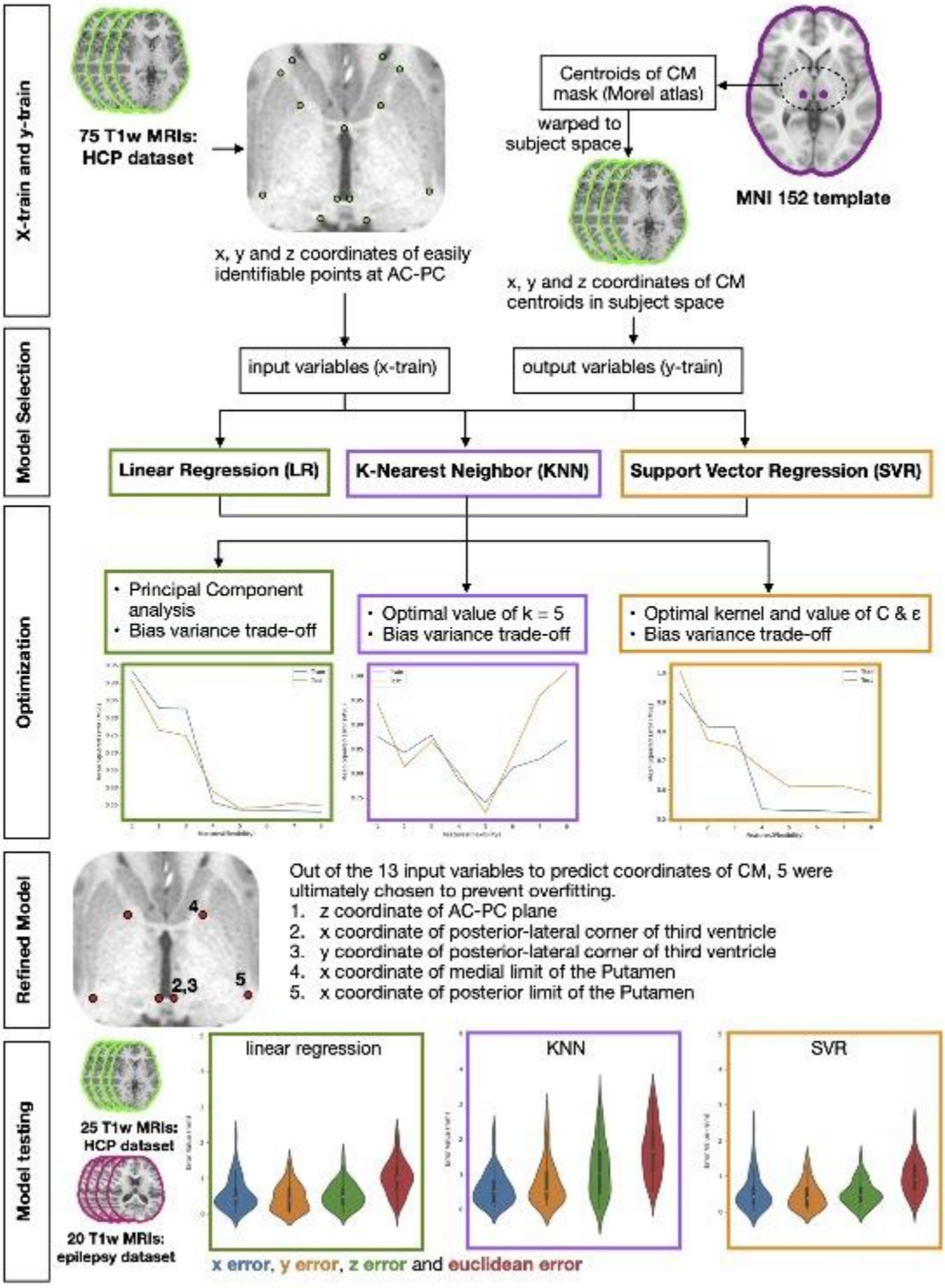
Introduction: Centromedian nucleus deep brain stimulation (CM-DBS) is a promising therapy for epilepsy, Tourette's, and disorders of consciousness. However, the CM is challenging to visualize on routine MRI. Indirect targeting often results in inaccurate placement. Here, we test the fit of three machine learning (ML) models to predict stereotactic coordinates of the CM using easily identifiable anatomical landmarks from a T1w-MR image.

Methods: Primary endpoint of the ML model was to output/predict coordinates of the centroid of the CM in each hemisphere. Three models, namely: support vector regression (SVR), K-nearest neighbour (KNN) and linear regression (LR) were tested on 100 T1w-MRI scans from a dataset of healthy adults. X-train (input coordinates for prediction) were x,y,z coordinates of easily identifiable points on AC-PC axial plane (see figure).The Y-train of the model were coordinates of the centroid of the CM as defined by the Krauth-Morel atlas, warped to each T1w image. A 75:25; train:test split was applied, i.e., 75% of the database was used to predict the coordinates in the remaining 25%. To prevent over-fitting from large number of input variables, bias-varience trade-off plots were made and ultimately 5 variable were chosen as inputs to these models. The three trained models were further validated on a dataset of 20 subjects with generalized

epilepsy.



Results: Error was defined as the distance between: coordinates of centroids of CM from Krauth/Morel atlas and predicted coordinates from three ML models (LR, KNN, SVR). Euclidean/radial error was shortest distance between these two points in space.

	x-error(mm)	y-error(mm)	z-error(mm)	euclidean-error(mm)
LR HCP-dataset	0.55±0.44	0.45±0.37	0.51±0.34	0.99±0.47
LR epilepsy-dataset	0.79±0.52	0.59±0.39	0.91±0.81	1.73±0.93
KNN HCP-dataset	0.59±0.46	0.74±0.61	1.14±0.77	1.68±0.74
KNN epilepsy-dataset	0.81±0.63	0.99±0.78	1.65±0.67	2.21±1.12
SVR HCP-dataset	0.54±0.47	0.44±0.36	0.51±0.33	0.98±0.49
SVR epilepsy-dataset	0.62±0.42	0.59±0.44	0.47±0.35	1.03±0.65

Conclusions: Preliminary tests suggest SVR with a linear kernal performed better than other ML models in predicting coordinates of the CM in healthy subjects, with a mean x, y, z and radial error of 0.54 ± 0.47 mm, 0.44 ± 0.36 mm, 0.51 ± 0.33 mm and 0.98 ± 0.49 mm respectively. Similar results were observed when SVR model was tested on 20 MRIs from an epilesy-dataset.

Keywords: Centromedian nucleus, Indirect targeting, Machine Learning

FP048 / #100

Topic: *AS07. Tumor*

PROSODY PERCEPTION IN LANGUAGE FUNCTIONING IS VULNERABLE TO BE INJURED BUT EVOKES SENSITIVE NETWORK PLASTICITY IN INTRINSIC BRAIN TUMOR PATIENTS

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Introduction: As an important component of human language, prosody affects multiple aspects like hearing, comprehension, memory and expression in linguistic communication. Prosodic speeches are easy to be understood, memorized and acquired, showing prominent speech rehabilitative effect in brain lesioning patients. In clinical practice, we often observe good plasticity of language function in brain tumor patients, while the underlying mechanisms stays unknown. In this study we used prosody features as an engage point to investigate the language functional network plasticity mechanisms under the status of intrinsic brain tumor invasion.

Methods: Focusing on advanced language tasks——auditory perception of natural speeches, we designed two comparative experimental groups with contrasting level of prosodic harmony. Using 256 channel high-density EEG system to collect resting-state and event-related EEG, we investigate and analyze the EEG activities in 47 brain tumor patients and 28 healthy controls (HCs).

Results: 1. Event-related potential (ERP) analysis of negative slow wave (NSW) and closure positive shift (CPS) showed deficits in patients' advanced language functions.
2. In HCs, processing of strong prosodic speeches evoked broad neural networks, with the center being left frontal lobe which was inhibited prominently in patients.
3. In patients, with the stimulation of strong prosodic speeches, active network re-construction was observed, with frontal lobe being the core correspondence hub.
4. Patients with frontal lobe tumors showed stronger frontal network re-construction, indicating that network plasticity tends to invoke neighboring hubs close to the frontal lesions.

Conclusions: Due to the network attribute of language function, the efficiency of network re-construction is higher than focal compensation in functional preservation. Strong prosodic speeches activate broad functional network re-construction and frontal lobe seems to be a coordinating center, so staged resective surgeries is worthwhile considered in frontal lobe to earn time and space for functional compensation. Moreover, for one-stage surgeries in frontal lobe, it might not be best choice to perform maximal resection of standard frontal lobectomy for every case. Further, for language rehabilitation, corpus of strong prosodic speeches shows good potential in evoking functional plasticity.

Keywords: language prosody, network plasticity, intrinsic brain tumor

FP049 / #175

Topic: *AS01. Movement Disorders*

RESPONSIVE MORPHOMETRIC FINGERPRINTS IN DEEP BRAIN STIMULATION FOR PARKINSON'S DISEASE

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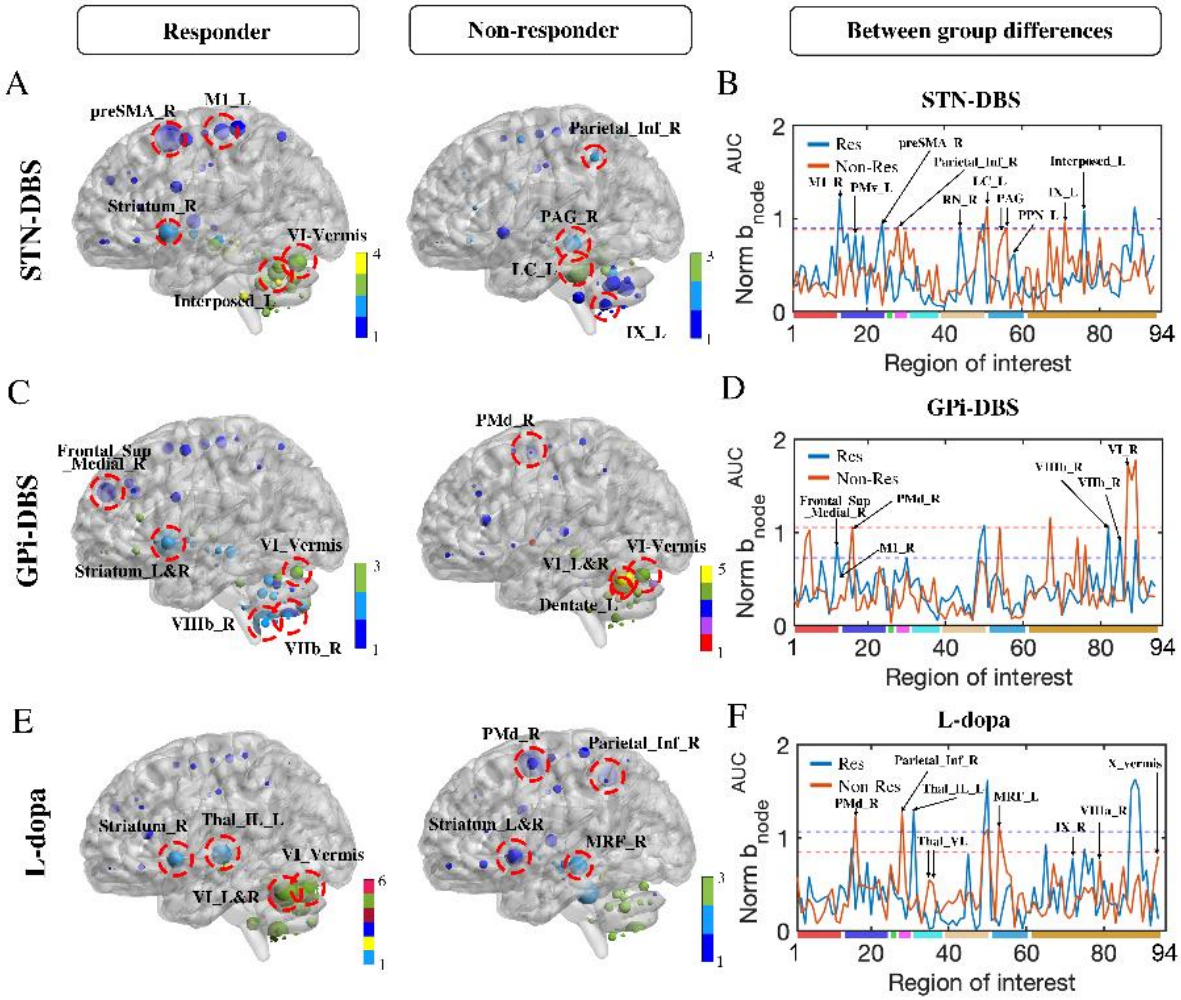
Introduction: Though advanced neuroimaging techniques have been applied in investigating brain networks related to of deep brain stimulation (DBS) in Parkinson's disease (PD), the association between DBS efficacy and grey matter organization remains poorly understood.It has been increasingly recognized that inter-individual differences in the structure of a brain region often co-vary with inter-individual differences in other regions. In this study, we hypothesize that the DBS response is associated with the grey matter organization and identified differential network characteristics based on graph theory of structural covariance network (SCN) between responders and non-responders of DBS.

Methods: This study included PD patients who received DBS in the subthalamic nucleus (STN-DBS, n=39) and the globus pallidus internus (GPi-DBS, n=37). MR images from 106 PD patients with pre-surgical levodopa challenge test were also analyzed. Grey-matter-based structural covariance networks (SCNs) were constructed to investigate network integration, segregation and robustness. Differential functional alterations in SCN hubs induced by DBS were analyzed using postsurgical fMRI. Morphological maps were constructed to predict outcome based on individual grey-matter fingerprints.

Results:



STN-DBS non-responders showed significantly decreased nodal betweenness in right pre-supplementary motor area (p=0.047) and left locus coeruleus (p<0.001), while GPi-DBS non-responders displayed increased local efficiency (p=0.008) and clustering (p=0.011) globally. Altered network hub patterns were found between different response groups. Functional connectivity alterations induced by DBS at the SCN hubs, including primary motor cortex, pre-supplementary motor area and dorsal lateral premotor cortex significantly correlated with improvement. Using a voxel-based brain map model, the outcome of DBS could be predicted at a promising level (R = 0.28, p=0.035 in STN-DBS; R=0.70, p<0.001 in GPi-DBS responders and R=0.47, p=0.022 in GPi-DBS non-responders).

Conclusions: The current study identified responsive grey matter fingerprints beneath both the STN-and GPi- DBS, and demonstrated the feasibility of using individual structural information based on grey matter data for predicting stimulation outcome. We found differential patterns of network hubs in different response groups. Functional alterations induced by DBS in SCN structural network hubs, including M1, preSMA and PMd were related to motor improvement. Morphology evaluation has the potential to be a supplementary tool for predicting DBS responsiveness and for helping stratify patients into clinical trials.

Keywords: Parkinson's disease, Deep Brain Stimulation, Morphometric fingerprint

FP050 / #192

Topic: *AS01. Movement Disorders*

MULTICENTER EVALUATION OF TRACTOGRAPHY-GUIDED DEEP BRAIN STIMULATION OF THE DENTATORUBROTHALAMIC TRACT FOR ESSENTIAL TREMOR

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Introduction: DBS is an effective therapy for essential tremor (ET). Several targets have been described along the posterior subthalamic area (PSA) and Vim. The dentatorubrothalamic tract (DRT) have been described as the common white-matter target for tremor. To evaluate the clinical outcomes of patients treated with prospective targeting of the DRT.

Methods: We prospectively included ET patients from two centers treated with DBS using direct DRT targeting. Anatomically-guided patient-specific tractography was used to define the DRT, specifically the bundle connecting the precentral gyrus (hand area) with the Vim. Side effects and tremor outcomes were evaluated at 6-months and 1-year follow-up.

Results: Twenty-one patients were operated of bilateral DRT-DBS. The target was set in the DRT at the level of the PSA and the trajectory adjusted to pass through the Vim. Intraoperatively, MER showed tremor cells in all cases at about 4-7 mm above target (Vim level). All patients had lesional effect by putting the cannula at the target and the intraoperative testing was only based on side effects with no trajectory changes for final placement. All patients were found to have postoperative bilateral lesional effect that was more than a month in 50% of patients. Six-to-twelve-month follow-up showed significant tremor improvement (Median preop 26 vs Postop 8 p=.001) at 0.8–2.3 mA amplitude range. 30% of patients reported mild gait and balance issues, which correlated with a more lateral electrode position in the leg area of the thalamus. No patient reported speech side effects at last follow-up year.

Conclusions: Bilateral DRT-DBS is an efficient technique for patients with ET. Targeting this bundle at the PSA is associated with significant tremor control, and low rate of side effects traditionally described for Vim-DBS. Targeting the “hand” bundle of the DRT may decrease the rate of gait and balance issues at long term.

Keywords: tremor, tractography, Deep Brain Stimulation

FP051 / #386

Topic: *AS01. Movement Disorders*

SEX DISPARITY IN PARKINSON'S DISEASE PATIENTS UNDERGOING DEEP BRAIN STIMULATION

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Introduction: Subthalamic nucleus (STN) deep brain stimulation (DBS) is a common procedure used to treat advanced Parkinson's disease (PD), and studies have shown that women are disproportionately undertreated as compared to men. We aimed to determine the differences in motor symptoms and quality of life domains between men and women undergoing STN DBS preoperatively and at one year.

Methods: We retrospectively evaluated 94 PD patients (26 women, 68 men) who underwent bilateral STN DBS between 2008 and 2022 at the University of British Columbia Hospital. The Unified Parkinson's Disease Rating Scale (UPDRS-III) and Parkinson's Disease Questionnaire 39 (PDQ-39) were collected preoperatively and at one year. Levodopa equivalency daily dose (LEDD) was calculated. Wilcoxon signed rank test and independent samples t-test were used to compare baseline demographic data. Exploratory linear mixed-effect models were used to investigate the interactions between time and sex for the PDQ-39 subscores, UPDRS-III scores, and LEDD.

Results: Preoperatively, women had a lower LEDD ($p=0.002$) and a larger UPDRS-III OFF ($p<0.001$) score than men. Women had worse PDQ-39 scores ($p<0.001$), with higher scores in the emotional well-being, mobility, stigma, bodily discomfort, and the activity of daily living subscores. At one year, women continued to have worse PDQ-39 scores, with higher scores in each of these domains, though there were no sex*time interactions. When adjusting for UPDRS-III OFF, age, and disease duration, we found a significant sex*time interaction in LEDD values, with a smaller decrease in LEDD in women ($p=0.020$). There was a sex*time interaction for the cognitive impairment subscore, with a greater increase over time in women ($p=0.009$).

Conclusions: Women with PD who undergo DBS are undertreated both before and after surgery. They have less decreases in LEDD over time, and they experience lower quality of life in multiple domains. The cognitive impairment subscore, which is recognized as a proxy for mood rather than cognition, worsens over time in women but not men. Our data supports the existing literature showing significant sex disparities in PD patients undergoing DBS.

Keywords: Deep Brain Stimulation, Gender Differences, Parkinson's disease

FP052 / #392

Topic: *AS01. Movement Disorders*

A PREDICTIVE METABOLIC NETWORK BIOMARKER OF RESPONSE TO SUBTHALAMIC NUCLEUS DEEP BRAIN STIMULATION FOR PARKINSON'S DISEASE

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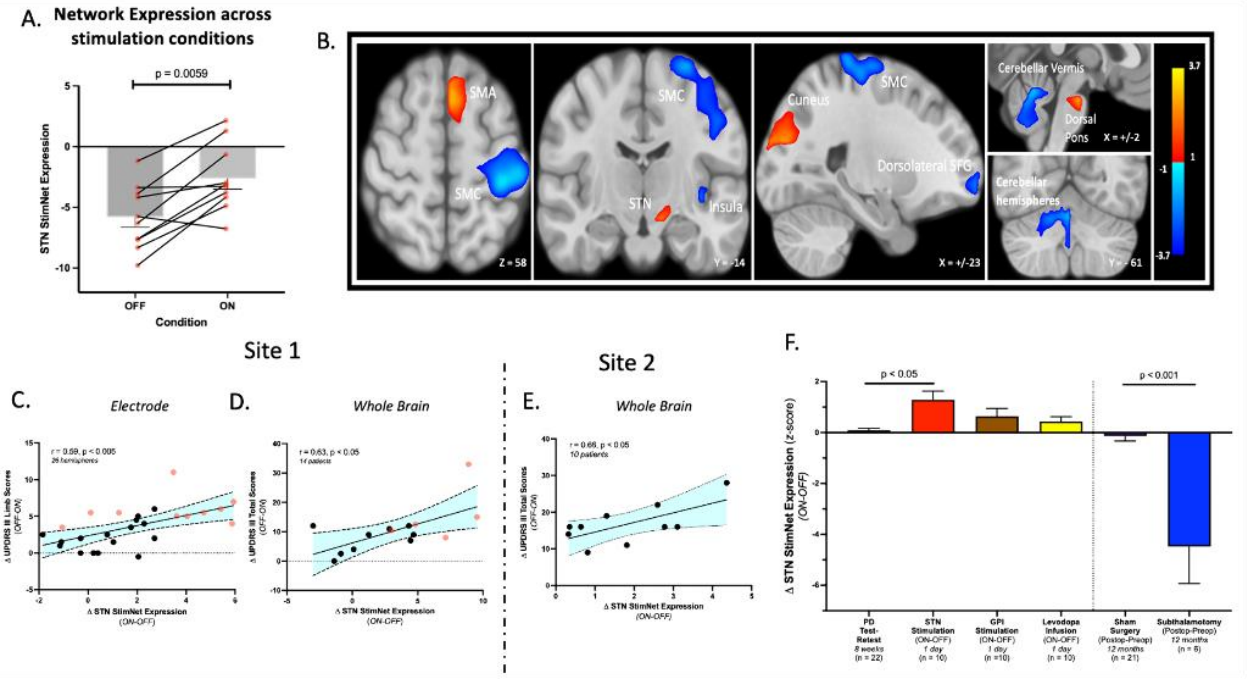
Introduction: Deep brain stimulation of the subthalamic nucleus has been shown to alleviate the motor deficits seen with Parkinson's Disease and improve overall quality of life. However, appropriate patient selection and timing of surgery remain open challenges.

Methods: We used Ordinal Trends Canonical Variates Analysis (OrT/CVA) on FDG-PET (ON/OFF conditions(10electrodes)) and identified a specific metabolic network (STN StimNet) induced by STN-stimulation in a subset of PD patients with large therapeutic responses. Further we quantified pattern expression for each electrode x conditon with data from two sites (n = 24pts) Addiitonally, network expression was quantified for a large cohort of PD (150pts) with increasing disease duration as well as for Parkinsonian-related syndromes(Atypical-PD(10pts) and RBD(13pts))

Results: A significant ordinal trend (permutation test,p< 0.01) on network expression scores (9/10 electrodes with stimulation mediated increases in network expression) was seen in the derivational PD cohort (Fig2A). The topography of STN StimNet was characterized by stimulation-induced changes within multiple nodes of the human motor circuit (Fig2B). Stimulation-mediated changes in network expression correlated with magnitude of motor improvements(Fig2C-E). Moreover, modulation of this network was specific for STN-stimulation; analogous changes were not observed with other stereotaxic interventions or levodopa
treatment(Fig2F).



Clinical response to STN DBS was predicted by baseline STN StimNet levels($r=-0.74$, $p<0.001$) and in a small subset of patients along with lead localization identified with very high accuracy identify (AUROC=95.8%) patients who would be most responsive to treatment. Finally, we estimated the clinical outcome of potential STN-stimulation from network expression computed in metabolic scans from 150 PD patients with disease duration of up to 21 years. Substantial clinical improvement was predicted in approximately 16% of patients with duration of 4-7 years, increasing to 27% with longer duration. Comparable benefit was not predicted for patients with shorter disease duration or those with autopsy-confirmed atypical parkinsonian syndromes(Fig4).

Conclusions: STN StimNet expression was associated with the motor benefits after DBS surgery. Baseline network activity accurately identified those individuals in whom treatment would be most beneficial, potentially serving as a biomarker for patient selection. Network expression in a large cohort of PD patients suggested predicted benefit plateaued after 4 years of disease duration.

Keywords: Deep Brain Stimulation, Imaging Biomarker, Parkinson's disease

FP053 / #407

Topic: *AS01. Movement Disorders*

COMPARATIVE OUTCOMES OF ALGORITHM-BASED VS. EXPERT-SELECTED TRAJECTORIES IN STN-DBS FOR PARKINSON'S DISEASE: BALANCING EFFICACY AND SIDE EFFECTS

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Introduction: Effective Deep Brain Stimulation targeting the subthalamic nucleus (STN-DBS) for Parkinson's Disease (PD) depends on precise DBS lead placement within the motor area of the STN. In many centres this is achieved by combining image-based targeting, interpreting electrophysiological data from microelectrode recording (MER), and intraoperative test stimulation. Semi-automated algorithms can use electrophysiological data to recommend suitable lead trajectories and depths, but their performance has not been rigorously compared to standard practice.

Methods: We compared suggested trajectories for DBS lead placement from one such commercially available semi-automated algorithm (HaGuide, AlphaOmega Inc.)—which primarily uses beta oscillatory activity extracted from MER data to determine STN boundaries—against those selected by an expert team during standard awake STN-DBS surgery for PD. In 18 consecutive patients (13 bilateral/5 unilateral, 31 total MER trajectories), we evaluated concordance between the suggested optimal trajectory according to the algorithm and the final expert-determined trajectory, and examined 6-month motor outcome (MDS-UPDRS-III score).

Results: Overall, there was a significant improvement in the 6-month UPDRS-III score across all patients (pre-op OFF medication 33.9 vs. post-op OFF medication/ON DBS 16.8, $p<0.0001$). In 5 cases, the semi-automated algorithm could not make a trajectory recommendation. Overall, in 50% of cases, there was a mismatch between the algorithm's preferred trajectory and the expert team's final selected trajectory. We observed no difference in motor improvement between concordant and discordant cases (Figure 1). The algorithm more often favoured a lateral trajectory (42.3%), in contrast to the expert team's preference for central trajectories (48.4%) (Table 1). Discordance was primarily due to concerns raised during intraoperative test stimulation, with the expert team rejecting algorithm-suggested trajectories due to low

thresholds for speech impairment and internal capsule-related side effects or sub-optimal therapeutic

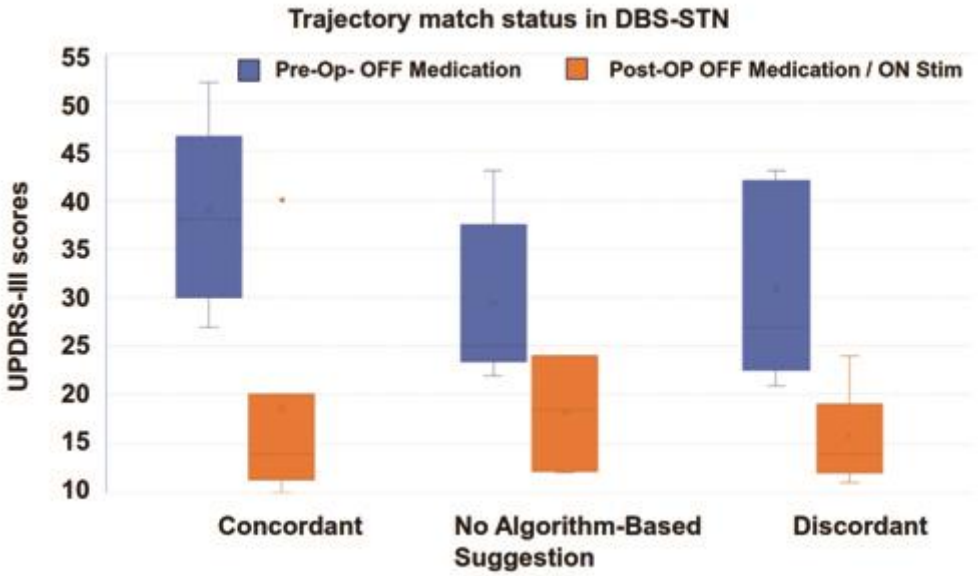

Figure 1: Boxplots shows the 'Pre-OFF Medication' and six month 'Post-OFF Medication ON stimulation' of UPDRS-III scores side by side for each Matched, No HaGuide Suggestion, and Discordant lead trajectories between Algorithm selected and Expert selected (implanted) trajectories.

Table 1: Frequency of trajectories suggested by semi-automated algorithm and final lead placement (counts and percentage of total)

Trajectory	Algorithm-suggestion		Final Trajectory	
	[Count]	[%]	[Count]	[%]
central	8	30.8%	15	48.4%
lateral	11	42.3%	6	19.4%
posterior	7	26.9%	7	22.5%
anterior	0	0.0%	2	6.5%
medial	0	0.0%	1	3.2%
total	26	100%	31	100.0%

motor effects.

Conclusions: Semi-automated identification of optimal trajectories for STN-DBS lead placement can yield favorable motor outcomes for properly selected PD patients. However, algorithms based primarily on beta oscillatory activity may be biased toward selecting more laterally placed trajectories through the STN. Though these trajectories may traverse more of the STN motor region, they can be associated with suboptimally low stimulation thresholds for adverse effects.

Keywords: Parkinson's disease, subthalamic nucleus, Deep Brain Stimulation

FP054 / #462

Topic: *AS01. Movement Disorders*

RESTORING DOPAMINERGIC FUNCTION AFTER CHRONIC INTRACRANIAL PHOTOBIOMODULATION IN DE NOVO PARKINSON'S PATIENTS: A PROOF OF CONCEPT

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Introduction: Recent studies in animal models of Parkinson's disease (PD) have indicated that photobiomodulation (PBM) i.e., the use of red to near infrared light (λ=600-1300 nm) on body tissues, reduces the degeneration of midbrain dopaminergic neurons with favorable safety profile. Most manifestations of PD are related to the loss of dopaminergic neurons located in the substantia nigra pars compacta (SNc). Mitochondrial dysfunction is one of the key mechanisms leading to neurodegeneration in PD. PBM restore mitochondrial function, resulting in an increase in adenosine triphosphate (ATP) energy production in cells and therefore can enhance survival of dopaminergic neurons and improve motor behaviour. Here we report the first-in-man clinical and imaging data at 2 years f.up in 2 de novo PD patients fitted with a bespoke intracranial device delivering 670 nm light close to both SNc. We compared those data to 2 matched controls PD patients. The patients are part of a larger randomized, open-label case-control study (NCT04261569).

Methods: Four patients newly diagnosis with PD (less than 2 years), naive of any treatments were randomised to either PBM or control group. The probe of the PBM device was implanted into the floor of the 3rd ventricle, connected to a rechargeable battery. Clinical and PET imaging evaluation were compared to baseline and included among others MDS-UPDRS scale performed every 6 months and PET imaging every year using [11C]PE2I ligand.

Results: No abnormal feeling nor adverse events were noticed by the patients after chronic PBM. PBM Group: MDS-UPDRS scores part III improved at 24 months, from 38/132 to 23/132 and from 18/132 to 17/132 in patient#1 and #2 respectively, off drugs conditions. Control group: MDS-UPDRS scores part III deteriorated as expected from 20/132 to 33/132 and from 29/132 to 38/132 in patient#3 and #4 respectively, off drugs conditions. With PBM, [11C]PE2I-PET at 12 (patient#1) and 18 months (patient#2) showed a remarkable increase of the [^{11}C]PE2I BP_{ND} in the caudate nucleus, the nucleus accumbens and the putamen. The [11C]PE2I BPND decreased as expected in all basal ganglia in controls patients.

Conclusions: PBM is well tolerated and show promise for stabilzing motor symptoms and restoraring partially dopaminergic function

Keywords: Parkinson's disease, photo-biomodulation, Deep Brain Stimulation

FP055 / #481

Topic: *AS01. Movement Disorders*

OPTIMIZING GKS TARGETING TO VIM NUCLEUS USING DTI, A STUDY ON INTRACTABLE TREMOR PATIENTS : A SINGLE-CENTER EXPERIENCE.

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Introduction: Intractable Tremor is a condition in which tremors are severe and do not respond to medications. There are many surgical options for treating intractable tremor, including gamma knife surgery (GKS), MRgFUS and DBS. Compared to other treatments, GKS is limited by the fact that it cannot be precisely ranged in relation to symptoms. The purpose of this study was to investigate the utility of diffusion tensor imaging (DTI) in refining GKS targeting to the ventral intermediate nucleus (VIM) of the thalamus and to improve the therapeutic effectiveness of GKS.

Methods: 62 patients for intractable tremor were treated through GKS from 2013 to 2022. The demographic details, initial clinical symptoms, treatment outcomes, and radiological observations were retrospectively examined. The effectiveness of the treatment was measured by the TRS score before and after treatment at 6 months. Complications associated with the procedure were evaluated. Specially, for patients who had DTI measured, Pre-operative and post-operative DTI scans were conducted to analyze their impact on treatment outcome and accuracy of GKS targeting to the VIM nucleus.

Results: GKS was found effective in reducing tremor in 70.58% of patients with DTI. Respectively, post MRI changes were not associated with treatment effect. Compared to conventional coordinating methods, the method using DTI resulted in closer x,y axes, which improves the accuracy of GKS in targeting the VIM nucleus and These values were located close to the axial coordinate values of MRGFUS and DBS, which are positioned by looking directly at the patient's symptoms. This means that DTI analysis is a way to increase the therapeutic effectiveness of GKS.

Conclusions: This study suggests that DTI in pre-GKS imaging may be useful for improving the precision of GKS by facilitating targeted delivery to the VIM nucleus, thereby improving treatment outcomes.

Keywords: Intractable Tremor, Gamma knife surgery, Diffusion tensor imaging

FP056 / #252

Topic: *AS01. Movement Disorders*

A SEMI AUTOMATIC ALGORITHM (STIMSEARCH) GUIDED PROGRAMMING OF PARKINSON'S PATIENTS FOLLOWING DEEP BRAIN STIMULATION SURGERY-INITIAL EXPERIENCE

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Introduction: Identifying clinically effective contact configuration and optimizing stimulation parameters after deep brain stimulation (DBS) surgery is a time-consuming and labour-intensive process. Programming has become more complex with the introduction of segmented leads. StimSearch™ is an automated programming algorithm developed by Boston Scientific Neuromodulation, which iteratively optimizes the stimulation setting based on physician's feedback. We conducted a study to investigate the clinical outcome and volume of tissue activated by two programming methods i.e. standard of care (SoC) and StimSearch.

Methods: Ten DBS patients with Parkinson's disease (58.500 ± 5.473 years) who exhibited greater than 50 % reduction in their OFF medication UPDRS III score following SoC programming participated in this study. Informed consent was obtained from all participants before their inclusion in the study. Patients underwent StimSearch based programming, 4-6 weeks after a stable program OFF medication UPDRS III was evaluated per SoC. SoC and Stimsearch settings were compared with respect to the clinical outcome and the volume of tissue activated (VTA) and patient's preference between the two programs was recorded.

Results: Out of the ten patients, seven continued with the StimSearch program, while three reverted to the SOC program. Among these seven patients, the OFF medication UPDRS III scores were 46.857 ± 9.719 at baseline (pre-op), 19.714 ± 4.070 in SOC, and 27.714 ± 10.419 in the StimSearch program. The time required for StimSearch programming the right and left STN was 13.194 ± 16.235 and 15.035 ± 16.476 minutes respectively. The two SFM aggregates had a DICE similarity coefficient of 0.64 bilaterally and 0.79 and 0.48 for right and left hemisphere respectively.

Conclusions: Programming with the StimSearch algorithm was fast and was preferred by the majority of the participants. Despite lower improvement in motor scores with the StimSearch algorithm, patients reported behaviour and mood benefits as a reason of continuance. The stimulation VTA and sites were comparable between the two methods. In this initial exploratory study, StimSearch has been shown to produce results similar to standard of care.

Keywords: DBS programming, Parkinson's disease, UPDRS

FP057 / #153

Topic: *AS04. Psychiatric Disorders*

WEIGHT RESTORATION IN PATIENTS WITH ANOREXIA NERVOSA AFTER SURGERIES AND BRAIN MORPHOMETRIC INSIGHTS

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Introduction: The bilateral anterior capsulotomy and deep brain stimulation (DBS) are the last treatment approach for patients with severe anorexia nervosa (AN). Nevertheless, little is known about the imaging biomarkers associated with the surgery outcome.

Methods: The retrospective study reviewed the preoperative imaging data of AN patients who received bilateral anterior capsulotomy or NAc DBS from 2019 to 2023. VBM analysis was conducted to evaluate the structural difference between AN patients and healthy controls (HC) and to identify brain structures associated with BMI changes after surgeries.

Results: Fourteen patients were included in the analysis, among whom 12 patients completed one year follow-up. The mean (SD) BMI of patients before and after surgeries was 13.1 (2.7) kg/m^2 and 20.6 (5.5) kg/m^2 ($P < 0.001$, $T = 4.62$) respectively. Significant increased gray matter volume was observed in the orbitofrontal cortex, rectal gyrus, cuneus and cerebellum while a reduction of gray matter volume was noted in widespread regions including temporal, parietal and paracentral gyrus in AN patients compared to the HC in peak-level analysis ($P_{uncorrected} < 0.001$). A significant positive correlation was observed in the preoperative volume of dorsal striatum with BMI changes after surgeries in peak-level analysis.

Conclusions: Ablation and DBS surgeries are effective for weight restoration in AN patients. Structure integrity of the striatum can be important for the restoration of BMI status in AN patients after surgeries.

Keywords: MRI, functional neurosurgery, anorexia nervosa

FP058 / #351

Topic: *AS04. Psychiatric Disorders*

DEEP BRAIN STIMULATION OF THE NUCLEUS ACCUMBENS FOR THE MANAGEMENT OF EATING DISORDERS: A SCOPING REVIEW

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Introduction: The nucleus accumbens is a heterogeneous structure that can be segregated into dorsomedial, intermediate, and ventrolateral territories based on differences in projection patterns and immunoreactivity to various peptides and neurotransmitters. Its intricate circuitry makes it a key target in understanding and addressing various psychiatric disorders. Among these, eating disorders, characterized by aberrant eating behaviors, pose significant challenges in clinical management.The nucleus accumbens, with its involvement in hedonic feeling, satiety signaling, and reward-based learning, has garnered attention as a potential target to understand the pathophysiology of eating disorders. Despite the advancement in conservative therapeutic strategies, treatment-resistant cases remain a significant concern, highlighting the need for novel approaches. This scoping review aims to explore the emerging role of deep brain stimulation (DBS) targeting the nucleus accumbens as a potential intervention for eating disorders, shedding light on its therapeutic efficacy in this context.

Methods: The completed review is reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR). It was justified to systematically summarize primary research as there is no relevant summary describing the deep brain stimulation of the nucleus accumbens to treat eating disorders.

Results: 12 articles were included in this review. From the included articles, 9 studies focused on the treatment of anorexia nervosa, with a total of 97 patients. Over a 12-month follow-up period, body mass index (BMI) consistently increased after nucleus accumbens stimulation. In other studies regarding the same condition and other eating disorders BMI did not normalize, although statistically significant improvements in BMI, quality of life, and cognitive flexibility performance were observed. Minimal postsurgical complications were reported, with only one case of intracranial hemorrhage among all evaluated patients.

Conclusions: DBS of the nucleus accumbens represents a significant advancement in neuromodulation for eating disorders, offering new avenues for personalized and effective interventions. Challenges remain in the treatment of eating disorders, including patient heterogeneity and the need for personalized approaches. Future research should focus on elucidating the underlying mechanisms of DBS efficacy, optimizing stimulation parameters, and conducting longitudinal studies with larger sample sizes to establish its long-term efficacy and safety profile comprehensively.

Keywords: Eating Disorders, Nucleus Accumbens, Deep Brain Stimulation

FP059 / #456

Topic: *AS04. Psychiatric Disorders*

DEEP BRAIN STIMULATION IN THE INFERIOR THALAMIC PEDUNCLE IN PSYCHIATRIC DISORDERS

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Introduction: Deep brain stimulation (DBS) in the inferior thalamic disorder (ITP) has been proposed to improve symptoms of obsessive-compulsive disorder (OCD) and major depression disorder (MDD). Animal models could explain the involvement of 5-HT and DA systems. Tractography images showed that ITP is part of the connection between brain stem structures and limbic loops. This study aims to show the follow-up of clinical results of DBS in ITP in 12 patients implanted in 2002.

Methods: Patients and Methods This is a series of cases in open-label clinical trials with patients who met MDD or OCD diagnosis by two different psychiatrists, at least 5 years in this clinical condition, severe symptoms according to the Hamilton Depression Scale or Yale-Brown Obsessive Compulsive Scale, unresponsiveness to complete schedule of pharmacological treatment and coadjuvants, non-diagnosis additional neurological disorder, sign of inform consent, follow-up of 6 months. The stereotactic system carried out bilateral implantation of the DBS device. A team made follow-up evaluations of experienced physicians.

Results: Twelve patients were implanted (Mexico 10 and Argentina 2), age mean 38.33±12.82, follow-up 6 to 228 months, baseline HAM-D score 36-42, baseline Y-BOCS score 25-40. Coordinates: X= 3-4 mm to the ventricular wall, Y=3-5 mm behind fornix, and Z= middle contact AC-PC level. Overall percentage of decrease of score 55.33±19.4 (OCD n=11 43.01±23.85), (MDD n=2 80.06±24.83), interval to replace battery 0-40 months, mean of amplitude 5.0 V, 130Hz, 450 ms, bipolar. Side effects: transient panic attacks (n=2) and anxiety (n=1). Seven patients explanted, three patients depleted, and two working.

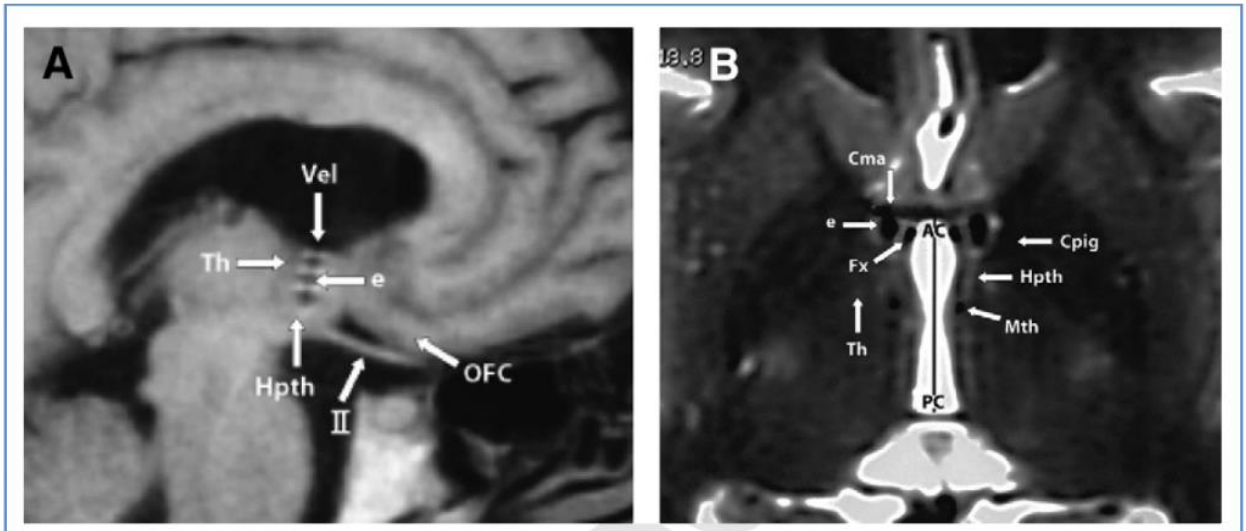

Figure 2. A postoperative magnetic resonance image showing electrode position. (**A**) Sagittal Section corresponding to 6.0 mm lateral to midsagittal plane, as for **Figure 1A**. (**B**) Axial T2 sequence at the intercommissural plane (AC-PC) level where the electrode (e) was placed, taken as reference fibers of the anterior commissure (Cma), fornix (Fx), mammillothalamic tract (Mth) and genus of internal capsule (Cpig) for direct targeting, that corresponds to **Figure 1B**. Hypth, hypothalamus.

Conclusions: DBS in ITP has been used to decrease at least 43% of the score in OCD and 80% of the score in MDD without permanent side effects. A major number of patients have been explanted or depleted of DBS. Randomized clinical trials are mandatory. Electrophysiological responses have been reported with DBS in ITP, mainly to frontal EEG activity (2). DBS in ITP could be a specific target for OCD and MDD with safe usefulness. More clinical and physiological information is needed.

Keywords: DBS, OCD, MDD

FP060 / #480

Topic: *AS04. Psychiatric Disorders*

ANATOMY OF THE BED NUCLEUS OF THE STRIA TERMINALIS

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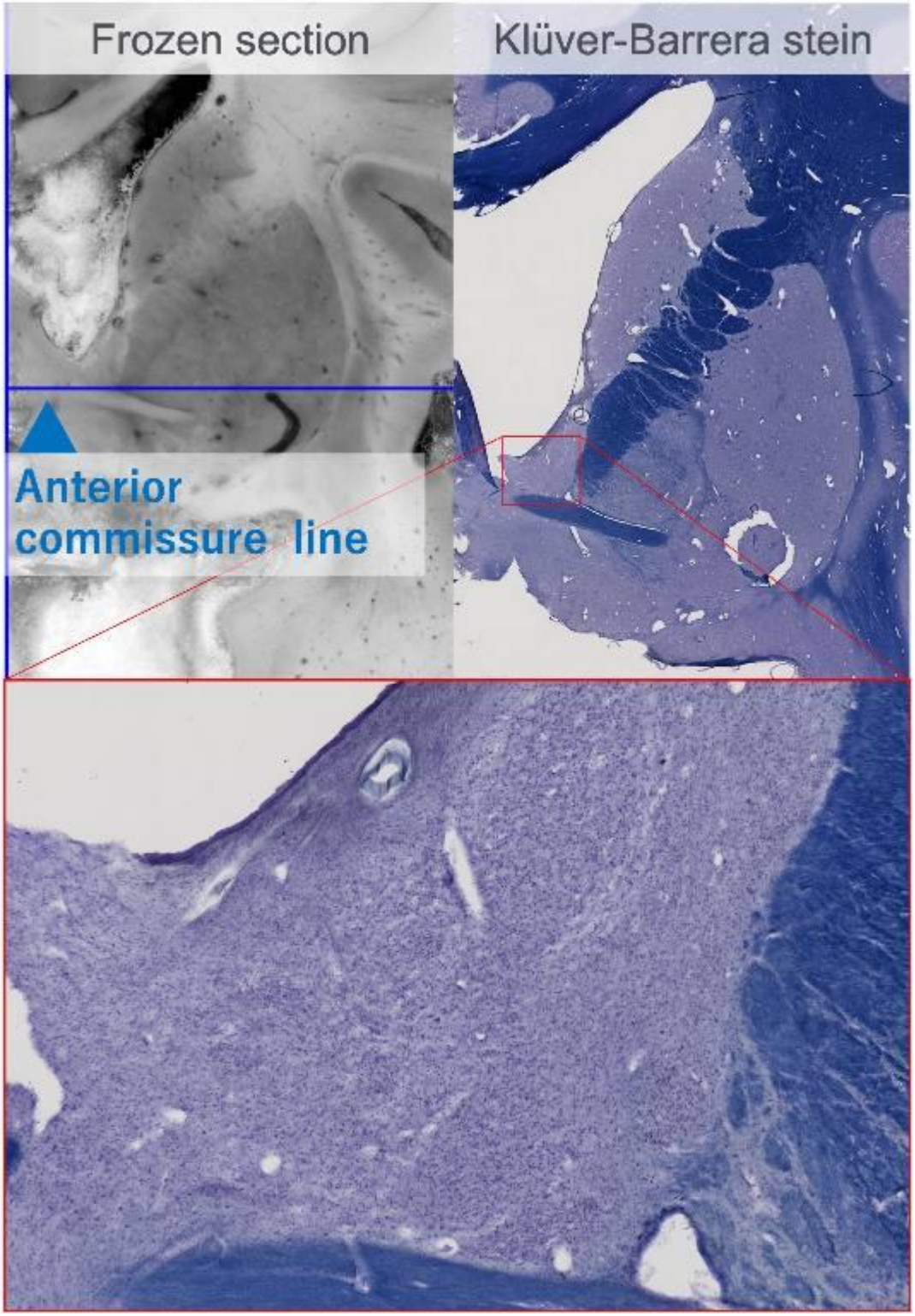
Introduction: Bed Nucleus of the Stria Terminalis (BNST) has recently attracted attention as a target of deep brain stimulation therapy for treatment-resistant major depressive disorders and threatening neuropathies, but there are few reports of studies using human brain specimens. In this study, we investigated BNST in human brain sections.

Methods: From the formalin-fixed brain specimens provided by Kyorin University, 50um-thick serial frozen sections were prepared, and photographs of the sections were stored as digital data. Klüver-Barrera stein was performed out of every 10 slices from each section. Cross-sections were made in axial sections parallel to the anterior commissure(AC)-posterior commissure (PC) line and in coronal sections perpendicular. The AC and PC lines were identified in each slice of the frozen sections, and the

coordinates of the AC and PC lines were confirmed using a



scale.

Results: The BNST was located between 8 and 10 mm from the midline in the lateral direction, between 11 and 15 mm anterior to the midcommissural point (MCP), and 8 mm above the AC-PC line.The central division, which is considered to have the highest connectivity with the amygdala, was a medium-sized cell

with a single morphology and high density, and was slightly gray on frozen sections.The center of the central division was located 8.8 mm lateral to the midline, 12.5 mm anterior to the MCP, and 3.2 mm superior to the AC-PC line, 2 mm medial to and 4 mm superior to the medial margin of the intersection of the internal capsule and AC.

Conclusions: The size and location of the BNST in the present study were almost the same as those in the past literature, but the surgical target seemed to be located slightly anterior and superior to the currently reported central division. Although it is difficult to visualize the central division on MRI, there is a possibility that the medial margin of the intersection of the internal capsule and AC can be used as a merkmar.

Keywords: BNST, Anatomy of human brain sections, Bed nucleus of the stria terminalis

FP061 / #172

Topic: *AS04. Psychiatric Disorders*

DBS FOR TREATMENT-RESISTANT OBSESSIVE-COMPULSIVE DISORDER: A SWEET SPOT ANALYSIS

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Introduction: Deep brain stimulation (DBS) is an accepted therapy for treatment-resistant obsessive-compulsive disorder (TR-OCD). Objective: to determine a sweet spot of DBS for TR-OCD in our patient population that is implanted in the Bed Nucleus of the Stria Terminalis (BNST) and Anterior Limb of the Capsula Interna (ALIC).

Methods: A finite element model (FEM) of the electrical field and Volume of Tissue Activated (VTA) model were built, and structural connectivity was mapped using the Lead DBS toolbox. Co-registration of the preoperative MRI to the postoperative CT was performed using Advanced Normalization Tools (ANT, Avants, 2008). Co-registration of the preoperative MRI to the postoperative MRI was done using SPM. Normalization was done using ANT. Electrodes were automatically segmented and manually optimized. A FEM of the electrical field was constructed based on the stimulation voltage on the active electrodes using the SimBio/FieldTrip method. The VTA was defined by applying a threshold of 0.2V/mm on the electrical field. A Spearman correlation coefficient was calculated between the VTA and the % reduction in Y-BOCS at last follow-up versus preoperative, using the Lead Group Analysis toolbox. Only voxels affected by at least 20% of the thresholded electrical fields were analysed. Statistically significant (α=0.05) voxels were selected to define a sweet spot for DBS therapy in our patients. We report on the first results of 8 patients.

Results: A statistically significant sweet spot was defined in the left medial medullary lamina of globus pallidus (GP) and at the right base of the ALIC.

Conclusions: Our preliminary analyses of the data from 8 patients suggest that the sweet spot may differ between hemispheres. It also appears that the sweet spot is not located in the center of the brain area targeted for DBS.

Keywords: Obsessive Compulsive Disorder, Deep Brain Stimulation, treatment outcome

FP062 / #197

Topic: *AS04. Psychiatric Disorders*

LONG-TERM OUTCOMES OF THALAMIC DEEP BRAIN STIMULATION IN PATIENTS WITH SEVERE TOURETTE SYNDROME: A SINGLE-CENTER EXPERIENCE

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Introduction: Tourette syndrome (TS) is a neuropsychiatric disorder characterized by tic movements. Deep brain stimulation (DBS) may be a treatment option for severe cases refractory to medical and behavioral therapies. In this study, we reviewed the long-term clinical outcomes of DBS for severe TS patients.

Methods: Consecutive patients who underwent centromedian thalamic DBS in our department between May 2018 and January 2023 were enrolled. At our center, DBS is indicated for patients aged 12 years or older who have severe medication-refractory symptoms of TS. The primary outcome measure was the Yale Global Tic Severity Scale (YGTSS) score. All patients were followed up at 6 months, 1 year, and annually thereafter. Adverse events related to surgical procedures were also recorded.

Results: The mean Yale Global Tic Severity Scale severity score improved significantly from 41.4 ± 7.0 at baseline to 19.8 ± 11.4 at 6 months ($P = 0.01$) and 12.7 ± 6.2 at the last follow-up ($P < 0.01$). The mean Yale Global Tic Severity Scale impairment score also improved significantly from 47.1 ± 4.7 at baseline to 23.1 ± 11.1 at 6 months ($P < 0.01$) and 7.6 ± 2.9 at the last follow-up ($P < 0.01$). However, there were problems with continuous postoperative monitoring (3 cases were lost to follow-up) and surgery-related adverse events, including 1 case each of lead misplacement and a delayed intracerebral hemorrhage due to severe self-injurious tics.

Conclusions: This study highlights not only the clinical efficacy of DBS for TS but also its challenges. Clinicians should understand the three-dimensional brain anatomy so that they can perform precise surgical procedures, avoid adverse events, and achieve favorable outcomes of DBS for TS.

Keywords: Deep Brain Stimulation, Adverse events, Tourette syndrome

FP063 / #169

Topic: *AS04. Psychiatric Disorders*

JOINT INVESTIGATION OF DOPAMINE AND FIBER TRACT ANATOMY IN THE HUMAN VENTRAL MESENCEPHALIC TEGMENTUM AS A POTENTIAL CAUSE FOR SUICIDE / MAJOR DEPRESSION

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Introduction: Major Depression (MDD) is a prevalent disease. Despite the effectiveness of standard treatment, 20% of patients stay treatment resistant. For a proportion Deep Brain Stimulation (DBS) might be an option. The slMFB (1) stimulation region involving the ventral tegmental area (VTA) points to a role of dopaminergic (DA) transmission in disease pathology. The focus here is the demonstration and analysis of individual DA anatomy in subjects who were suspected having committed suicide.

Methods: Figure 1 illustrates the general approach. Human midbrain (aged 55, 62, 36 years) samples were retrieved during autopsy from forensic pathology. The specimens were formalin fixated and scanned in a Bruker MRI scanner (7T). After histological workup (Nissl stain, HE, Luxol fast blue and TH=tyrosine hydroxylase stain) and cutting, roughly ACPC parallel slices (3 µm) were digitized and joined in MNI space together with a previously developed high resolution fiber tract atlas (n=1) (2). Sub-nuclei of the VTA region were identified and marked. TH cell and fiber counts were semi-quantitatively evaluated. Cell and fiber densities were rated as 0=no cells/fibers to 3=high densities of cells/fibers.

Results: Main results are shown in Figure 2. The parallel demonstration of histological information and TH signal/DA anatomy together with fiber tractographic anatomy in a common space is feasible, allowing for group level analyses. The analysis showed a marked loss of the TH signal in the subnucleus VTA proper.

Conclusions: Conclusion: There are hints for a role of TH signal pointing to DA cell/fiber density changes in the VTA in suicide and potentially MDD. The use of postmortem MRI as an individual scaffold helps to compensate for tissue distortions which arise through excision, preparational steps and histological handling. Due to the small sample size and a lack of a true comparison, study results must be regarded with caution. This work represents our first attempt to investigate the theory of DA cell loss in the human VTA as a cause for suicide/MDD. It therefore represents a study of feasibility.

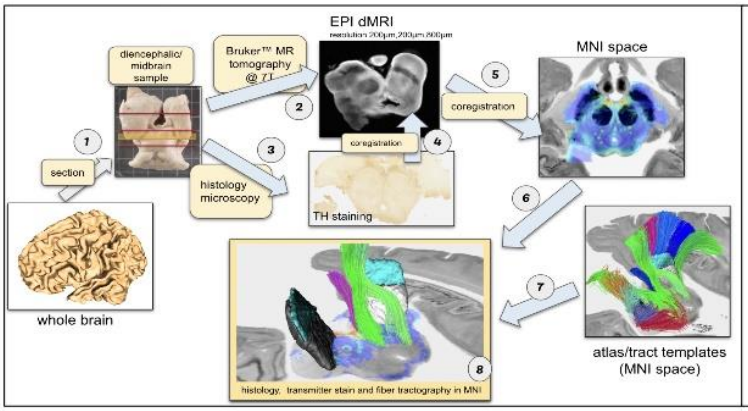

Figure 1

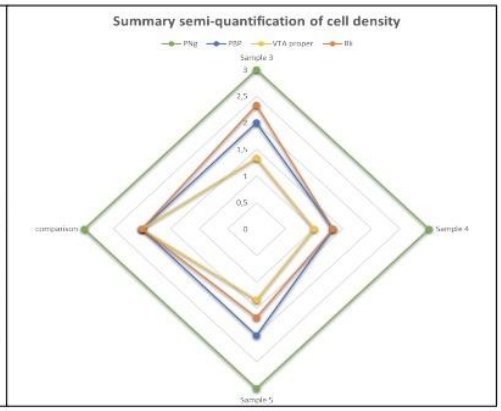

Figure 2

Keywords: ventral tegmental area, Dopamine and fiber anatomy, Major Depression and Suicide

FP064 / #79

Topic: *AS05. Neuro Restoration or Injury*

SELECTIVES NEUROTOMIES FOR RELIEF OF SPASTICITY FOCALIZED TO UPPER LIMB (SERIES OF 62 CASES)

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Introduction: Spastic disorders are sometimes disabling and their treatment can be very challenging .The basic phenomenon underlying spasticity is hyper excitability of the stretch reflex.Excess spasticity in limb make residual motor functions makes passive movement difficult and generates pain.When the spasticity is refractory to optimal oral medication , refractory to physical therapy , the neurosurgical procedures aims to re-establishthe tonic balance between agonist and antagonist muscles by reducing the excess of spasticity.

Methods: Sixty two(62) patients with upper limb spasstic underwent sixty four (64) neurosurgical interventions .The sex ratio was 35 males to 27 femals , age distribution varied between 10 and 58 years (26,1 on average). The spastic compenents prevailed in elbow, wrist and fingers . Causes of spasticity were dominated by the cerebral palsy in 28 cases (45,16%) , followed by head trauma in 17cases (27,42%). other etiologies are found in the remaining cases .All patients were selected by a multidisciplinary team according to a clinical evaluation and analytical assessment after a physical rehabilitation protocol well conducted.

Results: After a mean of 19 years , our results were rated 'Good to excellent'.In 55% of cases acquiered the function , 30% the comfort, 15%the aesthetic.Bad result was noted in 9% of patients .

Conclusions: When pharmacological and physical therapies are not effective in treating spastic components focalized to upper limb , neurosurgical procedures leads to long term satisfactory improvement in function , comfort and esthetic with a low morbidity rate in appropriately selected patients suffring from severe harmful spasticity .

Keyword: upper limb, spasticity , selectives neurotomies

FP065 / #46

Topic: *AS05. Neuro Restoration or Injury*

ENHANCED SCIATIC NERVE REGENERATION: INNOVATING WITH ELECTRICAL STIMULATION AND CONDUCTIVE NERVE GUIDES IN RAT MODELS

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Introduction: Peripheral nerve injury (PNI) manifests in approximately 2.2% of trauma instances, with the sciatic nerve being the most frequently impacted nerve in the lower limb. While autografts represent the preferred method for addressing substantial gaps, their effectiveness in promoting regeneration is somewhat constrained. This investigation seeks to assess the impact of a conductive nerve conduit and electrical stimulation on sciatic nerve regeneration within a rat model featuring transection injury.

Methods: We designed a silk-based conduit measuring 1.8 mm in diameter and 12 mm in length. Gold nanoparticles (AuNPs) were incorporated into the scaffold to enhance its conductivity. The conduit was filled with collagen hydrogel seeded with GFP+ adipose stem cells (ADSCs-GFP+). Cytotoxicity of the scaffold was assessed using an MTT assay. A 10 mm segment of the sciatic nerve was transected, and 12 mm sections of both non-conductive and conductive scaffolds, along with electrical stimulation, were implanted using 10-0 nylon monofilament sutures. Autotransplantation served as the control group. The sciatic functional index (SFI) was employed for evaluation purposes.

Results: According to the MTT assay, both silk and silk/AuNPs scaffolds exhibited no signs of cytotoxicity. Six weeks post-surgery, SFI assessment revealed superior functional recovery in subjects treated with conductive scaffolds combined with electrical stimulation compared to those without electrical stimulation. Immunofluorescent staining illustrated the persistence of ADSCs-GFP+ within the scaffold six weeks post-transplantation (depicted in green). Immunohistochemistry (IHC) staining and quantification of neurofilament (NF) and S100 proteins indicated increased expression levels in subjects treated with conductive scaffolds combined with electrical stimulation six weeks post-surgery, as opposed to other groups. Transmission electron microscopy (TEM) images of the conductive scaffold with electrical stimulation demonstrated the emergence of new axons six weeks post-transplantation.

Conclusions: Combining a conductive silk-based nerve guide conduit with electrical stimulation exhibited a synergistic impact on the functional restoration of sciatic nerve defects in a rat model.

Keywords: Peripheral Nerve, Neuromodulation, electrical stimulation

FP066 / #507

Topic: *AS05. Neuro Restoration or Injury*

PREDICTING AND RESTORING CONSCIOUSNESS: A COMBINED META-ANALYSIS OF BRAIN LESIONS, NEUROMODULATION STUDIES, AND NETWORK CONNECTIVITY IN PATIENT COHORTS

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Introduction: This study explores the connectomic correlates and mechanisms underlying acute loss of consciousness (LoC) following diffuse axonal injury (DAI) and compares it to permanent Unresponsive Wakefulness Syndrome (UWS) and coma. We additionally examine current and future avenues for restoration of consciousness.

Methods: This study analyzed 59 DAI patients with acute LoC and 17 with permanent UWS alongside 600 patients treated with neuromodulation techniques for disorders of consciousness (DoC). Findings were substantiated by comparing them to a meta-analysis of 150 functional and structural connectivity studies of DoC.

Results: Significant predictors of acute LoC included disconnections in key white matter tracts, such as the left corticothalamic tract, pontine tracts, corpus callosum, and extreme capsule. Network-level analysis pinpointed the default mode, salience/ventral attention, and dorsal attention networks as essential for consciousness emergence. Neural network modeling showed exceptional predictive accuracy for DAI-related LoC and UWS with a generalized R2 of 0.99 and a misclassification rate of 0% in validation datasets. When comparing the DAI cohort with acute LoC to patients with permanent UWS, we observed a distinct pattern of brainstem-thalamic and cortical disconnections predictive of permanent UWS. Hihger order network analysis with identified tracts serving as edges, and parcels as nodes, further substantiated our findings demonstrating widespread network dysfunction, increased modularity and loss of integrative function, which are critical in maintaining consciousness and mediating recovery. We additionally examined the potential therapeutic avenues through neuromodulation techniques, highlighting a significant functional connectivity overlap between neuromodulation targets in key brain regions involved in salience processing and cognitive integration (anterior insula, claustrum, and middle cingulate). We further substantiated the significance of our findings by comparing them to a meta-analysis of functional and structural connectivity in DoC.

Conclusions: Our study enhances understanding of the neural underpinnings of DoC caused by brain lesions, highlighting the potential of targeted neuromodulation in restoring consciousness. Alongside existing literature, we identify two critical systems for consciousness: the integrative function of cortical networks and white matter connections, plus the brainstem-to-thalamus input essential for consciousness and arousal. By linking brain network disconnection analyses with patient outcomes, we open avenues for new interventions that counteract brain lesion effects on consciousness.

Keywords: DBS, consciousness, coma

FP067 / #277

Topic: *AS08. Stereotactic Procedures*

ACCURACY AND SAFETY PROFILE OF INTRAOPERATIVE 3D FLUOROSCOPY FOR PREDICTING FINAL ELECTRODE POSITION IN DEEP BRAIN STIMULATION SURGERY

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Introduction: The effectiveness of deep brain stimulation (DBS) critically depends on accurate electrode position. Anatomical post-implantation confirmation of electrode position is required to exclude unwanted shifts. This project aims to validate intraoperative 3D fluoroscopy (3DF) as a tool to determine the final electrode position. Since it is a faster, cheaper, low-radiation method, readily available in the OR, it may replace the standard post-operative CT, if similar imaging acuity is verified.

Methods: This is a retrospective study that includes 64 patients (124 electrodes) who underwent DBS, from May 2019 to January 2022, at our institution. All patients underwent intraoperative 3DF after implantation of the definitive electrodes and a CT scan within 48 hours after surgery. In order to compare the accuracy of both methods, the images were fused in a stereotactic planning station and the electrode tip position was determined, as well as its distance to the midcommissural point in both imaging modalities. Intracranial air (pneumocephalus) volume was also quantified and its potential impact in determining the electrode position analysed. Finally, radiation exposure from 3DF and CT were assessed and compared.

Results: The difference between the electrode position estimated by 3DF and CT was 0,85 mm (± SEM 0,03), which is inferior to the CT resolution (1mm). The distance to the midcommissural point measured in both methodologies was not significantly different (13,00 ± 0,16 mm in 3DF and 13,06 ± 0,16 in CT; $p = 0,11$), but was, instead, highly correlated (correlation coefficient = 0,91; $p < 0,0001$). Despite the fact that pneumocephalus was larger in the 3DF images (6,89 ± 1,76 vs 5,18 ± 1,37 mm^3 in the CT group; $p < 0,001$), it was not correlated with the difference in electrode position measured by both techniques (correlation coefficient = 0,17; $p = 0,06$). Radiation exposure from 3DF was significantly lower than that from CT (0,36 ± 0,03 vs 2,08 ± 0,05; $p < 0,0001$).

Conclusions: 3DF accurately predicts final lead position in DBS. Being a method with fewer radiation, less expensive, faster, and that doesn't require patient transport outside the OR, it could replace CT as a tool to determine final electrode position.

Keywords: Deep Brain Stimulation, intraoperative 3D fluoroscopy, Targeting accuracy

FP068 / #316

Topic: *AS08. Stereotactic Procedures*

VALIDATION OF TENTHS STEREOTACTIC COORDINATES METHOD USING PROBABILISTIC TRACTOGRAPHY OF THE ANSA LENTICULARIS IN PARKINSON´S DISEASE PATIENT

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Introduction: The location of white matter tracts have individual variations that restricts their use for DBS or radiofrequency lesions for treating movement disorders. This study explores the stereotactic location of Ansa Lenticularis(AL) using probabilistic tractography, contrasting two surgical planning methods: the conventional Millimeters and the normalized “Tenths” stereotactic method, seeking validation of their certainty for planning electrode’s placement.

Methods: Two groups were analyzed with direct assignation: a Mexican group(16 PD patients;16 controls;total n=32), and a German group(39 PD patients). We acquired structural and diffusion MRI, generating 142 tractograms using probabilistic tractography and single-shell, three-tissue-constrained spherical deconvolution. Tractograms were filtered using the Schaltenbrand-Wahren atlas, applying conventional millimeter measurements and a method dividing the AC-PC line into tenths and using the resultant proportions for the stereotactic “Y”, “X” and “Z” coordinates. We compared the percentage of structural connectivity (% conn) of the AL tracts with bilateral regions of interest (ROIs): ventral thalamus (Voa and Vop), Globus pallidus internus (GPI), peduncle pontine nucleus(PPN), and the orbitofrontal cortex(OFC), in conventional Millimeters versus the Tenths method.

Results: Despite anatomical differences in the length of AC-PC line between Mexican and German groups(22.5±2.09mm and 24.4±2.56mm, respectively;p=0.002) and MRI acquisition parameters. We obtained significantly higher specificity and quantitative %conn, using the Tenths method over the Millimeters method in 5 out of 6 ROIs($p<0.001$), and the GPI-Voa in the right hemisphere (p=0.03) Fig 1.

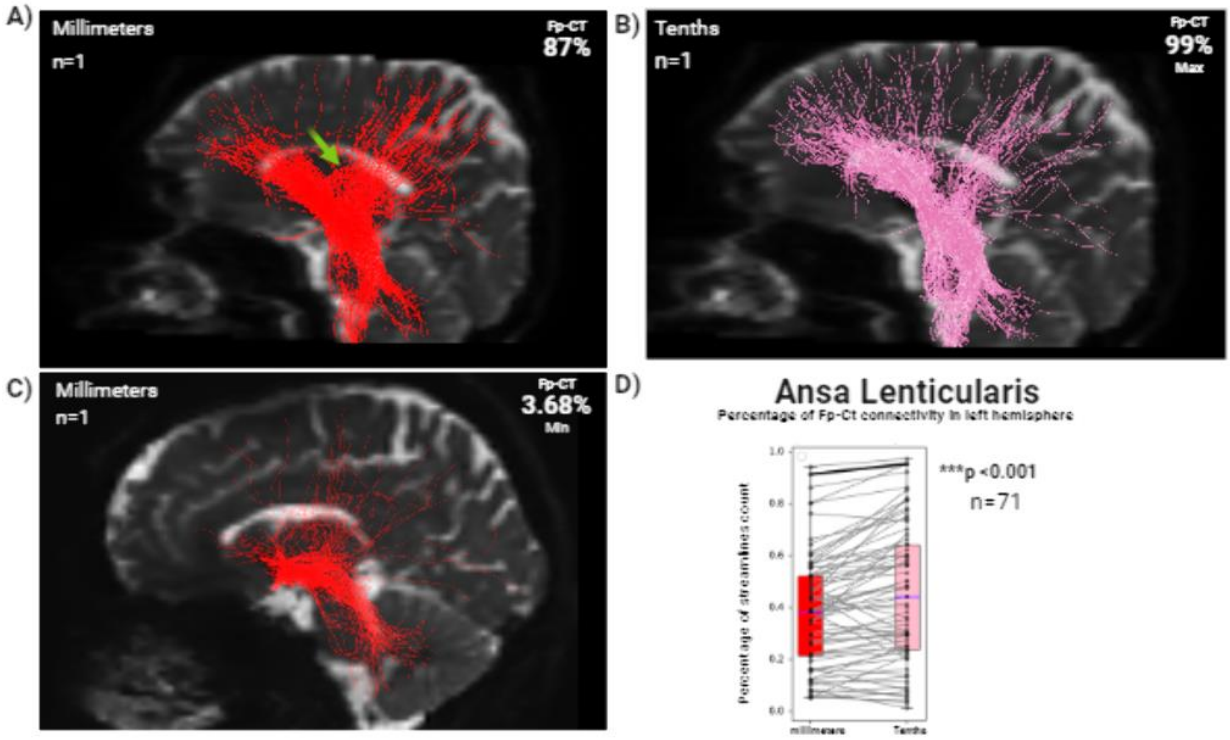

Fig 1 AL probabilistic tractography %conn of the orbitofrontal cortex with the brainstem tracts (Fp-Ct) .A) AL using millimeters method(red), the green-arrow indicates erratic-tracts that may not represent connections of AL.B) In the same patient, Probabilistic tractography using Tenths method(pink), enhanced %conn with OFC and brainstem.C) Probabilistic tractography of another subject seeding AL using Millimeters method with the minimal %conn with ROIs in the whole study.D) Boxplot %conn of 71 left hemispheres. Red bar indicates %conn when using Millimeters and pink using the Tenths method, with significant differences($p<0.001$) between them.

Conclusions: The Tenths method for stereotactic localization of the AL maximizes precision and accuracy, over the Millimeters method facilitating the planning of surgical targets in white matter.

Keywords: Parkinson Disease, probabilistic tractography, Ansa Lenticularis

FP069 / #500

Topic: *AS11. Basic Science or Technology Development*

IMPLANTABLE 3D RAY OF MICROELECTRODES FOR HIGH DEFINITION DEEP BRAIN STIMULATION (HDBS)

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Introduction: Vi present a new novel DBS probe with up to 64 3D cluster electrodes, made by help of nanotechnology and proven in animal PD-model of rat and pigs for high-definition brain stimulation (hDBS) Deep Brain Stimulation (DBS) leads has undergone very limited changes, despite being introduced more than 30 years ago. A factor that continues to limit its use is the relatively large electrode lead and consequently large stimulation fields.

Methods: To improve stimulation specificity, we have developed a novel microelectrode-based probe, wherein individual ultrafine (less than a human hair) microelectrodes with proven biocompatibility are used (1,2,4). The capacity for safe charge injection has been increased by surface nanostructures. The novel probe comprises dissolvable microchannels in gelatine which serve to guide the individual microelectrodes during insertion. A controlled spread of the ultraflexible microelectrodes in targeted tissue as well as a high biocompatibility has been verified in rats. By selecting appropriate subgroups of microelectrodes for stimulation and leaving microelectrodes causing side effects idle, an unprecedented stimulation specificity can be achieved with strong therapeutic effects and minimal unwanted side effects (2,3,4). Notably, the cluster technique allows an almost unlimited fine-tuning of stimulation fields in 3D. This has been demonstrated in both animal models of Parkinson's disease and pain indicating a wide range of potential applications.

Results: To translate the system to human scale we have developed a novel insertion system enabling the adaptation to established stereotactic procedures in humans. Probes comprising 32 ultrathin microelectrodes with a target spread of ~5-6 mm have been successfully implanted in the subthalamic area in pigs by using Vantage stereotactic frame (Elekta) in 7 T MRi to establish the coordinates.

Conclusions: In conclusion, we have developed a brand new technology that offers high definition brain stimulation (hDBS) in deep brain targets in larger brains. This has the potential to open a new era in DBS treatment and research. 1. Lind G et al, J. Neural Eng, 2010 2. Mohammed M. et al, J Neurosci Methods, 2022 3. Forni M. et al, Science Advances, 2021 4. Forni et al, J Neural Eng, 2023

Keywords: DBS, Microelectrodes, 7T MR

FP070 / #198

Topic: *AS11. Basic Science or Technology Development*

IDENTIFICATION OF THE PALLIDO-SUBTHALAMIC PATHWAYS IN HUMANS USING POST-MORTEM DIFFUSION MRI: PRELIMINARY RESULTS

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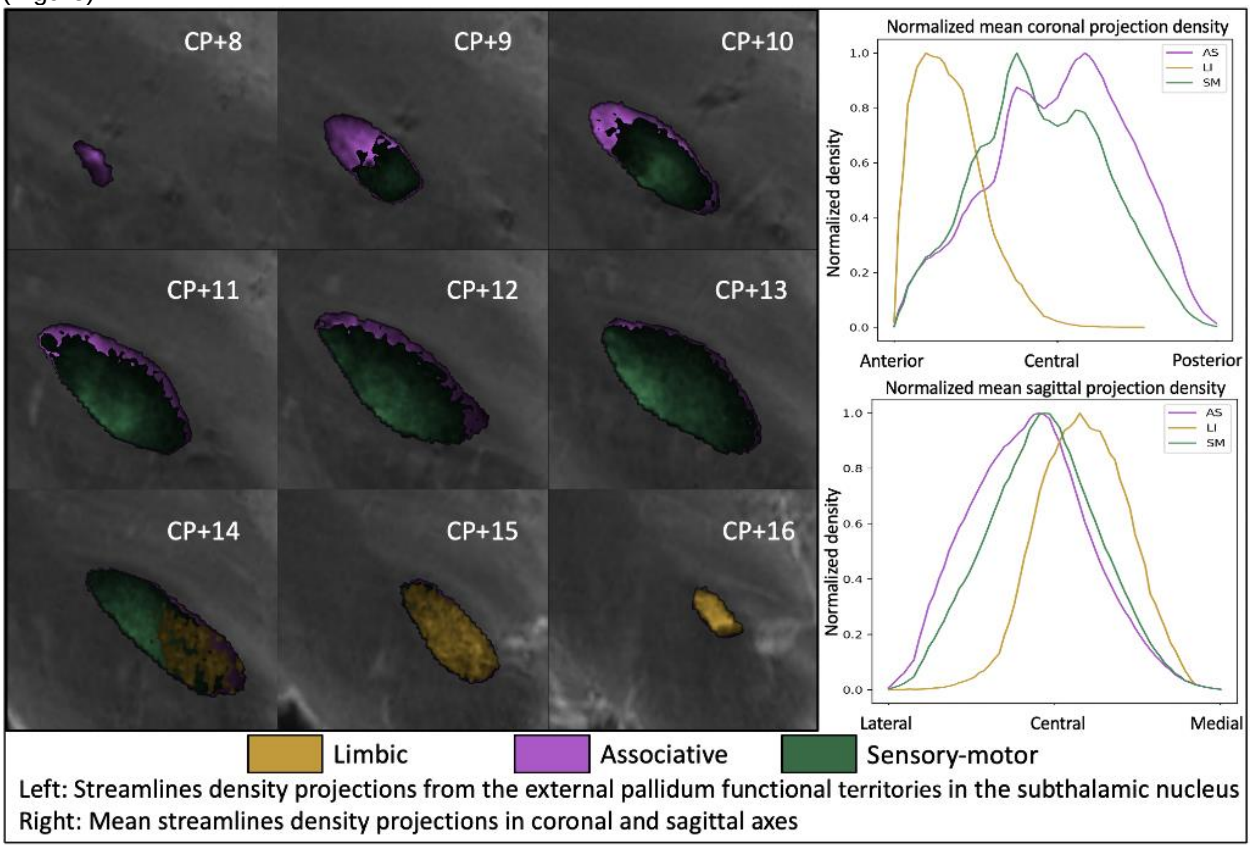
Introduction: The subthalamic nucleus (STN) plays a key role in the basal ganglia system. It is both a direct input (hyperdirect cortico-subthalamic pathway) and a powerful modulator of the system (indirect pallido-subthalamic pathway). In monkeys, the cortico-subthalamic pathway is characterized by projections originating mainly from the motor cortices and projecting to the entire STN, but also by weak associative and limbic projections terminating at the anterior tip. In humans, a recent in vivo diffusion MRI study found this segregation into two major anatomo-functional territories. In monkeys, the pallido-subthalamic projections are well known and have been used to identify three anatomo-functional territories within the STN. These projections have not been identified in humans. The aim of this study is to characterize the pallido-subthalamic projections and define the anatomo-functional territories of the STN using high-resolution ex-vivo tractography.

Methods: Two human brains were sectioned to include the STN and external Globus Pallidus (GPe), followed by 11.7 T MRI. Diffusion sequences were processed using MRtrix3. Sections of 50 µm were photographed for 3D reconstruction. Immunohistochemical staining identified the key structures. The STN was outlined using anisotropy fraction maps, MRI, photographic reconstructions, and histological stains (Perls, TH, serotonin). For the GPe, anatomical-functional territories were delineated by registering a 3D histological and functional atlas (calbindin) on the specimens.

Results: Projections from the GPe follow an ascending path, bypassing the GPi and heading towards the STN. The STN is organized into three anatomo-functional territories, limbic projections projecting to the anterior pole, motor projections central, ventral and posterior, and associative projections rather central, although covering almost the entire nucleus. Quantitatively, the associative territory represents 98% of the volume of the STN, with a central-posterior density peak, the sensory-motor territory represents 84%, with a central-inferior peak, and the limbic territory represents 40% of the NST, with an anterior peak. Overlap densities are 22.18% between associative and limbic projections, 79.58% between associative and sensorimotor and 15.21% between limbic and sensorimotor projections

(Figure).



Left: Streamlines density projections from the external pallidum functional territories in the subthalamic nucleus
Right: Mean streamlines density projections in coronal and sagittal axes

Conclusions: Our study is the first to identify in humans the anatomo-functional organization of the NST according to external pallidal projections, identifying three anatomo-functional territories within the human NST with significant overlap.

Keywords: subthalamic nucleus, Pallido-subthalamic, tractography

FP071 / #446

Topic: *AS11. Basic Science or Technology Development*

NEUROPHYSIOLOGICAL CHARACTERIZATION OF HUMAN SUBTHALAMIC NUCLEUS NEURONS IN PARKINSON'S DISEASE

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Introduction: Subthalamic nucleus (STN) has been established as an effective target for deep brain stimulation in Parkinson's disease (PD). The disease is characterized by aberrant burst firing in STN neurons. Therefore, it is crucial to understand the neurophysiological properties of these neurons before attempting to modulate them. We studied extracellular spike waveforms and discharge patterns to classify the STN neurons and determine their spatial distribution in PD patients. Additionally, we measured neuronal activity near the effective contact points of stimulation.

Methods: Microelectrode recording data was collected from 22 PD patients (11 males and females), sampled at 20 kHz and bandpass filtered at 0.5-5 kHz. Spike detection and analysis were carried out using UltraMegaSort toolbox and Matlab. Single unit clusters were isolated based on consistent waveform, spike amplitude, duration and a refractory period of 2.5 ms in the interspike interval (ISI) histogram. The following metrics were computed to classify the neurons: firing rate (FR), fano factor, burst index (BI), local variance (LV), coefficient of variation (CV), (CV 2), and interspike intervals (ISIs). A scatter plot of peak-trough ratio versus end-slope was used to distinguish between regular (RS) and fast-spiking (FS) neurons.

Results: A total of 323 neurons were isolated from the STN (n =37), of which 66 (20.4 %) displayed tonic discharge, 46 (14.2 %) periodic burst, 99 (30 %) irregular burst and 122 (37.7 %) irregular firing. Five spike waveforms were identified as triphasic 64(19.8 %), negative dominant 137(42.4%), Negative-positive 68 (21 %), positive-negative 40 (12.3%) and compound 14 (0.04 %). The RS neurons are most abundant (47 %) and FS interneurons are less populated (4%).

Conclusions: The irregular discharge pattern with negative waveforms are prevalent and widespread. The majority of tonic firing neurons were found ventrally, whereas irregular bursts were seen laterally. The majority of periodic burst units were found medially along the anteroposterior axis. The FS interneurons were prominent posteriorly and RS neurons are dispersed all over. The gradient of RMS suggests an increase in cell density in the anterior-posterior axis. Maximum therapeutic benefits were seen in the central and lateral regions that exhibited irregular, irregular bursts, and tonic firing patterns.

Keywords: subthalamic nucleus, Firing pattern, Neuronal activity

E-Poster Presentations

EP001 / #115

Topic: *AS01. Movement Disorders*

ALPHA POWER CORRELATES WITH HUNTINGTON'S DISEASE SYMPTOMS AND IS SUPPRESSED BY MEDICATION

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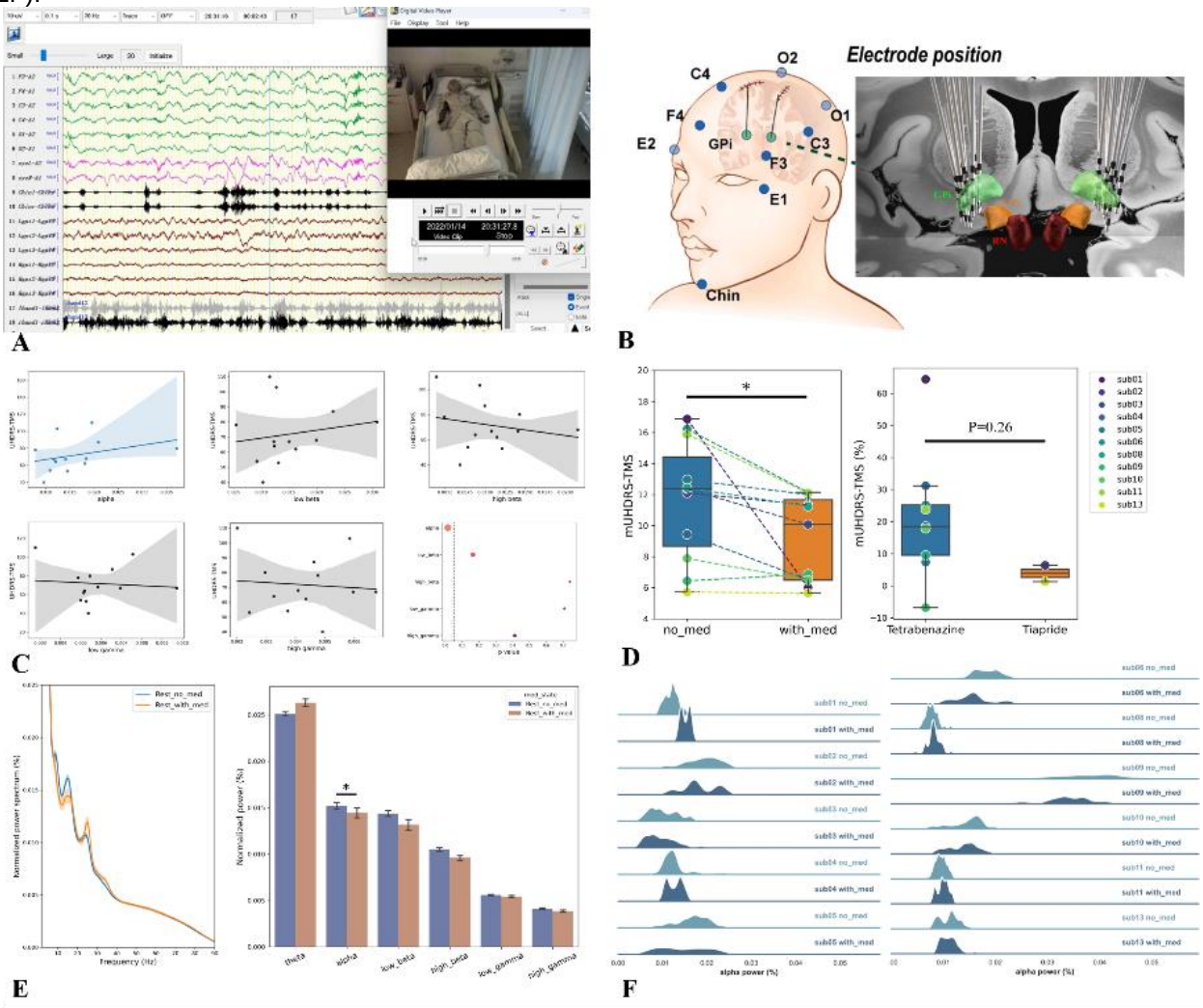
Introduction: Huntington's disease (HD) is a rare movement disorder characterized with excess involuntary movement, and globus pallidum internus (GPi) deep brain stimulation (DBS) is considered as an effective treatment of HD. Despite relatively clear studies of the molecular pathogenesis of HD, there is limited understanding of the electrophysiological mechanism of HD. Therefore, we aimed to investigate the oscillatory pattern of GPi in HD and explore how anti-HD medication modulate the GPi activity.

Methods: We directly recorded over 150 h of GPi local field potentials from 13 HD patients during GPi DBS externalization period (Figure 1A and B). We also recorded GPi activity in 11 HD patient after taking Tetrabenazine or Tiapride. A total of 578 sedate data segment was extracted, with 398 data segment without medication and 180 data segment with medication. The sum of the chorea and dystonia items of the Unified Huntington's Disease Rating Scale-Total Motor Scale (UHDRS-TMS) were used to rate the patients' symptoms during externalization. GPi spectrum was computed and a general linear model was built to find the correlation between frequency band power and preoperative UHDRS-TMS. Paired t-test was used to evaluate the therapeutic effect of medication. Linear mixed effect model was utilized to investigate the frequency band power change after medication.

Results: We found that the GPi alpha power was significantly positively correlated with the UHDRS-TMS (Figure 1C, p=0.01). After the administration of medication, we observed a significant reduction in the symptoms of patients (Figure 1D, p=0.02). In GPi activity, the medication suppressed the alpha power in group level (Figure 1E, p=0.02), which could also be reflected in individualized alpha power density distribution (Figure

1F).



Conclusions: Our findings revealed that the alpha activity of GPi was positively correlated with HD symptoms and was suppressed by the anti-HD medication. This suggests that alpha activity may act as the HD electrophysiological biomarker. These data may explain the electrophysiological pathogenesis of HD and facilitate the development of adaptive DBS systems targeting alpha activity in HD.

Keywords: Deep Brain Stimulation, Huntington's disease, Local Field Potential

EP002 / #141

Topic: *AS01. Movement Disorders*

LONG-TERM GPI DBS IN PEDIATRIC NON-DEGENERATIVE GENETIC DYSTONIA: A COHORT STUDY AND A META-ANALYSIS

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Introduction: The evidence of the effectiveness of deep brain stimulation (DBS) in children with medication-refractory non-degenerative monogenic dystonia is heterogeneous and long-term results are sparse. In addition, the response magnitude seems to be highly variable between genetic etiologies.

Methods: We performed a retrospective single center cohort study to evaluate long-term effectiveness and safety of GPi DBS in pediatric-onset, medically-refractory, non-degenerative, genetic or idiopathic dystonia treated with GPi DBS at our Center between 1999 and 2021. To compare our results to literature, we also conducted a systematic review and an individual-patient data (IPD) meta-analysis of the same clinical population. The primary outcome was the change in the BFMDRS-M at 1, 3, 5 years and at the last follow-up after surgery.

Results: The clinical cohort included 25 patients with a mean study follow-up of 11.4 years. The meta-analysis cohort included 224 patients with a mean follow-up of 3 years. Overall, the BFMDRSM mean improvement at 1 year and at last follow-up was 41% and 33% in the clinical cohort and 58.9% and 57.2% in the meta-analysis cohort, respectively. TOR1A-dystonia showed the greatest and most stable BFMDRS-M improvement in both cohorts at 1 year and at last follow-up (76.3% and 74.3% in the clinical cohort; 69.6% and 67.3% in the meta-analysis cohort), followed by SGCE-dystonia (63% and 63.9% in the meta-analysis cohort) and THAP1-dystonia (70.1% and 29.8% in the clinical cohort; 52.3% and 42.0% in the meta-analysis cohort). KMT2B-dystonia showed a less pronounced or sustained response (33.3% and 41.3%in the clinical cohort; 38.0% and 26.7% in the meta-analysis cohort).

Conclusions: Our study supports GPi DBS as an effective long-term treatment in children with non-degenerative genetic and idiopathic dystonia. Moreover, our data suggest a gene-specific differential effect of GPi DBS, highlighting the importance of extensive genetic screening prior to DBS to improve clinical decision making and patients' counseling.

Keywords: pediatrics, DBS, dystonia

EP003 / #29

Topic: *AS01. Movement Disorders*

TOWARDS A CUSTOMIZED MR-GUIDED FOCUSED ULTRASOUND SUBTHALAMOTOMOY FOR PARKINSON'S DISEASE

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Introduction: Parkinson's Disease (PD) is a neurodegenerative disorder that may be highly disabling for some patients. Surgical interventions have been used to address refractory motor symptoms. Magnetic resonance guided high-intensity focused ultrasound (MRgFUS) of the subthalamic nucleus (STN) is emerging as a non-invasive treatment. This study investigates the safety and efficacy of unilateral MRgFUS subthalamotomy, emphasizing individualized STN targeting based on regional anatomy. The approach was based on making the smallest lesion providing significant clinical benefit for each patient, with a detailed assessment of motor function including balance and gait.

Methods: Between June 2021 and December 2023, thirty PD patients underwent Unilateral MRgFUS subthalamotomy. Neuroimaging guided the targeting process and adjustments were made for individual symptoms. Tractography was use in all targeting. The primary endpoints were safety and motor scores improvements after six months.

Results: Significant contralateral improvements in tremor (64.4%), rigidity (58.3%), and bradykinesia (52.3%) in the Off-medication state were demonstrated. The procedure was well-tolerated, with only mild sonication-related adverse events. Gait stability remained unaffected, and subjective improvements in daily living and quality of life were noted.

Conclusions: This study suggests that a subthalamotomy tailored approach focusing on the smallest effective lesion yields promising results in improving PD symptoms with a favorable risk/benefit profile. Although the study has limitations, including a small sample size and a six-month follow-up, it underscores the need for further research and emphasizes the potential of MRgFUS subthalamotomy as a viable alternative for medically refractory PD.

Keyword: : MR-guided focused ultrasound · Parkinson Disease · Subthalamotomy · Customized·

EP004 / #136

Topic: *AS01. Movement Disorders*

CRANIAL CONDITIONS ASSOCIATED WITH SUCCESSFUL MRGFUS TREATMENT OF PATIENTS WITH LOW SDR - SINGLE-CENTER EXPERIENCE

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Introduction: The therapeutic effect of MRgFUS is limited to patients with low SDR. We investigated the cranial conditions associated with successful treatment among low-SDR patients. To address the small sample size, we performed an additional analysis using all experienced cases irrespective of SDR.

Methods: In this study, we included patients treated at our hospital from April 2020 to March 2023. Various descriptive statistics for the entire skull, along with averages for ten specific regions, were obtained for parameters such as SDR, skull thickness, and ultrasound incidence angle. The 1,024 ultrasonic transducer elements were categorized into ten regions as predefined by ExAblate4000's default settings. Treatment success was defined as a symptom rating score of <half the preoperative score at 6 months postoperatively. First, univariate analysis of cases with SDR < 0.40 was used to explore candidates for skull conditions that distinguish treatment success or failure. Subsequently, several multiple regression models including the obtained candidates were employed to investigate the association with the maximum temperature attained in all experienced cases irrespective of SDR.

Results: Of the 171 patients treated at our institution, 26 had SDR < 0.40, and 15 had successful treatment. Univariate analysis with SDR < 0.40 revealed that the ultrasound incidence angle of the parietal region of the sonication side (UIA-P) and SDR of the bilateral temporal region (SDR-T) tended to be smaller in the success group. The multiple regression model based on age, sex, diagnosis, SDR and UIA-P showed better prediction outcomes than the model without UIA-P (Akaike information criterion 273 from 292). Furthermore, replacing SDR by SDR without SDR-T enhanced the prediction (Akaike information criterion 273 from 266).

Conclusions: Even if the SDR is low, treatment success may be relatively more attainable if the ultrasound incidence angle at the parietal region of the sonication side is smaller or if the SDR calculated excluding the bilateral temporal regions is large.

Keywords: Magnetic resonance-guided focused ultrasound, Skull density ratio, thalamotomy

EP005 / #542

Topic: *AS01. Movement Disorders*

SPINAL CORD STIMULATION (SCS) FOR RESTLESS LEGS SYNDROME (RLS)

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Introduction: Objective: Spinal cord stimulation (SCS) is a well-established therapy for chronic neuropathic pain syndromes, only a few is reported about other conditions like gait disturbances (for PD e.g.) or other movement disorders. Restless legs syndrome (RLS) very common (3.9-14% prevalence). Its treatment consists usually in dopmaninergic medication. RLS can be a devastating painful and affecting sleep and patient's quality of life. We found in patients with SCS for PSPS I and II, which were associated with RLS, that their RLS symptoms improved as it was leg and back pain. We hereby present the first larger case series of patients with chronic neuropathic pain with associated RLS.

Methods: We retrospectively reviewed the charts of 19 (9m, 10f) consecutive RLS patients, who underwent SCS implantation for PSPS I or II with concomitant targeting of RLS. Electrode (Octrode Abbott, Pleno) tip was placed in the midline Th7 under local anesthesia. One female patient did not respond during the trial, electrode was explanted. 18 patients remained for follow-up.

Results: The responder rate was very convincing. Beside the improvement in overall mean VAS baseline 9 vs. 3 at 1 mo follow up, Patients completed the International Restless Legs Syndrome Scale questionnaire to objectively quantify the severity of his symptoms. Follow up RLS Score is available in 4 patients yet. It improved after implantation from 35 (31-40) to 22 (10-34) on the 40-point scale.

Conclusions: Conclusion: To our knowledge, this is the first reported case series using SCS as a potentially long-lasting, safe, and highly effective therapy for RLS. This effect may be explained by increased inhibition from hypothalamic cells controlling dopaminergic input to the spine. SCS turned out to be a potential alternative treatment for improving medical refractory RLS. Further prospective studies are warranted to proof the evidence.

Keywords: Neuropathic pain, Restless legs, Spinal Cord Stimulation

EP006 / #174

Topic: *AS01. Movement Disorders*

INDICATION AND USEFULNESS OF ADAPTIVE DBS: ANALYSIS OF 26 PARKINSON'S DISEASE PATIENTS 1 YEAR AFTER PERCEPT PC IMPLANTATION

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Introduction: Since the launch of Percept PC in Japan in 2020, we have been able to use LFP sensing and adaptive DBS (aDBS) for Parkinson's disease patients in routine clinical practice. However, its use has not yet been standardized, and its clinical usefluness remains unclear. Here, to investigate the usefulness and indications of aDBS, we analyzed clinical data obtained from 26 patients who had received Percept PC in our hospital for more than one year.

Methods: Twenty-six Parkinson's patients (52 electrodes) were included; 24 were newly implanted and 2 were replaced; 48 electrodes were implanted in the subthalamic nucleus and 4 in the globus pallidus. Cylindrical leads (Medtronic 3389) were used in 11 patients (22 hemispheres) and directional leads (Medtronic Sensite) in 15 patients (30 hemispheres).
A monopolar review was performed 3 months postoperatively to establish optimal electrodes, followed by LFP recording (Brainsense survey, streaming) and aDBS settings. At 3 and 12 months after DBS, aDBS and conventional DBS (cDBS) were performed for 48 hours each, and motor function (MDS-UPDRS 3, UDysRS) and PDQ-39 were compared within subjects. In daily life, patients were allowed to choose aDBS or cDBS according to their preferences.

Results: LFP detection rate was 79% at 3 months and 77% at 12 months. A within-subject comparison of aDBS and cDBS showed no difference in UPDRS3/UDysRS, but average stimulus amplitude was significantly lower in aDBS. aDBS implementation rate was 50% at 3 months and 46% at 12 months. Comparison of patient factors between the aDBS group (n=17) and the cDBS group(n=9) at 12 months showed significant differences in age at surgery (62.2 vs. 71.0 years), preoperative MDS-UPDRS 3 (ON) (19.0 vs. 33.5), preoperative L-dopa responsiveness (56.6% vs. 38.5%), and 12-month postoperative MDS-UPDRS 3 (ON) (17 .0 vs 39.2). .

Conclusions: There were no significant differences in motor symptoms and QOL scores between aDBS and cDBS within subjects. However, aDBS was selected in patients who were relatively young and had good L-doa responsiveness. The present aDBS system could be adapted to typical wearing-off cases, and it seemed to be useful in saving stimulus power and adjustment labor.

Keywords: closed-loop DBS, LFP sensing, Adaptive DBS

EP007 / #544

Topic: *AS01. Movement Disorders*

HYBRID DBS SYSTEMS FOLLOWING IPG REPLACEMENT – FIRST EXPERIENCES

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Introduction: Objective: Until recently, DBS cross-over devices, as switching the IPG from one company to another during replacement procedures, were not an option. Since 2022, adapters for switching from conventional Medtronic DBS systems are available. They allow the connection to Medtronic extensions and leads and connect to Boston Scientific DBS IPGs.

Methods: We report our first experiences using this adapter regarding safety and programming, especially related to the conversion from single-source IPGs to Multiple Independent Current Control (MICC) IPGs. Intra- and postoperative complications were assessed as well as adverse effects following conversion. the rationale for switching the manufacturer and the device were patient's preference, limited longevity of the prior IPG (< 3 y battery life), smaller IPG size options and limitations due to side effects with the prior system. The average IPG longevity prior to conversion was 2.7 y (0.9 – 4.8 y)

Results: We included 11 male and 12 female patients, PD (STN) n=14, Dystonia (GPI) n=5, ET (VIM) n=3, epilepsy /tremor (VIM/ANT) n=1. No complications occurred; impedances were within range. All patients received postoperative programming by a movement neurologist. All patients were switched to the multiple independent current setting the day after surgery. Off the 23 patients, 11 reported an unchanged status, 12 patients improved significantly compared to the preoperative status or as a reduction of stimulation side effects at the first post op visit. All of the patients in the single visit subgroup received > 2 active electrodes, 18/23 patients in the multi visit subgroup received > 2 active electrodes.

Conclusions: Conclusion The high number of patients using more than 1 active contact shows the significance of the change to a MICC system. 54.4% (n=12) of the patients experienced a reduction in at least one symptom or side effect, a reduction in tremor, bradykinesia or rigidity. Final data on IPG longevity is not available yet, but calculation show a clear improvement to be expected. Nor surgical complication occurred. DBS system cross-over IPG replacement is safe and technically easy. Clinical improvement was observed in a significant number of patients adding benefit beyond the smaller IPG size and improved battery life

Keywords: IPG replacement, hybrid systems, DBS

EP008 / #8

Topic: *AS01. Movement Disorders*

STIMULATION OF COMBINED SUBTHALAMIC NUCLEUS AND SUBSTANTIA NIGRA FOR REFRACTORY FREEZING OF GAIT IN ADVANCED PARKINSON DISEASE: EXPERIENCE FROM OUR CENTER

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Introduction: Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is a safe procedure to treat motor symptoms in patients with Parkinson's disease (PD). Most patients develop gait disorders and freezing of gait (FOG) as PD progresses. Alternative DBS targets to successfully treat these symptoms have been explored, including the stimulation of the pars reticulata of substantia nigra (SNr). This anatomical landmark is deep to the STN, allowing for combined stimulation of both targets with a single electrode.

Methods: 16 patients with advanced PD were operated using multidirectional electrodes (Cartesia Lead, Boston Scientific, Massachusets, USA). Surgical planning was performed with BrainLab Elements planning station (BrainLab, Munich, Germany). Target was selected 1.5-2mm into the SNr trough the STN. Surgery was carried with a Leksell stereotactic frame (Elekta, Stockholm, Sweden). The procedure was done with the patient awake, with intraoperative registration and stimulation test. Final electrode position was verified though intraoperative OARM2-CTscan (Medtronic, Minnesota, USA). Patients follow up was done by neurology on a weekly basis for programming until appropiate response, then was adjusted according to patient needs.

Results: All 16 patients (32 electrodes) had an adecuate SNr-STN electrode positioning, according to planning (median error of 0,258mm). 1 of 16 patients suffered minor complication (bleeding in the electrode trajectory). 4 out of the 32 electrodes produced minor adverse secondary effects at 1,5mAh (3 produced diplopia and 1 internal capsule stimulation). Clinical global impression (CGI) from patient and neurologist was marked improvement in 15 out of 16 patients. 11 of 16 patients presented FOG before DBS implant. 1 of them referred improvement with STN stimulation only, while the other 8 referred significant reduction in FOG with STN-SNr stimulation.

Conclusions: In our series, implant of STN-SNr electrodes was safe with few minor complications. The STN-SNr resulted in a useful alternative target in patients with FOG resistant to levodopa + STN stimulation alone. This information could be useful for target selection in patients with advanced PD an FOG. Further research in this field is required to optimally select patients that can benefit from this additional therapy target.

Keywords: Freezing of Gait in Parkinson Disease, Combined Stimulation of Subthalamic Nucleus and Substantial Nigra, Alternative Targeting in Parkinson Disease

EP009 / #28

Topic: *AS01. Movement Disorders*

THE EFFECTS OF DEEP BRAIN STIMULATION ON SLEEP ACROSS VARYING TARGETS AND DISEASES: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Deep brain stimulation (DBS) is a standard treatment for movement disorders, epilepsy, and others, yet its influence on post-procedural sleep quality remains an under-researched topic. No comprehensive systematic review and meta-analysis of sleep-related effects by most common targets of DBS, across indications, exists. We aimed to systematically measure differences in sleep quality across targets, diseases, follow-up lengths, and sleep-reporting scales.

Methods: A systematic search from PubMed, Embase, and Web of Science for primary studies in English until October 1, 2023, was performed. We extracted demographic data, disease type/duration, DBS target, stimulation laterality (unilateral vs bilateral), follow-up lengths, and sleep pre/post-op measurement scales (Epworth Sleepiness Scale (ESS), Parkinson's Disease Sleep Scale (PDSS), Pittsburgh Sleep Quality Index (PSQI), Non-motor Symptom Scale (NMSS)). A random effect model meta-analysis was performed using the mean difference of scales' pre- and post-scores, by target and follow-up times. A subgroup analysis by stimulation laterality was performed.

Results: 61 studies were identified for qualitative synthesis, representing 2849 patients. The mean age of patients was 60.5±8 years (mean ± SD) and patients were 53% male. The meta-analysis including STN-DBS in PD patients showed significant sleep improvement observed at 3 months but not 12 months with the PDSS, at 12 months but not 3 months with the ESS, and at 6 months with the NMSS. The PSQI showed no significant improvement in sleep at 1, 3, 6, or 12 months. In the subgroup analysis of STN-DBS for PD patients, there was a significant difference seen in the PSQI score by laterality at 6 months but not at 3 months. For globus pallidus internus DBS, 78% of studies reported no significant improvement in sleep quality. For the centromedian thalamus, only 1 of 3 studies observed a significant improvement in sleep, showing synchronization of interictal discharges during slow-wave sleep. Moreover, for ventral intermediate nucleus DBS, no studies reported significant sleep improvement.

Conclusions: Significant standardization in sleep measurement outcomes and additional studies on more DBS targets and diseases are needed to determine the target-dependent effects of DBS surgery on sleep, as well as the optimal follow-up duration at which to measure sleep changes after DBS surgery.

Keywords: Parkinson's, sleep, DBS

EP010 / #68

Topic: *AS01. Movement Disorders*

SPECTRE IMAGING EXPLAINS EFFECTS OF STN DBS ON SINGLE SUBJECT LEVEL AND MAY AID TARGETING AND PROGRAMMING TO IMPROVE NON-MOTOR OUTCOME

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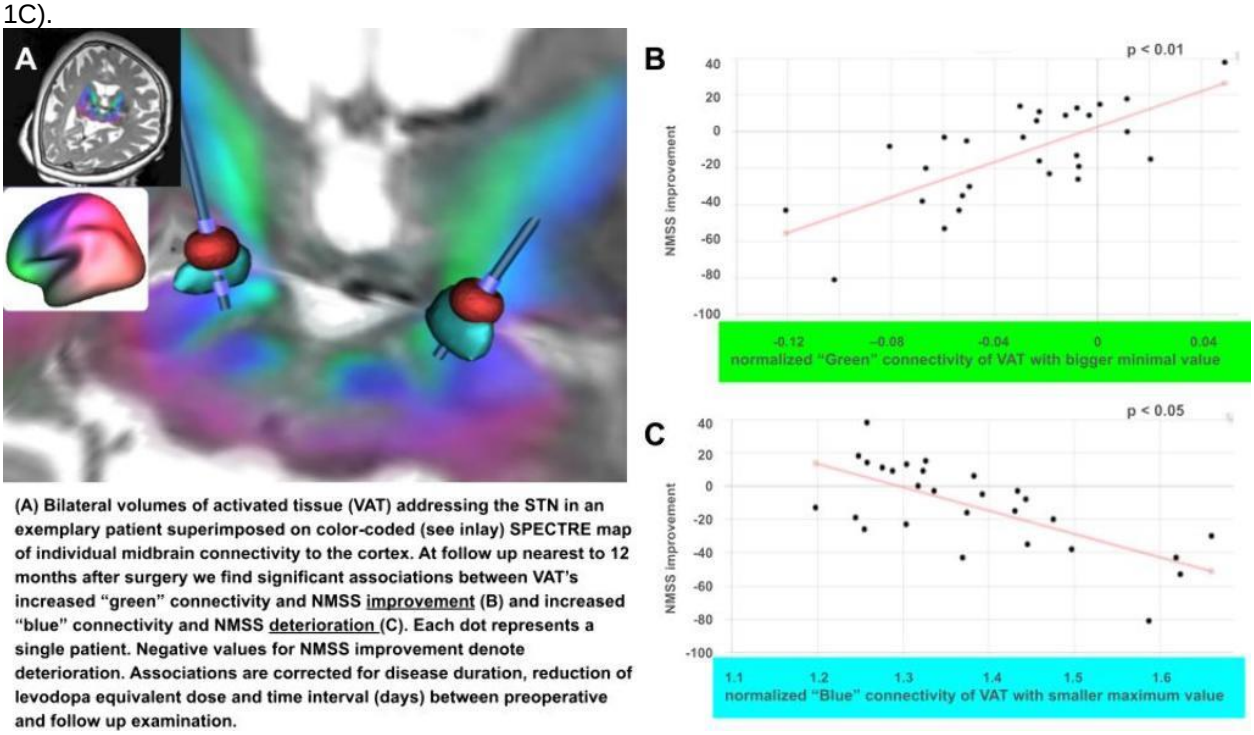
Introduction: We have recently demonstrated that motor improvement after deep brain stimulation (DBS) of the subthalamic nucleus (STN) can be associated with individual structural motor connectivity analyzed by Subject sPEcific brain Connectivity display in the Target REgion (SPECTRE, Reisert et al. 2021). Here, we investigate whether effects on non-motor symptoms are also explainable by individual connectivity.

Methods: Patients with Parkinson's disease and STN-DBS, who had given informed consent to our prospective registry were selected for this analysis, if the following was available: Preoperative and postoperative follow-up at approximately 12 months of the non-motor symptoms scale (NMSS), preoperative 3T diffusion-weighted MRI, postoperative CCT, bilateral volumes of activated tissue (VAT, simulated with Brainlab Guide XT) reconstructed from stimulation parameters at follow-up. NMSS improvement was calculated by subtracting follow-up values from preoperative values. For generation of individual SPECTRE maps, limbic/associative/sensori-motor (green/blue/red) cortical schemes defined in standard space were warped to subject space and in a tract weighting approach 500 probabilistic streamlines per voxel were seeded in the VATs to compute their cortical associations (Fig. 1A). Blue/motor and green/limbic connectivity of both VATs (left/right) were used to predict changes in NMSS scores with multiple linear regression correcting for disease duration, reduction of levodopa equivalent dose and time interval between preoperative and follow-up examination.

Results: From our DBS-registry, 28 patients fulfilled the criteria and were included in the analysis. Regression analyses found significant models for both green/limbic ($F(4,23) = 5.902$, $p = 0.002$, $R^2 = 0.506$) and blue/motor connectivity ($F(4,23) = 5.174$, $p = 0.004$, $R^2 = 0.473$) controlling for the above mentioned additional factors. NMSS improvement was positively associated with green/limbic connectivity of the VAT ($t = 3.115$, $p = 0.0049$, Fig.1B) and negatively associated with blue/motor connectivity ($t = -2.768$, $p = 0.0109$, Fig.

1C).



(A) Bilateral volumes of activated tissue (VAT) addressing the STN in an exemplary patient superimposed on color-coded (see inlay) SPECTRE map of individual midbrain connectivity to the cortex. At follow up nearest to 12 months after surgery we find significant associations between VAT's increased "green" connectivity and NMSS improvement (B) and increased "blue" connectivity and NMSS deterioration (C). Each dot represents a single patient. Negative values for NMSS improvement denote deterioration. Associations are corrected for disease duration, reduction of levodopa equivalent dose and time interval (days) between preoperative and follow up examination.

Conclusions: Providing connectivity on a single subject level, SPECTRE imaging can predict non-motor effects of STN-DBS and has the potential to improve image-based DBS programming and targeting for DBS implantation. References: Reisert M et al. Hum. Brain Mapp. 42,2309–2321(2021)

Keywords: Non-Motor Symptoms, STN DBS in Parkinson's disease, connectivity

EP011 / #98

Topic: *AS01. Movement Disorders*

LONG TERM FOLLOW UP OF DBS VERSUS PALLIDOTOMY IN PARKINSONS DISEASE

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Introduction: Both Pallidotomy and Bilateral Subthalamic Nucleus DBS(Deep Brain Stimulation) are established surgical treatment of Parkinsons Disease(PD). We tried to compare the efficacy of pallidotomy and bilateral subthalamic nucleus (STN) stimulation in patients with PD.

Methods: All the patients who were operated for Parkinsons disease in Annapurna Neurological Institute and Allied Sciences and have long term follow up of two years duration were included in this study. Seventy-four patients with advanced PD and young onset PD were selected to have staged pallidotomy or bilateral STN stimulation. The primary outcome was the change from baseline to 24 months in the motor part of the Unified PD Rating Scale (motor UPDRS) in the off phase. Secondary outcomes were parkinsonian symptoms in the on phase (motor UPDRS), dyskinesias (Clinical Dyskinesia Rating Scale and dyskinesias UPDRS), functional status (activities of daily living UPDRS and Schwab and England scale), PD Quality of Life questionnaire, changes in drug treatment, and adverse effects were evaluated.

Results: The off-phase motor UPDRS score improved from 50.5 to 27 points in the group of pallidotomy patients and from 51.5 to 26.5 in the STN stimulation patients ($p = 0.002$). Of the secondary outcome measures, on phase motor UPDRS improved significantly in favor of the STN stimulation patients whereas Dyskinesias improvement was more in favour of Pallidotomy patients. Reduction of antiparkinsonian drugs was greater after STN stimulation than after pallidotomy. Cost of DBS was ten times more than pallidotomy whereas surgical timing and hospital stay was lesser in pallidotomy cases. There was 6 Mortality in the DBS group in long term follow up and 3 mortalities in Pallidotomy group. Four died due to pneumonia related complications and one committed suicide. One patient in pallidotomy case had Parkinsons crisis.

Conclusions: Pallidotomy was equally effective with bilateral STN stimulation in reducing parkinsonian symptoms in patients with advanced PD and young onset PD. In terms of cost efficacy, we believe that pallidotomy still has a significant role and should not be deserted.

Keywords: Pallidotomy, DBS, Long term follow up

EP012 / #178

Topic: *AS01. Movement Disorders*

CLINICAL USE OF DIRECTIONAL ELECTRODES IN DEEP BRAIN STIMULATION FOR PARKINSON DISEASE: A SYSTEMATIC LITERATURE REVIEW AND META-ANALYSIS

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Introduction: Since their introduction in 2015, directional leads have almost completely replaced conventional leads for deep brain stimulation (DBS) in Parkinson disease (PD). Yet the benefits of directional DBS (dDBS) over omnidirectional DBS (oDBS) remain unclear. This systematic review compares the literature on dDBS and oDBS for PD, focusing on clinical outcomes, stimulation parameters and stimulation-induced side effects.

Methods: This review was conducted according to PRISMA guidelines. A search of databases was carried out to include Pubmed, Cochrane (CENTRAL) and EmBase, using relevant keywords such as ‘directional’, ‘segmented’, ‘brain stimulation’ and ‘neuromodulation’. Screening was based on title and abstract.

Results: A total of 37 papers with 1,287 participants and 1,469 leads were included after screening. The difference in mean UPDRS III change after dDBS compared to oDBS was 1.06 (95% CI: -1.34; 3.45, p = 0.39). The therapeutic window was 0.76 mA wider when using dDBS (95% CI 0.11 mA; 1.41 mA, p = 0.02) with a lower therapeutic current (0.39 mA, 95% CI 0.23 mA; 0.55 mA, p = 0.01) and a lower side-effect threshold (0.56 mA, 95% CI 0.38 mA; 0.73 mA, p < 0.01). Median follow-up time for these studies was 6 months (1 week to 2 years). Dyskinesia was the most commonly reported side effect, without a significant difference between dDBS and oDBS (standard mean difference = 0.23 [95 % CI: -0.45; 0.92, p = 0.5]). Directionality was used in 36-100% of directional leads.

Conclusions: The findings suggest that stimulation parameters favour dDBS. However, these do not appear to have a significant short-term clinical impact, and availability of long-term data is limited. Directional DBS is widely accepted, but clinical data justifying their increased complexity and cost is currently lacking.

Keywords: Deep Brain Stimulation, DBS, Parkinson's disease

EP013 / #206

Topic: *AS01. Movement Disorders*

MORPHOMETRIC CORRELATES OF TREMOR IN PARKINSON'S DISEASE, ESSENTIAL TREMOR AND DYSTONIA

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Introduction: The ventral intermedial nucleus of the thalamus (Vim) is an established surgical target for the treatment of medically refractory essential tremor (ET), Parkinson's disease (PD) tremor, and dystonic tremor (DT). The Vim is central to the dentato-thalamo-cortical pathway (DTCp).This work focused on investigating whether variability in outcomes for thalamic surgery for tremor could be due to local changes in thalamic morphometry, changes in DTCp due to regional disease-causing altered connectivity, or global pattern of disease.

Methods: Diffusion and structural MR Imaging of 35 patients who underwent Vim DBS or lesioning for tremor, paired with clinical outcomes, were used to investigate voxel-wise differences in thalamic tracts. These were correlated with tremor severity, disease duration or improvement following surgery. Whole brain probabilistic tractography was run from left and right thalami for each patient; putative Vim locations were defined by combining fractional anisotropy maps and T1 imaging, which allowed sub-selection of the tracts correspondent to the DTCp, on which tract-based morphometry was performed. Thalamic strength of connectivity to parcellated brain regions was assessed. Tractographic thalamic segmentation was performed, and tensor-based morphometry tested for the effect of age, tremor severity and tremor duration, controlling for age, sex and intracranial volume.

Results: The recruited cohort consisted of PD N=13, ET N=12, DT N =7 and tremor of unknown aetiology N=3. Tract-based VBM showed increased anterior peri-callosal cortico-cortico tract volume correlating with tremor severity. There was no correlation with disease duration or improvement following surgery. Stronger thalamic connectivity to precentral gyrus correlated with better post-operative outcomes. Atrophy of the anterior thalamic nuclei correlated with age, which is concordant with literature. Focal increases in tissue volume in motor thalamus on the left side correlated with tremor severity. Focal increases in tissue density in right motor thalamus and medullary lamina correlated with tremor duration. Results did not differ between the PD, ET, DT and tremor of unknown etiology groups.

Conclusions: The identified morphometric changes may correlate to chronic pathological over-activation of motor circuitry in tremor. The identified morphometry patterns can shed light on the pathophysiology of medically refractory tremor and potentially be used to leverage tools allowing better surgical candidate selection.

Keywords: Deep Brain Stimulation, thalamic segmentation, voxel based morphometry

EP014 / #210

Topic: *AS01. Movement Disorders*

SLEEP OUTCOMES AND RELATED FACTORS IN PARKINSON'S DISEASE AFTER SUBTHALAMIC DEEP BRAIN ELECTRODE IMPLANTATION: A RETROSPECTIVE COHORT STUDY

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Introduction: Subthalamic nucleus deep brain stimulation (STN-DBS) improves sleep qualities in Parkinson's disease (PD) patients; however, it remains elusive whether STN-DBS improves sleep by directly influencing the sleep circuit or alleviates other cardinal symptoms such as motor functions, other confounding factors including stimulation intensity may also involve. Studying the effect of microlesion effect (MLE) on sleep after STN-DBS electrode implantation may address this issue. We aim to examine the influence of MLE on sleep quality and related factors in PD, as well as the effects of regional and lateral specific correlations with sleep outcomes after STN-DBS electrode implantation.

Methods: In 78 PD patients who underwent bilateral STN-DBS surgery in our center, we compared the sleep qualities, motor performances, anti-Parkinsonian drug dosage, and emotional conditions at preoperative baseline and postoperative 1-month follow-up. We determined the related factors of sleep outcomes and visualized the electrodes position, simulated the MLE-engendered volume of tissue lesioned (VTL), and investigated sleep-related sweet/sour spots and laterality in STN.

Results: MLE improves sleep quality with Pittsburgh Sleep Quality Index (PSQI) by 13.36% and Parkinson's Disease Sleep Scale-2 (PDSS-2) by 17.95%. Motor ($P = 0.014$) and emotional ($P = 0.001$) improvements were both positively correlated with sleep improvements. However, MLE in STN associative subregions, as an independent factor, may cause sleep deterioration ($r = 0.348$, $P = 0.002$), and only the left STN showed significance ($r = 0.327$, $P = 0.004$). Sweet spot analysis also indicated part of the left STN associative subregion is the sour spot indicative of sleep deterioration.

Conclusions: Conclusion: The MLE of STN-DBS can overall improve sleep quality in PD patients, with a positive correlation between motor and emotional improvements. However, independent of all other factors, the MLE in the STN associative subregion, particularly the left side, may cause sleep deterioration.

Keywords: Parkinson's disease, Spindle, sleep

EP015 / #245

Topic: *AS01. Movement Disorders*

EXOSCOPIC MICROVASCULAR DECOMPRESSION FOR TRIGEMINAL NEURALGIA, HEMIFACIAL SPASM, AND GLOSSOPHARYNGEAL NEURALGIA

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Introduction: The exoscope system is becoming increasingly used in neurosurgery. Its three-dimensional ultra-high-definition image is valuable in identifying and dissecting the delicate neural and vascular structures during microvascular decompression. In addition to the visual image enhancement, the exoscope system can provide a supine position option for patients who undergo microvascular decompression. The authors review more than 200 cases of exoscopic microvascular decompression for trigeminal neuralgia, hemifacial spasm, and glossopharyngeal neuralgia.

Methods: The authors retrospectively reviewed 240 patients who underwent microvascular decompression (MVD) for trigeminal neuralgia (61 patients), hemifacial spasm (174 patients), and glossopharyngeal neuralgia (5 patients). Most patients underwent MVD via a supine retrosigmoid approach. The postoperative outcomes were compared with 326 patients who underwent microscopic MVD. The authors described several nuances to performing the exoscopic MVD.

Results: In the exoscopic group, the postoperative outcomes were excellent at 82% and good at 8% of the trigeminal neuralgia patients. Of the hemifacial spasm patients, 84% of them had excellent, and 10% of them had good outcomes. These outcomes were similar to the microscopic outcomes in each trigeminal neuralgia and hemifacial spasm group ($p > 0.05$). All five glossopharyngeal patients had excellent outcomes after exoscopic MVD. The cranial nerve-related complications were less frequent in the exoscopic group ($p > 0.05$); however, postoperative pneumocephalus was more frequent in the exoscopic group compared with microscopic surgery ($p < 0.05$). Our exoscopic MVD series showed non-inferior surgical outcomes compared to the operative microscope with no significant increase in surgical risk. To perform exoscopic MVD in a supine position, the team needed to arrange the operative layout to optimize the exoscopic trajectory to observe the cerebellopontine angle efficiently. In addition, surgeons need to utilize bed rotation and head positioning before closing the dura to minimize postoperative pneumocephalus.

Conclusions: In conclusion, an exoscope can be a practical alternative to performing MVD for trigeminal neuralgia, hemifacial spasm, and glossopharyngeal neuralgia. The team may need to arrange the operative layout to maximize the benefit of using an exoscope in the retrosigmoid approach. With an exoscope, we can perform MVD in a supine position to benefit the patients.

Keywords: Microvascular decompression, exoscope, supine position

EP016 / #317

Topic: *AS01. Movement Disorders*

7-TESLA MRI BRAIN NETWORK ANALYSIS IN DEEP BRAIN STIMULATION FOR PARKINSON'S DISEASE (STEREO-DBS)

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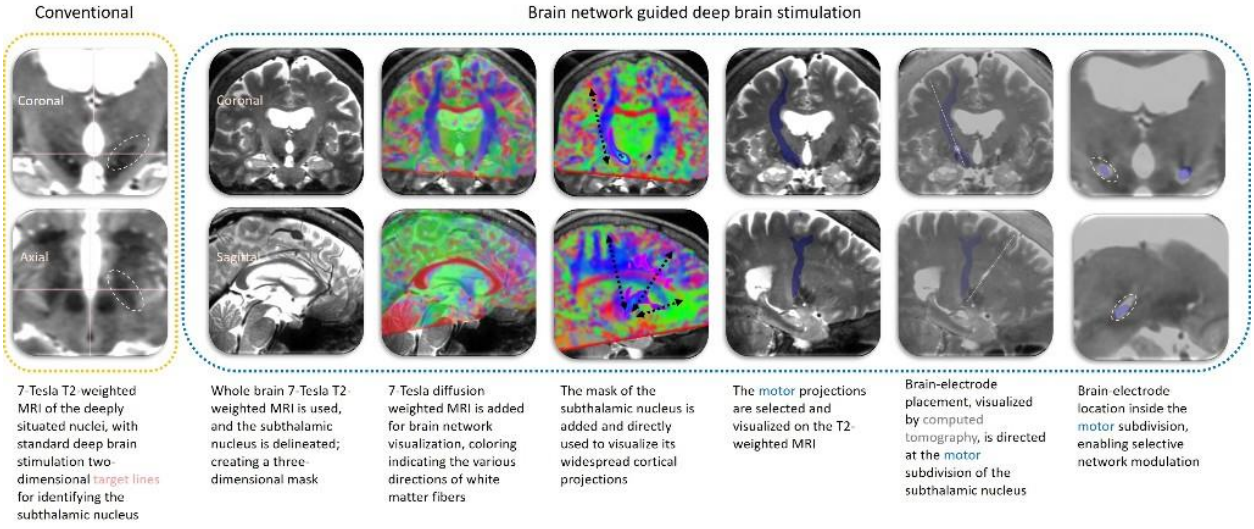
Introduction: Although magnetic resonance imaging (MRI) has been used to localize the subthalamic nucleus for brain-electrode placement in the past 20 years; individual motor improvement following deep brain stimulation surgery in Parkinson's disease remains variable. The effect of deep brain stimulation relies on modulating brain networks, and this preliminary study investigates the use of ultra-high resolution 7-Tesla MRI to enable patient-specific brain-electrode placement directed at the subthalamic motor
network.



Methods: A prospective single center uncontrolled open-label study with blinded endpoint evaluation; the first 30 Parkinson's patients undergoing deep brain stimulation surgery using 7-Tesla MRI brain network analysis from March 2022 through February 2023 are reported. The primary outcome is the percentage change in motor symptoms as measured by Unified Parkinson's Disease Rating Scale Motor Examination (MDS-UPDRS-ME) after six months of deep brain stimulation therapy in the off-medication state. Secondary outcome measures consist of MDS-UPDRS Motor Complications–Dyskinesia, disease related quality of life measured with the Parkinson's Disease Questionnaire 39 and Starkstein apathy scale.

Results: In all 30 patients (representing 60 nuclei), selective visualisation of motor projections originating in the subthalamic nuclei using 7-Tesla MRI was successfully performed before deep brain stimulation surgery and electrode placement was directed at the motor subdivision. Average UPDRS-ME improvement was 60% (range 45% - 83%; P = 0.001). Average MDS-UPDRS Motor Complications-Dyskinesia improvement was 76% (range 33% - 100%; P = 0.001), average quality of life improved 23% (ranging from 67% deterioration to 92% improvement; P = 0.023) and occurance of apathy was seen in 15% of patients.

Conclusions: In this pilot study, 7-Tesla MRI enabled patient-specific subthalamic network guided brain-electrode placement and all Parkinson patients had a response. The average found motor improvement of 60% in this group of patients compares favorably with the universal reported improvement of 48% (at six months follow up). Since the introduction of deep brain stimulation for Parkinson's disease approximately a fifth of reported patients showed less than 30% improvement, and this insufficient effect was not seen in this study. (ClinicalTrials.gov number, NCT05843084.)

Keywords: Parkinson's disease, 7-Tesla MRI, Deep Brain Stimulation

EP017 / #403

Topic: *AS01. Movement Disorders*

DBS FOR DISABLING TREMOR AT THE VENTRAL INTERMEDIATE NUCLEUS OF THE THALAMUS VERSUS POSTERIOR SUBTHALAMIC NUCLEUS: AN INTERIM REPORT FROM THE ADROIT STUDY

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Introduction: Deep brain stimulation (DBS) of the ventral intermediate nucleus of the thalamus (VIM) has been shown to be effective in suppressing medically refractory tremor in randomized trials. Recent studies have suggested that stimulation of the posterior subthalamic area (PSA) is equivalent and in some cases potentially more effective than VIM DBS.

Methods: ADROIT is a large, international, prospective, post-market observational study that collects long-term safety and effectiveness data on Abbott DBS systems in a real-world setting. Follow-up occurred at initial programming, 6 months, and annually post implant through 5 years. Safety and efficacy analyses were performed on the subset of newly implanted patients with disabling tremor and at least one lead in the VIM or PSA. Evaluated outcomes included improvement in tremor severity and disability through 1 year utilizing the Fahn Tolosa Marin Tremor Rating Scale (FTM-TRS) and adverse events throughout follow-up.

Results: As of October 2023, there were 102 subjects with leads implanted in the VIM and 22 subjects with leads in the PSA for disabling tremor at 26 sites in the United States and Europe. For the VIM cohort, paired analyses showed an average improvement in FTM-TRS from 53.9 ± 15.9 at baseline to 19.8 ± 14.5 at 1 year (n=52). Similar analyses for the PSA cohort showed an average improvement from 62.2 ± 13.7 to 26.5 ± 14.6 (n=14). The mean difference in FTM-TRS score improvement between brain targets was not significantly different at 1 year (1.6, 95% CI -6.7, 9.9). A similar result was observed when considering the improvement in target limb severity score alone (difference 0.4, 95% CI -1.1, 1.8).

Conclusions: DBS significantly reduced tremor severity in patients with disabling tremor. Clinical results from a prospective real-world observational study showed no differences in efficacy based on FTM-TRS scores for patients implanted with leads in the VIM or PSA. Long-term follow-up will continue in the ADROIT study for further evaluation.

Keywords: PSA, tremor, DBS

EP018 / #477

Topic: *AS01. Movement Disorders*

SAFETY OF SPINAL CORD STIMULATION FOR SEVERE MEDICATION-REFRACTORY RESTLESS LEGS SYNDROME

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Introduction: Restless legs syndrome (RLS) is a neurological disorder characterized by an irresistible urge to move the legs, often accompanied by unpleasant sensations. While pharmacotherapy and nonpharmacologic approaches offer relief for some, there is a subset of patients with refractory RLS for whom these treatments are ineffective. Spinal Cord Stimulation (SCS) has emerged as a potential therapeutic option, yet its specific application for RLS remains underexplored.

Methods: We are presenting a trial with six patients diagnosed with medication-refractory RLS. After a multidisciplinary review and institutional approval, patients were implanted with a spinal epidural paddle electrode and subsequently fitted with an internal pulse generator (IPG). The primary endpoint was the assessment of safety, while secondary endpoints focused on the efficacy of SCS, measured by changes in the International RLS Study Group rating scale and RLS-Quality of Life questionnaire scores.

Results: Preliminary findings in four patients indicate that SCS may substantially improve RLS severity and quality of life. Subjectively, patients reported leg restlessness relief with SCS activation. Objective improvements in sleep quality were noted, with a reduction in periodic limb movement arousals. Detailed results and patient-reported outcomes will be presented.

Conclusions: SCS appears to be a safe and potentially effective intervention for patients with medication-refractory RLS. Further research is warranted to define the role of SCS in RLS management. These findings represent preliminary results from an ongoing investigation into the use of SCS for RLS, emphasizing the need for larger, controlled trials to confirm these observations.

Keywords: Restless leg syndrome, scs, Spinal Cord Stimulation

EP019 / #50

Topic: *AS01. Movement Disorders*

EXAGGERATED ALPHA RHYTHM FROM SUBTHALAMIC NUCLEUS DISCRIMINATES FREEZERS FROM NON-FREEZERS PARKINSON'S DISEASE PATIENTS: A POSSIBLE FEATURE FOR CLOSED-LOOP DEEP BRAIN STIMULATION

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Introduction: Freezing of Gait (FOG) is a disabling symptom affecting over half of Parkinson's disease patients and strategies to treat FOG are often ineffective. This claims to the need for electrophysiological biomarkers potentially able to guide therapy

Methods: We recorded local field potentials from the subthalamic nucleus (LFP-STN) in 23 Parkinson's disease patients during DBS surgery. These patients were classified according to FOG manifestation: 14 FOG and 9 without FOG (n-FOG). LFP-STN rhythms bandpower and dynamics were characterized at rest

Results: FOG patients showed enhanced alpha bandpower (FOG vs. n-FOG: 0.331 ± 0.087 vs. 0.248 ± 0.089; p = 0.011) and intermittent (burst) alpha amplitude (FOG vs. n-FOG: 0.610 ± 0.068 vs. 0.524 ± 0.086; p = 0.005). Both intermittent alpha (r = 0.330, p = 0.046) and intermittent high beta amplitude (r = 0.415, p = 0.011) positively correlated with the FOG score. In contrast, just alpha burst amplitude correlated with FOG severity (r = 0.479, p = 0.003), and just high beta burst amplitude negatively correlated (r = -0.411, p = 0.014) with the performance-oriented mobility assessment

Conclusions: Alpha and high beta subthalamic oscillations impact FOG symptoms and represent a potential biomarker for closed-loop brain stimulation

Keywords: Parkinson's diseas, freezing of gait, alpha oscillations

EP020 / #60

Topic: *AS01. Movement Disorders*

CLINICAL TRENDS AND CLINICIAN PERCEPTIONS REGARDING ASLEEP AND AWAKE DBS

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Introduction: DBS clinical practice continues to evolve leading to a wide variability in intraoperative methods, and consensus regarding optimal workflow is lacking. Our objective is to determine trends and perceptions regarding Asleep and Awake Deep Brain Stimulation (DBS) in the USA and abroad.

Methods: A panel of DBS clinicians created a REDCap survey regarding DBS practice in the US and abroad. The survey was sent out to the Functional Neurosurgery Working Group of the Parkinson Study Group, DBS Think Tank, World Society for Stereotactic and Functional Neurosurgery, and Movement Disorder Society members with stated DBS interest.

Results: There were 321 individual respondents from 38 countries and six continents. Sixty percent were neurosurgeons, 37% neurologists and 3% Advanced Practice Providers. Fifty-eight percent perform both awake and asleep DBS procedures, 26.8% awake only, and 15.5% asleep only. Of 117 centers performing both awake and asleep DBS, 70% choose awake for STN, 45% choose awake for GPi, and 92% choose awake for VIM. When asked to agree or disagree to: “asleep DBS is equal to or more effective than awake DBS” for each target, respondents agreed/disagreed as follows: VIM:12.7%/60.6%, GPi: 57.4%/23.8%, STN: 29.4%/41.3% (remainder ‘similar’ or ‘no experience’). Of 162 respondents who perform asleep DBS, 21.6% use intra-operative MRI (iMRI). Out of the 78.4% who do not use iMRI for asleep DBS, 54.3% use microelectrode recording (MER). Of 187 respondents who perform awake DBS, the most commonly used tools reported were: pre-op MRI (95.2%), MER (91.4%) and test stimulation (stim, 95.1%). When presented with 7 techniques for awake/asleep DBS, the choice for the “Most optimal technique for each target,” was ‘awake+MER+stimulation+/-intraoperative imaging’ for STN and VIM. For GPi, ‘Asleep i-MRI’ and ‘awake+MER+stimulation+/-intraoperative imaging’ received a similar number of responses. For the “Least optimal technique for each target,” respondents chose ‘asleep iCT/Oarm’ for STN, GPi and VIM.

Conclusions: Results confirmed high variability in the use of intraoperative methods. There was a preference for the use of Awake DBS for VIM and STN, while the results for GPi were equivocal. These results provide only a snapshot of current DBS trends, and perceptions may change with further technological advances.

Keywords: Deep Brain Stimulation, SURVEY, Asleep/Awake

EP021 / #125

Topic: *AS01. Movement Disorders*

BILATERAL SIMULTANEOUS MAGNETIC RESONANCE-GUIDED FOCUSED ULTRASOUND (MRGFUS) PALLIDOTOMY FOR STATUS DYSTONICUS

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Introduction: Status dystonicus (SD) is a rare life-threatening complication of genetic or acquired dystonia necessitating urgent admission to intensive care (ICU). Pharmacological treatments are poorly effective, while stereotactic radiofrequency (RF) ablation and deep brain stimulation (DBS), both of the globus pallidus pars interna (GPi), are often successful. However these open procedures are not always feasible in patients with SD, due to concomitant cachexia or persistent infections. Transcranial magnetic resonance-guided focused ultrasound (MRgFUS) is emerging as an incisionless treatment for the targeted ablation of brain structures in Essential Tremor and Parkinson Disease. To date, MRgFUS ablation has been always performed in awake patients and in a staged fashion to minimize the risk of neurological deficits.

Methods: We performed bilateral simultaneous MRgFUS pallidotomy under general anesthesia in a child with pantothenate kinase associated neurodegeneration (PKAN) and in a young adult with GNAO1-encephalopathy. Both patients had medically refractory SD and open surgery was at high risk due to cachexia and recurrent infection.

Results: From post-operative day (POD) 3 a major reduction in dystonic spasms was evident in Patient 1 (with sedation boluses reduced from 10-15/day to 2-3/day). The boy was discharged from the ICU on POD 12. At the 3-month follow-up the boy had regained normal vigilance and his neurological picture largely overlapped with that prior to SD. In Patient 2 the severe dyskinetic episodes ceased from POD 2, allowing discontinuation of continuous intravenous dexmedetomidine and propofol on the same day. The patient was discharged from the ICU on POD 4. At the 3-month follow-up the patient had regained normal alertness, with a dystonia severity improved if compared to that prior to the development of SD.

Conclusions: In our limited experience with two patients, simultaneous bilateral MRgFUS pallidotomy was safe and effective in resolving medically refractory SD. Further studies are needed to confirm simultaneous bilateral MRgFUS pallidotomy as a valid alternative therapeutic option for fragile patients with medically refractory SD who cannot undergo DBS or standard RF pallidotomy.

Keywords: Pallidotomy, MRgFUS, Status Dystonicus

EP022 / #147

Topic: *AS01. Movement Disorders*

EFFECTIVENESS OF VIM DBS FOR HEAD TREMOR IN ESSENTIAL TREMOR PATIENTS: A SINGLE-CENTER EXPERIENCE

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Introduction: Deep Brain Stimulation (DBS), particularly targeting the ventral intermediate nucleus (VIM), has demonstrated significant efficacy in mitigating tremors affecting the arms and hands in patients with essential tremor (ET). However, the effectiveness of DBS in alleviating head tremors within this population remains relatively unexplored, along with the associated influencing factors. Herein, we present findings from a single-center experience.

Methods: We conducted a retrospective chart review of patients diagnosed with ET who underwent unilateral or bilateral VIM DBS procedures at the Center for Neurological Restoration (CNR) within the Cleveland Clinic between January 2020 and December 2023. Patients without a confirmed diagnosis of ET or those presenting with concurrent diagnoses of ET and Parkinson's disease (PD) were excluded from the study. Head tremor severity was assessed using the Fahn-Tolosa-Marin (FTM) Tremor Rating Scale preoperatively and at the first visit after three months postoperatively, with concurrent recording of stimulation parameters. A positive response was defined as an improvement of at least 1 point in a sub-item of the FTM scale. Statistical analyses were employed to evaluate group differences, including students' t-tests and chi-square tests.

Results: Among the 150 patients who underwent VIM DBS, 48 patients with ET met the inclusion criteria for our study by having the two time-point scales and DBS parameters available. The mean age was 68.0±7.5 years, with a disease duration of 24.0±15.0 years. The average preoperative resting head tremor severity was 1.2±0.7, while postural head tremor severity was 1.11±0.77. The average time for postoperative FTM visits was 4.3±5.1 months. Eighty-five percent of patients exhibited a positive response to treatment. For responders, the average amplitude and frequency were 1.9±0.7 mA and 138.8±13.5 Hz, respectively, compared to 1.7±0.7 mA and 135.4±16.4 Hz for non-responders (p-value =0.602, and 0.474, respectively).

Conclusions: Our preliminary findings suggest that VIM DBS shows promising efficacy in managing head tremors in patients with ET. However, a more extensive review is ongoing to comprehensively analyze factors associated with treatment response and to validate these results.

Keywords: DBS, Head tremors, essential tremor

EP023 / #226

Topic: *AS01. Movement Disorders*

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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Introduction: 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 0.4% up to even 100%. Therefore, 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).

Methods: 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 by two independent observers, marking PLE on the 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. In addition, observed PLE on individual hemispheres was delineated manually and measured using Analyze 14.0 software.

Results: In our cohort, PLE was observed in 32.17%, mostly bilaterally. Mild PLE was observed in the majority of patients, regardless of the level observed. Age, sex, diabetes, hypertension, vascular disease, and the use of anticoagulant/antiplatelet therapy showed no significant association with the occurrence of PLE. Total grey matter volume showed a significant association with the PLE occurrence ($r = -0.22$, $p = 0.04$), as well as cortex volume ($r = -0.32$, $p = 0.0005$). Cortical volumes of hemispheres, overall hemisphere volumes, as well as hemisphere/total intracranial volume ratio showed significant association with the PLE occurrence. Furthermore, the volume of the cortex and total grey volume represent moderate indicators, while hemisphere volumes, cortical volumes of hemispheres, and hemisphere/total intracranial volume ratio represent mild to moderate indicators of possible PLE occurrence.

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

Keywords: DBS, MRI, Parkinson's disease

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Topic: *AS01. Movement Disorders*

THALAMIC DEEP BRAIN STIMULATION IN PATIENTS WITH DYSTONIC HEAD TREMOR: A LONG-TERM STUDY OF 18 PATIENTS

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Introduction: Dystonic head tremor is a particular manifestation of dystonia which is difficult to treat. While deep brain stimulation (DBS) of the globus pallidus internus has been established as a treatment for different phenotypes of dystonia, its role in dystonic tremor has been debated. Although thalamic targets have been used for treatment of dystonic tremor of the extremities, there is very limited experience with dystonic head tremor. Here, we present our experience with thalamic ventral intermediate (Vim) nucleus DBS in a consecutive series of patients providing long-term follow-up.

Methods: Eighteen patients with dystonic head tremor as the leading symptom underwent stereotactic CT-guided implantation of quadripolar DBS electrodes into the thalamic Vim. Patients' symptoms were evaluated with the Burke-Fahn-Marsden Dystonia Rating Scale motor (BFMDRS-M) and disability (BFMDRS-D) scores, and a modified Fahn-Tolosa-Marin Tremor Rating Scale (mFTMTRS), preoperatively, at short-term (3 months – 2 years), and at long-term follow-up (>2 years).

Results: There was improvement in both tremor and dystonia rating scales at short-term and at long-term follow-up. Tremor scores were reduced from a value of 7.94 preoperatively to 2.0 at short-term ($p<0.001$) and to 1.71 at long-term ($p<0.001$). BFMDRS-M scores were reduced from 14.56 to 7.8 ($p<0.001$) and to 7.0 ($p<0.001$), and BFMDRS-D scores reduced from 3.88 to 2.65 ($p<0.05$) and to 2.71 ($p<0.05$), respectively during chronic stimulation.

Conclusions: Our results show that Vim DBS is a safe and efficient treatment option for dystonic head tremor and that results are stable for up to 18 years.

Keywords: dystonia, Deep Brain Stimulation, ventral intermediate nucleus

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Topic: *AS01. Movement Disorders*

OSCILLATORY SUBTHALAMIC BETA ACTIVITY CORRELATES WITH CLINICAL MOTOR PROGRESSION IN PARKINSON'S DISEASE

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Introduction: Parkinson's disease is characterized by exaggerated beta activity (13 to 35 Hz) in cortico-basal ganglia circuits. Beta activity includes both periodic fluctuations (oscillatory activity) and aperiodic fluctuations (non-oscillatory activity). In this study we investigated wether the oscillatory and non-oscillatory components of beta activity correlate with the motor severity and/or with the motor progression of the disease (Pardo-Valencia et al., J Physiol 2024).

Methods: We recorded and analyzed subthalamic local field potentials in 21 parkinsonian patients at rest, off and on dopaminergic medication state. The relationships between oscillatory and non-oscillatory beta activity were analyzed in the time domain (amplitude and duration of the “beta bursts”) and in the frequency domain (power and sharpness of the spectral peak). We explicitly estimated the oscillatory and non-oscillatory components of beta activity and tested their possible correlations with the motor severity (assessed by the off UPDRS-III scores) and the motor progression of the disease (assessed by dividing off UPDRS-III scores by disease duration). The data were analyzed with Bayesian statistics.

Results: Somewhat surprisingly, we did not find any clear correlation between measures of beta activity and motor severity. Interestingly, we found strong Bayesian evidence that the oscillatory component of beta activity correlated with the rate of motor progression of the disease. Conversely, we obtained moderate evidence that the non-oscillatory component did not correlate with the rate of motor progression of the disease.

Conclusions: Oscillatory beta activity may play a role not only in the pathophysiology but also in the progression of Parkinson’s disease.

Keywords: subthalamic nucleus, Beta Activity, Parkinson's disease

EP026 / #284

Topic: *AS01. Movement Disorders*

LONG TERM OUTCOMES FROM DBS FOR IDIOPATHIC CERVICAL DYSTONIA - A SEVEN YEAR EXPERIENCE

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Introduction: Cervical dystonia (CD) is a rare but debilitating neurological disorder characterised by increased neck muscle tone. Treatments include local therapies such as botulinum toxin injections, and surgical interventions such as deep brain stimulation for those who are not responsive to pharmacological therapy. Surgical targets include the globus pallidus internus (GPi) or subthalamic nucleus.

Methods: We performed a retrospective review of patients from our regional tertiary neurosurgery unit. Patients underwent pre-operative assessments including suitability for anaesthesia, movement disorder score Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS), Clinical Global Impressions Scale (CGIS), Patient Global Impressions Scale (PGIS), and quality of life (EQ5D-3L) measures. Assessments were repeated at yearly follow-up.

Results: Twenty patients (M:F) with idiopathic CD underwent bilateral GPi DBS between 2011 and 2022. DBS was performed at a mean of 11 years (±SD 5 years) after diagnosis of cervical dystonia. Mean age at time of surgery was 58 years (±SD 9 years). There were no post-operative surgical complications. Stimulation parameters were also collated. Nineteen patients showed improvement in all components of TWSTRS scores at six months, with one patient remaining static. At five years there was data for 4 patients, none of whom had returned to their baseline level of TWSTR and three had over 75% improvement from baseline. There was improvement in quality of life scores at 6 months for 17 patients, and three had no change. For 79% of patients, there was sustained improvement in quality of life at two years compared to baseline. At longest follow up which was 82 months, we found a reduction of TWSTR score of 80% and improvement in EQ5D of 67% and CGIC and PGIC demonstrated maximal satisfaction of clinician and patient.

Conclusions: Our longitudinal cohort demonstrates that GPi-DBS has long term benefits in idiopathic CD. Use of clinician and patient impression scores enables in-depth assessment of outcome that is not necessarily quantifiable within existing scores, and adds a dimension of insight into the effects of treatment. There are minimal side effects and stimulation may take time to have effect but there are programming techniques that can be employed to optimise effect.

Keywords: globus pallidus DBS, outcomes, cervical dystonia

EP027 / #286

Topic: *AS01. Movement Disorders*

NEURAL OSCILLATORY DYNAMICS IN PARKINSON DISEASE AND DYSTONIA: INSIGHTS FROM EEG ANALYSIS

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Introduction: Parkinson disease (PD) and dystonia (DYS) are associated with changes in neural oscillations across different frequency bands, rather than being confined to one specific frequency band. Changes in total power and entropy across raw data may enable the identification of comprehensive shifts in neural dynamics that may align with clinical symptoms, thus serving as markers for adaptive deep brain stimulation therapy.

Methods: Nine patients diagnosed with PD (age onset of disease: 28–58 years; eight male and one female) and six primary patients with DYS (age onset of disease: 33–51 years; four male and two female) participated in the study. We used EEG recordings from the motor cortex to investigate how the spontaneous power of classical cortical frequency bands and total power across broad bands manifest in PD patients compared to those with DYS. Additionally, we analyzed approximate entropy (ApEn) from the oscillatory activities across different frequency bands and across broad bands in the motor cortex.

Results: Our results show that in DYS enhanced theta (4-8 Hz) and gamma (30- 100 Hz) frequency bands were accompanied with lower values in theta entropy ($p<0.01$), whereas in PD patients enhanced beta frequency band (12-30 Hz) was accompanied with reduced values in beta entropy ($p<0.01$). Overall, the total ApEn was higher in DYS patients' motor cortical areas as compared to PD patients.

Conclusions: In DYS patients lower ApEn values in the theta band signify higher energy availability in the lower frequency band, whereas higher ApEn values within the beta and gamma bands imply lower energy availability compared to those with PD. Entropy-based values may be used as biomarkers to evaluate the effectiveness of treatments and neuromodulation strategies for both PD and DYS.

Keywords: Approximate entropy, dystonia, Beta Oscillatory activity

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Topic: *AS01. Movement Disorders*

LONG-TERM OUTCOME OF ADAPTIVE DBS USING LFP SENSING

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Introduction: It has been reported that during the off-phase of PD motor symptoms, beta band local potentials (LFPs) are observed in the basal ganglia. Adaptive deep brain stimulation (DBS) utilises a sensing technique that measures LFPs from electrodes implanted in the target nuclei and automatically controls the stimulation program. In this study, the long-term results of STN-DBS in an adaptive setting were investigated.

Methods: We include twelve patients who received STN-DBS with Medtronic Percept PC, adaptive DBS compatible neurostimulator and Medtronic DBS leads. Four patients were first treated with conventional DBS and were set up to receive adaptive DBS at their exchange of IPG (group A). Eight underwent STN-DBS implantation with adaptive DBS-compatible devices (group B). Their devices were programmed with adaptive settings from the start of treatment. Motor scores evaluated by UPDRS-III and stimulation programs were evaluated at 1, 3, 6, and 12 months after adaptive settings.

Results: In 19 out of 24 electrodes, beta-band LFPs were detected during the off-state of motor symptoms, and disappeared in the on-state. Adaptive DBS was set by tracking the beta-LFP power. The current values were reduced to 65.5+/-30.5% of those in conventional program in group A, with no alteration in motor scores at 12 months . Stimulus-induced dysphonia improved in two patients after the change to adaptive settings. By contrast, in group B, current values were increased by 34.1% (0.70+/-0.45 to 1.15+/-0.66 mA) at one month postoperatively compared with those measured just after the implantation, with no deterioration in motor scores.

Conclusions: Adaptive DBS using beta-band LFP sensing technology can reduce the stimulation power in chronic phase compared with the conventional DBS settings. During the postoperative acute phase, current value was automatically adjusted according to the increased power demand due to loss of micro lesioning effect of the surgery to maintain the motor function. Adaptive DBS is expected to improve the QOL of PD patients. Because the present study was based on a small number of cases, a larger scale and longer-term study is desirable to establish the superiority of adaptive settings.

Keywords: STN-DBS, Adaptive DBS, Parkinson Disease

EP029 / #387

Topic: *AS01. Movement Disorders*

STRATEGIES TO ENHANCE TARGETING PRECISION IN MRGFUS-MEDIATED THALAMOTOMY

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Introduction: The ventralis intermedius nucleus (Vim) is a common target for reducing tremors, traditionally approached indirectly using anatomical landmarks. However, individual variations in the dimensions, configuration, and spatial distribution of the Vim introduce imprecision in indirect targeting. As successive sonication sessions progress, the efficiency of transcranial energy transmission diminishes, resulting in decreased responsiveness of the target tissue to the applied energy. Consequently, to enhance treatment outcomes, it is imperative to complete ultrasound sessions within a specified range of repetition numbers, achievable by initiating the treatment with a personalized target location, specifically through direct targeting.

Methods: We acquired fluid and white matter suppression (FLAWS) images using the MP2RAGE sequence, enhancing the gray and white matter contrast. This improvement aids in delineating boundaries between the thalamus and internal capsule, as well as distinguishing between the Vim and ventralis caudalis (Vc). We execute the co-registration of the FLAWS sequence and CT images. To mitigate co-registration errors arising from the fickle positioning of the spine, we selectively incorporate images covering the range from the vertex to the tip of the clivus and foramen magnum, excluding the spinal region. Then, we proceed with co-registration, incorporating the FLAWS sequence with the 3D-FIESTA sequence acquired by integrating a stereotactic frame. Targeting is performed based on the direct delineation of the Vim from the FLAWS sequence. As sonications progress, we overlay the accumulative thermal dose map onto the FLAWS sequence and meticulously assess the three-dimensional spatial relationship between the intended target and the thermocoagulation lesion.

Results: Forty-eight patients were treated: essential tremor in thirty-nine, tremor-dominant Parkinson’s disease in six, and dystonia in one. Essential tremor and dystonia demonstrated a mean reduction in severity exceeding 80%, whereas tremor in Parkinson's disease exhibited a reduction of more than 60%. Dysarthria, arm ataxia, and veering tendency were common adverse effect, however, they were tolerable and disappeared within 3 months. There was no severe permanent neurological deficit.

Conclusions: The incorporation of advanced image sequences, which improve the differentiation of the Vim from critical neighboring neurostructures like the internal capsule and Vc, and precise co-registration of images and are crucial for augmenting targeting precision and optimizing outcomes.

Keywords: essential tremor, focused ultrasound, Parkinson's disease

EP030 / #405

Topic: *AS01. Movement Disorders*

ONE-YEAR OUTCOMES BY OPERATIVE APPROACH FOR IMPLANTATION OF DBS SYSTEMS IN PATIENTS WITH PARKINSON'S DISEASE AND ESSENTIAL TREMOR: RESULTS FROM THE ADROIT SONOMA STUDY

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Introduction: Deep brain stimulation (DBS) is safe and effective for alleviating motor symptoms associated with movement disorders, including Parkinson's disease (PD) and essential tremor (ET). Optimal lead placement is achieved through various types of operative techniques that may vary by sedation method, micro-electrode recording (MER) use, clinical testing, and intraoperative imaging methods.

Methods: ADROIT is a large, international, prospective, post-market observational study that collects long-term safety and effectiveness data on Abbott DBS systems in a real-world setting at clinical sites worldwide. We report on procedural variations and associated safety and efficacy outcomes for newly implanted PD and ET patients through 1 year post implant.

Results: As of October 2023, 479 subjects received a new DBS implant for PD (n=340) or ET (n=139) at 40 sites in the United States (n=20), Europe (n=16), and Asia Pacific (n=4). Most DBS components were implanted in a single procedure (68.0%, 319/469) and approximately half (47.8%, 224/469) of lead implant surgeries were performed under general anesthesia. Intraoperative stimulation was used in 78.8% of procedures, intraoperative imaging in 82.3%, and MER in 73.2%. In patients with PD, UPDRS III scores from baseline (off meds) to 1 year (on meds/on stim) improved similarly with any operative technique: 53.2% in MER only, 53.8% in intraoperative imaging only, and 53.8% in MER plus intraoperative stimulation procedures. Similar findings were observed for ET with improvement in FTM-TRS of 61.5% in MER only, 60.0% in imaging only, and 63.3% in MER plus intraoperative stimulation procedures.

Conclusions: There is procedural variation for stereotactic lead implantation across sites and geographies, however comparable outcomes are observed across procedural approaches for PD and ET.

Keywords: essential tremor, Parkinson's disease, DBS

EP031 / #470

Topic: *AS01. Movement Disorders*

DEVELOPMENT OF A BETA-SENSING PATHWAY IN DBS TO OPTIMISE UTILITY OF LOCAL FIELD POTENTIAL RECORDINGS USING THE PERCEPT SYSTEM. (NEWCASTLE BETA-SENSING ALGORITHM – NBA)

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Introduction: To establish a pathway for utilisation of beta-sensing using the Percept technology which is applicable to real world clinical practice and optimises the utility of the new technology.

Methods: The availability of beta sensing offered a new opportunity to utilise the new technology to optimise deep brain stimulation in patients with Parkinson's disease. To date publication outlining the technology has been research based and in this study we integrated the technology into our clinical pathway and adjusted practice to use the new information. The multiple iterations of the pathway has led to a refined algorithm which has been applied to our patients.

Results: To best utilise the beta sensing technology a discovery phase is needed to identify the contacts with the hights beta peaks and to set up the timeline recordings prior to the first programming session. Acquiring seven days of beta timeline data asks a baseline for comparison of therapy at future visits and interrogation of the system. Beta Streaming acts as an important visual tool for establishing therapy thresholds but also allows for improved dialogue with the patient and thus empowering the patient to feel more in control of the programming session comparison to traditional methods. BrainSense event markers can be set up when patients identify specific problematic symptoms, these events can be marked and stored on the IPG alongside the beta timeline data allowing clear visualisation of whether a problem is due to over or under stimulation.

Conclusions: The Newcastle Beta-sensing algorithm allows for Percept sensing technology to be used in real world clinical practice and offers an advantage over traditional programming.

EP032 / #494

Topic: *AS01. Movement Disorders*

OUTCOMES OF PALLIDAL DEEP BRAIN STIMULATION FOR TREATING PURE BLEPHAROSPASM

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Introduction: Blepharospasm (BSP) is a disease in which the closure rate of the bilateral eyelids increases, mainly due to involuntary contraction of the orbicularis oculi, procerus, and corrugator muscles. The objective of this study was to report postoperative outcomes after deep brain stimulation (DBS) in 10 cases of pure BSP after at least 12 months of follow-up.

Methods: Ten patients with pure BSP who underwent bilateral globus pallidus interna (GPi) DBS at The Catholic University of Korea, Incheon St. Mary's Hospital, between 2019 and 2021 were included. The Burke-Fahn-Marsden dystonia rating scale (BFMDRS), Blepharospasm Disability Index, and Jankovic Rating Scale were used for analysis before surgery, at 6 months of follow-up as short-term outcomes, and at follow-up over 1 year (12-37 months) as long-term results.

Results: The median age of patients at surgery was 56.5 years (interquartile range [IQR], 50.5-65.8 years) and the median length of time from disease onset to the time of surgery was 58.0 months (IQR, 46.8-64.3 months). The median postoperative follow-up period was 22.5 months (IQR, 15.3-29.0 months). The median BFMDRS movement subscale scores at the three time points (preoperative baseline, 6 months, and over 1 year of follow-up) were 7.0 (IQR, 6.0-8.0), 4.5 (IQR, 3.9-6.0; 35.7% improvement, $p<0.001$), and 3.8 (IQR, 2.8-5.3; 45.7% improvement, $p=0.002$), respectively.

Conclusions: Bilateral GPi DBS for pure BSP can be effective if conservative treatment options fail. Its benefit is not only observed in the short term, but is also maintained during long-term follow-up.

Keywords: Blepharospasm, Meige syndrome, Deep Brain Stimulation

EP033 / #539

Topic: *AS01. Movement Disorders*

CAN RADIOFREQUENCY LESION BE BETTER THAN DBS?

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Introduction: Deep Brain Stimulation (DBS) has emerged as one of the most important surgical techniques in the field of neurology in the past decades. Pallidotomy still represents a viable alternative for Parkinson disease (PD) symptoms treatment and has several important advantages, including a decreased need for access to specialists and clinical follow-ups, improved affordability, and a lower infection, producing high long term success rates and low morbidity rates.

Methods: Unilateral posteroventral pallidotomy was done in 83 patients (35 women, 48 men). They had predominantly unilateral symptoms with dominant dyskinesia, akinesia, and rigidity. All patients were evaluated by means of Unified Parkinson's Disease Rating Scale (UPDRS), Hoehn and Yahr Staging, and Montreal Cognitive Assessment (MOCA) and quality of life in Parkinson's Disease (PDQ39). Mean duration of PD was 13yr (range 6-17yr). After unilateral pallidotomy, 51(63%) patients underwent contralateral pallidal DBS or pallidotomy 5,8 years later (range 3-7 yr). Mean follow-up was 2.6 years (range 2-3 yr) after second surgery, pallidal lesion or DBS, contralateral to initial pallidotomy.

Results: UPDRS off motor scores were 54 +/- 2 preoperatively and a 31 +/- 6 at last follow-up ($P < 0,02$). Tremor, rigidity, and bradykinesia of limbs remained improved more significantly contralateral to pallidotomy than contralateral to DBS ($P < 0,044$ vs. $P< 0,41$). Dyskinesia scores improved more markedly contralateral to pallidotomy than contralateral to DBS. Four patients exhibited moderate dysarthria and one moderate nonreversible dysphonia, after second surgery. Overall, 68% of patients had a good or excellent outcome at PDQ39 scores compared with the patient's preoperative condition.

Conclusions: After pallidotomy there was a statistically significant improvement on quality of life. Symptoms contralateral to pallidotomy improve more than symptoms contralateral to the more recent pallidal DBS, despite visits to optimize and adapt DBS parameters. The most important step when considering lesion or DBS surgery is proper patient selection: Dyskinesias or dystonia are the dominating symptoms, especially if unilateral. Careful selection of appropriate candidates is crucial for favorable pallidotomy outcomes.

Keywords: DBS, Pallidotomy, Parkinson

EP034 / #12

Topic: *AS01. Movement Disorders*

PUTAMEN ATROPHY AS A PREDICTIVE FACTOR FOR DEEP BRAIN STIMULATION EFFICACY IN PATIENTS WITH POST-ANOXIC ENCEPHALOPATHY

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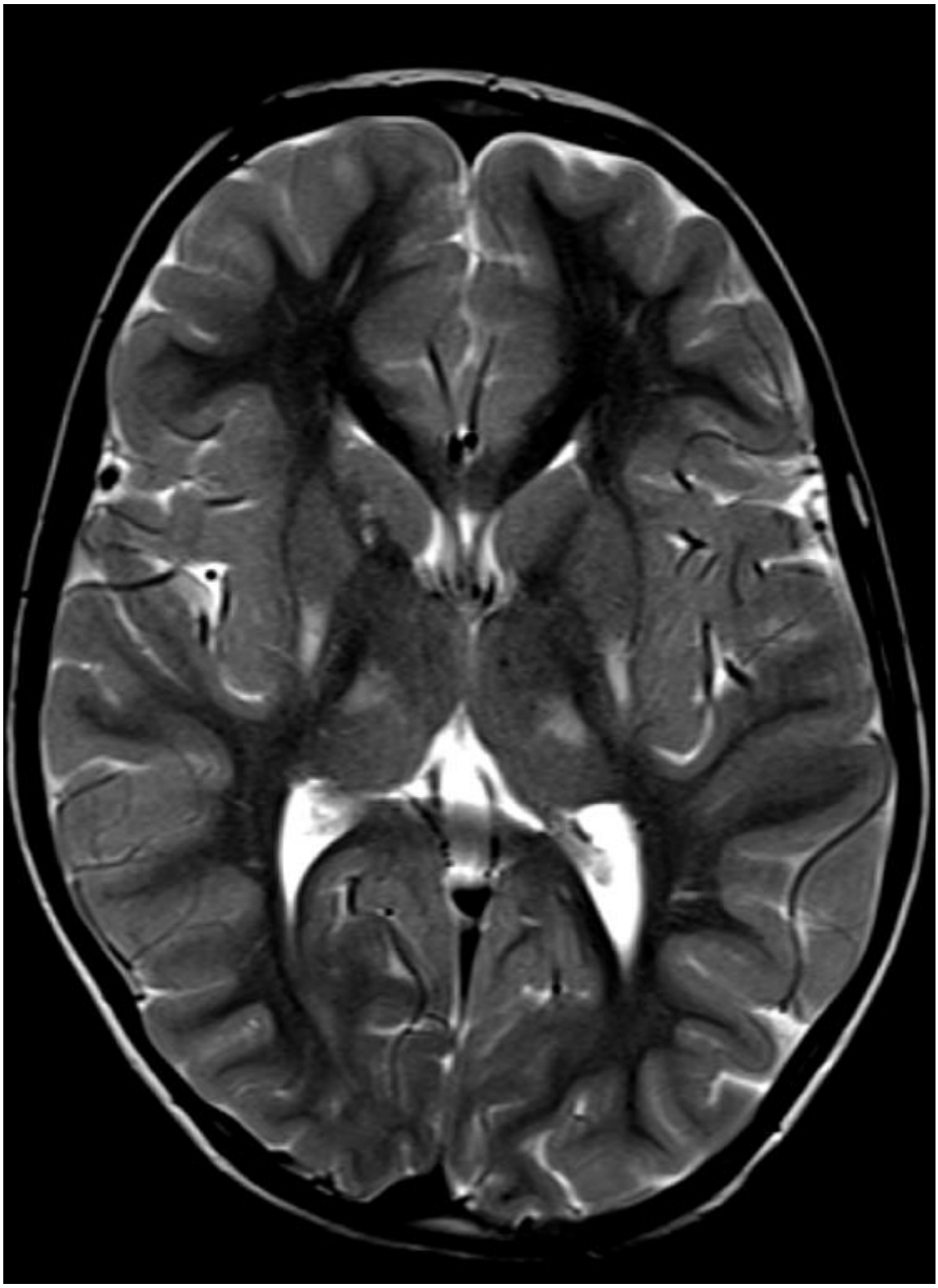
Introduction: A significant cause of mortality and morbidity in term newborns is perinatal asphyxia, with a prevalence of 1-6 per 1000 live births in high-income countries and 5-10 per 1000 live births in developing countries. The primary consequence of perinatal asphyxia is brain injury, detectable on conventional MRI, manifesting as damage to the ventrolateral thalami, posterior putamen, and white matter. These lesions often lead to adverse neurological outcomes, such as tetraparetic motor deficits associated with dystono-dyskinetic syndrome. While Deep Brain Stimulation (DBS) is a therapeutic option, its efficacy in this population remains limited.

Methods: We conducted a retrospective study involving 71 patients treated with Deep Brain Stimulation (DBS) of the Globus Pallidus intern (GPi) for secondary dystono-dyskinetic syndrome resulting from post-anoxic encephalopathy (EP). We assessed pre-operative MRI scans for damage to deep grey nuclei, white matter, and the cerebellum. Patients' clinical conditions were evaluated using the Burke-Fahn-Marsden Dystonia Rating Scale (BFMDRS) before surgery, at 1 year post-surgery, and during the last follow-up. Subsequently, we analyzed the correlation between identified brain lesions on MRI, initial clinical severity, and response to DBS.

Results: Among the 71 patients, 42 exhibited putamen atrophy. Patients with putamen atrophy (Figure 1) demonstrated more severe clinical conditions than those without before surgery ($p = 0.0289$ for the motor part and $P < 0.0003$ for the functional part of BFMDRS). Additionally, we observed that patients with putamen atrophy had poorer outcomes compared to those without atrophy at the 1-year post-DBS assessment ($p = 0.0384$ for the motor part and $p < 0.0001$ for the functional part of BFMDRS) and during the last follow-up. No significant differences were found regarding lesions in other brain areas. Figure 1. Axial T2-weighted MRI reveals significant atrophy (accompanied by hypersignals) of the posterior part of

the



putamen.

Conclusions: We emphasize the importance of analyzing brain lesions on pre-operative MRI in patients with post-anoxic encephalopathy. Atrophy of the motor putamen can serve as a predictive factor for poor outcomes following bilateral GPi DBS.

Keywords: Post-anoxic Encephalopathy, MRI lesions, Deep Brain Stimulation

EP035 / #18

Topic: *AS01. Movement Disorders*

BASAL GANGLIA-MUSCULAR COMMUNICATIONS PREDICT REM SLEEP BEHAVIOR DISORDER SEVERITY IN PARKINSON'S DISEASE

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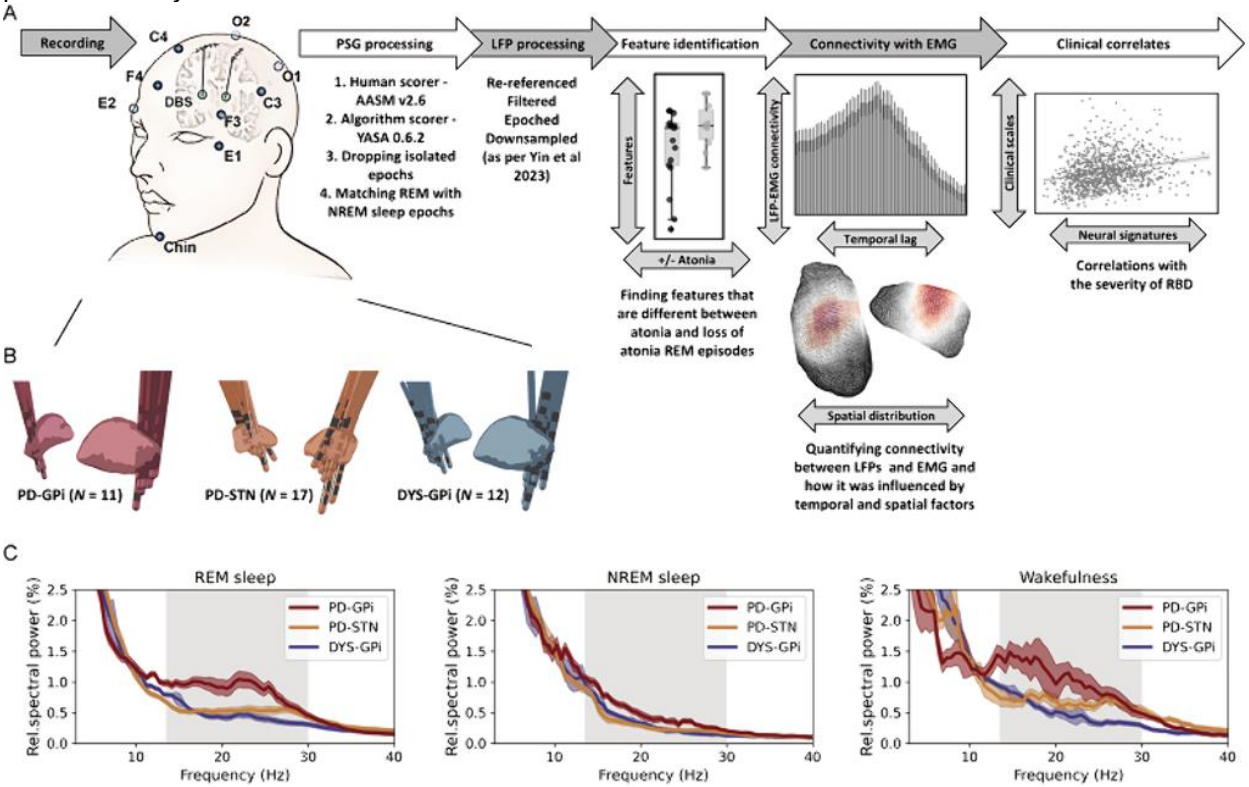
Introduction: Rapid eye movement (REM) sleep behavior disorder (RBD) is one of the most common sleep complaints and represents a key prodromal marker in Parkinson's disease (PD). It remains unclear whether and how basal ganglia nuclei, structures that are directly involved in the pathology of PD, are implicated in the occurrence of RBD.

Methods: Here, in parallel with whole-night video-polysomnography, we recorded local field potentials from two major basal ganglia structures, the globus pallidus internus, and subthalamic nucleus, in two cohorts of patients with PD who had varied severity of RBD. Basal ganglia oscillatory patterns during RBD and REM sleep without atonia were analyzed and compared to another age-matched cohort of patients with dystonia that served as controls.



Results: We found that beta power in both basal ganglia nuclei was specifically elevated during REM sleep without atonia in patients with PD, but not in dystonia. Basal ganglia beta power during REM sleep positively correlated with the extent of atonia loss, with beta elevation preceding the activation of chin electromyogram activities by ~200 ms. The connectivity between basal ganglia beta power and chin muscular activities during REM sleep was significantly correlated with the clinical severity of RBD in PD.

Conclusions: These findings support that basal ganglia activities are associated with if not directly contribute to the occurrence of RBD in PD. Our study expands the understanding of the role basal ganglia played in RBD and may foster improved therapies for RBD by interrupting the basal ganglia-muscular communication during REM sleep in PD.

Keywords: Parkinson's disease, REM sleep behavior disorder, local field potentials

EP036 / #66

Topic: *AS01. Movement Disorders*

ASSESSMENT OF IMAGE-GUIDED PROGRAMMING (IGP) ON BILATERAL STN AND GPI DEEP BRAIN STIMULATION PROGRAMMING TIME

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Introduction: Optimization of Deep Brain Stimulation (DBS) programming can be a lengthy, empirical trial-and-error process potentially leading to extended programming sessions and frequent visits. An image-guided programming (IGP)-based platform can help visualize lead location relative to anatomy with capability of reducing programming times and aiding active contact(s) selection through direct visualization and targeting of Stimulation Field Models (SFMs). Here we describe assessment of Parkinson's disease (PD) patient outcomes using an IGP tool as conducted during initial DBS programming, either with STN or GPi as brain target.

Methods: Novel IGP software (GUIDE XT, Boston Scientific) was evaluated from an ongoing prospective, multicenter, registry (NCT02071134) in which preoperative MRI and post-operative CT scans were provided to localize the DBS lead relative to each subject's anatomy and to select programming parameters per alignment with SFMs. Time to reach effective DBS settings during the initial programming session was collected, along with device-aided suggested stimulation settings.

Results: To date, 57-subjects (mean age 62.9-years, 77% male) with 10.1-years of disease have enrolled. Initial programming sessions (post-implant), where IGP provided settings for directional leads, lasted 39.4±4.4 minutes (mean±SE). Fifty-five percent (31/56) completed initial programming of bilateral directional leads with IGP in <30-minutes. Motor function (mean MDS-UPDRS Ill scores [Meds OFF]) was significantly improved by 55% (n=45) and 45% (n=37) at 6-and 12-months, respectively. Of 21-patients for whom follow-up programming information out to 6- and 12-months was available, 52% and 43% of DBS programs remained unchanged from initial setting (i.e., no change in active contact(s) and cathodic/anodic distribution of current), respectively, as suggested by IGP.

Conclusions: These results indicate that shorter and more efficient initial programming sessions utilizing IGP suggested settings may help facilitate sustained and clinically significant motor improvement. Though optimization was subjective in this evaluation, available tools reducing programming time are thought to be especially important. Thus, further studies are needed.

Keyword: Deep Brain Stimulation, DBS, Parkinson's disease, image-guided programming

EP037 / #119

Topic: *AS01. Movement Disorders*

CLINICAL TRENDS IN ASLEEP AND AWAKE DBS: COMPARING NORTH AMERICA AND EUROPE

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Introduction: DBS practices may vary geographically. We aim to compare trends and perceptions regarding Asleep and Awake DBS in North-America (NA) and Europe (EU).

Methods: A panel of DBS clinicians sent a survey to DBS clinicians of the Parkinson Study Group, DBS Think-Tank, World Society for Stereotactic and Functional Neurosurgery, and Movement Disorder Society.

Results: There were 214 respondents from NA (53% neurosurgeons, 43% Neurologists and 4% APP) and 61 from EU (69%, 30%, and 1%, respectively In NA, 54% perform both asleep and awake, 28% awake only, and 18% asleep only. In EU, these numbers were 66%, 18%, and 16%. In NA, centers performing both awake and asleep DBS (N=60), 75% choose awake for STN, 45% for GPI, 90% for VIM. In EU centers performing both (n=33), 30% choose awake for STN, 0% for GPI and 80% for VIM. For asleep-DBS, NA centers offer i-MRI in 37%, vs EU centers 0%. In NA, microelectrode-recording (MER) is used during asleep-DBS in 27% vs in EU 69% of cases. Whether awake or asleep, single-channel MER is most common in NA vs 2-3 or 4-5 channels in EU. When asked to agree or disagree with: “asleep-DBS is equal to or more effective than awake-DBS” for each target, NA respondents agreed/disagreed as follows: STN: 28%/43%; GPI: 53%/29%; VIM: 13%/64% vs EU respondents: STN: 53%/35%; GPI: 73%/15%; VIM: 15%/56% (remainder: ‘similar’ or ‘no experience’). When presented with 8 techniques for awake/asleep DBS, the choice for the ‘Most optimal technique for each target’, was ‘awake+MER+test stimulation for STN and VIM (not GPI) in NA and EU. Similarly, when choosing the ‘least optimal technique for each target’, NA and EU agreed on ‘asleep iCT/Oarm’ for STN, GPI and VIM.

Conclusions: Both continents preferred Awak- DBS for VIM and STN, and Asleep-DBS for GPI. ‘The most optimal technique’ in NA and EU was ‘awake+MER+stim’ for STN and VIM, and ‘asleep iMRI’ for GPI. ‘The least optimal technique’ for all 3 targets was ‘asleep iCT/Oarm’ (without physiology) in both continents. In EU, but not NA, asleep-DBS was performed with MER in the majority of cases.

Keywords: Deep Brain Stimulation, SURVEY, Asleep/Awake

EP038 / #143

Topic: *AS01. Movement Disorders*

ENHANCING PARKINSONIAN TREMOR SUPPRESSION: A COMPARATIVE STUDY OF VENTRAL INTERMEDIATE VS. VENTRAL INTERMEDIATE PLUS VENTRO-ORAL THALAMOTOMY

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Introduction: Ventral intermediate (VIM) thalamotomy is a widely accepted surgical procedure for treating medication-refractory parkinsonian tremor, reportedly offering 50–70% improvement in contralateral limb tremor scores at 6 months or longer. Despite its efficacy, there remains a need for enhanced therapeutic outcomes. Alongside the VIM, other targets associated with pallidal input, such as the globus pallidus internus and pallidothalamic tract, have also been recognized for their contributions to the suppression of parkinsonian tremor. Moreover, neurophysiological evidence suggests the involvement of the ventro-oral nucleus (VO) of the thalamus in parkinsonian tremor. This study evaluates the therapeutic outcomes of targeting VIM alone versus VIM+VO in thalamotomy procedures.

Methods: This retrospective study involved 24 consecutive patients with medication-refractory parkinsonian tremor who underwent VIM or VIM+VO thalamotomy using either magnetic resonance-guided focused ultrasound (MRgFUS) or radiofrequency ablation at Shonan Fujisawa Tokushukai Hospital. Patients who did not achieve successful coagulation of the thalamic targets due to insufficient temperature elevation during MRgFUS were excluded. Tremor scores for the contralateral limbs were assessed at baseline and during follow-up visits at 1, 3, 6, and 12 months. Lesion mapping analysis was performed to confirm the lesion locations.

Results: Out of the 24 patients initially screened, 20 were eligible for analysis. The average (± SD) follow-up period was 7.8 ± 4.1 months. The tremor scores of limbs contralateral to the thalamotomy sites significantly improved in both groups after the procedures. The VIM group showed an average improvement of 43% in tremor scores at the last visit, whereas the tremor scores in the VIM+VO group improved by 89% on average. Statistical analysis confirmed a significant difference in percent improvement between the two groups ($p = 0.008$, 95% CI: -0.76 to -0.12).

Conclusions: This study demonstrates that thalamotomy targeting both the VIM and VO offers superior tremor suppression compared to targeting the VIM alone in patients with Parkinson's disease. These findings suggest that including the VO in the target area may significantly enhance the efficacy of surgical interventions for parkinsonian tremor. Further research is warranted to explore the potential benefits and mechanisms underlying the improved outcomes observed with VIM+VO thalamotomy.

Keywords: Parkinsonian tremor, Ventral intermediate thalamotomy, Ventro-oral nucleus

EP039 / #326

Topic: *AS01. Movement Disorders*

DIRECTIONAL STIMULATION CAUSES DISTINCT STN EVOKED POTENTIALS IN PARKINSON'S DISEASE PATIENTS.

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Introduction: Research indicates that the use of directional deep brain stimulation (DBS) results in larger therapeutic windows (TW) in Parkinson's disease (PD) patients compared to omnidirectional stimulation. However, this improvement comes with a larger programming parameters space, resulting in longer programming times for individual patients. Introducing an objective biomarker to assess the clinical effect of stimulation settings could potentially address this issue. In this investigation, we explore the utilization of deep brain evoked potentials (EP) as a potential biomarker for this purpose.

Methods: In 14 PD patients, subthalamic nucleus (STN) local field potentials (LFPs) were recorded intraoperatively during DBS implantation using a the newly implanted lead. Bipolar stimulation was administered using the directional contacts on one level at 10Hz. Of these contacts, one acted as the cathode while while the remaining two acted as anodes. Three stimulation intensities corresponded to subthreshold, therapeutic threshold and side-effect threshold when stimulating omnidirectionally. For each of the directional contacts as the cathode and each stimulation amplitude, a 20s differential recording was made from the contact levels surrounding the stimulation level. EPs were calculated by averaging the stimulation epochs. Peak-to-through amplitudes (P2P), area under the curve (AUC) and energy of the signal (E) were computed.

Results: The resulting evoked potentials can be characterized as underdamped oscillations, also known as evoked resonant neural activity (ERNA). Stimulation amplitude significantly influenced ERNA features, with larger amplitudes resulting in larger P2P, AUC, and E (n=12). A significant directional effect was observed when stimulating at therapeutic threshold (n=8) and side-effect threshold (n=13), for at least one of the features. Moreover, these differences between directions were more pronounced at lower intensities.

Conclusions: Directional DBS stimulation causes distinct evoked potential amplitudes in PD patients. Further research is necessary to confirm if these variations are linked to clinical effectiveness of the chosen stimulation parameters. If so, ERNA could be a good biomarker for directional DBS programming.

Keywords: electrophysiology, ERNA, directional stimulation

EP040 / #398

Topic: *AS01. Movement Disorders*

UNFOLDING THALAMIC ANATOMY IN DEEP BRAIN STIMULATION FOR WRITER'S CRAMP TREMOR

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Introduction: Thalamic deep brain stimulation (DBS) is a recognized treatment for medically refractory tremor. The variation in the thalamic structure and optimal patient specific functional location induce error when using coordinate-based indirect targeting, contributing to inconsistent outcomes. The objective of this investigation was to elucidate the intricate three-dimensional (3D) architecture of the thalamic nuclei and elucidate the interplay among anatomical structures within this region using the fiber dissection technique. This study sought to juxtapose these findings with those derived from high-resolution magnetic resonance imaging (MRI) in a patient presenting with dystonic tremor attributed to writer's cramp.

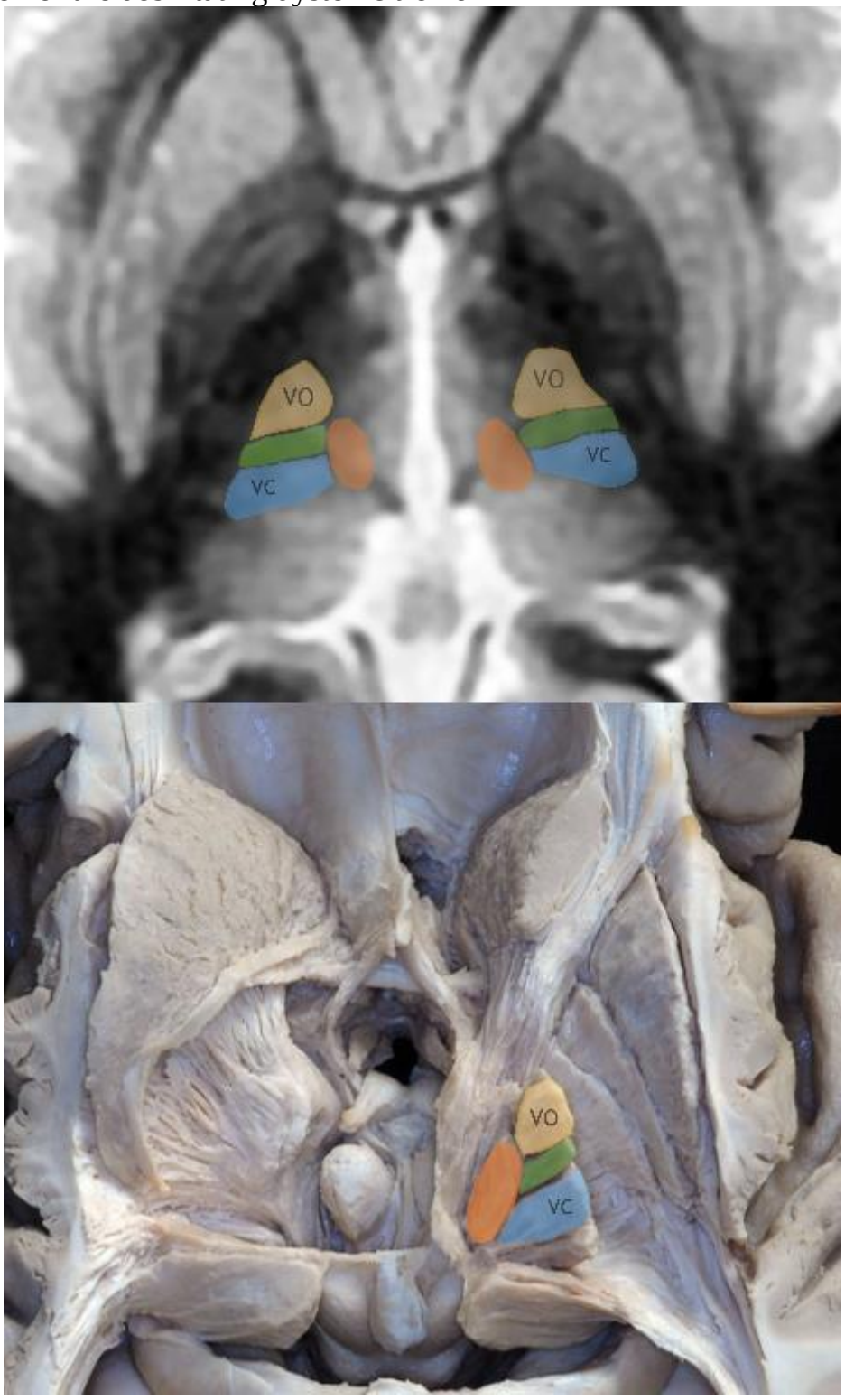
Methods: Fiber dissections were conducted across 20 hemispheres, adhering to Klingler method. A comprehensive approach was adopted, encompassing fiber dissections from all brain perspectives, unveiling the anatomy and main thalamic nuclei connections. These dissections were compared with the ventral intermediate nucleus (VIM) of the thalamus DBS targeting, used for tremor treatment in a case of left-hand writer's cramp, employing 3T high-resolution MRI FGATIR sequence.

Results:

Thalamic Nuclei	Tracts connected to
VO	Pallidothalamic tract (VOa) and crossing DRTT (VOp)
VIM	Crossing and ipsilateral Dentatorubrothalamic tract (DRTT)
VC	Medial Lemniscus

The thalamus was dissected to clarify its relationships with internal capsule and GPi laterally; subthalamic nucleus, medial lemniscus, DRTT inferiorly, and their connections to the thalamus (Table 1). A female left-handed writer's cramp patient with refractory tremor underwent right GPI and VIM DBS. High-resolution MRI FGATIR sequence was used for targeting (Figure 1) the right GPI DBS (X=15.5;Y=2;Z=-1.5) and right VIM DBS (X=10;Y=-3.2;Z=1.3) were performed to improve dystonic movements and tremor. 1mA, 130Hz, 60ms in ventroposterior GPI led to dystonia improvement. Unified dystonia rating scale improved 77% (11 to 2.5). 1.5mA, 130Hz, 60ms in a multitarget stimulation of VIM, VO and DRTT induced

complete reduction of the debilitating dystonic tremor



transoperatively.

Conclusions: The present investigation elucidated the 3-D anatomy of the thalamus along with its main connections and interrelations. Deep comprehension of this neuroanatomy, alongside precise visualization of the boundaries of the VO, VIM, and VC thalamus, constitutes a cornerstone for direct

thalamic targeting, which was exemplified in the presented case to manage debilitating and residual tremor after GPI DBS effectively.

Keywords: Deep Brain Stimulation, thalamus, writer's cramp

EP041 / #430

Topic: *AS01. Movement Disorders*

COMPARISON OF DIFFERENT SURGICAL STRATEGIES FOR CERVICAL DYSTONIA: EVIDENCE FROM BAYESIAN NETWORK META-ANALYSIS AND RETROSPECTIVE STUDY

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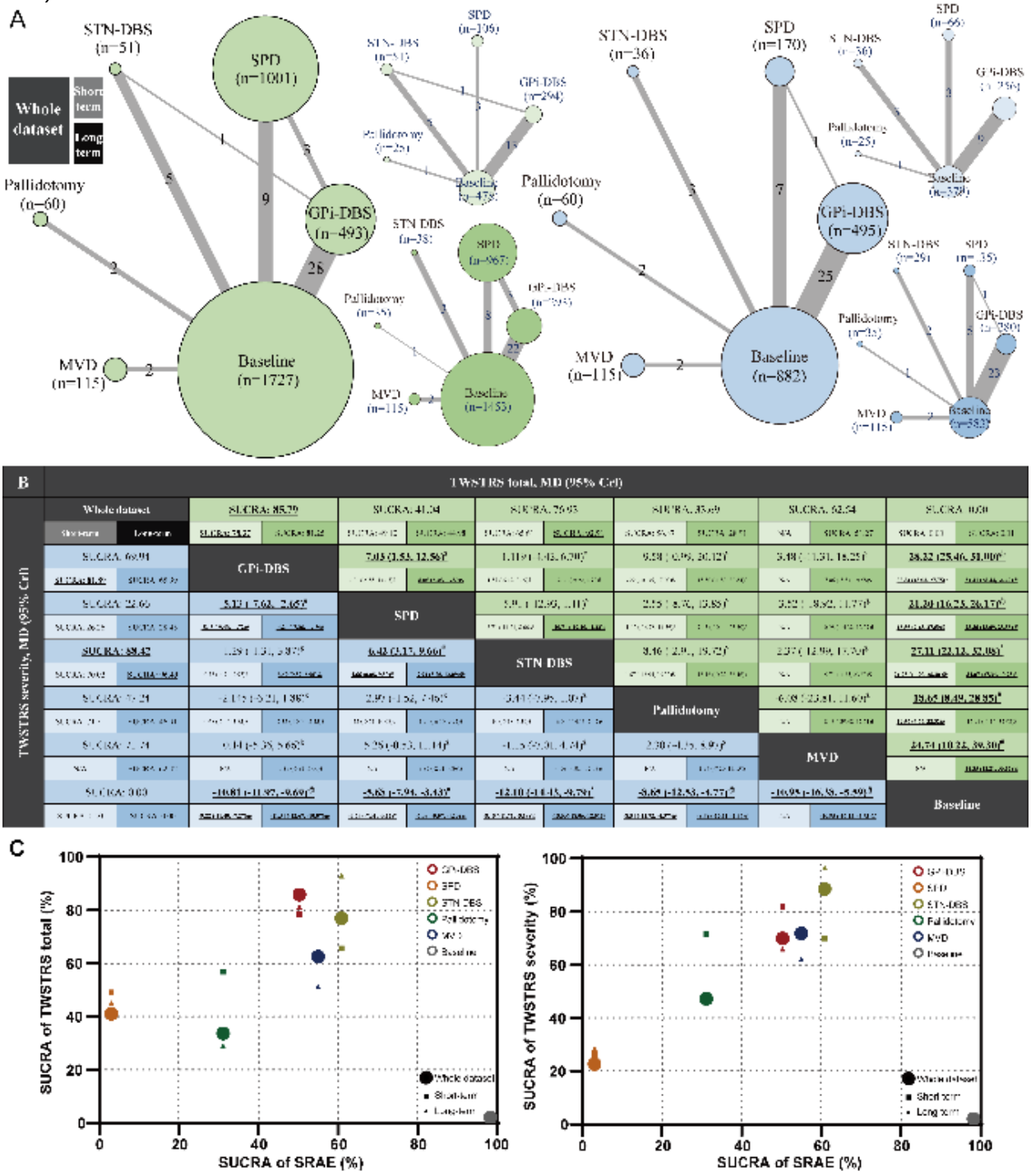
Introduction: The recognized first-line treatment for cervical dystonia (CD) is injection of botulinum toxin (BTX). However, up to one-third of patients experience a suboptimal response to BTX, and approximately 10% do not respond to these injections. Furthermore, factors such as adverse effects induced by injection, non-sustained benefits, and long-term injections may reduce patient compliance. Several surgical stratgies including globus pallidus internus/subthalamic nucleus-deep brain stimulation (GPi/STN-DBS), selective peripheral denervation (SPD), microvascular decompression (MVD) and pallidotomy were used for treating these patients who resist conventional treatment. Previous pairwise meta-analyses cannot comprehensively assess the clinical outcomes of multiple interventions or identify the optimal treatment for CD. We conducted the first network meta-analysis combined with retrospective cohort comparing different surgical strategies for CD to inform clinical practice.

Methods: Electronic databases were searched for surgical strategies on treatment of CD. The primary outcome was the improvement of total Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS). Subgroup analysis was performed to compare short-term (< one year) and long-term (≥ one year) outcomes. Safety outcome included surgery-related adverse events (AEs).

Results: A total of 55 trials with 2032 patients employing five surgical strategies were identified, including GPi/STN-DBS, SPD, MVD and pallidotomy. Retrospective study enrolled 32 CD patients who underwent GPi/STN-DBS surgery. All strategies led to significant improvement in total TWSTRS (mean improvement range: 18.65–28.22). GPi-DBS showed significantly greater enhancement than SPD for the whole dataset (mean difference [MD]: 7.03; 95% credible interval [Crl]: 1.53–12.56), while both GPi-DBS (MD: 8.05; 95% Crl: 2.35–13.80) and STN-DBS (MD: 10.71; 95% Crl: 2.22–19.20) exhibited more long-term improvement than SPD. There was no significant statistical difference between GPi and STN-DBS, which was consistent with our result of retrospective study. With regards to safety outcome, GPi/STN-DBS and MVD were associated with fewer surgery-related AEs than SPD (ln odds ratio [OR] ranged: -1.68 to -

1.41).



Conclusions: DBS should be the preferred surgical option for CD, and STN is a promising alternative target choice due to its comparable efficacy with GPi. However, more direct evidence is still required.

Keywords: Deep Brain Stimulation, surgical strategy, cervical dystonia

EP042 / #458

Topic: *AS01. Movement Disorders*

OPTIMAL STIMULATION SITES AND CONNECTOMES FOR GPI- AND STN-DBS IN CERVICAL DYSTONIA

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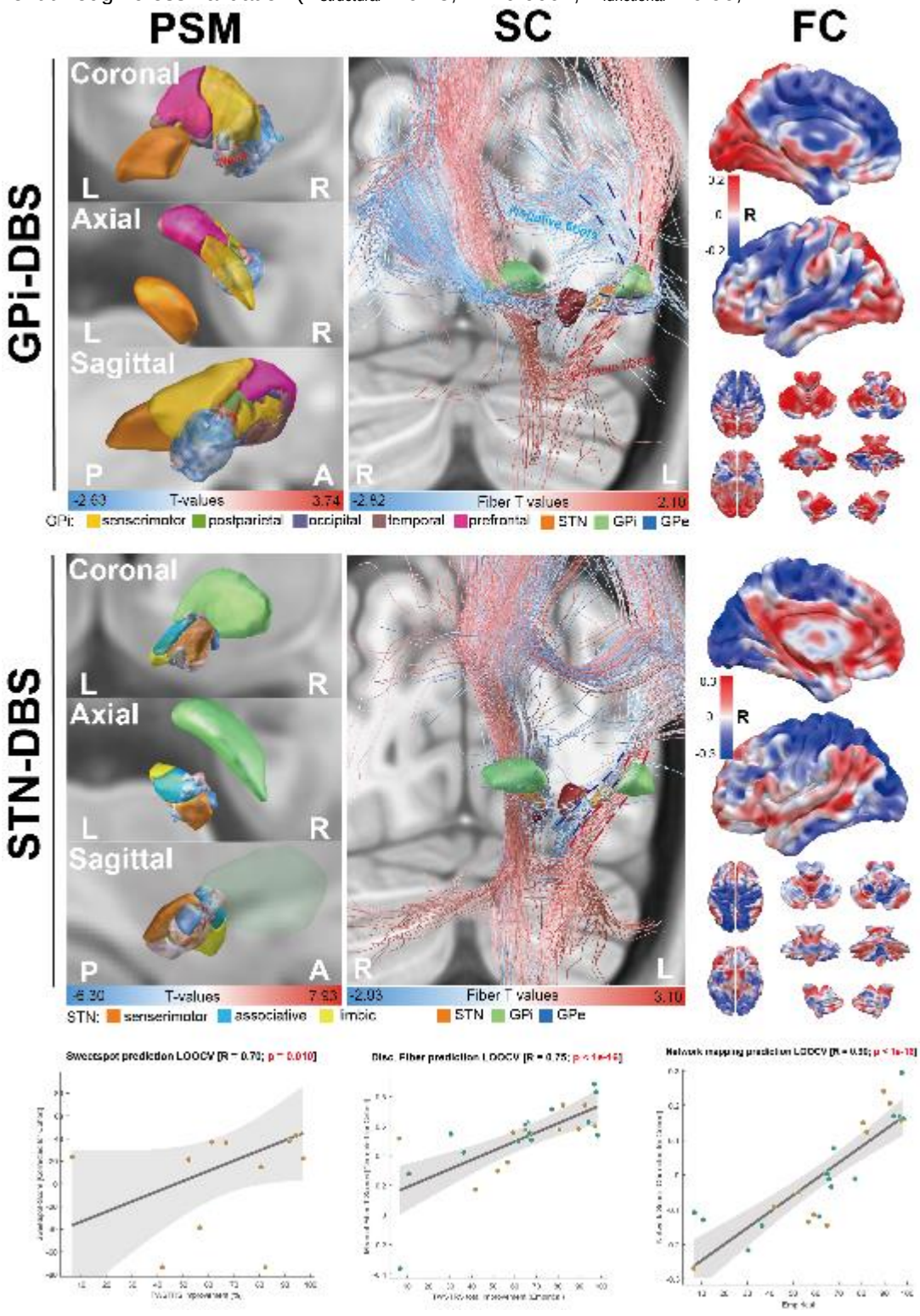
Introduction: Cervical dystonia (CD) is the most common type of focal dystonia, with an estimated prevalence of 1.18 per 100,000 persons year. Globus pallidus internus (GPi)-/subthalamic nucleus (STN)-deep brain stimulation (DBS) has shown efficacy in treating CD. However, the optimal stimulation sites and connectomes of the two targets remain unclear. We therefore evaluated the effects of electrode locations and stimulation-dependent connectivity profiles on the clinical impairment of CD patients after GPi-DBS and STN-DBS.

Methods: Stimulation effects of 50 stimulation settings in 25 CD patients were assessed. The volume of tissue-activated (VTA) models was constructed to determine the sweet/sour spots for the GPi- /STN-DBS and detect the structural/functional connectivity of the two targets and combined dataset associated with improvement of the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS). Meanwhile, cross-validation of each predictive model was performed using the leave-one-out test.

Results: The sweet spots of GPi- and STN-DBS were mainly located in the posterior ventral medial part of the GPi and dorsolateral part of the STN, respectively. The ideal probabilistic stimulation maps of STN-DBS exhibited predictive clinical improvement of CD (R = 0.70, P = 0.010). For structural connectivity, projections to the primary motor cortex (M1) were beneficial for GPi- and STN-DBS, and GPi-DBS had a more negative connection to the occipital lobe. In contrast, STN-DBS had more positive fiber connecting to the premotor cortex and cerebellum. The functional connectivity of GPi- and STN-DBS also had similarities and differences, with the agreement map finding that the orbitofrontal area, superior temporal gyrus, angular gyrus, and cerebellum were positively correlated to improving TWSTRS scores. Moreover, the structural/functional connectivity model based on the combined dataset predicted postoperative

improvement through cross-validation ($R_{structural}$ = 0.75, P < 0.0001; $R_{functional}$ = 0.90, P < 0.0001).



Conclusions: Our findings suggested the optimal stimulation localization and connectivity for GPi- and STN-DBS, which may help in surgical planning. In addition, we were able to predict the postoperative

improvement of CD patients undergoing both targets of DBS procedures based on one unified structural/functional connectivity model.

Keywords: cervical dystonia, Deep Brain Stimulation, connectivity

EP043 / #21

Topic: *AS01. Movement Disorders*

UTILIZATION OF SUSCEPTIBILITY-WEIGHTED MR IMAGING IN DBS PLANNING: A SINGLE CENTER EXPERIENCE

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Introduction: Software planning of deep brain stimulation surgery (DBS) target and trajectory usually includes routine non-enhanced and enhanced T1 and T2 sequences. Susceptibility-weighted imaging SWI) provides clear images of the target and vessels based on distortion of the magnetic field by specific products; however, it is not routinely used in pre-operative planning. In this study, we tried to evaluate the accuracy of SWI MRI both in target detection in a subset of patients undergone DBS surgery for Parkinson's disease in a single center.

Methods: Fifty patients with Parkinson's disease who had undergone deep brain stimulation surgery in a single center were included into this study. In addition to routine T1 and T2 sequences, SWI MR images were also obtained pre-operatively. We evaluated the coordinates of the subthalamic nucleus (STN), as well as its lateral and medial visible boundaries in every case. MER data were utilized to analyze final accuracy.

Results: There was a 90% concordance of the target, and an 82% concordance of medial and lateral boundaries of the STN.

Conclusions: Our study showed that there is a reliable concordance of the target while using SWI imaging. SWI can be used as an adjunct for target planning, but may not replace routine sequences.

Keyword: SWI, DBS, Parkinson's disease

EP044 / #53

Topic: *AS01. Movement Disorders*

DOES DEEP BRAIN STIMULATION IN PARKINSON'S DISEASE AFFECT MEMORY?: A META-ANALYSIS ON SHORT-TERM AND CHRONIC STIMULATION OUTCOMES

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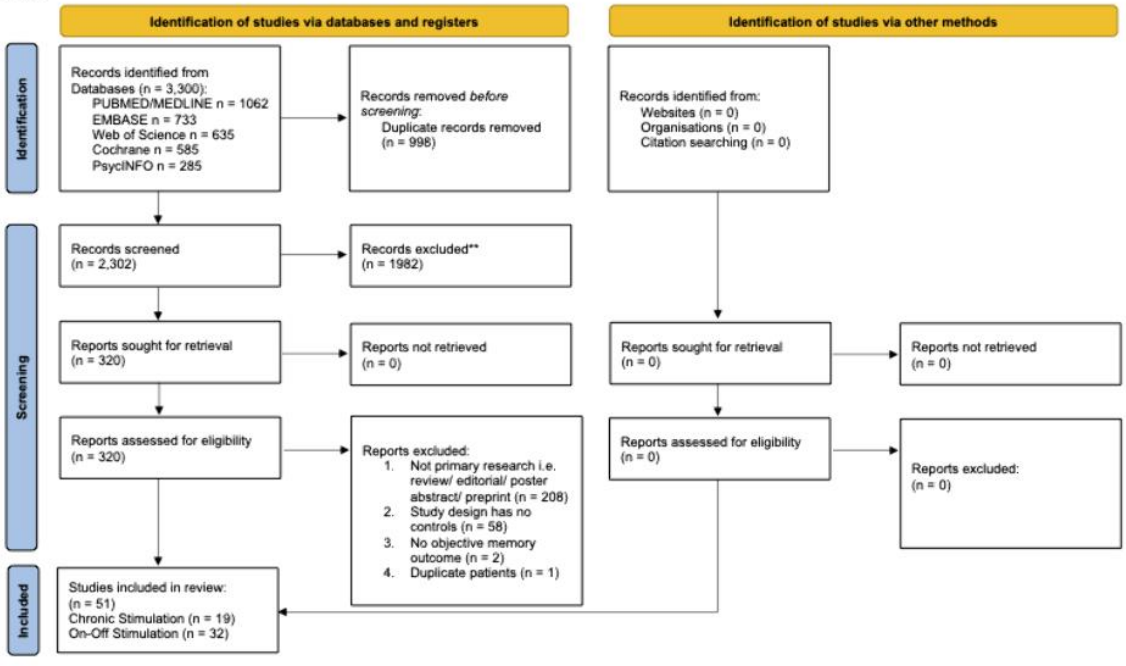
Introduction: Deep brain stimulation (DBS) is an effective treatment for advanced Parkinson's disease (PD). However, there have been concerns for cognitive side effects after DBS in PD, particularly in the subthalamic nucleus. Existing reviews found inconsistent results on the cognitive effects of DBS in PD, in part contributed to by heterogenous study design and varied neuropsychological outcome measures. Thus, we conducted a systematic review and meta-analysis of controlled studies focusing on the effects of acute (on-off) and chronic (3 months or longer) DBS on specific memory subdomains in PD.

Methods: We conducted a systematic review of Medline, EMBASE, Web of Science, Cochrane, and PsycINFO databases until 12 September 2023. We included publications reporting neuropsychological assessments of memory in PD patients treated with DBS. We excluded articles that did not report primary research or include a control group in the study design. The study followed PRISMA guidelines and was registered on PROSPERO (CRD42022324796). 2302 abstracts were reviewed by two independent researchers, and a total of 51 articles were included (Figure 1). Data was extracted using a standardised form, and random-effects meta-analyses estimating the standardized mean difference of memory subdomain outcomes was
conducted.

Figure 1: PRISMA flow diagram showing study inclusion of articles reporting neuropsychological measures of memory after deep brain stimulation in Parkinson's Disease



Results: We analysed 32 and 19 studies reporting memory outcomes after acute and chronic stimulation in PD respectively. Neuropsychological assessment included global tests (Mini Mental State Examination, Mattis Dementia Rating Scale, repeatable battery of neuropsychological status), as well as specific memory subdomains including verbal (bisyllabic word repetition, paired-associate learning, Rey auditory verbal learning test, California verbal learning test, Hopkins verbal learning test), visual (brief visuospatial memory test, Benton visual retention test) and working memory (Cambridge neuropsychological test automated battery, forward and backward digit span, Sternberg memory scanning). Short-term stimulation showed a decrease in reaction time in working memory, while chronic stimulation showed a significant effect of decreased verbal memory after long-term DBS.

Conclusions: DBS in PD may be associated with deterioration in memory subdomains. Further research on the role of the basal ganglia circuit in the neurophysiology of human memory is required to better understand and reduce the side effects of DBS, or facilitate neuromodulation of memory in PD patients in the future.

Keywords: Memory, Parkinson's disease, Deep Brain Stimulation

EP045 / #77

Topic: *AS01. Movement Disorders*

OUTCOMES AFTER DEEP BRAIN STIMULATION FOR ELDERLY VERSUS NON-ELDERLY PATIENTS WITH PARKINSON'S DISEASE

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Introduction: The decision to offer deep brain stimulation (DBS) to elderly patients with Parkinson's disease (PD) presents challenges due to higher perceived risks and uncertain long-term benefits. Here, we aimed to compare the outcomes after DBS for elderly versus non-elderly patients with PD.

Methods: We analyzed data from our institutional cohort and retrieved publicly available data through a systematic review. The exposure was age at DBS electrode insertion, which was defined as elderly (≥70 years old) and non-elderly (<70 years old). The outcomes examined were changes in the Movement Disorders Society-Parkinson's Disease Rating Scale (MDS-UPDRS) or UPDRS part III total score, levodopa-equivalent daily dose (LEDD), and adverse events.

Results: The included studies and our cohort comprised a total of 527 patients, with 111 (21.1%) classified as elderly. There was no statistically significant difference in the change in MDS-UPDRS or UPDRS part III total score and generally no statistically significant difference in the change in LEDD between the elderly and non-elderly patients. Elderly patients had a higher incidence of wound infection (elderly 5.4% vs non-elderly 1.9%; p=0.087) and inadequate wound healing (elderly 3.6% vs non-elderly 1.4%; p=0.230), but this difference was not statistically significant. There was no significant difference in the incidence of mortality (elderly 0% vs non-elderly 0%; p=1.000), stroke (elderly 0% vs non-elderly 0.2%; p=1.000), and cognitive decline between the age groups.

Conclusions: Elderly patients have similar motor outcomes and levels of PD medication reduction after DBS for PD, but may be at higher risk of wound complications.

EP046 / #122

Topic: *AS01. Movement Disorders*

PERCEPTIONS REGARDING ASLEEP AND AWAKE DBS AMONG NEUROLOGISTS AND NEUROSURGEONS

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Introduction: DBS is a multidisciplinary treatment with NSXs performing the procedure and NLGs optimizing clinical outcome. Whether their respective viewpoints regarding asleep and awake DBS procedures converge is of potential interest but has not been studied. Our objective is to compare trends and perceptions regarding Asleep and Awake deep brain stimulation (DBS) between neurologists (NLGs) and neurosurgeons (NSXs) in the USA and abroad.

Methods: A panel of DBS clinicians created a REDCap survey regarding DBS practice in the US and abroad. The survey was sent out to the Functional Neurosurgery Working Group of the Parkinson Study Group, DBS Think Tank, World Society for Stereotactic and Functional Neurosurgery, and Movement Disorder Society members with stated DBS interest.

Results: Of 321 individual respondents from 38 countries and 6 continents 60% were NSXs, 37% NLGs, and 3% Advanced Practice Providers. Fifty-eight percent perform both awake and asleep DBS procedures, 26.8% awake only, and 15.5% asleep only. Focusing only on 117 respondents who offer both options, 70% choose awake for STN, 45% choose awake for GPI, 92% choose awake for VIM. When asked to agree or disagree with “asleep DBS is equal to or more effective than awake DBS” for each target, NLGs agreed/disagreed as follows: VIM: 11.8%/62.8%, STN: 26%/47%, GPI: 49%/31%, vs NSXs: VIM: 13.6%/58%, STN: 32.6%/37.1%, GPI: 64.1%/18% (remainder: ‘similar’ or ‘no experience’). When asked to choose the ‘most optimal technique’ out of 7 awake/asleep DBS techniques, both NLGs and NSXs selected ‘awake+microelectrode recording (MER)+test stimulation (stim)’ for STN and VIM. For GPI, NLGs preferred ‘awake+MER+stim’, while NSXs preferred ‘asleep interventional-MRI’ (iMRI). For ‘least optimal technique for each target’, NLGs and NSXs both chose ‘asleep iCT/Oarm’ for STN, GPI and VIM.

Conclusions: In this survey, NLGs and NSXs showed similar preferences for awake DBS when targeting VIM and STN, while for GPI the results were more variable. Compared to NLGs, NSXs had a more favorable opinion on asleep procedures, especially iMRI, while NLGs preferred physiological confirmation for all targets. These results provide only a snapshot of current DBS trends, and perceptions may change with future technological advances.

Keywords: SURVEY, Asleep/Awake, Deep Brain Stimulation (DBS)

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Topic: *AS01. Movement Disorders*

EFFICACY OF LESIONING SURGERY FOR DYSTONIA

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Introduction: Dystonia is a movement disorder characterized by involuntary, sustained, and patterned muscle contractions, which cause twisting and repetitive movements. Dystonia includes various types of movement disorders such as cervical, generalized, task specific focal hand dystonia. Several potential stereotactic targets have been suggested for the treatment of dystonia such as GPi, Vim, PTT and VoA-VoP junction.

Methods: All the patients of dystonia who underwent surgical interventions in Annapurna Neurological Institute and Allied Sciences since January 2015 till December 2023 were included in our study. We performed unilateral pallidotomy/ Pallidothalamic tractotomy for cervical dystonia, bilateral pallidotomies for generalized dystonia and unilateral VoA/VoP junction thalamotomy for task specific focal dystonia (TSFD). We used ZD Fishers frame and the thermal lesioning machine of Cosman Radiofrequency (RF) generator with the lesioning electrode of 0.75 mm internal diameter and 2 mm exposed tip was used.

Results: There were altogether 45 cases out of which six cases were TSFD (13 writers cramp and 2 musicians cramp), 18 cases were cervical dystonia and 12 cases were generalized dystonia. The preoperative score of 2 reached to 4 in postoperative period in both Musicians cramp in 6 months follow up. There was 80 percent improvement in Writers cramp rating score which was also persistent in one year follow up. There was hemiballismus in one case of writers cramp after few days of surgery. There was overall 80 percent decrease in the symptoms of dystonia. The mean age was 41.49 years±12 years. The male: female ratio was 3:1. The mean percentage change in BFMDRS was 70 percent (p value<0.05) in postoperative period. There was relapse of symptoms in 3 cases of generalized dystonia and 2 cases of cervical dystonia in one year follow up period. One case of tardive dystonia with repeated bilateral pallidotomy had status dystonicus and finally she got better with intrathecal baclofen pump. One case had hemiparesis and three cases had transient dysarthria.

Conclusions: Lesioing surgery for dystonia is rewarding for TSFD, cervical dystonia and generalized dystonia. However, tardive dystonias and generalized dystonias have higher relapse rate.

Keywords: dystonia, Lesioning, Movement disorder

EP048 / #187

Topic: *AS01. Movement Disorders*

DELAYED POSTOPERATIVE IMPEDANCE ISSUES IN PATIENTS TREATED WITH DEEP BRAIN STIMULATION: A SINGLE-CENTER RETROSPECTIVE STUDY

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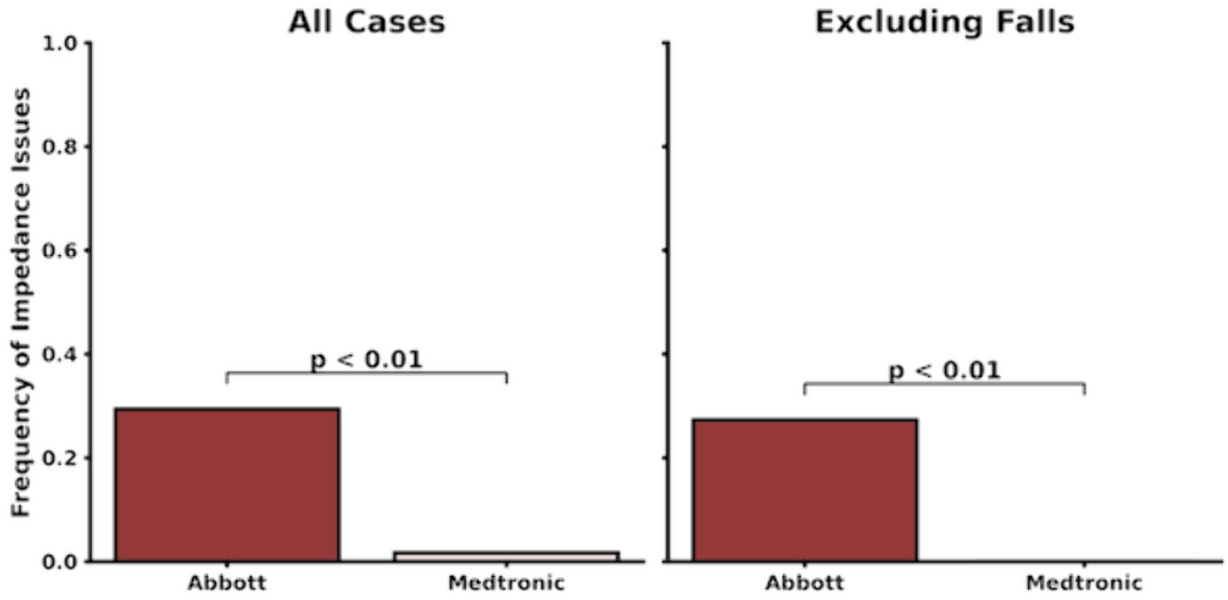
Introduction: Deep Brain Stimulation (DBS) is a well established adjunct neurotherapeutic intervention for a number of Movement Disorders, Psychiatric indications and medically refractory Epilepsy. In order to ensure the highest chance of therapeutic success, device related complications must be monitored. The authors hope to elucidate any disparities between the two neurostimulators used in their practice.

Methods: The authors performed a retrospective review of all patients with DBS who have been managed at the HMH-Jersey Shore University Medical Center from October 2021 to January 2024 and had been implanted with either the Abbott St. Jude or the Medtronic DBS Systems. The implant type, date, significant events following surgery, impedance issue types, and revision operations were noted. Chi-square tests for independence and all analyses were performed using Python 3.8.0 (Python Software Foundation, Wilmington, DE).

Results: A total of 155 DBS patients were identified; thirty four patients with the Abbott system and 121 with the Medtronic system. Upon follow-up, 16 independent impedance issues were identified from 12 patients. Two patients (1.7%) from the Medtronic group and 10 patients (29.4%) from the Abbott group ($p<.01$). Falls were the most common significant event noted and occurred prior to 5 impedance cases (31.3%). When falls were controlled for, 9 patients (11 impedance issues) were identified. All of these patients were from the Abbott group ($p<.01$). Eight of these patients experienced impedance issues with their original implant. Seven cases (63.6%) were due to high impedance and four were due to low impedance. Revision surgery occurred in 6 (66.7%) of these patients after an average of 1.05 years following primary implantation. Surgical replacement of the internal pulse generator (IPG) (n=2), IPG and extension wires (n=2), or IPG and lead revision (n=1) resolved impedance in 5 cases. For the 1 patient who's IPG replacement did not resolve the issues, high intraoperative impedance at one contact was noted. This issue persisted postoperatively and has become a multi-contact

issue.



Conclusions: Patients from our practice with movement disorders treated with the Abbott St. Jude DBS Systems have significantly higher rates of impedance issues requiring reoperation when compared to those implanted with the Medtronic Systems.

Keywords: movement disorders, DBS, impedance

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Topic: *AS01. Movement Disorders*

SCALP NERVE BLOCK REDUSEES HEADACHES ASSOCIATED WITH SONICATION DURING TRANSCRANIAL MAGNETIC RESONANCE-GUIDED FOCUSED ULTRASOUND

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Introduction: During magnetic resonance-guided focused ultrasound (MRgFUS), patients often complain about headaches during sonications. This type of headache can be severe and may lead to the discontinuation of treatment. In this study, we assessed the efficacy of scalp nerve block (SNB) for decreasing headache during MRgFUS procedure.

Methods: This retrospective study evaluated 70 consecutive patients with a skull density ratio (SDR) of ≤0.55 who received MRgFUS for the treatment of essential tremor or Parkinson's disease. During the study period from April 2020 to February 2022, an SNB protocol for all patients with a skull density ratio ≤0.55 was instituted on October 6, 2021. The number of patients with a skull density ratio ≤0.55 was 34 before the protocol and 36 afterward. Headache intensity was evaluated using a numerical rating scale (NRS) after each sonication. To assess the effect of SNB on headache severity, multiple regression analysis was performed per patient and per sonication. In the per-patient analysis, the effect of SNB was evaluated using the maximum NRS, mean NRS, and NRS at the first ultrasound exposure that reached 52.5°C. In the per-sonication analysis, the effect of SNB was evaluated not only for the entire sonication, but also for sonications classified into ≤9999 J, 10000–29999 J, and ≥30000 J energy doses.

Results: With SNB, headache reduction was observed in the NRS after the first sonication that reached 52.5°C in each patient (β = −2.40, 95% confidence interval [CI] −4.05 to −0.758, p = 0.00499), in the NRS when all sonications were evaluated (β = −0.647, 95% CI −1.19 to −.106, p = 0.0201), and in the NRS when all sonications were classified into 10000–29999 J (β = −1.83, 95% CI −3.17 to −0.485, p = 0.00889).

Conclusions: SNB markedly decreased the severity of headache during MRgFUS, particularly that caused by sonication with a moderate energy dose. These findings suggest that scalp nerves play a role in headache mechanisms during MRgFUS.

Keywords: Magnetic resonance-guided focused ultrasound, scalp nerve block, headache

EP050 / #335

Topic: *AS01. Movement Disorders*

THE SURGICAL MANAGEMENT OF CEREBRAL PALSY

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Introduction: Cerebral palsy (CP) is a complex movement disorder with various aetiologies, typically developing during childhood. The efficacy of pharmacological treatment if often low. Deep brain stimulation (DBS) and stereotactic lesioning have shown promise in managing dystonic CP.` This study aims to analyze the outcomes of DBS and stereotactic radiofrequency (RF) lesioning in treating CP.

Methods: At the Romodanov Neurosurgery Institute, 31 patients with CP underwent treatment. Among them, 7 patients underwent unilateral stereotactic RF pallidotomy, 5 patients - unilateral thalamotomy (Voa-Vop), 15 patients - bilateral DBS of the globus pallidus internus (GPi), and the remaining 4 patients underwent combined staged operations: unilateral pallidotomy followed by DBS treatment. In this subgroup, the target of DBS was the subthalamic nucleus on the side of the pallidotomy and GPi on the contralateral hemisphere. The mean age at surgery was 34.5 years (range 9-60 years). Motor outcomes were assessed using the Burke-Fahn-Marsden Dystonia Rating Scale, and patients were evaluated at one and two years post-operation.

Results: Most patients (71.0%) had a congenital course of CP, while in 4 cases (12.9%), CP was attributed to toxic causes, in 3 cases (9.6%) traumatic causes, and in the remaining 2 patients (6.5%) to metabolic disorders. Among the patients, 11 (35.5%) were diagnosed with the spastic type of CP, 15 (48.4%) with the dyskinetic type, and 5 (16.1%) had mixed CP. Significant motor improvement, particularly tremor relief, was observed in patients with dyskinetic type of CP, particularly after GPi DBS. Progressive improvements were noted in patients who underwent DBS treatment over the two-year post-operative period. However, there were no significant differences in motor improvement between the one and two-year follow-ups after unilateral lesioning. Notably, there were no postoperative complications.

Conclusions: Despite the study's limited sample size, our findings suggest that GPi DBS is the preferred surgical treatment method for dyskinetic CP. However, RF lesioning remains a viable option for CP management. Combined staged operations, such as unilateral pallidotomy followed by DBS treatment, appear to be safe and effective in highly selected patients with CP.

Keywords: Deep Brain Stimulation, dystonia, Cerebral Palsy

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Topic: *AS01. Movement Disorders*

IS 3TMRI SAFE AFTER BILATERAL DEEP BRAIN STIMULATION?

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Introduction: Deep brain stimulation involves applying electromagnetic waves to specific areas of the brain using electronic devices and is commonly used to treat resistant neurological and neuropsychiatric disorders. The FDA has approved its use in various conditions, but precise patient selection and implantation are crucial to minimize complications and achieve clinical improvement. While MRI at 1.5T is safe, its compatibility with deep implants at 3Tremains is uncertain. Despite the changes in materials and programming algorithms that have allowed a reduction in all these effects, the immediate postoperative use for 3-tesla fields has not been clearly established. Therefore, the main objective of this study is to determine the safety of 3T MRI in postoperative DBS patients.

Methods: We measure temperature at the beginning and end of the resonance imaging, both before and after electrode placement. Once implanted, we describe the presence of edema, bleeding, or electrode displacement in relation to the 3T field.

Results: In total, there were 71 patients included in the dataset. The mean age was approximately 50.89±16.78 years. Diagnostic frequencies show Parkinson's 38 cases (72.73%), depression 3 (5.77%), dystonia 5 (9.62%), aggression 9 (13.46%), epilepsy: 16 (30.77%), others 3 (4.48%). BMI statistics reveal a mean of 25.39±10.57. Pre-surgery temperatures average 35.98°C before and 36.17°C after resonance, exhibiting a weak correlation (0.14) with BMI. Post-DBS surgery, temperatures start at 35.75°C and rise to 36.15°C, with significant temperature increases ($p \approx 0.001$) observed in the second session. No edema, electrode displacement or bleeding cases were found related to the MRI acquisition in this study. However, of a total of 63 observations, 7.27% exhibited bleeding related to DBS electrodes but no related to MRI. The correlation coefficient between BMI and bleeding presence is 0.078. No significant correlation exists between temperature change and bleeding (0.117) or BMI and bleeding (0.078).

Conclusions: As described above, we can conclude that there are no relationships between postoperative 3T MRI, BMI, and temperature changes before and after MRI with the presence of edema, bleeding, or electrode displacement. Therefore, this study could suggest the safety of a 3T field in postoperative patients undergoing deep brain stimulation surgery.

Keywords: 3TMRI, Deep Brain Stimulation, electrodes

EP052 / #402

Topic: *AS01. Movement Disorders*

CT IMAGING OF DEEP BRAIN STIMULATION LEADS; MINIMIZATION AND CONTRASTS BETWEEN ABBOTT AND MEDTRONIC IMAGE ARTIFACT

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Introduction: Post-operative Computer-assisted Tomography (CT) is typically merged with pre-planning Magnetic Resonance Imaging (MRI) to verify lead placement in Deep Brain Stimulation (DBS). Here, we contrast the CT imaging of the stimulating leads from Medtronic and Abbott to see if they can be differentiated from each other and examine the scan parameters that allow the image artifact to be kept to a minimum.

Methods: The authors performed a retrospective review of 28 leads from 14 of our recent bilateral DBS implants performed on a Philips Brilliance 64 channel CT scanner. The cases were split evenly across Medtronic and Abbott and using a pseudo-randomized block design further contrasted Scan Filtering (Bone vs. Soft tissue), and scan slice thickness (0.33mm, 0.67mm, 1.0mm). Brainlab was used to construct 3D neural models allowing the diameter of the exposed contact region, its height and the diameter of the insulated cable to be measured and contrasted statisticlly using ANOVA.

Results: The segmented leads are physically a consistent diameter throughout their length (Abbott:1.29mm, Medtronic:1.36mm). CT imaging however, reveals an artifact profile with an increased diameter around the exposed contact region that narrows as lead wires become fully insulated or connect to different wire materials. No left/right differences were found (p=ns). Contact diameter was not different between Abbott (2.64mm) and Medtronic (2.84mm) leads (p=ns). However, the insulated lead diameter of the Abbott (1.62) was statistically less than that of the Medtronic (2.47mm) (p=0.00008). The height at which the lead image narrowed was also different with Abbott images near twice the height (23.84mm) of Medtronic (10.94mm). The Bone filtering resulted in smaller diameters for both the cable (1.74mm vs. 2.6mm; p=0.000016) and contact (2.50mm vs. 3.15mm; p<0.00001) regions. Finally, slice thickness showed no differences for the lead diameter (p=ns), while the contact diameter exhibited larger diameters as the slices became thicker (2.58mm @ 0.3, 2.69mm @ 0.67, 3.15mm @ 1.0; p=0.015).

Conclusions: The CT images of Medtronic and Abbott leads can be differentiated from each other by contact region height and cable diameter. Further, by utilizing bone filtering and the thinnest slice available, the extraneous image artifact can be minimized.

Keywords: DBS, CT, Stimulating Leads

EP053 / #454

Topic: *AS01. Movement Disorders*

VALIDATING BETA OSCILLATIONS IN LOCAL FIELD POTENTIALS RECORDINGS AS OBJECTIVE MEASURE OF SYMPTOMS OF PARKINSON'S DISEASE BY CORRELATING WITH PARKINSON'S KINETOGRAPH(PKG) IN CLINICAL PRACTICE.

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Introduction: With the recent advances in deep brain stimulation(DBS) technology it is important to apply and analyse utility of new advances in real world clinical practice. Medtronic Percept introduced sensing capability and recording or local field potentials(LFP). In this study we have attempted to verify beta sensing as a valid objective measurement when compared to Parkinson's Kinetograph(PKG) and conventional subjective outcome measures.

Methods: Prospective study looking at 5 patients with deep brain stimulation of the subthalamic nucleus for Parkinsons disease. We use LFP recordings to help with programming and record if the time taken to gain optimum stimulation is reduced. We also used Beta sensing survey and record fluctuation in the beta oscilliations over a week, prior to programming and 1 week of sensing at each session of programming as well as at 3months at 6 months and 1 year. The unique feature of this study is the use of Parkinsons kinetograph(PKG) concurrently along side the beta sensing survey. This allows us to record UPDRS at each stage of programming as well as using the objective PKG recordings, and compare to the Beta sensing survey to see if reduction in beta fluctuations truly correlate with validated objective and subjective clinical outcomes.

Results: 4 male and 1 female patient had the Medtronic Percept implant and PKG device recordings. Initial UPDRS III scores were between 29 and 47. LFP recordings on initial survey predicted the best contact for stimulation in all 5 patients. The median post op UPDRS III was 15 with an average of 46.5% drug reduction. Importantly the LFP recordings correlated with the PKG readings showing a direct objective relationship between Beta fluctuations in LFPs and clinical symptomology. We employed the Independent-Samples Kruskal-Wallis test to examine differences between groups, and there was a significant reduction in Beta oscillations when optimum therapy was achieved.

Conclusions: Conclusion This study has demonstrated correlations between beta fluctuations in LFP and validated objective measure of clinical symptoms (PKG). Thus verifying beta sensing results as a biomarker which can be used in clinical practice to monitor treatment efficacy in Parkinson's disease.

Keywords: local field potentials, Brain sensing, parkinson's kinetograph

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Topic: *AS01. Movement Disorders*

VALIDATION OF AUTOMATIC SEGMENTATION OF VENTRALIS INTERMEDIUS NUCLEUS IN TREMOR TREATMENT

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Introduction: The ventralis intermedius nucleus (VIM) deep brain stimulation (DBS) is well established as a safe and effective symptomatic treatment of essential tremor[1,2]. Due to the difficulty in visualizing the VIM in MRI, the selection of the target has traditionally been done based on indirect targeting using coordinates derived from autopsy-based atlases, making corrections based on the size of the third ventricle and the distance to the internal capsule. Nowadays, automatic segmentation technology is available for preoperative planning in numerous targets. However, in contrast to other targets as subthalamus[4,5], there are not case series validating its effectiveness. The aim of this preliminary study is to validate the Brainlab automatic segmentation algorithm in VIM lead planification for tremor DBS.

Methods: We have analyzed retrospectively the differences in leads location between the group of patients treated using atlas planification and the group treated using Brainlab automatic segmentation.

Results: We have included 17 patients and 31 leads, in the atlas group there were 10 patients and 17 leads, whereas in the segmentation group, 7 patients and 14 leads. The median age was 58 years (interquartile range (IQR): 39) in the atlas group and 68 years (IQR: 14) in the segmentation group. 90,00% (9/10) in the atlas group and 85,71% (6/7) in the segmentation group were males. The VIM size in the atlas group was 0,18 cm^3 (IQR: 0,05) in the right and 0,17 cm^3 (IQR: 0,04) in the left, in the segmentation group was 0,20 cm^3 (IQR: 0,03) in the right side and 0,18 cm^3 (IQR: 0,05) in the left. In MRI, the lead was within the VIM in 86,66% (13/15) in the atlas group and 92,85% (13/14) in the segmentation group. The lead median length within the VIM in MRI was 3,50 mm (IQR: 2,50) in the atlas group and 4,00 (IQR: 2,50) in the segmentation group. There were not significative differences between both groups.

Conclusions: We have not found any differences in the location of the lead between both groups. Thus, the following step will be compared the differences between the theoretical and the final coordinates to quantify the role of microregistration and macrostimulation.

Keyword: Deep Brain Stimulation, Essential Tremor, Nucleus Ventralis Intermedius

EP055 / #83

Topic: *AS01. Movement Disorders*

DEEP BRAIN STIMULATION LEADS TO LONG-TERM IMPROVEMENT OF NEUROPATHIC TREMOR DUE TO CHRONIC INFLAMMATORY DEMYELINATING POLYNEUROPATHY

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Introduction: Chronic inflammatory demyelinating polyneuropathy (CIDP) is a peripheral neuropathy caused by immune-mediated demyelination, causing tremors in 3.9%–58% of affected patients. This neuropathic tremor may persist after treatment and is known to be refractory to conventional medication. We present two cases of neuropathic tremor due to CIDP in which deep brain stimulation (DBS) over a long-term period led to marked improvement.

Methods: Case 1: A 66-year-old woman presented with severe 2–3-Hz resting, postural, and kinetic tremors of both hands. The tremor was refractory to medication. Case 2: A 56-year-old man presented with a 6-year history of CIDP after developing sensory dullness and tremors in the extremities. The CIDP had gone into remission 1 year previously and the sensory deficits had improved, but the tremors had gradually worsened: severe 8–12-Hz postural, kinetic, and resting tremors were present in both upper extremities.

Results: Case 1:Bilateral VIM-DBS was performed and the tremor improved well. However, 2 months after the procedure, the tremor worsened and was accompanied by sensory disturbance in the extremities. A diagnosis of CIDP was made, and treatment with corticosteroids and intravenous immunoglobulin achieved remission 6 months later. Although there was residual tremor after CIDP remission, it has been well controlled by DBS for the last 10 years. Case 2: Right VIM-DBS was performed and the tremors on the left side showed marked improvement. Over the next 8 years, the tremors were well controlled and there were no relapses of CIDP.

Conclusions: CIDP may produce tremor through central nervous system dysfunction, and DBS shows long-term efficacy for the control of such tremors. In addition, remission of CIDP may be an important requirement for a stable effect of DBS. If the tremor worsens during the postoperative course, the disease status of CIDP should be evaluated.

Keywords: Neuropathic tremor, DBS, CIDP

EP056 / #99

Topic: *AS01. Movement Disorders*

LOW TECHNOLOGY AND HIGH OUTCOMES IN MOVEMENT DISORDER SURGERY

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Introduction: The efficacy of ablative surgery has also similar outcomes as compared with the use of neuromodulation. The use of DBS in movement disorder surgery tend to be expensive and difficult to implement in the LMIC setting. Ablative surgery using radio frequency is a cost effective surgical treatment for LMIC as Nepal.

Methods: Between April 2014 and July 2023, 151 patients undergoing different procedure for movement disorders. Our target was either globus pallidus (GPi) interna or Pallidothalamic tract (PTT) for lesioning in Parkinson's disease and generalized dystonia. For task specific focal dystonia (TSFD), we used VOA-VoP junction of thalamus. For essential tremor, ViM thalamotomy was done. We used St Judes and Scene ray DBS. The ZD Fisher frame with its software and inbuilt Schaltenbrant Atlas along with standard functional coordinates were used for target calculation. We used the thermal lesioning machine of Cosman RF generator generator and the voltage, impedance and rate of the thermal coagulation were set. The lesioning electrode of 1 mm diameter and 2 mm exposed tip was used.

Results: The study included 99 men and 52 women, and the age ranged between 22 to 82 years (average age,62.8). Our results for pallidotomy and PTT lesioning were satisfactory in terms of improvement in UPDRS score for Parkinsons disease. Among 45 cases of dystonia, there was 80% improvement in outcomes. The outcome was very impressive in TSFD and cervical dystonia, however, there was recurrence in 20 % cases of generalized dystonia. There was 12 cases of essential tremor who underwent ViM lesioning with satisfactory outcomes. There was total 15 cases of focal task specific dystonia who underwent Ventrooralis thalamotomy with good outcome.

Conclusions: Lesioning surgeries still have a definitive place in movement disorder irrespective of the financial situation of the nation. Lesioning surgeries have surpassed DBS in our setup due to affordability, no need of time consuming adjustment of battery parameters and comparable outcomes.

Keywords: Movement disorder, Technology, Lesioning

EP057 / #148

Topic: *AS01. Movement Disorders*

DIRECTLY IDENTIFYING AND PRECISELY LESIONING THE CEREBELLOTHALAMIC TRACT AT THE THALAMIC BASE FOR TREMORS : A PROSPECTIVE OPEN-LABEL STUDY

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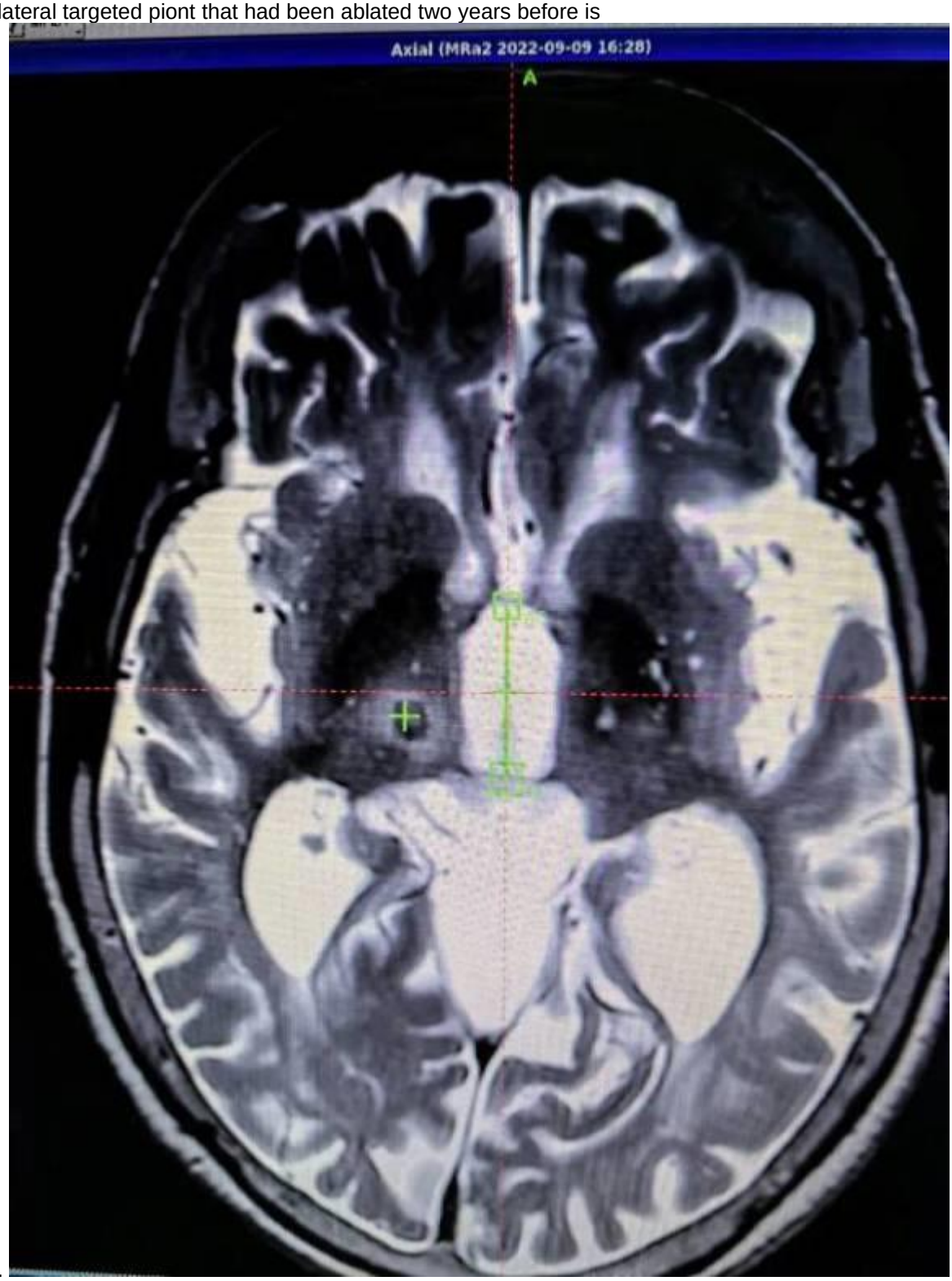
Introduction: Targeting the ventralis intermediate nucleus (Vim) for tremors is well established, but sometimes accompanied by some extent adverse effects due to the fact that the vim is a functional area and unable to be discriminated on MR imaging . However, the cerebellothalamic tract (ctt) can be distinguished on MR imaging due to its myelinated and closely packed fibers converging into a dense bundle at the inferior aspect of the thalamus. Thus, the aiming to accurately localize and precisely lesion this cct site is believed to gain more satisfying outcome for the treatment of tremor.

Methods: 57 patients with tremors were enrolled in this study, obtaining the specific 3T MR images to visualize the target, fusing MR image with stereotactic CT image, refining the target coordinates according to individual tremor pattern and affected body parts, lesioning the target under macrostimulation. The tremors relief, complications, and patients satisfaction were evaluated and followed up.

Results: 79 procedures were performed in 57 patients, including 17 Parkinson's disease patients and 5 essential tremor patients with staged bilateral lesions. On MR imaging the ctt was delineated as a low-signal area where was at 2 to 4 mm posterior to the midcommmissural point, 10.5 to 16mm lateral to the midline, and 1mm below to 1mm above the AC-PC plane. The lesioning zone precisely covered the targeting site on postoperative MR images. The contralateral tremors disappeared totally , no adverse effects and complaints were found in all patients but one with a transient unsteady gait, the satisfying results kept stable with 6 to 72 months follow-up.

Conclusions: The ctt was visible on MR imaging; precisely lesioning the cct spot for tremors produced excellent results with fewer adverse effects; the staged bilaterally lesioning ctt was feasible. Figure Legend. Showing a staged bilateral ctt lesioning, the routine MRI was scanned 7days after the second surgery when patient being discharged, demonstrating the lesioning site with surrounding edema, and the

controlateral targeted piont that had been ablated two years before is



visible.

Keywords: tremor, Stereotactic Neurosurgery, cerebellothalamic tract

EP058 / #152

Topic: *AS01. Movement Disorders*

A CORRELATION ANALYSIS BETWEEN MRI AND INTRA OP MER IN TARGETING STN IN DBS FOR PD PATIENTS:AN INSTITUTIONAL EXPERIENCE

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Introduction: Deep Brain Stimulation (DBS) for Parkinson's Disease (PD) is commonly performed with the patient awake for microelectrode recording (MER) and intraoperative clinical testing. However, technical advancements in MR imaging questions whether MER provides any additional advantage in DBS surgery. Our aim is to find the correlation between intra-op MER and preoperative MRI in localising the upper border of Subthalamic Nucleus (STN) in patients undergoing awake DBS for PD

Methods: 25 Parkinson's Disease patients who underwent awake STN DBS with intra-operative MER at our institution from March 2020 to May 2023 were included in this retrospective study. Using T2 weighted MRI, we identified the upper STN border for each electrode and compared it with the corresponding intra-operatively obtained MER data. Two researchers independently analyzed each dataset to mitigate reporting bias. Correlation analysis was performed for the 50 electrodes, employing t-tests and Mann-Whitney tests to assess significance in the differences between MRI and MER data for both sides. Correlation coefficients were calculated for these variables.

Results: The study included 17 males and 8 females, averaging 58.28 ± 9.78 years. Evaluating the upper border of the STN in MRI and MER data, mean distances were -3.95mm ± 0.74 and -3.53 ± 1.16, respectively, for all electrodes. On the right, MRI showed -3.82mm ± 0.82, and MER showed -3.32mm ± 1.47; on the left, MRI displayed -4.08mm ± 0.64, and MER showed -3.74mm ± 0.71. The mean differences between MRI and MER distances were -0.52mm ± 0.96 on the right and -0.34mm ± 0.71 on the left, indicating MRI identified a higher upper STN border. No statistical significance of difference between sides was observed ($p < 0.45$). Correlation coefficients were +0.8 ($p < 0.05$) for right electrodes, +0.43 ($p < 0.02$) for left electrodes, and +0.69 overall ($p < 0.05$), all statistically significant.

Conclusions: We conclude that there is a strong positive correlation between MRI and MER data in locating the upper border of STN, both overall and on each side individually. Therefore, we feel that preoperative MRI can reliably predict the upper border of STN. However, a larger sample size is required to validate these findings.

Keywords: Parkinsons disease, Deep Brain Stimulation, Micro-electrode recording

EP059 / #155

Topic: *AS01. Movement Disorders*

GETREADY PATIENT APP

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Introduction: The movement disorder neurostimulation team at the Royal Victoria Infirmary, Newcastle, United Kingdom devised 'Get Ready®' for patients who are candidates for deep brain stimulation for movement disorders. The app is a mobile phone application that provides condition-specific material designed to inform patients of the different assessments they will undergo pre-operatively, in addition to providing pre-habilitation exercises and written psychological support. The app also allows remote data collection, in the form of patient reported outcome scales and allows images of post-operative wound sites to enable remote visits. Our goals from this app were to: Improve access to written information. Provide pre-surgery advice/ guidance e.g. provide exercise regimes, encouraging medication compliance, which improves patient wellbeing, supportive messaging to improve patients mental health. Improve post-surgerical written advice e.g. wound care, re-charging of implanted devices. Collection of patient satisfaction data. Collection of pre and post-surgery outcome data electronically.

Methods: We recruited patients referred for DBS surgery for three conditions, essential tremor, Parkinson's disease and dystonia. We have created a digital pathway for all three groups, with information and assessments released at pre-specified time-points following enrolment.

Results: The app has enabled the movement disorders team, to capture data at regular intervals pre and post-operatively. This has been completed both by patients at home, prior to their clinic appointment and it has provided clinicians a standardised means of capturing in clinic assessments such as the MDS-UPDRS part III. We have carried out patient satisfaction surveys that will be incorporated into the poster. We have also captured a log of deep brain stimulation assessment queries, prior to utilisation of the app and after utilisation of the app and we are able to demonstrate a reduction in time spent answering queries following introduction of the app.

Conclusions: This project has benefited patient care by improving their access to information at all stages of their patient journey from the initial referral through to post surgery recovery and the first year of assessment. This is supported by patient feedback.

EP060 / #159

Topic: *AS01. Movement Disorders*

SUBTHALAMIC NUCLEUS VERSUS FOREL'S FIELD ELECTRICAL STIMULATION IN PARKINSON'S DISEASE. FIVE-YEAR EFFECTS ON MOTOR SYMPTOMS AND QUALITY OF LIFE

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Introduction: Electric stimulation centered at the Fields of Forel (FF) reduce motor symptoms compared to STN. This approach improved clinical unresponsive freezing of gait. However, no long-term follow-up study has compared the stimulation effects between the two targets

Methods: Twenty-two patients were studied (10 FF and 12 STN). Motor symptoms, cognition, quality of life and gait symptoms were assessed using the MDS-UPDRS III, the MDR Scale, the PDQ-39, and the FOG score. The Levodopa equivalent daily dose was recorded

Results: Relative to preoperative period, FF patients had an average reduction of 32.2% in the MDS-UPDRS III scores ($P < 0.01$), a decrease of 35.3% in the FOG scores ($P < 0.01$), and an improvement of 25.9% in the PDQ-39 ($P < 0.01$). There was a 7.5% decline in cognition ($P<0.01$). [JP1] LED was reduced by 26.3% ($P < 0.01$). The STN group had an average reduction of 39.4% in the MDS-UPDRS III scores ($P < 0.01$), a decrease of 23.7% in the FOG scores ($P < 0.01$), and an improvement of 33.2% in the PDQ-39 scores ($P < 0.01$). Cognition declined 1.6 % ($P < 0.01$), and LED reduced by 15.06% ($P =0.02$). FF patients were older than STN patients at the time of surgery: 61.2 yr and 55.7 yr, respectively ($P=0.02$); and had longer time of disease ($P = 0.02$). Compared to STN, FF-DBS yielded a greater reduction in FOG ($P = 0.02$) and was associated with a higher decrease in cognition ($P < 0.01$). The effect on quality of life was similar in both groups

Conclusions: Both FF and STN stimulation improved motor and quality of life over a 5-year period. FF-DBS had a higher reduction both in FOG and in LED compared to STN-DBS. Nevertheless, FF-DBS was accompanied by higher decline in cognition, likely attributed to the older age and more advanced stage of PD. These data support our hypothesis that FF-DBS is a feasible option for treating motor symptoms in PD, including FOG in advanced stages

Keywords: Fields of Forel, Brain Stimulation, Parkinson's disease

EP061 / #177

Topic: *AS01. Movement Disorders*

OPTIMAL SUBTHALAMIC STIMULATION SITES AND RELATED NETWORKS FOR FREEZING OF GAIT IN PARKINSON'S DISEASE

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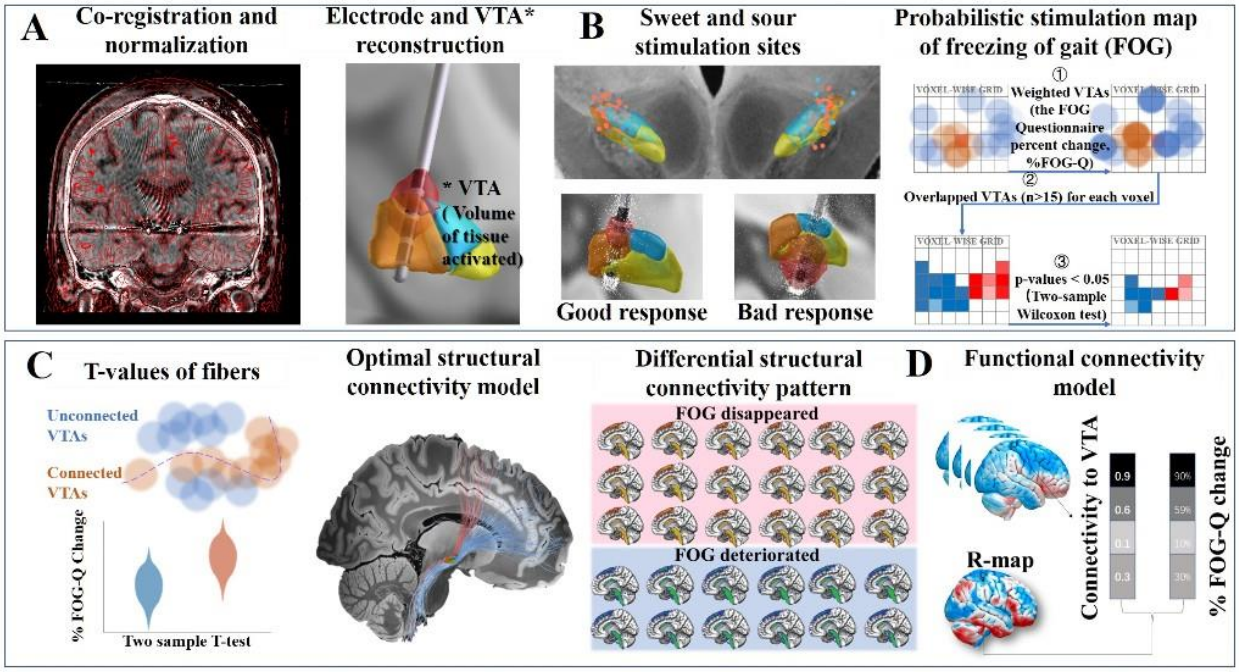
Introduction: Freezing of gait (FOG) is a common and debilitating symptom in Parkinson's disease (PD). Although subthalamic deep brain stimulation (STN-DBS) is an effective treatment for PD, postoperative FOG severity has been reported to alleviate, deteriorate, or remain constant. We conducted this study to explore the optimal stimulation sites and related connectivity networks for STN-DBS treating PD-FOG.

Methods: 76 PD-FOG patients who underwent bilateral STN-DBS were retrospectively included. The volumes of tissue activated (VTA) were estimated based on individual electrode reconstruction. The optimal/sour stimulation sites were calculated at coordinate/VTA/mapping level and mapped to anatomical space based on patient-specific images and stimulation settings. The structural/functional predictive connectivity networks for postoperative FOG-Q change were also identified based on normative connectomes derived from Parkinson's Progression Marker Initiative database. Leave-one-out cross-validation model validated the above results.



Results: The dorsolateral two-thirds of STN was identified as the optimal stimulation site, while the ventrocentral portion of the right STN and internal capsule surrounding the left central STN were considered as the sour stimulation sites. Modulation of the fiber tracts connecting to the supplementary motor area (SMA), preSMA, and pedunculopontine nucleus accounted for FOG alleviation, whereases tracts connecting to medial and ventrolateral prefrontal cortices contributed to FOG deterioration.

Conclusions: The optimal/sour stimulation sites and structural/functional predictive connectivity networks for STN-DBS treating FOG are identified and validated in sizable PD patients. With the growing

understanding of stimulation sites and related networks, individualized DBS treatment with directional leads will become an optimal choice for PD-FOG patients in the future.

Keywords: Parkinson's disease, Subthalamic deep brain stimulation, freezing of gait

EP062 / #203

Topic: *AS01. Movement Disorders*

RESPONSE OF FREEZING OF GAIT TO DEEP BRAIN STIMULATION IN PARKINSON'S DISEASE

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Introduction: Deep brain stimulation (DBS) of the subthalamic nucleus (STN) aims to alleviate both Parkinson's Disease (PD) cardinal symptoms as well as gait disorders. Despite this, there are patients refractory to conventional programming parameters, therefore other options such as low-frequency STN stimulation or combined stimulation of the STN and substantia nigra reticulata (SNr) ca be used to improve freezing of gait (FOG). We present the evolution of freezing of gait (FOG) in patients with PD treated with DBS in the STN.

Methods: 63 patients were analyzed. 47 patients presented FOG preoperatively, which were classified as: 1- FOG with complete response to medication (60%), 2- FOG with partial response (25%), 3- FOG without response (0%), 4- FOG after DBS as part of the evolution of PD (8%). Patients were programmed initially using conventional parameters. Those which FOG did not improve were programmed at low frequencies (40/80Hz) in the STN. Those who did not respond were then programmed using combined stimulation of the STN and the SNr. We conducted aggregation analysis with Quentry software (Brainlab) to determine the highest voxel overlap from the activated contacts.

Results: No patient developed FOG due to DBS surgery. 37 patients completed the follow-up. 65% of patients with FOG responded to high-frequency STN stimulation. 13.5% responded to STN stimulation at low frequency. 16% improved with combined stimulation (STN+SNr) and 4% did not improved or worsened their FOG despite using different stimulation parameters. Aggregation analysis showed highest voxel overlap at the dorsolateral region of the SNr.

Conclusions: FOG are common in PD and although most respond to conventional high-frequency STN stimulation parameters, up to 30% can be redeemed through other modalities.

Keywords: Deep Brain Stimulation, Parkinson's disease, freezing of gait

EP063 / #228

Topic: *AS01. Movement Disorders*

TRACTOGRAPHY GUIDED RADIOFREQUENCY THALAMOTOMY

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Introduction: Thalamotomy is well established treatment for medically refractory tremor. It is particularly useful for people in whom deep brain stimulation may be contraindicated. In recent times thalamotomies fell out of fashion due to the risk of medical complications arising from targeting errors. However, with advances in imaging science we believe that using tractography guided thalamotomies prove to be accurate, safe and effective. Here we describe a case series of 18 patients in a single tertiary care centre in Southampton in whom such a procedure was used to excellent effect.

Methods: This is a retrospective, observational clinical study. Patients were selected following a multi disciplinary team discussion. They were all over the age of 70 and had medical co-morbidities or frailty scores such that deep brain stimulation would not have been appropriate. Physical assessment, including handwriting and tremor were measured before and after the procedure. All patients were invited to undergo a tractography based MRI scan before the procedure and pre-operative planning was performed. This MRI was then merged with a preoperative CT scan as part of the operation. The merged imaging was used intraoperatively to guide the thalamotomy placement which was confirmed with a post-op CT once thalamotomy was completed. Following the procedure writing assessment and Quality of Life assessment questions were performed.

Results: To date we have performed 18 tractography guided thalamotomies in patients in whom a medically refractory tremor was causing significant disability.In 100% of the patients excellent tremor control was achieved with no complication. QoL and Function questionnaires revealed significant improvement in functionality. Postoperative writing assessments also showed improvement.

Conclusions: In our case series we show that tractography guided thalamotomies are safe and effective surgical procedures that can be undertaken with a high level of accuracy.

Keywords: Radiofrequency Thalamotomy, tremor, tractography

EP064 / #229

Topic: *AS01. Movement Disorders*

SEGREGATING THE STRUCTURAL CONNECTIVITY INTO THE SUBTHALAMIC NUCLEUS AND THE INTERNAL PALLIDUM: DIFFERENCES OF THE TWO SURGICAL TARGETS

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Introduction: Deep brain stimulation (DBS) is an established treatment for advanced Parkinson's disease (PD). The subthalamic nucleus (STN) and the internal pallidum (GPi) are the two main surgical targets. Stimulation of the two targets was recently shown to yield similar improvement in motor outcome via a common fronto-parietal network. Nonetheless, different side effects may emerge from the stimulation of the two nuclei and a lesser reduction of levodopa medications is expected from patients undergoing GPi-DBS. Since STN and GPi are functionally linked but histologically distinct, we hypothesize that differences from stimulation may rely on a diverse organization of structural connectivity inside the two nuclei.

Methods: To test our hypothesis, FSL probabilistic tractography was performed on 250 subjects from the Human ConnectomeProject (HCP) to investigate the structural connectivity of STN and GPi with 10 anatomic areas. For each HCP subject, the connectivity map (C-Map) of the two masks with each target area was determined by dividing the seed-to-target voxels within the mask by their maximal intensity value. 10 average C-Maps representing the maximal connectivity of the CM mask with the target areas were derived by averaging each map across the HCP subjects. Then, Lead-DBS was used to generate VTAs (volume of tissue activated) from 110 PD patients (58 STN-DBS from Milan and 52 GPi-DBS from Los Angeles) and the 10 C-Maps were co-registered with the patient's T1 MRI sequence. Finally, the calculated intersection volume between the patient's VTA and each C-Map was compared between STN-DBS and GPi-DBS patients for the two hemispheres with two-way MANOVA.

Results: STN-DBS patients displayed a statistically significant greater VTA/C-Map intersection volume with limbic (amygdala [$p=0.032$], hippocampus [$p<0.001$]), precentral [$p<0.001$] and postcentral [$p=0.031$] connections, while GPi-DBS patients had greater VTA/C-Map intersection with cerebellar connections [$p<0.001$]. Significant right-left asymmetry for the two nuclei was found in VTA/C-Map intersections with cerebellar, precentral and superior frontal connections.

Conclusions: Regardless of the correct targeting of the motor component, stimulation-related effects may stem from the heterogeneous organization of the connections inside the two nuclei. This could explain differences in outcomes for the two targets despite a similar motor improvement.

Keywords: Surgical Targets, Deep Brain Stimulation, Parkinson's disease

EP065 / #240

Topic: *AS01. Movement Disorders*

EXPLORING THE ROLE OF SPINAL CORD STIMULATION PARAMETERS IN MODULATING MOTOR OUTCOMES IN PARKINSON'S DISEASE

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Introduction: Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by motor symptoms such as bradykinesia, dystonia, tremor, and postural instability. Despite the emergence of neuromodulation therapies like spinal cord stimulation (SCS) as potential interventions for managing refractory PD symptoms, the optimal parameters for achieving significant therapeutic improvement remain undetermined.

Methods: Two female patients diagnosed with PD underwent SCS to address refractory neuropathic pain. Patient one presented with debilitating tremors in the arms, dystonic movements in the toes, neuropathic pain in the upper limbs, and low back pain radiating to the right lower limb. Although interventions including botulinum toxin infiltration (BT), radiofrequency (RF) treatment, and nerve blocks initially provided pain relief, the efficacy was transient, lasting less than six months. Following a successful SCS trial, the patient proceeded to undergo a permanent SCS procedure. Patient two suffered from medication-refractory low back pain extending to the thighs, dystonic movement in the right lower limb, and tremor in the right hand. In both cases, a higher percutaneous lead was implanted at the thoracic levels T4 and T8 and stimulated using parameters outlined in Table 1. Pain intensity was assessed using the Visual Analog Scale (VAS), and motor symptoms were evaluated using the Unified Parkinson's Disease Rating Scale (UPDRS) pre- and post-operatively.

Table 1. SCS levels and parameters.

	Frequency	Pulse width	Amplitude	Mode
T4	90 Hz	210ms	0.7mA	FAST
T8	450 intraburst	210ms	0.8mA	Microburst (12.5ms ON/12.5ms OFF)

Results: Patient one experienced 80% amelioration in VAS scores (from 9 to 1), alongside a 42% enhancement in UPDRS scores (from 24 to 10). This progress included 70% reduction in hand tremors and 80% alleviation in dystonic symptoms, which persisted throughout one-year follow-up period. Patient two showed a 50% improvement in the UPDRS scale (from 24 to 12) and 100% VAS (from 8 to 0) previously persistent in three-month follow-up. These reports match the use of SCS to address pain and dystonia in PD.

Conclusions: While these case reports have illustrated the efficacy and safety of percutaneous SCS using T4 (FAST-mode) and T8 (microburst-mode) for alleviating pain and motor symptoms in PD, larger-scale studies are needed to validate these findings.

Keywords: Spinal Cord Stimulation, Parkinson's disease, parameters

EP066 / #309

Topic: *AS01. Movement Disorders*

TRACTOGRAPHIC CHARACTERISTICS OF STN DBS PATIENTS WITH COMPLETE LEVODOPA REDUCTION

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Introduction: Subthalamic nucleus (STN) deep brain stimulation (DBS) is an effective therapy for Parkinson's disease (PD) patients with medically refractory tremors, motor fluctuations, and drug-induced dyskinesias. Dorsolateral STN has been identified as the motor part that allows effective control of PD motor symptoms, whereas ventromedial STN has been associated with limbic areas and non-motor symptoms. We aim to evaluate the tractographic characteristics of STN DBS patients who were able to achieve complete levodopa reduction after surgical treatment.

Methods: We retrospectively reviewed PD patients who received STN DBS at our institution. Imaging-guided targeting with quantitative susceptibility mapping (QSM) techniques were employed to target dorsal posterior STN, and intraoperative microelectrode recording (MER) were used to confirm the placement of the DBS lead in STN. Patients' responses to STN stimulation were assessed intraoperatively. We evaluated motor outcomes of STN DBS and investigated the tractographic characteristics in patients with complete levodopa reduction. Clinical outcomes including levodopa-equivalent daily dose (LEDD), unified Parkinson's Disease Rating Scale (UPDRS), and side effects were evaluated at baseline, 6-month and 1-year follow-up visits.

Results: Twenty-five STN DBS patients with complete levodopa reduction and 30 STN DBS patients without complete levodopa reduction were analyzed in this study. Baseline characteristics including disease duration (7.5 vs. 10 years, $p = 0.07$) and baseline LEDD (807.4 vs. 1048.2, $p = 0.117$) did not differ between the two groups. Patients with complete levodopa reduction had a greater preoperative off medication tremor UPDRS part III sub-scores (11.7 vs. 7.2, $p = 0.007$). Patients without complete levodopa reduction postoperatively had greater levodopa responsiveness preoperatively, with 75.9% of UPDRS improvement versus 57.9% ($p = 0.036$). Postoperatively, both groups had similar off-medication, on-stimulation UPDRS part III scores (11.8 vs. 11.9, $p = 0.962$).

Conclusions: Bilateral STN DBS is an effective treatment for PD patients. Using QSM to target the dorsolateral motor STN in PD patients can lead to greater degree of medication reduction and improved motor outcomes. QSM radiomics and tractography can identify potential patients who can tolerate a higher degree of medication reduction, and may be used to improve post-DBS management strategies.

Keywords: subthalamic nucleus, Parkinson's disease, tractography

EP067 / #332

Topic: *AS01. Movement Disorders*

THE USE OF DIRECTIONAL LEADS, ANATOMICAL 3D STIMULATION AND BRAINSENSE TECHNOLOGY FOR DEEP BRAIN STIMULATION: BENEFITS, TECHNICAL NOTES, AND OUR EXPERIENCE

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Introduction: Deep brain stimulation (DBS) has become the treatment of choice for advanced stages of Parkinson's disease, medically intractable essential tremor, and complicated segmental and generalised dystonia. In addition to accurate electrode placement in the target area, effective programming of DBS devices is considered the most important factor for the individual outcome after DBS. Programming of the implanted pulse generator (IPG) is the only modifiable factor once DBS leads have been implanted and it becomes even more relevant in cases in which the electrodes are located at the border of the intended target structure and when side effects become challenging.

Methods: We analysed 10 patients who underwent a DBS procedure with directional leads were we used 3D anatomical stimulation, BrainSense technology and rechargeable pulse generator (IPG) capable of multiple independent current control and 10 patients who received non-directional leads with a similar IPG. While trajectory planning and most steps of the surgical procedure were identical to conventional DBS lead implantation, differences in indication, electrode handling, lead control, parameters of the stimulation, and complications were documented and analysed in comparison to a control group with ring electrodes.

Results: Stimulation under 3D visualisation during the first stimulation reduced the time needed to find the most adequate stimulation parameters by at least 30 minutes, neurologists feel more confident when stimulating patients using 3D visualisation, BainSense helped to find the most adequate part of the electrode to be used for stimulation such as directional electrodes reduced side effects of the stimulation up to 20 percent compared to non-directional electrodes

Conclusions: We concluded that the use of directional leads, 3D anatomical stimulation and BrainSense technology decreased the side effects of the stimulation, the need for repositioning of the electrode, the time needed to find the best parameters for stimulation and increased the effectiveness of the stimulation.

Keywords: Directional Leads, 3D stimulation, BrainSense

EP068 / #435

Topic: *AS01. Movement Disorders*

A SINGLE CENTER PROSPECTIVE EVALUATION OF INTRAOPERATIVE COMPLICATIONS IN PATIENTS WHO HAVE UNDERGONE DEEP BRAIN STIMULATION PROCEDURES.

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Introduction: Deep brain stimulation (DBS) is regarded as a safe neurosurgical treatment for patients with movement disorders, epilepsy, and neuropsychiatric disorders. DBS may be associated with intraoperative complications like intracranial hemorrhage being the most frequent but others complications resulting from DBS hardware implantation should not be forgotten. The aim of this study was to assess the incidence of intraoperative complications in DBS procedures to improve the safety profile of those operations.

Methods: All functional DBS procedures performed in patients with movement disorders and drug-resistant epilepsy over a period from January 2018 till June 2023 at Department of Neurosurgery, Institute of Psychiatry and Neurology, Warsaw were analyzed for intraoperative complications based on radiological examinations and patients medical records.

Results: During this time period, 260 patients underwent 380 DBS lead implantations in 351 stereotactic procedures. Intracranial hemorrhages (ICHs) occurred in 4 patients. Two patients were diagnosed with right frontal lobe hemorrhage, and 2 patient with subdural bleeding limited to the burr hole. ICHs produced only transient headaches that resolved within a week. There were two cases of pneumothorax. There was 1 case of hematoma at the implantable pulse generator (IPG) side which required evacuation. Additionally 2 DBS leads required replacement within 2 days after initial surgery.

Conclusions: Our surgical technique has low incidence of intraoperative complications. No patient suffered from permanent deficits.

Keyword: intracerebral hemmorhage, pneumothorax, intraoperative complications

EP069 / #449

Topic: *AS01. Movement Disorders*

FLUCTUATIONS IN EFFICACY AND THEIR INFLUENTIAL FACTORS WITH PREDICTION MODELS OF SUBTHALAMIC DEEP BRAIN STIMULATION IN PARKINSON'S DISEASE

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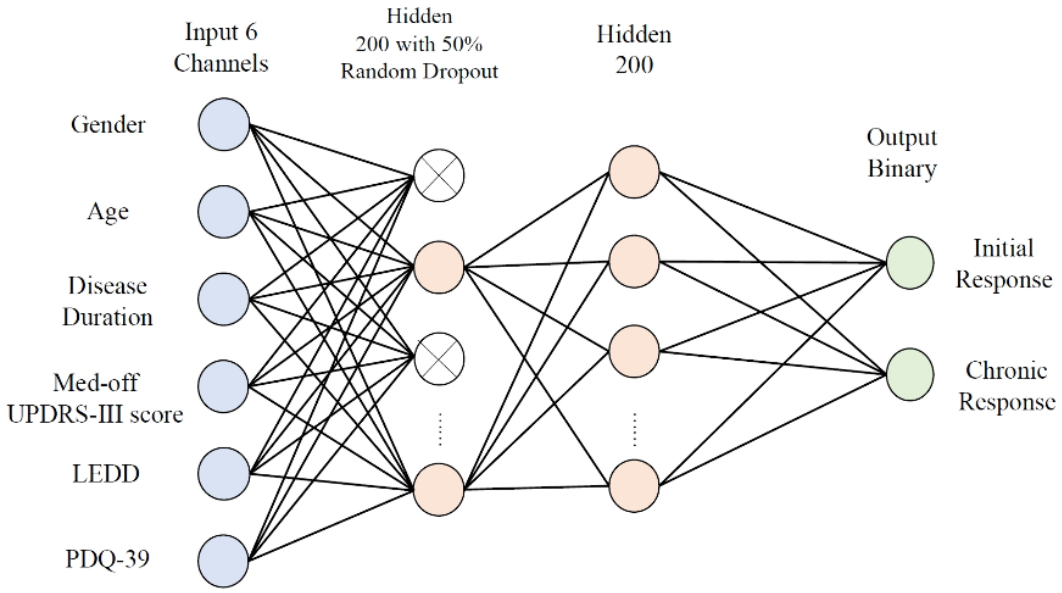
Introduction: Subthalamic deep brain stimulation (STN-DBS) is an established treatment for Parkinson's disease (PD), known to improve motor symptoms. However, its long-term effectiveness varies. This study investigates these fluctuations and develops machine learning models to predict them on an individual basis.This study investigates these fluctuations and develops machine learning models to predict them on an individual basis.

Methods: We studied 92 PD patients treated with bilateral STN-DBS at our center. Based on their motor symptom changes from 1 month (after DBS activation) to 1 year, they were categorized into two groups: the Decreased group (less motor improvement over time) and the Stable group (consistent or increased improvement). We used a multilayer perceptron (MLP) classifier to predict individual efficacy changes.



Results: Both groups showed significant motor symptom improvement at both 1-month and 1-year evaluations. Emotional symptom improvements were similar in both groups. The Decreased group had milder symptoms, higher levodopa-equivalent daily dose (LEDD) at the start, and more pronounced initial improvement. They also underwent more medication reductions post-STN-DBS than the Stable group. By analyzing differences in motor and nonmotor symptoms, and factors influencing MLP predictions, we created models to forecast efficacy changes. The MLP model showed 89.47% accuracy, 86.5% sensitivity, and 87.5% specificity.

Conclusions: Various factors affect STN-DBS efficacy over time. Our predictive models can assist in selecting suitable surgical candidates, providing patient and family counseling, and setting realistic expectations about treatment outcomes.

Keywords: Subthalamic deep brain stimulation, motor fluctuations, Parkinson's disease

EP070 / #515

Topic: *AS01. Movement Disorders*

DEEP BRAIN STIMULATION IN WOODHOUSE–SAKATI SYNDROME

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Introduction: Woodhouse–Sakati syndrome (WSS) is a rare autosomal recessive disease with distinctive neuroendocrine manifestations with dystonia being the most common. No clear guidelines are available for the treatment of dystonia in WSS. This study analyze the impact on Deep Brain Stimulation (DBS) on WSS associated Dystonia

Methods: Patients with genetically confirmed WSS who underwent GPI DBS for dystonia were analyzed retrospectively. The participants were assessed using the Burk-Fahn-Marsden Dystonia Rating Scale (BFMDRS) and videotaped pre- and postsurgery at different follow-up points. The primary outcome was the BFMDRS score one year after surgery compared with that at baseline. The primary outcome was correlated with preoperative factors, such as the age at onset, disease duration at surgery, proportion of life lived with dystonia, and severity rate.

Results: Five patients with severe progressive generalized dystonia secondary to clinically and genetically confirmed WSS underwent bilateral GPI DBS from February 2011 until March 2021. The mean age at disease onset and at the time of DBS were 11.3 and 18.6, respectively. All patients' BFMDRS total scores improved from baseline to 12 months post-DBS. The mean pre-DBS BFMDRS score was 71.1, and the mean post-DBS BFMDRS score was 43.6. The percentage improvement in the BFMDRS mean scores from before to after DBS was approximately 39.

Conclusions: Our case series showed clinical improvement in patients who underwent bilateral GPI as an advanced therapy for generalized dystonia secondary to WSS. We recommend further research on DBS in a larger sample of WSS patients to obtain significant results.

Keyword: Dystonia, Woodhouse-Sakati Syndrome, Deep Brain Stimulation

EP071 / #101

Topic: *AS01. Movement Disorders*

EFFICACY OF LESIONING SURGERY FOR DYSTONIA

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Introduction: Dystonia is a movement disorder characterized by involuntary, sustained, and patterned muscle contractions, which cause twisting and repetitive movements. Dystonia includes various types of movement disorders such as cervical, generalized, task specific focal hand dystonia. Several potential stereotactic targets have been suggested for the treatment of dystonia such as GPi, Vim, PTT and VoA-VoP junction.

Methods: All the patients of dystonia who underwent surgical interventions in Annapurna Neurological Institute and Allied Sciences since January 2015 till December 2023 were included in our study. We performed unilateral pallidotomy/ Pallidothalamic tractotomy for cervical dystonia, bilateral pallidotomies for generalized dystonia and unilateral VoA/VoP junction thalamotomy for task specific focal dystonia (TSFD). We used ZD Fishers frame and the thermal lesioning machine of Cosman Radiofrequency (RF) generator with the lesioning electrode of 0.75 mm internal diameter and 2 mm exposed tip was used.

Results: There were altogether 45 cases out of which six cases were TSFD (13 writers cramp and 2 musicians cramp), 18 cases were cervical dystonia and 12 cases were generalized dystonia. The preoperative score of 2 reached to 4 in postoperative period in both Musicians cramp in 6 months follow up. There was 80 percent improvement in Writers cramp rating score which was also persistent in one year follow up. There was hemiballismus in one case of writers cramp after few days of surgery. There was overall 80 percent decrease in the symptoms of dystonia. The mean age was 41.49 years±12 years. The male: female ratio was 3:1. The mean percentage change in BFMDRS was 70 percent (p value<0.05) in postoperative period. There was relapse of symptoms in 3 cases of generalized dystonia and 2 cases of cervical dystonia in one year follow up period. One case of tardive dystonia with repeated bilateral pallidotomy had status dystonicus and finally she got better with intrathecal baclofen pump. One case had hemiparesis and three cases had transient dysarthria.

Conclusions: Lesioing surgery for dystonia is rewarding for TSFD, cervical dystonia and generalized dystonia. However, tardive dystonias and generalized dystonias have higher relapse rate.

Keywords: Movement disorder, dystonia, Lesioning

EP072 / #142

Topic: *AS01. Movement Disorders*

HIGH INTENSITY MR GUIDED FOCUSED ULTRASOUND FOR MOVEMENT DISORDERS, BILATERAL IS POSSIBLE AND WORTH IT?

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Introduction: Unilateral magnetic resonance-guide focused ultrasound (FUS) is efficacious for the treatment of medically refracttory movement disorders such as tremor or Parkinson´s disease. There is less experience with bilateral FUS in both movement disorders.

Methods: We present our data of patients treated with bilateral FUS for tremor and Parkinson´s disease. Safety, efficacy and image data are going to be analyzed in detail. We review the available literature and compare wiht our results.

Results: In our more than four hundred patients serie, we have treated only 17 staged, bilateral FUS patients. 9 patients had Parkinson´s disease and 8 had essential tremor. We have performed 8 staged bilateral FUS thalamotomy, 7 staged bilateral FUS subthalamotomy and 2 staged bilateral FUS pallidothalamyc tract (Ptt). The second target mirrored the first one. Adverse events after second FUS procedure were mild and manily transient. All the patients improved after the bilateral FUS procedure.

Conclusions: We report a small serie of patients with possitive results, most of them with a longterm follow up. It is clear that a larger randomised clinical trial would be necessary to demonstrate the safety and efficacy of this procedure. The limited literature available on this topic shows that bilateral FUS is possible but the disability when treating the second side doesn't improved as much as in the firts side. Me must take this into consideration when we make benefit-risk balance.

Keywords: movement disorders, MRguided focused ultrasound, bilateral treatment

EP073 / #217

Topic: *AS01. Movement Disorders*

HISTORY AND FUTURE PROSPECTS OF THALAMOTOMY

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Introduction: Tremor has challenged neurological and neurosurgical researchers and clinicians for many decades, and the evolution of its treatment has left an important footprint in the medical field. The disorder severely affects the quality of life of patients, and its treatment has undergone significant changes over its long history. Understanding the history of thalamotomy helps us delve into the future of this treatment.

Methods: We conducted the systematic review according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) standards. We conducted a systematic literature search using PubMed using terms including thalamotomy AND tremor up to March 2023. In addition, a manual search method, including Google Scholar databases, was performed. After this initial screening process, two authors (KS and DW) independently assessed the eligibility of full-text papers.

Results: We identified a total of 92 publications. Chemothalamotomy for Parkinson's disease was first documented as early as 1955, with an original paper in 1963 providing detailed information on 149 operations performed on 114 patients. Subsequently, a study involving radiosurgery, including the gamma knife, was published in 1998, and MR-guided focused ultrasound (MRgFUS) was introduced in 2013. In terms of treatment effectiveness, the tremor improvement ratio stands at 82.9% for chemothalamotomy, while radiosurgery and MRgFUS show an 81.1% improvement rate. When it comes to side effects, chemothalamotomy recorded a rate of 9.4%, which is comparable to the 9.3% observed with radiosurgery and MRgFUS. However, chemothalamotomy had a higher rate of postsurgical mortality at 3.4%, whereas there have been no reported cases of postsurgical mortality in recent radiosurgery and MRgFUS procedures.

Conclusions: Techniques for thalamotomy have advanced over time, and the number of serious side effects has decreased. As the technique is expected to develop further in the future, clinicians should aim for safer treatment.

Keywords: MR guided Focused ultrasound, history, thalamotomy

EP074 / #80

Topic: *AS01. Movement Disorders*

INTRATHECAL BACLOFEN PUMP SURGERY IN SPASTICITY: DESCRIPTIVE ANALYSIS OF LONG TERM FOLLOW-UP IN SINGLE INSTITUTION

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Introduction: The intrathecal baclofen (ITB) treatment is increasingly being utilized in the management of spasticity, particularly preferred in non-ambulatory patients with generalized spasticity. We present our series of patients who underwent ITB treatment, elucidating procedure-related complications and detailing the treatment experiences of patients in our hospital.

Methods: Between 2005 and 2023, the files of patients with an ITB pump implanted by a single neurosurgeon at a single center were retrospectively examined from both the neurosurgery and Physical Medicine and Rehabilitation clinics. Data related to the ITB test trial for the cases were also recorded. Patients were contacted by phone, and those who agreed to participate were invited for a follow-up examination at the hospital to complete the questionnaire. For patients unable to come to the hospital, the surveys were conducted through online meetings. The study was approved by the Marmara University Medical Faculty Medical Ethics Committee: 09.2023.602.

Results: Charts of 47 operated patients were reviewed. Among them, 31 had spastic and dystonic cerebral palsy, 9 had spinal cord injury, 2 had demyelinating disease, and 2 had hereditary spastic

paraparesis.

Infection	10	26,3%
Catheter	1	2,6%
Pump device alarming	1	2,6%
Baclofen overdose	1	2,6%
Pump released from the abdominal wall	1	2,6%
Total adverse event	14	36,8%

Conclusions: In our case series, the most common diagnoses were spastic or dystonic cerebral palsy and spinal cord injury. Complications related to the ITB pump identified in our series include infections, as well as pump and catheter-related issues. The complication rate associated with ITB pump surgery is relatively high; however, according to literature reports, ITB pump remains the most effective treatment for severe spasticity and dystonia observed in patients with severe cerebral palsy and spinal cord injury.

Keywords: complication, spasticity, intrathecal baclofen pump

EP075 / #129

Topic: *AS01. Movement Disorders*

GOLFER'S DYSTONIA SUCCESSFULLY TREATED WITH VENTRO-ORAL THALAMOTOMY

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Introduction: Golfer's dystonia, a relatively understudied condition affecting athletes, lacks effective treatments and awareness. This case report explores the successful use of ventro-oral (Vo) thalamotomy in treating Golfer's dystonia, a form of task-specific focal dystonia

Methods: A 53-year-old male with Golfer's dystonia experienced left-hand stiffness, progressing to wrist flexion, hindering golf performance and daily tasks. Traditional treatments had no effect, leading to ventro-oral thalamotomy. Immediate improvement occurred, resolving dystonia, restoring motor control, and notably enhancing golf performance (score improved from 112 to 80).

Results: Task-specific dystonia commonly appears in adulthood, affecting motor skills. The patient's golf score, initially comparable to professionals, deteriorated significantly (112) post-symptom onset. Ventro-oral thalamotomy showcased gradual improvement, emphasizing its potential in managing golf-related dystonia, specifically for focal hand types

Conclusions: This case supports ventro-oral thalamotomy's efficacy in addressing Golfer's dystonia when conventional treatments fail. Continued monitoring is crucial for assessing long-term effectiveness and symptom recurrence, offering a promising avenue for future research in similar cases.

Keywords: thalamotomy, Brain lesioning, dystonia

EP076 / #179

Topic: *AS01. Movement Disorders*

ASSESSING THE SUSTAINABILITY IMPLICATIONS OF WORKFLOW CHANGES IN DBS SURGERY WITHIN A EUROPEAN PUBLIC HEALTHCARE SYSTEM

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Introduction: Efficient management of surgical pathways is crucial for sustaining public healthcare systems while ensuring optimal clinical outcomes. This study examines the evolution of the surgical path and its financial implications.

Methods: A retrospective analysis from 2017 to 2024 was conducted at Cruces University Hospital in Barakaldo, Basque Country, Spain, to assess modifications in the surgical pathway. Data on per-patient costs, surgical duration, hospital stay, and clinical results were collected and compared.

Results: On average, 23 patients underwent DBS system implantation annually for movement disorders, except in 2020, when only 10 patients underwent surgery. Clinical outcomes remained consistent. The improvement in intra and pre-operative imaging has facilitated progress in surgical technique. Initially, surgery involved an ICU overnight admission post-electrode implantation, followed by a second stage for neurostimulator placement on another session (€33,584 per patient). Eventually, it evolved into a single-day procedure without ICU admission (€26,337 per patient, 22% cost reduction). However, post-pandemic, costs rose due to factors like price inflation and adoption of higher-cost, yet more durable neurostimulators (Abbott's Infinity 7 €11,162 vs Medtronic's Percept PC €16,225). The surgery costs have increased due to the rise in the cost of the implanted materials, including the IPG, extensions, and electrodes. The prices rose from 15,452 euros to 25,322 euros, resulting in a final procedure cost of 37,374 euros in 2023. This increase occurred even with procedural efficiencies, which led to a 14% reduction in average surgical duration from 2020 to 2022 (from 387 to 333 minutes), and a decrease in hospital stay from 3 days in 2022 to 1 day in 2024, with no increase in readmissions or emergencies. Performing surgery under general anesthesia versus local anesthesia and sedation before 2020 significantly enhanced patient experience without directly impacting costs.

Conclusions: Neurosurgeons must acknowledge the impact of their practice and continually strive for excellence in improving workflow efficiency. This proactive approach is crucial for sustaining and broadening access to surgery within public healthcare systems. Clinicians should assess whether the increased hardware cost translates into medium-term clinical improvement or an increase in cost-effectiveness, which needs to be evaluated soon.

Keywords: Deep Brain Stimulation, workflow efficiency, cost-effectiveness

EP077 / #199

Topic: *AS01. Movement Disorders*

COMPARATIVE ANALYSIS OF STATISTICAL METHODS FOR DETERMINING DEEP BRAIN STIMULATION SWEET SPOTS

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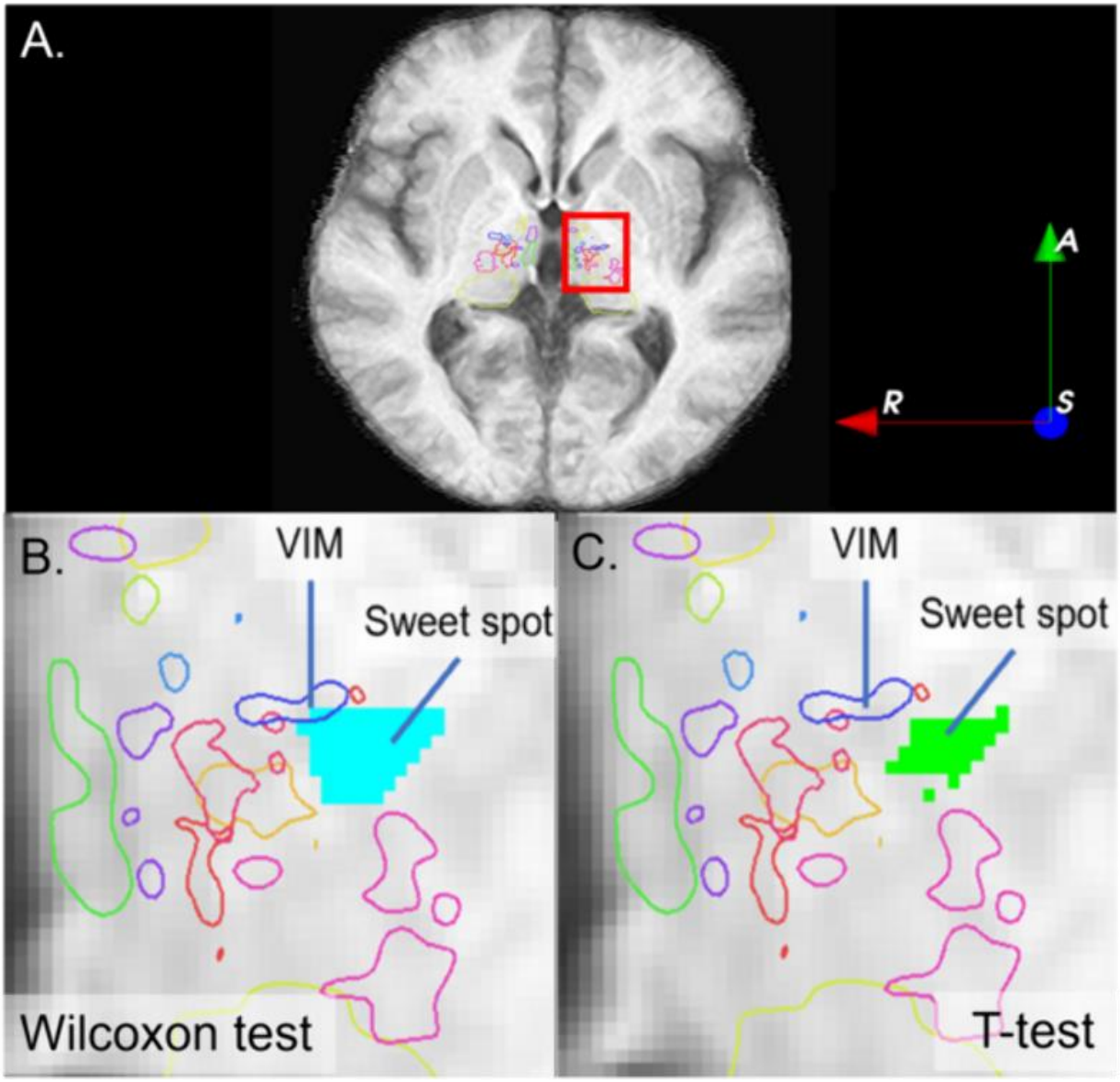
Introduction: The precise location of the optimal target, or sweet spot, for Deep Brain Stimulation (DBS) is still unknown. However, its determination plays a pivotal role in guiding algorithms for the automatic programming of DBS parameters. Several studies have approached this problem, mainly employing t-test and Wilcoxon test to obtain probabilistic stimulation maps. However, a thorough assessment of the chosen statistical method's influence on the sweet spot extracted from group analysis is still missing. The objective of this study is to compare the outcomes of the above mentioned statistical tests applied to DBS patients data.

Methods: The data used for the study was captured during the intra-operative stimulation tests of 6 Essential Tremor (ET) patients bilaterally implanted in the ventro-intermediate nucleus (VIM). Stimulation settings were used to compute patient-specific electric field simulations which were then transformed to a group-specific MRI template. A voxel-wise one-tailed one-sample t-test was evaluated against a voxel-wise one-tailed Wilcoxon signed rank test. Voxels significantly (p-value < 0.05) associated with tremor improvement exceeding 60% were extracted. False Discovery Rate (FDR) was then applied to correct for false positives. The resulting significant sweet spot clusters were compared by visual analysis and by computing their total volume, intersection volume, and Dice coefficient. Lastly, for validation, the overlap between electric field and sweet spot was correlated with the degree of improvement.

Results: The generated stimulation maps and extracted sweet spots are shown in Figure 1. The applied statistical methods resulted in sweet spots of sizes: 28.88 mm^3 for the t-test and 58.25 mm^3 for the Wilcoxon. The Dice coefficient was 66%. The significant volume obtained with the t-test was entirely contained in the volume extracted with the Wilcoxon test. Stimulations encompassing the sweet spot were positively correlated to improvement with similar coefficients for both

methods.



Conclusions: Users should be aware that the chosen statistical method can largely impact the extracted significant volume in group analysis. Despite the difference in size, stimulation of both sweet spots was correlated to improvement. The definition of robust criteria to guide the method's choice is thus fundamental. This work was supported financially by the Swiss National Science Foundation (205320_207491).

Keywords: Deep Brain Stimulation (DBS), Probabilistic sweet spot

EP078 / #204

Topic: *AS01. Movement Disorders*

A CRITICAL APPRAISAL OF FOCUSED ULTRASOUND IN MOVEMENT DISORDERS

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Introduction: In recent years stereotactic functional neurosurgery has seen the establishment of a new tool, focused ultrasound (FUS). Even though not personally familiar yet with FUS, we embarked on a journey through the literature to try to understand this newcomer and its rapid expansion.

Methods: Publications with clinical data on FUS thalamotomy and FUS pallidotomy were scrutinised and analysed in relation to other techniques.

Results: We found considerable variations in the use of different scales and outcome measures, as well as how results of FUS are reported, which, when compared to outcomes of DBS seem to suggest that the success of FUS in relation to other procedures is not to be found mainly in its effects or side effects. The symptom reduction might in many patients be good enough regarding thalamotomy, but concerning pallidal surgery, FUS outcome compares poorly to other techniques. Regarding side effects of FUS, these would have been considered high in studies on DBS.

Conclusions: A broader perspective is needed regarding FUS. Clinicians must give a thought to human psychology and the interaction between patients, professionals, and industry, and consider the dynamic between the Haves and the Have nots. Only by taking this into consideration is it possible to understand the dramatic changes of perspectives occurring within the profession over a few years´ time: why MER is no longer necessary for those who previously would never implant an electrode or do a RF lesion without it in a target that cannot be visualized; how the discourse has changed from DBS being a reversible technique with few complications, to DBS becoming a problematic technique with many complications; how the focus has changed from side-effects occurring by lesion in the target area to purported complications of a probe en route to the target; how what would previously had been considered as a high level of side effects is now considered as safe; how irreversibility has changed from being undesirable to desirable, etc. FUS has undoubtedly advantages in surgery for movement disorders. However, a nuanced discussion is necessary regarding its place in the armamentarium of stereotactic functional neurosurgery.

Keywords: tremor, FUS, thalamotomy

EP079 / #259

Topic: *AS01. Movement Disorders*

RADIOFREQUENCY LESIONING FOR HEMIDYSTONIA: A SYSTEMATIC REVIEW

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Introduction: Radiofrequency lesioning (RL) has been a mainstay in functional neurosurgery to treat dystonic movement disorders, which was replaced by deep brain stimulation (DBS) in the late 1990s. Studies on RL have shown variable benefit in patients with hemidystonia. The aim of this systematic review is to summarize published reports on RL for hemidystonia and to evaluate clinical outcome.

Methods: A systematic literature review was performed according to PRISMA guidelines in PubMed, Embase, and Web of Science using a customized software (UiPath, NY) to identify all case reports, case series, and cohort studies reporting patients with hemidystonia treated with RF. Manuscripts were then automatically searched for the search term "hemidystonia". The selected manuscripts were manually screened to identify appropriate reports.

Results: More than 20 reports were identified with 118 cases published between the years 1982 - 2022. Thalamotomy was performed in 88 cases, pallidotomy in 27 cases, and both in the remaining 3 cases. Until 1998, improvement in hemidystonia was not quantified using standard rating scale. Qualitatively good improvement was reported in 18/39 (50%) patients with hemidystonia after thalamotomy. In addition, newer reports indicated a 35% benefit in BFMDRS total score in 7 patients and 60% in 15 patients, respectively. With respect to pallidotomy, 4/8 (50%) patients for whom individual patient data were available were classified as responders, when considering a 20% cut-off for improvement. The lack of a standardized assessment of the results contributes to the difficulty in interpreting the outcome.

Conclusions: With recent advances in targeting methods, RL may be reconsidered as a treatment option for hemidystonia as an alternative to DBS. Further studies with standardized assessment of outcomes are needed to better characterize variability in outcome and to identify prognostic factors.

Keywords: Radiofrequency Lesioning, Hemidystonia

EP080 / #323

Topic: *AS01. Movement Disorders*

A PROPOSED PRE-INTERVENTION FRAMEWORK FOR NEUROSURGERY IN CHILDREN WITH MEDICALLY REFRACTORY HYPERTONIA

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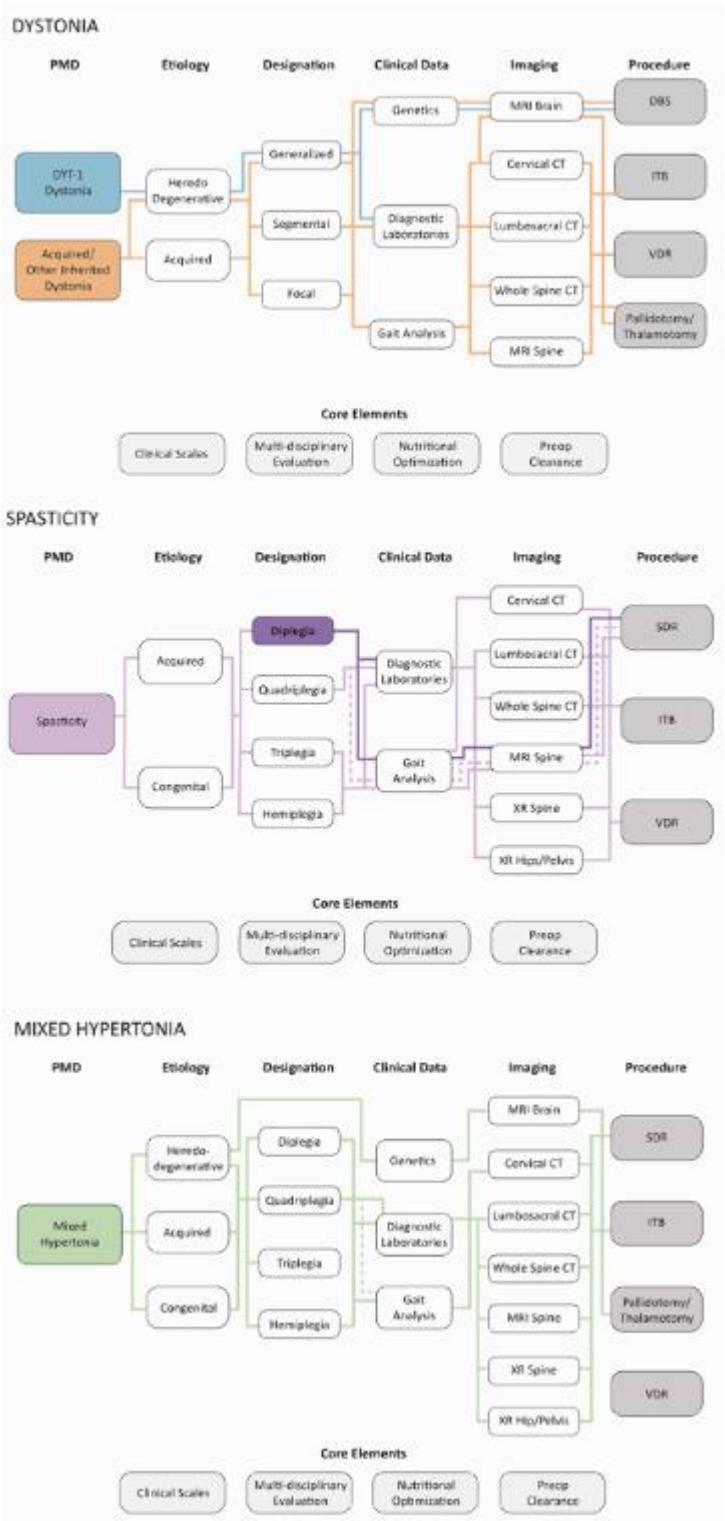
Introduction: People with pediatric movement disorders (PMDs) frequently require escalating medical, interventional, and neurosurgical therapies to maintain or improve their quality of life. Institutional studies describe local preintervention evaluation for selected PMDs; however, no international consensus guidelines exist recommending a common preintervention workflow. A preoperative work-up for children with medically refractory epilepsy is defined by the International League Against Epilepsy (ILAE). We provide a systematic review of pediatric preintervention screening for movement disorders and present a suggested preintervention framework for children with PMDs destined for neurosurgical interventions.

Methods: A systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines using three databases. Fifteen studies were included.

Results: Presurgical evaluations included a multidisciplinary clinical evaluation, clinical scales, radiological imaging, physical therapy (PT), occupational therapy (OT), gait analysis, nutritional analysis, and genetic analysis. These data were used to create presurgical algorithms for pediatric hypertonia defined by dystonia, spasticity, or mixed hypertonia. Each diagnosis-specific algorithm guides the clinician

from left to right through the recommended evaluation and towards appropriate neurosurgical



treatments.

Conclusions: An algorithmic approach to the presurgical evaluation of PMDs could be similar to that which exists for medically refractory epilepsy, and should include a multidisciplinary, multimodal

evaluation. An evidence-based, structured, diagnosis-related presurgical algorithm for PMDs can improve patient care via standardization of indications, work-up, and recommendations.

Keywords: Hypertonia, Pre-Surgical Evaluation, PEDIATRIC

EP081 / #492

Topic: *AS01. Movement Disorders*

THE CORRELATION OF CRANIOMETRIC MEASUREMENTS AND SUBTHALAMIC NUCLEUS TARGET COORDINATIONS IN DEEP BRAIN STIMULATION SURGERY FOR PARKINSON 'S DISEASE

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Introduction: Deep brain stimulation (DBS) surgery is a promising therapeutic option for Parkinson's disease (PD). However, individual anatomical variations may influence electrode placement accuracy and treatment outcomes. This study aimed to investigate the correlation between craniometric measurements and subthalamic nucleus (STN) target coordinates in DBS surgery for PD in Vietnam.

Methods: Retrospective study on 77 Parkinson's disease patients undergoing bilateral STN-DBS surgery from January 2014 to July 2023 at Nguyen Tri Phuong hospital and University Medical Center in Ho Chi Minh City. Craniometric measurements and STN target coordinates were analyzed using Pearson correlation, univariate, and multivariate linear regression. The coordinates of the STN were compared between the two hemispheres in the same patient, based on skull morphology indices.

Results: Significant gender-based differences were observed in craniometric measurements, with males exhibiting larger dimensions. Strong positive correlations were found between cranial circumference and breadth/length, as well as between AC-PC distance and cranial measurements. STN coordinates demonstrated correlations with various cranial measurements, with X2 coordinates correlating most strongly with horizontal arc and third ventricle width (the correlation coefficients are r = 0.4 and r = 0.42, respectively).. Linear regression equation: Optimal X (mm) = 0.967 + 0.202* Third ventricle width (mm) + 0.024* Horizontal arc (mm). The linear regression equation in the compatible hemispheric group is: X is compatible (mm) = 0.031* Horizontal diameter (mm) + 0.014* Horizontal arc (mm) + 0.129* Third ventricle width (mm) with R2= 0.50. Skull morphology indices revealed potential asymmetries affecting STN coordinates, particularly in patients with abnormal cranial indices.

Conclusions: The craniometric measurements and third ventricle width correlate with the STN coordinates, especially the X-coordinates. Our study highlights the importance of considering individual craniometric measurements and skull morphology in DBS surgery planning for STN target. Understanding these relationships could aid in optimizing electrode placement and improving therapeutic outcomes. Further research is warranted to validate these findings and optimize surgical strategies for personalized DBS therapy in PD patients.

Keywords: Skull Morphology, subthalamic nucleus, Deep Brain Stimulation

EP082 / #502

Topic: *AS01. Movement Disorders*

ENHANCING INTRAOPERATIVE MANAGEMENT OF PROPOFOL-INDUCED DYSKINESIA IN GPI DBS FOR PARKINSON'S DISEASE

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Introduction: The globus pallidus internus (GPi) is increasingly recognized as a viable target for deep brain stimulation (DBS) in Parkinson's disease (PD). GPi DBS has proven to be a safe and effective approach for alleviating many motor symptoms associated with advanced PD, even intraoperatively when patients are not on dopaminergic medications, thus minimizing the occurrence of dyskinesia. However, isolated instances of spontaneous involuntary movements during GPi surgery, particularly under propofol anesthesia, have been documented in a few cases in the literature. This case represents a unique occurrence where dyskinesia was relieved during bilateral GPi DBS surgery, a phenomenon not previously reported to our knowledge.

Methods: We present the case of a 54-year-old male diagnosed with PD who underwent GPi DBS to manage motor fluctuations, including tremor, bradykinesia, rigidity (observed in the OFF state of dopaminergic medications), and dyskinesia (ON state). Following a levodopa challenge, the patient exhibited an 80% improvement, with UPDRS scores decreasing from 50 in the OFF to 10 in the ON state.

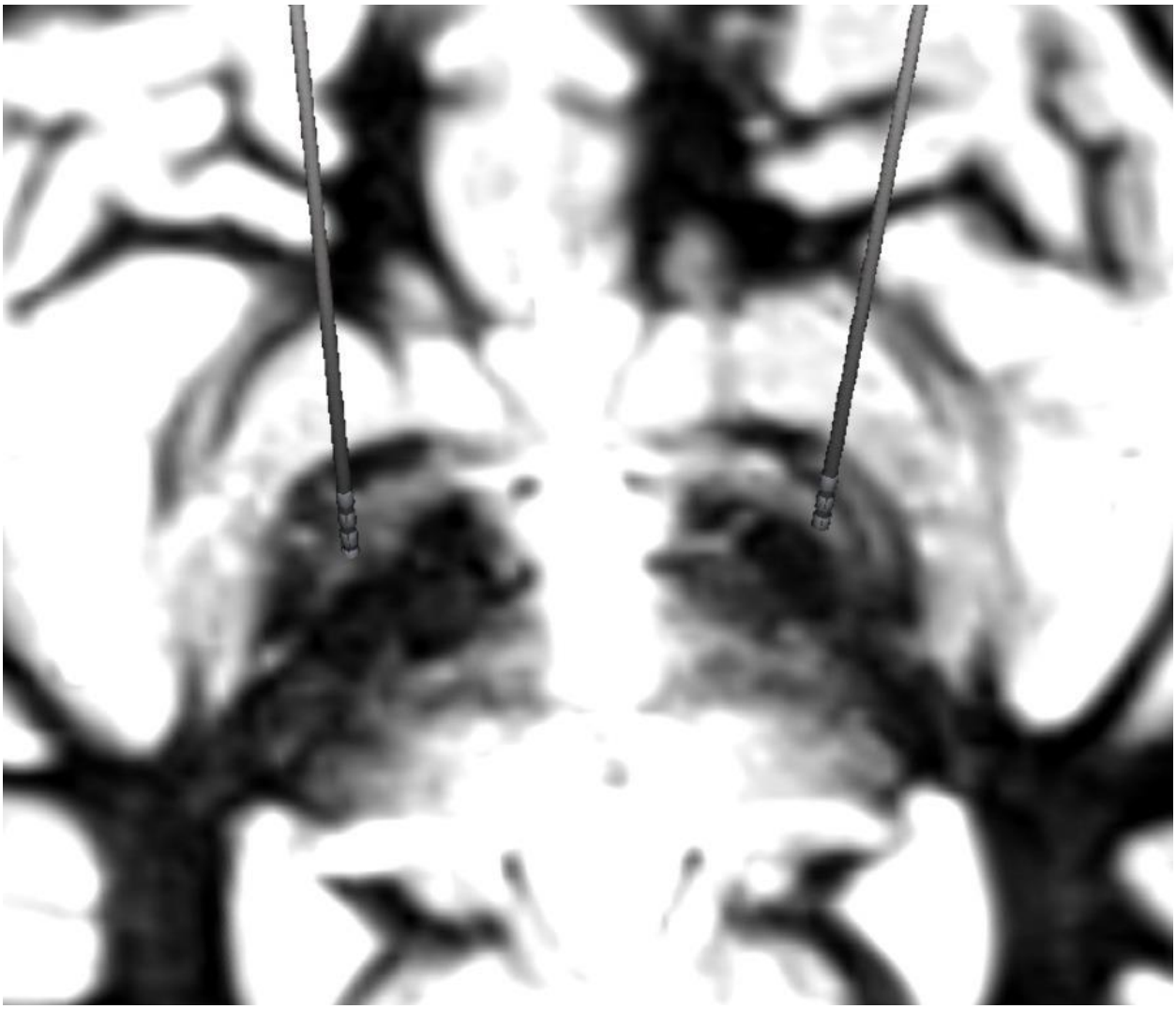
Results:

DBS parameters and coordinates

Target	Contacts	Frequency	Pulse width	Amplitude	x	y	z
left GPi	1+/5,6,7-	130Hz	60ms	1.5mA	-19	2.5	-2
right GPi	1+/5,6,7-	130Hz	60ms	1.5mA	18	4	-3

The patient presented for DBS surgery after a 13-hour withdrawal from dopaminergic medication. He presented debilitating rigidity, tremor and bradykinesia, but no dyskinesia was evident at baseline. However, transient sedation with propofol precipitated dyskinesias, resembling those induced by levodopa, worse on the right hemibody. Despite the discontinuation of sedation, the dyskinesias persisted. Following placement and activation of directional Boston Scientific bilateral GPi DBS leads (Table 1), the patient experienced complete resolution of dyskinesia, bradykinesia, and tremor. Rigidity scores decreased from 4+ to 1+ post-

stimulation.



Conclusions: Propofol-induced acute dyskinesia represents a severe drug-induced adverse reaction, potentially mitigated by GPi DBS. This observation raises intriguing questions regarding the role of the motor region of GPi in alleviating not only dyskinesia stemming from dopaminergic medications but also other drug-induced dyskinesias, including propofol-induced. Further research is warranted to elucidate the metabolic pathways of these drugs and ascertain whether Parkinson's disease contributes to the manifestation of such an adverse reaction.

Keywords: Deep Brain Stimulation, Dyskinesia, Propofol

EP083 / #160

Topic: *AS01. Movement Disorders*

STEPWISE DUAL TARGETS LESIONING IN A SINGLE PROCEDURE FOR THE TREMOR AND AKINESIA IN MIXED-TYPE PARKINSION'S DISEASE

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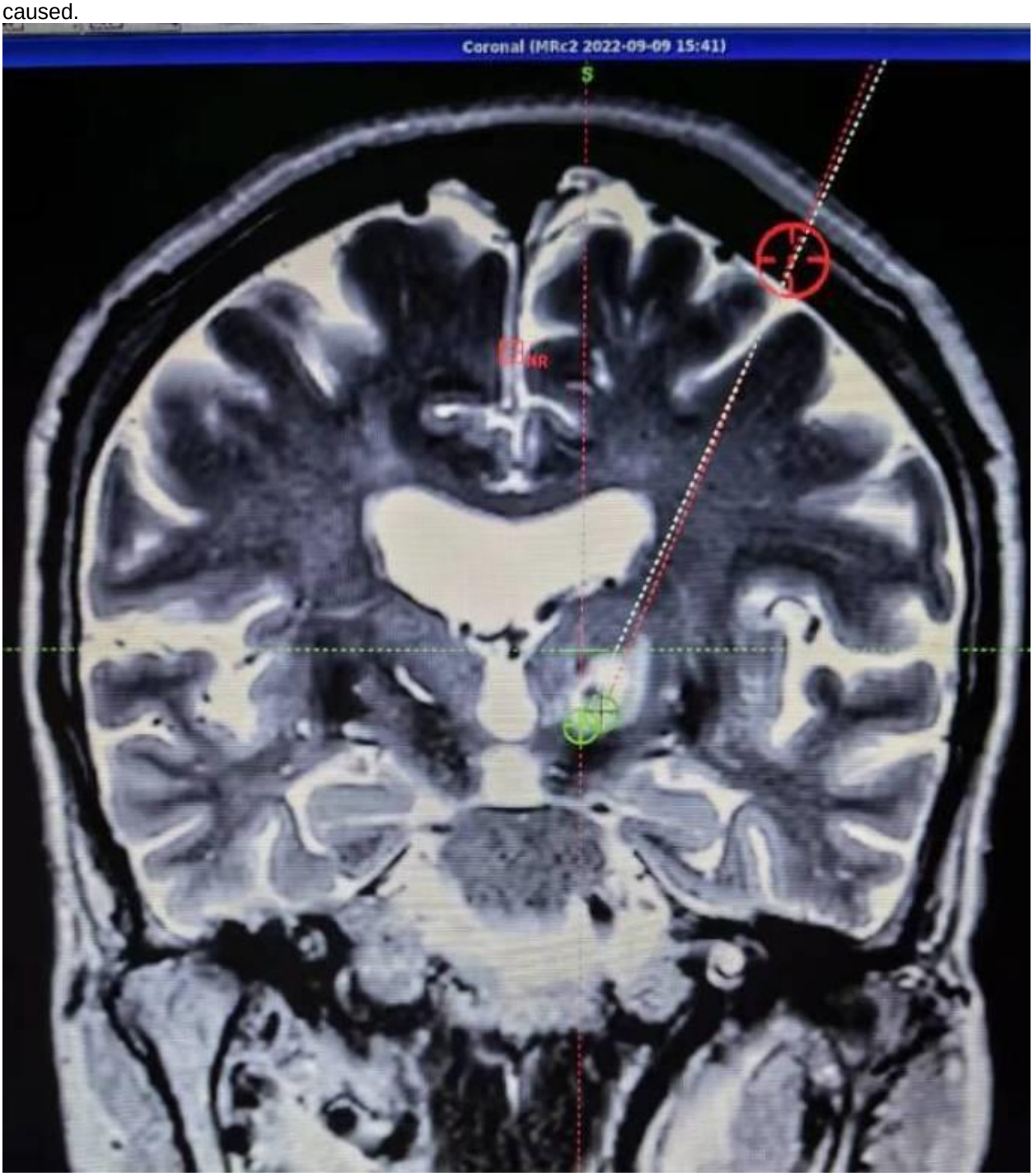
Introduction: Targeting the cerebellothalamic tract (ctt) and ventral intermediate nucleus (VIM) can abolish tremor and alleviate rigidity, but has no effect on akinesia; whereas targeting the pallidothalamic tract (ptt) can improve bradykinesia and rigidity, but doesn't always has satisfying result for tremor; therefore, a combination of two targets lesioning, i.e., stepwise to lesion ctt at inferior aspect of thalamus and ptt at Forel's H field in which contain globus pallidus internus projecting fibers to thalamus and pedunculopontine nucleus, will improve all motor symptoms of mixed-type parkinsion's disease (PD).

Methods: 12 mixed–type PD were enrolled in this pilot study, of those 6 underwent unilateral lesioning and 6 staged bilateral lesioning .The Unified Parkinson]s Disease Rating Scale (UPDRS) part Ⅲ was used to evaluate the results of 18 unilateral procedures, as well as compare the scores after second surgery with after first surgery and before first surgery in 6 staged bilateral procedures. The complications and the subjective impressions of patients were also analyzed.

Results: UPDRS scores significantly reduced after operation, the more significantly after bilateral surgery. In all 18 treated side, tremor completely disappeared, akinesia, rigidity, gait and posture significantly improved when compared with before operation ($p<0.001$), and the improvement maintained stable up to the last follow-up of 6 to 50 months. The levodopa equivalent daily dose was significantly reduced, and 3 patients stopped medication. 2 patients experienced two-days transient dyskinesia, and 1 had a three-days transient worsening speech difficulty, which all occurred in first week after operation, no other obviously adverse effects were reported. All patients were satisfied with their results.

Conclusions: Stepwise dual radiofrequency lesions of ctt and ptt magnificently improve the Contralateral overall motor symptoms in mixed-type PD, and the staged bilaterally lesioning is feasible without noticeable permanent complications. Figure legend. The MRI showing staged bilateral surgery, stepwise dual targets lesioning by a single burr hole, lesioning the ctt at the thalamic base and ptt inferior to thalamus. the imaging was taken one week after second-sided operation, demonstrating the targets surrounding edema at its peak time, but without any side effects being

caused.



Keywords: Stereotactic Neurosurgery, cerebellothalamic tract, pallidothalamic tract

EP084 / #371

Topic: *AS01. Movement Disorders*

TRANSCRANIAL MAGNETIC STIMULATION FOR ESSENTIAL TREMOR TREATMENT: A CASE SERIES

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Introduction: Transcranial Magnetic Stimulation (TMS) is a potential treatment for tremors due to its ability to modulate underlying pathological circuits and brain functions through the production of a magnetic field that induces a transient focal electrical field in the target brain region.

Methods: In this study, two essential tremor patients underwent TMS between 2022 and 2024 as a replacement for propranolol monotherapy. Given that pharmacological treatment was unsatisfactory, TMS treatment was performed.

Results: Case description
M.A.R., 66y.o., had the onset of symptoms in childhood and presented vocal, head and bilateral tremors in the limbs with worsening on the right, having difficulty writing, eating, drinking coffee and performing manicures, leading to social embarrassment. She underwent therapeutic treatment with propranolol and 10 TMS sessions in 2022 in right dorsolateral prefrontal cortex (F4) using 10Hz, 1800 pulses, three centimeters anterior to left M1 using 1Hz and 400 pulses; and right cerebelar (IZ) using 1Hz 400 pulses. After TMS, she showed improvement in personal care, writing, speaking, reduced tremors by 20% and has greater confidence and coherence in reasoning. Long-term follow up three months after TMS showed maintenance of benefits. G. P. M, 18y.o., presented with the onset of symptoms at the age of 8, with worsening since 2021, with tremor in the left upper limb and social embarrassment. He underwent therapeutic treatment with propranolol and then with 10 TMS sessions in 2023 in right dorsolateral prefrontal cortex (F4) using 10Hz, 1800 pulses, three centimeters anterior to right M1 using 1Hz and 400 pulses; and left cerebelar (IZ) using 1Hz 400 pulse. After a few months of TMS, his tremor of the left right upper limb improved from grade 2 to grade 1 and also his sleep improved. Long-term follow up three months after TMS showed maintenance of benefits.

Conclusions: Transcranial Magnetic Stimulation in ipsilateral cerebellar region and contralateral M1 considering the worse tremor side is a promising therapeutic possibility for essential tremor patients. Possibly, the crossing dentatorubrothalamic tracts are involved in the improvement presented by these patients.

Keywords: targets, essential tremor, transcranial magnetic stimulation

EP085 / #485

Topic: *AS01. Movement Disorders*

NEUROSURGICAL TREATMENTS OF SPASMODIC DYSPHONIA: ILLUSTRATION OF TWO CASES AND LITERATURE REVIEW

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Introduction: Spasmodic dysphonia is a debilitating neurological disorder characterized by involuntary spasms of the vocal cords, resulting in impaired speech production. Neurosurgical interventions, including deep brain stimulation (DBS) targeting the globus pallidus internus (GPi-DBS) and unilateral radiofrequency pallidotomy (RF-P), have shown promise in the management of medically refractory spasmodic dysphonia. This study aims to present two illustrative cases of spasmodic dysphonia treated with GPi-DBS and RF-P, respectively, and provide a comprehensive literature review to evaluate the safety and efficacy of these interventions

Methods: We conducted a retrospective analysis of two patients diagnosed with spasmodic dysphonia who underwent neurosurgical treatment at our institution. One patient received GPi-DBS, while the other underwent unilateral RF-P. Pre-operative and post-operative assessments included evaluation of vocal parameters such as voice quality, intelligibility, and severity of dystonia. Additionally, a thorough review of the existing literature was performed to summarize the outcomes of GPi-DBS and RF-P in the treatment of spasmodic dysphonia.

Results: Both patients exhibited significant improvement in their spasmodic dysphonia symptoms following neurosurgical interventions. The patient treated with GPi-DBS experienced a notable reduction in vocal cord spasms, leading to improved voice quality and intelligibility. Similarly, the patient who underwent unilateral RF-P demonstrated significant improvement in speech production, accompanied by a reduction in dystonia severity. The literature review findings highlighted the safety and effectiveness of both GPi-DBS and RF-P, with high patient satisfaction rates and minimal adverse effects reported across various studies.

Conclusions: Our findings, along with the comprehensive literature review, support the notion that GPi-DBS and unilateral RF-P are safe and effective neurosurgical treatments for spasmodic dysphonia. These interventions offer substantial relief from vocal cord spasms, resulting in improved voice quality, intelligibility, and overall quality of life for affected individuals. Further research is needed to refine patient selection criteria, optimize surgical techniques, and establish long-term outcomes. The presented cases and literature review contribute to the growing body of evidence supporting the use of GPi-DBS and RF-P as viable treatment options for medically refractory spasmodic dysphonia.

Keywords: spasmodic dysphonia, Pallidotomy, DBS

EP086 / #522

Topic: *AS01. Movement Disorders*

COMPARING THE FEATURES OF CERVICAL DYSTONIA SUBTYPES-A RETROSPECTIVE STUDY IN PAKISTAN

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Introduction: Cervical dystonia (CD) being the most comman are characterised by abnormal twisted postures of head and neck. Although they differ phenotypically but one hallmark feature of CD is the heterogeneity and variability of the clinical signs of these patients.We aim to find out the how different subgroups of cervical dystonia differ in terms of sensorimotor features as they usually differ clinically in terms of onset and spread

Methods: Clinical and demographic data of 600 patients was collected. Motor features (head tremor and tremor elsewhere) and sensory features (sensory trick and neck pain) were investigated. We analyzed possible associations between motor and sensory features in CD subgroups [focal neck onset, no spread (FNO-NS); focal neck onset, segmental spread (FNO-SS); focal onset elsewhere with segmental spread to neck (FOE-SS); segmental neck involvement without spread (SNI)]

Results: Neck pain was present in 61.3% of patients. Head tremor was present in 54.43% and tremor elsewhere was present in 16% of CD. In FNO-NS, FOE-SS, and SNI subgroups, head tremor was associated with the presence of tremor elsewhere. Sensory trick was associated with pain in patients with FNO-NS and with head tremor in patients with FNO-SS.

Conclusions: The frequent association between head tremor and tremor elsewhere may suggest a common pathophysiological mechanism. For sensory trick in FNO-NS and FNO-SS it may be hypothesised that theres a gating mechanism attempting to reduce pain and a sensorimotor mechanism attempting to control tremor.

Keywords: cervical dystonia, Parkinson's, Sensorimotor

EP087 / #186

Topic: *AS01. Movement Disorders*

VENTRO-ORAL THALAMOTOMY IN THE TREATMENT OF FOCAL HAND TASK-SPECIFIC DYSTONIA

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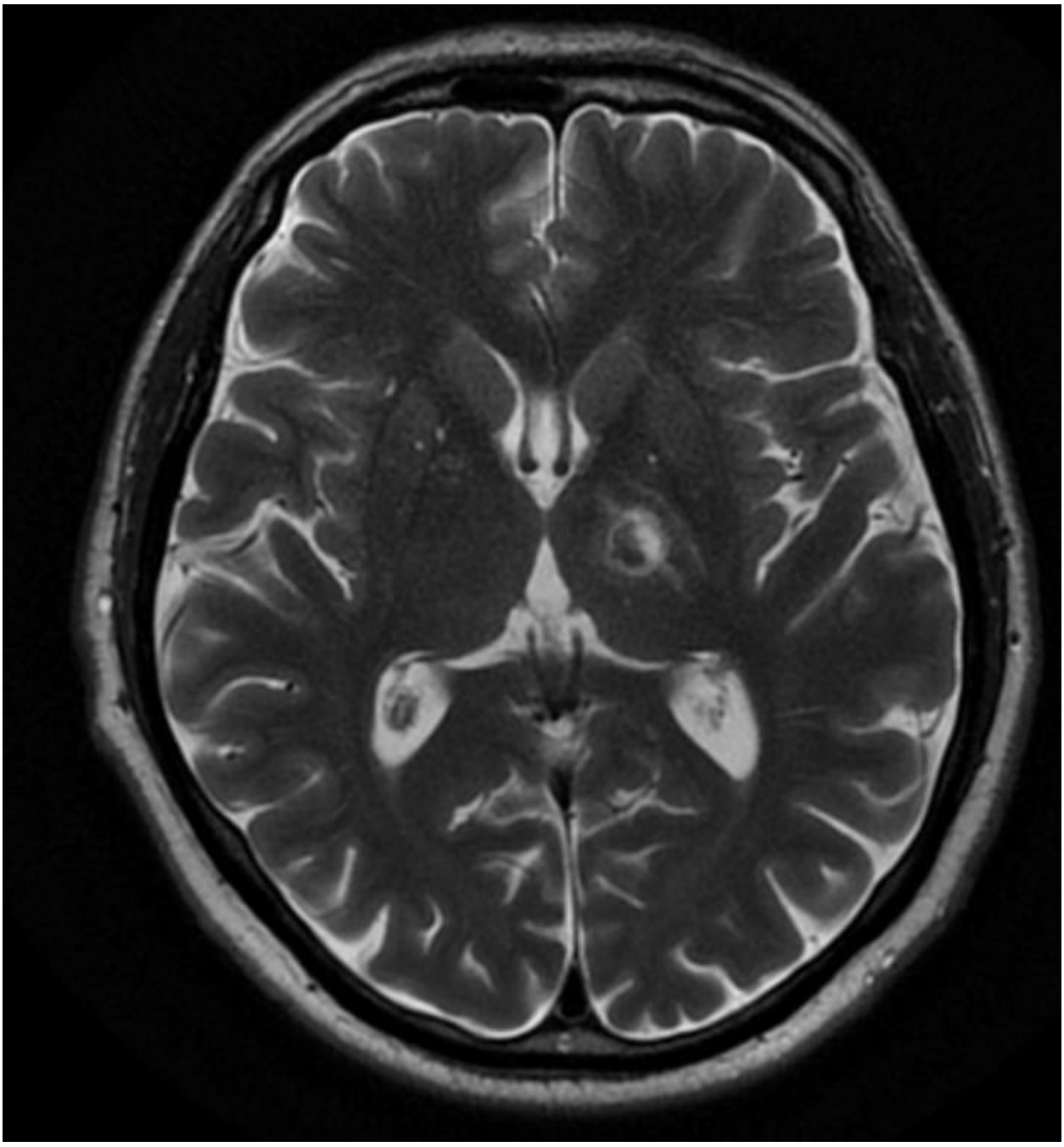
Introduction: focal hand task-specific dystonia can lead to significant occupational disability and to lost patient's career. Surgical results with favorable outcomes have been published but their evidenced base is still limited. Ventro-oral thalamotomy (Vo thalamotomy) demonstrates favorable outcomes in term of safety and efficacy. We show our initial experience of Vo thalamotomy in the treatment of focal hand-task specific dystonia.

Methods: 6 patients with medically refractory focal hand task-specific dystonia underwent unilateral Vo thalamotomy since 2022. Surgery included MRgFUS and RF ablation. Stereotactic coordinates of Vo thalamotomy were: X = 13,5 mm, Y = 2 mm posteriorly from the midpoint of the intercommissural line, Z = 1 or 3 mm (for RF and MRgFUS respectively). Evaluation was performed according to TFSD scale.

Results: all patients were men, the mean age was 47.1 years (from 20 to 64) years, the mean duration of disease was 13.8 years (from 5 to 37). Focal hand dystonia included 5 patients with musician's dystonia and 1 case with writer's cramp. Focused ultrasound thalamotomy was performed in 5 cases, RF thalamotomy - in 1. The mean follow-up was 6 months (from 1 to 24). All patients experienced significant relief of dystonia, TFSD was changed in the mean from 1,3 to 4. Short-term complications (dysarthria, ataxia) developed in 3 patients.

Clinical characteristics

Focal hand dystonia	Age, y	Duration of symptoms, y	Procedure	Range of temperature	Number of lesions	Complications	Follow-up, months	Baseline TFSD	The last TFSD
Musician's dystonia	40	12	MRgFUS	55-61°	3	Dysarthria	24	3	5
Writer's cramp	56	5	MRgFUS	55-60°	4	None	8	2	4
Musician's dystonia	28	5	MRgFUS	55-60°	2	Ataxia	8	0	3
Musician's dystonia	48	13	MRgFUS	55-60°	1	None	6	0	4
Musician's dystonia	47	11	RF	70°, 30 s	6	None	1	2	4
Musician's dystonia	64	37	MRgFUS	>60°	3	Dysarthria, ataxia, monoparesis	1	1	4



Conclusions: Vo thalamotomy can improve of focal hand-task specific dystonia. Further observation for the patients and additional studies are needed.

Keywords: focal hand dystonia, thalamotomy, MRgFUS

EP088 / #220

Topic: *AS01. Movement Disorders*

COMMERCIALLY AVAILABLE DETERMINISTIC TRACTOGRAPHY IS USEFUL IN PLANNING DBS FOR TREMOR

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Introduction: Increasing evidence suggests the Dentato-rubro-thalamic tract (DRTT) represents a targeting 'sweet-spot' for both DBS and lesioning in Essential Tremor. Probabilistic tractography is regarded as the gold standard modality for DRTT delineation, but is computationally very intensive and not commercially available for stereotactic planning. One mainstream commercial sterotaxy software (Brainlab Elements) now incorporates tractography, although this is deterministic. This has intrinsic limitations such an inability to resolve crossing or kissing fibres, despite its computational simplicity. One small study has compared DRT assessed via gold-standard probabilistic and deterministic methods utilizing the same Brainlab Elements. It concluded the latter could not accurately depict the crossed DRTT but for the uncrossed DRTT the two were within 2mm. It is unclear if this is resolution is good enough for real world surgical targeting.

Methods: Eight patients underwent bilateral DBS for essential tremor with electrodes targeting the VIM thalamus. Pre-operative MRI imaging included 3T 64 direction DTI imaging which was fused with a stereotactic CT performed on the morning of surgery. All surgical planning was performed using Brainlab elements. The targeting strategy and operative workflow employed is described. In all cases, the anteroposterior i.e. Y co-ordinate was adjusted to ensure the planned trajectory passed through the DRTT as reconstructed. Preop and postop Fahn-Tolosa-Marin Tremor score was calculated to assess outcome.

Results: Sixteen leads were inserted into eight patients. Mean pre-operative Fahn-Tolosa-Marin Tremor score was 51.5. Mean post-operative score was 13.7, representing an average 74% reduction in tremor score severity. This is at least equivalent to large published VIM series where typical reductions are around 60% or less. No lead revisions were required due to inefficacy or uncontrollable side effects.

Conclusions: These data provide real word support that, despite its theoretical limitations, commercially available deterministic tractography is useful in informing DBS for tremor targeting. We demonstrate that a targeting strategy incorporating this data produces results consistent with large published VIM DBS series.

Keywords: VIM DBS, essential tremor, Dentatorubrothalamic tract (DRTT)

EP089 / #303

Topic: *AS01. Movement Disorders*

A COMPARISON OF LOW- AND HIGH-FREQUENCY SUBTHALAMIC NUCLEUS DEEP BRAIN STIMULATION ON BRADYKINESIA IN PARKINSON'S DISEASE

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Introduction: The current clinical approach for assessing bradykinesia in Parkinson's Disease (PD) relies on subjective metrics and scales. Inertial sensors offer the ability to quantify, with increased granularity, subcomponents of bradykinesia, including motor speed, amplitude, and rhythm. We investigated the differential effects of different subthalamic nucleus (STN) deep brain stimulation (DBS) stimulation parameters on the speed, amplitude, and rhythm subcomponents of bradykinesia, as measured by inertial sensors.

Methods: We recruited advanced PD patients with bilateral STN DBS implantation. We implemented a single-blind stimulation trial where each combination of medication state (off and on), electrode contacts (4 ring contacts), and stimulation frequency (60Hz and 180Hz) were assessed. For each stimulation trial, subjects performed extremity motor tasks, and we continuously recorded upper limb bradykinesia metrics using sensors placed on one finger on each hand. We identified STN DBS parameters that were associated with improved upper extremity bradykinesia symptoms using a mixed linear regression model.

Results: N=22 subjects (6 females) participated in this study. Compared to 180Hz STN DBS, 60Hz stimulation and dopaminergic medications improved all subcomponents (speed, amplitude, and rhythm) of bradykinesia. Ventral contacts yielded improved symptom improvement compared to dorsal contacts.

Conclusions: We identified differential impacts of STN DBS stimulation parameters on symptoms of bradykinesia that may advise programming for PD patients. Wearable sensors represent a valuable, low-cost addition to the armamentarium that furthers our ability to conduct objective, quantitative clinical assessments, and will further optimize DBS programming.

Keywords: Parkinson's disease, Sensors, Bradykinesia

EP090 / #475

Topic: *AS01. Movement Disorders*

SAFE ROBOTIC ASSISTED IMPLANTATION OF DEEP BRAIN STIMULATION IN PARKINSON'S DISEASE PATIENTS WITH INCIDENTAL UNSECURED ANEURYSMS

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Introduction: Incidental vascular findings are not uncommon in patients undergoing planning scans for DBS implantation. The annual risk of incidental aneurysm rupture for aneurysms <3mm, <5mm and <7mm is estimated at 0%, <0.5% and <1% though evidence remains inconclusive. Changes to CSF dynamics during DBS implantation may increase the risk of aneurysm rupture therefore the management plan must carefully considered. Endovascular coiling may commit patients to uninterrupted antiplatelet therapy for up to 6 months. Delayed DBS implantation poses a risk progression of movement disorder symptoms. This case series describes a surgical technique with minimal CSF loss and successful DBS implantation without aneurysm rupture.

Methods: Retrospective case note, database and image review was performed including risk factors, treatment of Parkinson's disease and aneurysms, complications, and outcomes were recorded. Stereotactic planning of trajectories was done on 3T contrast enhanced volume T1 MRI and CT angiogram to avoid vessel collision on NeuroInspire, Renishaw® bespoke planning software. Asleep direct targeting of Subthalamic nucleus (STN) and Zona incerta (Zi) was performed using Renishaw® tooling. Press fit Carbothane™guide tubes, NeuroGuide ™Resishaw® and DBS electrodes were delivered. Continuous irrigation ensured minimal CSF loss and changes to CSF dynamics.

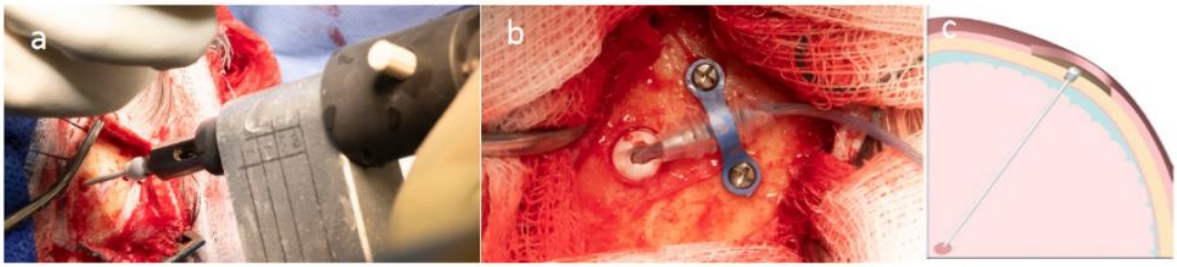

Figure 1. a. Robotic assisted implantation of guide tube b. Electrode insertion via guide tube c. Schematic diagram of guide tube, modified from Moran et al (2020)

Results: Successful DBS implantations were achieved without aneurysm rupture in three male patients (age 65-69), with 5mm right PCOM, 2mm right MCA and 7mm basilar tip aneurysms with PHASES scores of 2, 4 and 5 respectively. One patient with basilar tip aneurysm underwent successful elective coiling six months following DBS implantation due to worsening headaches without any clinical or radiological evidence of aneurysm enlargement or rupture. Two remain under surveillance with stable aneurysm size.

Conclusions: Management of incidental cerebral aneurysms in patients undergoing DBS surgery is multi-faceted. Endovascular coiling of aneurysm may commit patients to uninterrupted antiplatelet therapy delaying surgery by at least three to nine months. This risks the progression of Parkinson's Disease motor symptoms and may change their suitability for DBS implantation. Careful risk benefit evaluation and patient counselling is crucial. DBS implantation can safely be considered without preoperative endovascular treatment in patients with unsecured cerebral aneurysms using surgical techniques minimising changes in CSF dynamics.

Keywords: DBS, aneurysms, Parkinson

EP091 / #63

Topic: *AS01. Movement Disorders*

CONTRALATERAL DUAL TARGETING GPI AND STN FOR LEVODOPA INDUCED DYSKINESIA IN A PD PATIENT WITH PALLIDAL VASCULAR MALFORMATION

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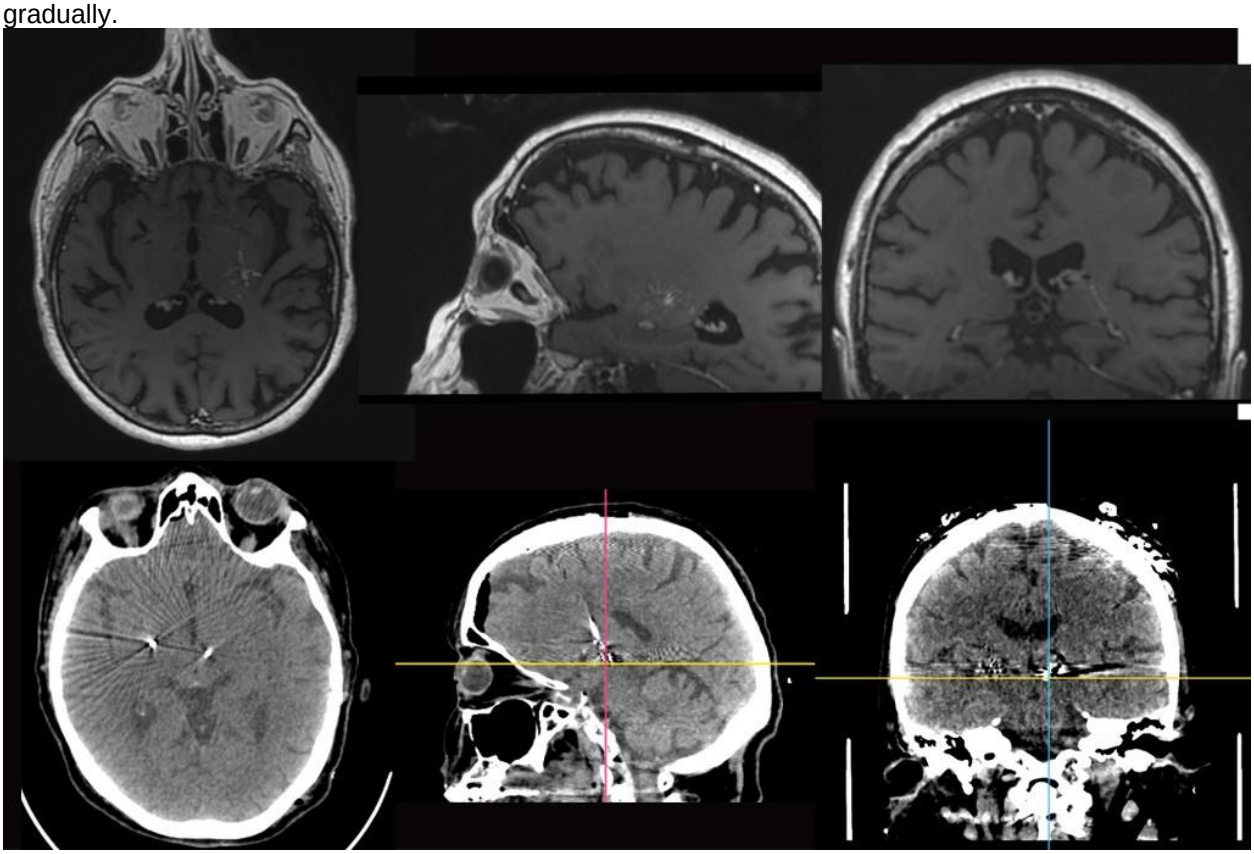
Introduction: Levodopa induced dyskinesia (LID) is one of the therapeutical limiting factors of long-term medical treatment of Parkinson Disease.It is seen 40-60% of the time and considered of DBS surgery indication. There are few RCTs indicating that no specific superiorities between STN and GPi stimulation overall but when it comes to dyskinesia, GPi is thought to be more effective. GPi stimulation exerts better outcomes as it suppresses the dyskinesia symptoms just via stimulation itself. In this abstract, we present a patient candidate for DBS surgery and presented with left-sided LID even though dyskinetic symptoms affect bilateral extremities. Initially, bilateral GPi DBS surgery was the procedure of choice but contrast enhanced MRI scans showed vascular malformation located at the posterior part of the left Pallidum nuclei complex. Therefore, STN lead implanted the same side as the lesion located and GPi lead implanted to the contralateral side.

Methods: 69 years old female patient with 10-year history of PD diagnosis. Patient's clinical feature lack of tremors and presence of rigidity/bradykinesia. After 10 years of medication, LID was developed for the last 2 years. LID commenced on the left side, at upper and lower distal extremities, and persisted unilateral fashion. Patient's preoperative med-on and med-off UPDRS scores, AIMS/OSI scores were examined. Stereotactic trajectories were calculated for left sided STN and right sided GPi electrode implantation.

Results: Patient experienced relief on rigidity and bradykinesia shortly after bilateral stimulation commenced. Postoperative UPDRS score declined to 17 from 47 and AIMS/OSI score to 0/0 from previous 9/3. Previous left sided dyskinesia manifestation subsided even before decrease in medication doses were achieved. STN and GPi stimulations were tailored without any adverse effect to occur. After 1 week of stimulation tailoring period, anti-parkinson medications were set to decrease in dosages

gradually.



Conclusions: Right sided GPi stimulation exerts strong anti-dyskinetic effects while preoperative dopaminergic medication doses were administered to patient and, with STN stimulation combined, anti-parkinsonian cardinal symptomatic relief were achieved successfully. Unilateral GPi stimulation was deemed adequate for dyskinetic relief but STN stimulation itself also helped to reduce medication doses which has also contributed to the total anti-dyskinetic effect of the procedure.

Keywords: Levodopa Induced Dyskinesia, Parkinson Disease, Vascular Malformation

EP092 / #102

Topic: *AS01. Movement Disorders*

VIM THALAMOTOMY IN THE TREATMENT OF ESSENTIAL TREMOR: OUR EXPERIENCE

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Introduction: Deep brain stimulation and high-intensity MRI guided focused ultrasound are widely used now a days for the treatment of medication-resistant essential tremor. Radiofrequency in the ventral intermediate nucleus of the thalamus is also an effective surgical intervention for essential tremor.

Methods: Twelve patients with essential tremor underwent unilateral ventral intermediate nucleus (Vim) thalamotomy from January 2019 to December 2023 at Annapurna Neurological Institute and Allied Sciences. All patient were refractory to medical treatment for more than 3 years. We performed the Clinical Rating Scale for Tremor (CRST) to calculate the total score. Vim thalamotomy was performed in all patients.

Results: The study included 6 men and 6 women, and the age ranged between 22 and 76 years (average age, 50.75). Among them one has Holmes tremor. Among them only one patient is left handed.There was significant improvement in tremor in the contralateral hand, from a mean baseline score of 60.58±25.08 to a score of 25.66± 18.24 at 1 month. The lesion was detectable on MRI T2- and DWI image after the procedure. The mean volume of the lesion was 500±40 mm^3.

Conclusions: The study show good results in the hand tremor and improved the quality of life in patients with essential tremor.

Keywords: essential tremor, thalamotomy, ventral intermediate nucleus

EP093 / #278

Topic: *AS01. Movement Disorders*

BILATERAL DEEP BRAIN STIMULATION OF THE SUBTHALAMIC NUCLEI IN PARKINSON'S DISEASE PATIENTS WITH CAMPTOCORMIC POSTURE

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Introduction: Camptocormia is a disabling syndrome characterized by forward flexion that can be an idiopathic condition or associated with numerous diseases such as movement disorders, especially Parkinson's disease (PD). Treatment options are usually futile and L-dopashows little or no effect, contrary to some individual reports which indicate that some degree of improvement in posture could be expected in bilateral deep brain stimulation (DBS) of the globus pallidus internus (GPi) or subthalamic nucleus (STN) in PD patients with camptocormia. Outcome results are inconsistent, especially for STN and the data is scarce.

Methods: A 67 year old female and a 66 year old male, both suffering from PD in the last 15 and 8 years, respectively, were subjected to bilateral STN DBS procedure. The positions of electrodes were verified with a postoperative magnetic resonance imaging. The results were objectivized by measuring the thoracolumbar flexion angle before and after operation and using all recommended scales for the international survey of DBS. The flexion angle was measured after the first, third, sixth and 12th month after surgery for the female patient and after the first, third and sixth month after surgery for the male patient.

Results: The degree of forward flexion of the spine has substantially decreased and the quality of life, motor symptoms and functioning improved in both patients. The thoracolumbar angle of the female patient before the surgery was 80°. One month after surgery the angle was 20°, three months after surgery it was 16°, six months after it was 13°, while twelve months later it was only 10° . The thoracolumbar angle of the male patient was 65° before the surgery, 15° after one month, 13° after three months and only 10° six months after the surgery.

Conclusions: Based on these results we believe that STN DBS should be considered as a potential treatment option for PD patients with camptocormia. Further analysis is needed to determine exactly which PD patients are candidates for bilateral STN or GPi stimulation in the treatment of camptocormia.

Keywords: STN, DBS, Camptocormia

EP094 / #324

Topic: *AS01. Movement Disorders*

OPTIMAL STIMULATION OF PALLIDOTHALAMIC TRACT FOR DYSTONIA

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Introduction: The field of Forel (FF) is a subthalamic area through which the pallidothalamic tracts originating from the globus pallidus internus (GPi) traverse. The FF was used as a stereotactic surgical target for dystonia, but the optimal area of stimulation remains unknown. We aimed at localizing the sweet spot within pallidothalamic tract(PTT) at FF.

Methods: We retrospectively studied clinical results following deep brain stimulation(DBS) of PTT for dystonia which were performed in our hospital. Using brainlab elements, stimulation condition and the position of the stimulating contact within the FF were analyzed.

Results: Compared to the Burke-Fahn-Marsden Dystonia Rating Scale-Movement Scale scores before surgery, improvements were observed at 1 week, 3 months, and 6 months after surgery in all patients. The most common adverse effect of stimulation was dizziness. PTT DBS showed symptom improvement at lower amplitude compared to GPI DBS.

Conclusions: Our study supports the presence of a sweet spot located within FF and expects it to be applied to lesioning and magnetic resonance-guided focused ultrasound. Research on the subject is still scarce, but further studies are being planned.

Keywords: dystonia, Deep Brain Stimulation, pallidothalamic tract

EP095 / #156

Topic: *AS01. Movement Disorders*

EARLY EXPERIENCE OF EFFECTIVENESS OF DEEP BRAIN STIMULATION IN PARKINSON'S DISEASE TREATMENT WITH SINGLE-CENTER EXPERIENCE FROM PAKISTAN

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Introduction: Parkinson's disease (PD) is considered the second most common brain neurodegenerative disorder after disorder as Alzheimer's disease; it presents with motor symptoms that include bradykinesia, resting tremor, postural problems, and rigidity while other non-motor symptoms include autonomic manifestations (bowel problems such as sexual dysfunction, constipation and urinary complaints) neuropsychiatric problems (psychosis, anxiety, cognitive impairment, depression, compulsive disorders and apathy) and some sensory issues. In medication Levodopa up to date is considered one of the most useful medications to suppress signs and symptoms of PD, as time passes, long-term use results in Levodopa-induced dyskinesia.

Methods: This study was a descriptive prospective study, and patients were treated at Neurospinal and Cancer Care Institute Karachi, from February 1, 2016, to June 30, 2020. We had 21 cases of Parkinsonian disease. Inclusion criteria were Idiopathic Parkinson's disease, marked motor fluctuations against the response to dopaminergic therapy, UPDRS-III scores, which is 30 or higher, with a duration of disease of five years or longer, developing dyskinesia while the exclusion criteria were patients with known comorbid or active psychiatric disease

Results: The mean age of the patient was 64 years. The standard deviation was 1.11697. The male patients' mean, median, and mode had a standard deviation of 0.3. For the duration of the disease, the mean was 1.4, the median was 1 (5-6 years), and mode one. The standard deviation was 0.51177. The primary symptoms' mean was 2.2857, the median was 2.0, and the mode was two (tremor). The mean on medication (age) was 2 (45-49), and the median and mode were the same.

Conclusions: Deep brain stimulation (DBS) is an effective treatment option for a carefully selected patient. DBS can improve tremors, dyskinesias, rigidity, motor fluctuations, and bradykinesia. DBS is unlikely to benefit Autonomic dysfunction, cognitive disorders, hypophonia, and postural instability. Although it is an expensive treatment compared to lesioning or gamma knife, it is reversible

Keywords: Parkinsonian disease, Deep Brain Stimulation, tremor

EP096 / #329

Topic: *AS01. Movement Disorders*

SUBTHALAMIC NUCLEUS DELTA OSCILLATION INCREASES DURING FREEZING OF GAIT IN PARKINSONS DISEASE

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Introduction: Freezing of gait (FOG), a sudden, involuntary cessation of movement, is a hallmark symptom in advanced Parkinson's disease (PD). It is characterized by moments where individuals feel their feet are anchored to the floor, preventing the initiation or continuation of walking. The underlying causes of FOG are complex, involving disrupted neural activity, motor circuit communication, and dopamine regulation abnormalities.

Methods: This study examines a 68-year-old male PD patient, treated since 2010, who exhibited worsening symptoms, including frequent FOG episodes. Following bilateral deep brain stimulation (DBS) of the subthalamic nucleus (STN) in February 2023, with parameters set to 1.4 mA, 60 µs, 130 Hz, we initiated power spectral density (PSD) measurements of local field potentials (LFP) via the implanted electrodes. Observations were made one and a half months post-surgery, during which the patient experienced three FOG episodes.

Results: Our analysis revealed a statistically significant increase in delta oscillation PSD in both hemispheres during FOG episodes compared to symptom-free periods. These findings suggest that delta oscillations might play an important role in the pathophysiology of FOG by indicating abnormal brain activity and impaired motor circuit communication.

Conclusions: The connection between delta oscillation increases and FOG episodes underscores the importance of further research into the mechanisms of PD. Understanding these oscillations could lead to novel biomarkers or therapeutic targets for managing FOG in PD patients, offering new avenues for treatment and improving quality of life.

Keywords: Delta oscillation, STN, Parkinson Disease

EP097 / #498

Topic: *AS01. Movement Disorders*

FORMATION OF BILATERAL THALAMIC CYSTS AFTER RADIOSURGICAL TREATMENT IN A PATIENT WITH PARKINSON'S DISEASE

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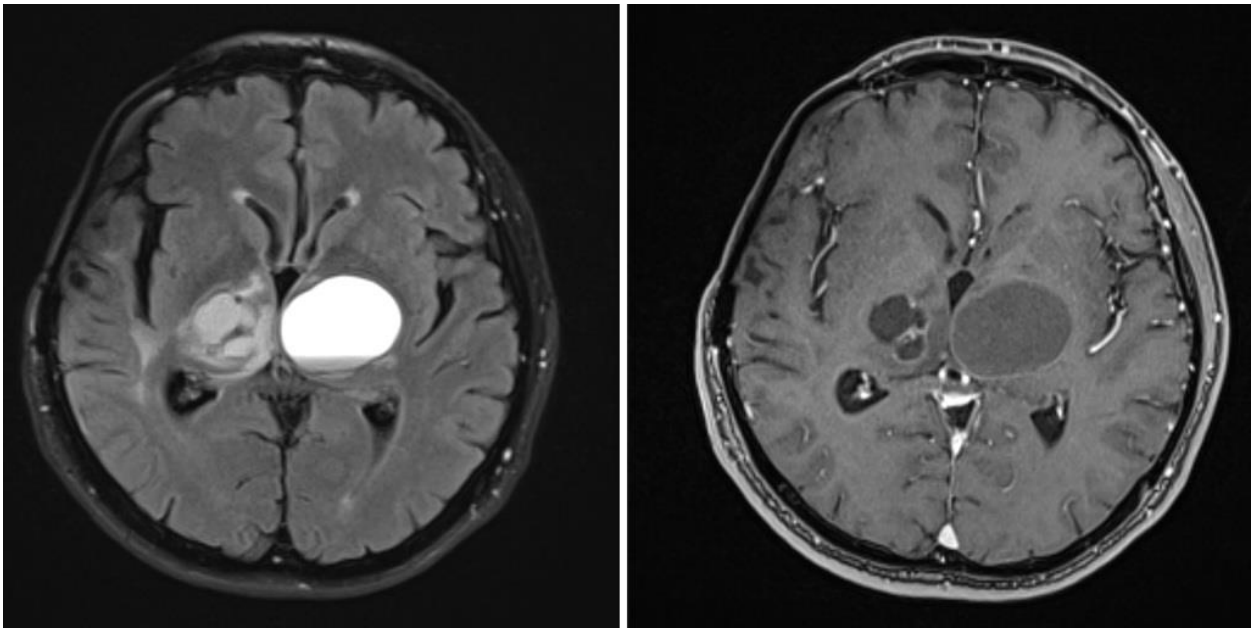
Introduction:

Methods: The patient

Results: After the treatment



Conclusions: Radiosurgery

Keywords: thalamic cyst, radiosurgery, Parkinson's disease

EP098 / #33

Topic: *AS01. Movement Disorders*

REVISION OF ELECTRODE POSITION IN PATIENTS WITH PARKINSON'S DISEASE; DOES LOCATION REALLY MATTER?

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Introduction: High-frequency stimulation of the subthalamic nucleus (STN-HFS) is highly effective in treating motor symptoms in Parkinson's disease (PD) and medication side effects as well as in improving quality of life. Despite preoperative screening for patients as eligible candidates for this treatment, electrode position may furthermore influence treatment quality. In this study, we tried to reposition deep subthalamic electrodes in patients operated previously based on an image-guided image-verified approach and evaluated the outcome.

Methods: Six patients with Parkinson's disease who had undergone deep brain stimulation surgery previously were included into this study. All patients complained of unsatisfactory outcome including uncontrolled tremor, impaired gait and balance issues. Pre-operative non-stereotactic MRI confirmed suboptimal placement of at least one electrode. Repositioning of electrodes was performed through a routine stereotactic procedure using intraoperative neurophysiologic studies and post-op imaging. Outcome was evaluated clinically by the neurologist and measured using UPDRS scale.

Results: All six patients experienced significant improvement of symptoms after repositioning.

Conclusions: Final electrode position is considered the major and most important determinant of outcome of deep brain stimulation surgery. Intraoperative neurophysiological studies are effective in localizing the target, but better be confirmed using post-operative imaging to conform final electrode position, and guarantee outcome.

Keywords: Electrode location, Parkinson's disease, Deep Brain Stimulation

EP099 / #499

Topic: *AS01. Movement Disorders*

COMBINATION OF SUBTHALAMIC AND PALLIDAL STIMULATION FOR MOTOR FLUCTUATIONS AND DYSKINESIA IN PARKINSON'S DISEASE

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Introduction: Parkinson's disease DBS

Methods: A female patient

Results: After DBS treatment

Conclusions: Combined deep brain stimulation

Keywords: Parkinson's disease, globus pallidus internus, subthalamic nucleus

EP100 / #306

Topic: *AS02. Epilepsy*

SURGICAL TECHNIQUES AND POSTOPERATIVE OUTCOMES OF ADULT EPILEPSY SURGERY IN AFRICA

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Introduction: Epilepsy is a relatively common neurological disorder in Africa with a median prevalence in sub-Saharan Africa of approximately 15 per 1000 people, higher than rates reported in Asia, Europe, and North America. This review aims to summarize surgical management of adult epilepsy from available African literature, specifically surgical techniques, diagnostic modalities, and postoperative outcomes.

Methods: A literature search was undertaken from peer-reviewed articles and conference proceedings describing epilepsy surgeries performed in African medical centers. Included studies were assessed primarily for surgical techniques and patient outcomes. The Engel classification system was used to evaluate postoperative outcomes, providing a standardized framework for postoperative seizure control assessment. Other factors assessed were diagnostic modalities and fraction of patients noted to have drug-resistant epilepsy.

Results: The review encompassed data from nine studies representing 7 African countries (Egypt, Gabon, Kenya, Morocco, South Africa, Tunisia, Uganda). There were 359 cases of epilepsy surgery and 198 patients noted to have drug-resistant epilepsy. Patient age ranged from 18 to 64 years. Diagnostic procedures included MRI (42.2%, N=215), EEG (41.8%, N=213), and CT (15.9%, N=81). Of the 98 patients with epileptogenic foci reported, 76 (77.6%) had a concordant focus, 11 (11.2%) were discordant, 10 (10.2%) involved multiple foci, and 1 was uncertain or non-localizing. Focal resection (59.4%, N=212) was the predominant surgical technique reported, with lesionectomy (29.4%, N=105) and craniotomy (3.9%, N=14) also utilized. Hemispherectomy (3.9%, N=14), corpus callosotomy (2%, N=7), and Gamma Knife surgery (1.4%, N=5) were also noted. The majority of documented 1-year postoperative outcomes were favorable, with 80.6% of cases (N=195) achieving Engel Class I status. Engel Class II (14.9%, N=36), III (3.7%, N=9), and IV (0.8%, N=2) outcomes were less common, providing insight into the spectrum of postoperative results across studies.

Conclusions: Focal resection is the most reported epilepsy surgery technique in Africa. Despite data availability limitations, the review suggests positive 1-year postoperative outcomes, particularly seizure freedom. The findings highlight the importance of selecting appropriate surgical interventions to enhance epilepsy prognosis in the African context. This review also advocates for increased epilepsy surgery reporting across Africa to facilitate robust cross-paper analyses and improve surgical decision-making.

Keywords: Engel Outcomes, Africa, epilepsy surgery

EP101 / #497

Topic: *AS02. Epilepsy*

FOCAL COOLING MODULATES TEMPERATURE DYNAMICS AND DELINEATES THE EPILEPTIC ZONE IN PENICILLIN-INDUCED SEIZURES MODEL IN MACACA FASCICULARIS.

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Introduction: Seizures increase neuronal activity, cerebral blood flow, and tissue oxygenation, potentially affecting brain temperature. Our study explores using temperature sensors and cooling probes in sEEG to enhance seizure detection and accurately map the epileptic zone (EZ)

Methods: In two Macaca fascicularis, we inserted a dual-function lead into the hippocampus for temperature recording and cooling, equipped with temperature sensors and a penicillin injection cannula to induce an epileptic zone (EZ). Electrical and thermal signals were captured via a sEEG lead and thermocouples near and within the EZ across 15 trials (5-7 hours each). We applied focal cooling to measure temperature and electroclinical events during seizures, comparing fluctuations to baseline (33.5°C) and cooled states (21°C, 23°C, 17°C), against pre-injection non-seizure temperaturesepsy management

Results: The baseline brain temperature of the animals was 33.50 °C ± 1.85 °C, with a stable body temperature ranging between 36 and 37 °C. Without seizures and prior to penicillin injections, brain temperature variability over multiple 2-minute intervals was observed in both animals, with a fluctuation of 0.05 ± 0.02 °C (n=10, two animals). During seizures induced by penicillin, we noted an increase in brain temperature of 0.29 ± 0.2 °C from the baseline. Interestingly, temperature changes during seizures (ΔT°S) after focal cooling of the epileptic zone (EZ) showed significant differences: a ΔT°S of 0.35 ± 0.05 °C at a cooling temperature of 23 °C, 0.35 ± 0.19 °C at 21 °C, and 1.60 ± 0.34 °C at 17 °C. The largest increase in ΔT°S, observed when cooling to 17 °C, was significantly higher (Kruskal-Wallis test, $p<0.0001$) compared to the brain's surrounding temperature, suggesting that the lowest temperature tested (17 °C) most effectively delineated the EZ. No correlation was identified between seizure duration and ΔT°S

Conclusions: Our study reveals that seizures cause a temperature rise in the epileptic zone (EZ), with focal cooling significantly delineating these changes. Temperature sensors indicate an epileptic focus with increased metabolism, aligning with research on seizure-induced blood flow and metabolism. Our results endorse thermographic mapping for EZ identification before surgery, offering a new tool for epilepsy management

Keyword: neuromodulation, seizure detection, epileptic zone

EP102 / #213

Topic: *AS02. Epilepsy*

ENCEPHALOCELE-RELATED TEMPORAL LOBE EPILEPSY: SINGLE CENTRE EXPERIENCE

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Introduction: Temporal encephalocele refers to a herniation of temporal lobe tissue, as well as meninges and cerebrospinal fluid, into a skull defect in the middle cerebral fossa. Among epileptogenic lesions, temporal encephaloceles are quite rare, and the data on them is scarce. Herein we report our experience with encephalocele-related temporal lobe epilepsy.

Methods: We retrospectively analyzed adult patients with mesiobasal temporal lobe epilepsy who were treated at the Russian Polenov Neurosurgical Institute between 2015 and 2024. We identified cases where temporal encephalocele was considered a definitive or most likely epileptogenic lesion.

Results: Eight patients (five men and three women) with ERTLE were identified, which comprised 4% of all patients with mesiobasal temporal lobe epilepsy in our clinic. The median age was 46.0 years (range 23-64) and the median age at the seizure onset was 34.5 years (range 3-43 years). In one case the course of disease did not meet the criteria of drug resistance. The median score of the Montreal Cognitive Assessment scale was 23 points (range 18-26). In almost all of the cases the irritation and seizure onset zones were located in the temporal region on the corresponding side; however, one patient had bitemporal ictal and interictal activity on scalp electroencephalography. Invasive recordings were performed in four patients; in three cases the seizure onset and early propagation involved both the hippocampus and the temporal cortex. In one patient seizures were shown to initiate directly from the encephalocele area. Six patients underwent surgical treatment for their epilepsy: two patients - tailored resection, two - anterior temporal resection, one - multilobar resection, and one - stereotactic radiofrequency ablation of the encephalocele. Of note, in four of the patients the encephaloceles were discovered only intra-operatively. Histopathologically, focal cortical dysplasia type I or II was found in four cases, and gliosis - in one.The median follow-up is 8.2 months (range 1-24). Four of the six patients have become seizure free (including the one who underwent stereotactic ablation).

Conclusions: ERTLE should be suspected in MR-negative cases of temporal lobe epilepsy. However, it can still be difficult to diagnose preoperatively due to the small size of the lesion. The surgical treatment is generally successful, but one should consider the possibility of bilateral or temporal-plus forms.

Keywords: temporal encephalocele, temporal lobe epilepsy, epilepsy surgery

EP103 / #365

Topic: *AS02. Epilepsy*

UNCOVERING THE IMPACT OF METABOLIC SYNDROME ON RESECTION OUTCOMES FOR PATIENTS WITH DRUG RESISTANT EPILEPSY: A PROPENSITY-MATCHED COHORT STUDY

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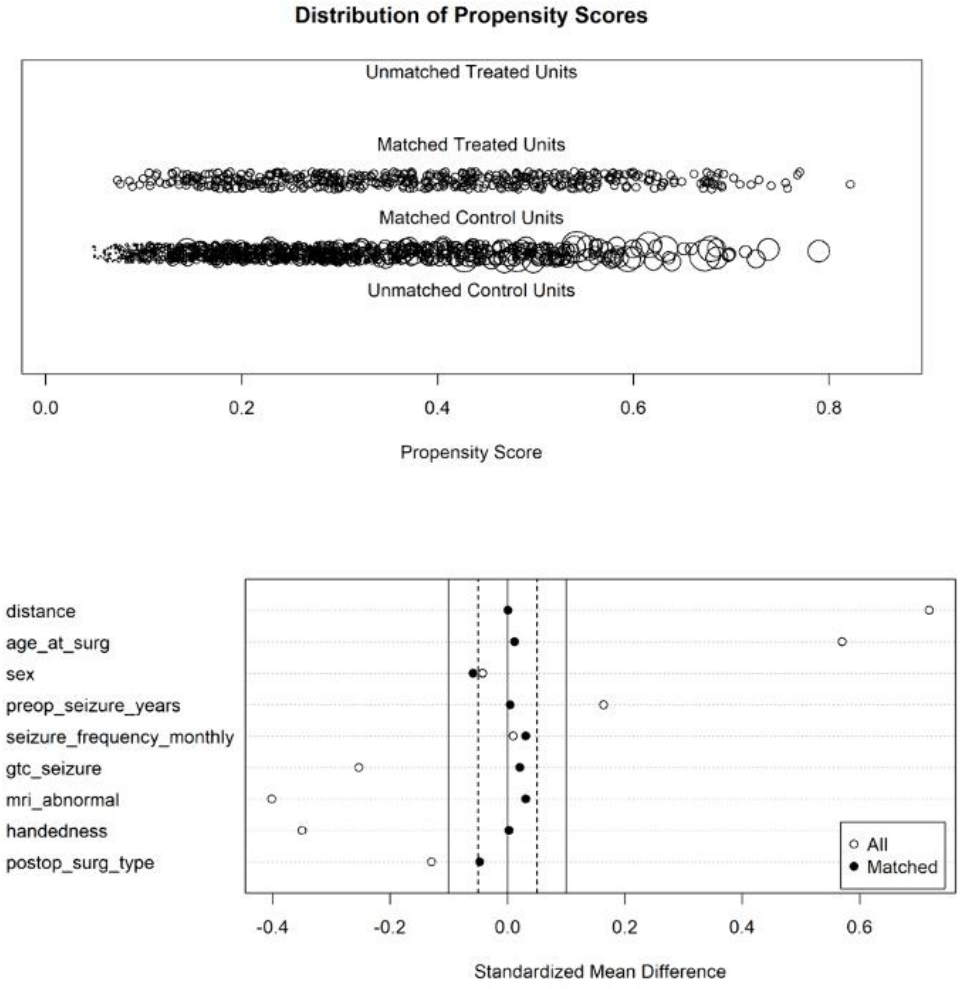
Introduction: For the one-third of epilepsy patients who develop drug-resistant epilepsy(DRE), surgery can be the only potential cure. Emerging evidence links epilepsy and Metabolic Syndrome(MetS) – a cluster of comorbidities tied to adverse outcomes in cardiac, GI, and spine surgeries. This study investigates how MetS criteria influence seizure freedom outcomes and postoperative complications following neurosurgical intervention for DRE. This is the first study to date exploring MetS in the context of brain surgery.

Methods: DRE patients undergoing their first neurosurgical resection between 2000-2017 were identified. The MetS cohort including patients meeting at least 2 MetS criteria before surgery(Table 1) was matched with non-MetS cohort using covariates: age at surgery, gender, epilepsy duration, seizure frequency, prior GTC, abnormal MRI, handedness, and surgical type. Average Treatment Effect estimated differences in Engel classification, surgical complications (intracranial hemorrhage, perioperative stroke, wound infection, meningitis), length of stay, medical complications (anemia, sepsis, DVT, stroke, UTI, pneumonia, MI, hydrocephalus) or ICU admissions within 30 days postoperatively, and death. Table 1: Study definition of Metabolic Syndrome.

Metabolic Syndrome Criteria	Defined by...
Abdominal Obesity	BMI >= 30
Hyperglycemia	Diabetes Mellitu
Dyslipidemia	Dyslipidemia, h
Hypertension	Hypertension di

Figure 1: Propensity Score Matching Results using R MatchIt package Version 4.5.5



Results: 441 of 1,466 (30.1%) DRE patients undergoing neurosurgical intervention trended towards MetS diagnosis. Preoperatively, MetS patients exhibited a significantly higher Area Deprivation Index (p=0.0005) when compared to non-MetS patients. Postoperatively, MetS patients exhibited significantly increased cumulative surgical (p=0.0005) and medical complications (p=0.0003), longer length of stay (p=0.002), and more ICU admissions within 30 days (p=0.008) than their non-MetS counterparts. Differences in Engel Outcomes (p=0.4) and death (p=0.5) between the two groups were insignificant.

Conclusions: DRE patients trending towards MetS before neurosurgical resection are at higher risk of postoperative surgical and medical complications. These patients may have a longer hospital course and greater risk for ICU admission in the month following surgery. Importantly, our results reflect that MetS criteria do not predict worsened postoperative seizure freedom or mortality outcomes. Early identification and management of Metabolic Syndrome components may be important in minimizing surgical and medical complications in DRE patients.

Keywords: drug resistant epilepsy, neurosurgery, metabolic syndrome

EP104 / #183

Topic: *AS02. Epilepsy*

CONNECTIVITY ANALYSIS OF ANTERIOR THALAMIC NUCLEUS IN PATIENTS WITH DRUG-RESISTANT EPILEPSY

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Introduction: Stimulation of the anterior thalamic nucleus (ANT-DBS) has emerged as a treatment option for patients with drug-resistant epilepsy, particularly when resective surgery is not feasible or when previous surgeries, including vagus nerve stimulation (VNS), have yielded unsatisfactory outcomes. Despite its FDA approval and inclusion in clinical guidelines, the efficacy of ANT-DBS varies considerably among patients. Recently, there has been growing interest in connectomic DBS, an approach that analyzes the efficacy correlation with the connectivity of the stimulation site to other brain regions. Given the heterogeneous nature of epilepsy patients, a personalized treatment approach holds promise for enhancing ANT-DBS outcomes. In this study, we aimed to investigate the structural connectivity of the anterior thalamic nucleus (ANT) and its influence on the efficacy of ANT-DBS in patients with drug-resistant focal epilepsy.

Methods: Four patients with focal drug-resistant epilepsy were included in this study. Prior to ANT-DBS, all patients underwent 3T MRI with diffusion-tensor imaging. The follow-up period lasted for three months after initiating stimulation. Patients with at least a 50% reduction in seizure frequency were considered responders. Connectivity analysis was performed using LEAD-DBS in MATLAB, utilizing preoperative MRI and postoperative CT images, with active contacts employed as regions of interest (ROIs).

Results: At the three-month follow-up, two patients demonstrated a favorable response to ANT-DBS, while the remaining two patients were classified as poor responders. Connectivity analysis of stimulated regions within the ANT revealed distinct patterns between responders and non-responders. Responders exhibited connectivity to limbic structures, including the hippocampus (n=1) and parahippocampal gyrus (n=1), while non-responders showed connectivity to the caudate nucleus (n=2).

Conclusions: Our findings suggest that the efficacy of ANT-DBS may be influenced by the structural connectivity of stimulated regions, with better outcomes observed in patients demonstrating connectivity to limbic structures. Further research with larger patient cohorts is needed to validate these findings and elucidate their clinical implications for the management of drug-resistant epilepsy.

Keyword: ANT-DBS, drug-resistant epilepsy, structural connectivity

EP105 / #521

Topic: *AS02. Epilepsy*

VERTICAL PARASAGITAL HEMISPHEROTOMY FOR INTRACTABLE EPILEPSY WITH HEMISPHERIC ORIGIN

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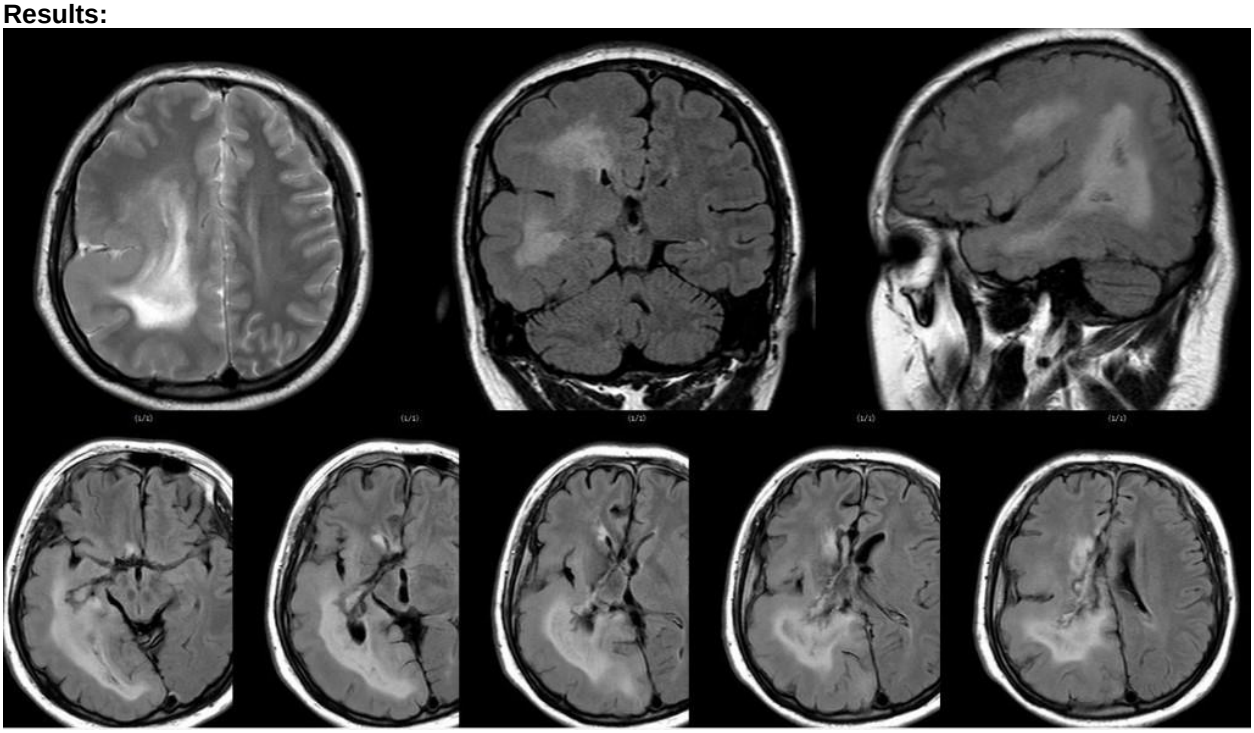
Introduction: Cerebral hemisphere dissection is the important treatment option for intractable epilepsy caused by hemispheric lesions. Historical evolution of hemispheric surgery was transitioned from anatomical hemispherectomy to different hemispherotomy techniques. Vertical approach is an important variants among hemispherotomy techniques.

Methods: To investigate the feasibility and efficacy of vertical hemispherotomy in intractable epilepsy involving one cerebral hemisphere, a retrospective analysis was performed for 9 patients who underwent vertical hemispherotomy in our hospital from May 2021 to March 2023 and follow up was also conducted.

Results:



The operation time of 9 patients was 272±46 min, the blood loss was 163±68ml, there was no blood transfusion during the operation, there was no death after the operation. Of the 9 patients, 8 of them was seizure-free during follow up(Engle I), and 1 patient had occasional seizures, which was Engle grade II. About complications, all patients had varying degrees of limb mobility impairment, and one patient developed isolated hydrocephalus, which resolved after septostomy. Among the long-term complications, 8 patients were left with mild limb mobility impairment, mainly manifested by fine movement of the hand, and 2 patients were left with mild facial paralysis on one side.

Conclusions: Vertical hemispherotomy is an important variant of hemisphere surgery for patients with refractory epilepsy with lesions involving one cerebral hemisphere, and seems could be more complete

dissection and less blood loss in advantage of direct insight into basal ganglia and being away from insular.

Keywords: intractable epilepsy, hemispherotomy, parasagital

EP106 / #321

Topic: *AS02. Epilepsy*

LASER INTERSTITIAL THERMAL THERAPY (LITT) TO TREAT REFRACTORY EPILEPSY FOR A WIDE VARIETY OF ETIOLOGIES.

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Introduction: Laser Induced Thermal Therapy (LITT) is a minimally invasive approach to the surgical treatment of drug-resistant epilepsy We report our single-center experience in 25 patients with different etiologies using the Visualase Thermal Therapy System.

Methods: A retrospective analysis was performed of all patients with epilepsy treated with LITT from 2018 to 2023. Twenty three patients with lesion-associated epilepsy and two epileptic patients without lesions were included in this study. The ages ranged from 2 to 63 year. Epileptic foci had varied etiologies: hippocampal sclerosis (n = 5), low grade tumor/s (n = 10), heterotopy (n = 3), tuberous sclerosis (n =3), focal cortical dysplasia (FCD) and uncertain with normal MRI (n=2). Demographics, hospital stay and outcomes were recorded. Analysis also included review for any complications or readmissions following the procedure. Engel Outcomes were assessed at the 6 month, 1 and 2 year time points.

Results: In all, 31 laser catheters were placed in 25 patients requiring intervention for epilepsy. Two fibers were used in six patients. (4 hippocampal sclerosis two cases with possible FCD and normal MRI. In the 25 patients with > 1 year follow-up, 20 (80%) achieved Engel I-II status and five Engel III. One underwent craniotomy after LITT. The average hospital stay was 1.5 days. All patients were discharged to their homes following the procedure, and none required discharge to a rehabilitation facility. There were no complications and there no readmissions

Conclusions: LITT demonstrates similar outcomes for the treatment of epilepsy for a variety of etiologies as those described using traditional open surgery at 2 years and beyond

Keywords: refractory epilepsy, laser interstitial thermal therapy (LiTT), Epilepsy

EP107 / #255

Topic: *AS02. Epilepsy*

TWO-YEAR SEIZURE-FREE OUTCOME FOLLOWING TEMPORO-PARIETO-OCCIPITAL DISCONNECTION (TPO) VIA ROBOT-ASSISTED MAGNETIC RESONANCE IMAGING-GUIDED LASER INTERSTITIAL THERMAL THERAPY (MRIGLITT): A CASE REPORT

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Introduction: Magnetic Resonance Imaging-Guided Laser Interstitial Thermal Therapy (MRIgLITT) has demonstrated safety and efficacy in disconnecting brain tissue, notably in procedures such as corpus callosotomy and hemispherotomy. Recently, we extended its application to temporo-parieto-occipital disconnection (TPO) for refractory epilepsy within the posterior quadrant.

Methods: A 14-year-old right-handed teenager presented to our Epilepsy Surgery Unit with epilepsy onset at age eight, following a perinatal ischemic event resulting in a large left temporal porencephalic cyst. Initially manifesting as oculocephalogyric and loss of awareness seizures, his condition progressed to include visual distortions and restless episodes despite multiple antiepileptic drugs. Video-electroencephalography (VEEG) revealed intercritic left temporo-occipital anomalies, with left temporo-occipital seizures documented. Magnetic resonance imaging (MRI) confirmed the presence of a large left temporo-parietal cystic cavity consistent with porencephaly, prompting consideration of left TPO disconnection. Our surgical plan involved MRIgLITT-guided TPO disconnection, utilizing five trajectories: four parietal and one temporal. Parietal trajectories targeted the anterior part of the superior and inferior parietal lobes posterior to the post-central sulcus, while a single temporal trajectory traversed mesial structures (amygdala, hippocampus) with occipital entry due to cyst occupancy of the superior temporal gyrus. Under robotic arm assistance (Neuromate), laser fiber insertion and ablation were performed within a 1.5 T intraoperative MRI suite.

Results: The patient experienced no intra- or post-operative complications, was discharged four days post-procedure, and remained seizure-free throughout a two-year follow-up period.

Conclusions: TPO disconnection via MRIgLITT has proven both feasible and efficacious over a two-year follow-up period. Our forthcoming poster will detail another TPO procedure scheduled for two weeks hence, with subsequent presentation of outcomes at the upcoming WSSFN Congress.

Keywords: Temporoparietooccipital disconnection, MRIgLITT, Pediatric Epilepsy Surgery

EP108 / #526

Topic: *AS02. Epilepsy*

RADISOURGERY AND FOCAL EPILEPSY

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Introduction: Epilepsy patients are an important sectore in the medical health care and the intractability to medications leads to catastrophic medical peroblems and econonic burden. Interventional option directed towards the epileptic zone or lesion is mandadtory in many clinicla scenario. Non-invasive procedures such as radiosurgery offer a low risk profile for already disabled patient and could be an alternative for open invasive surgery. We explored focal epilepsy treated by radiosurgery.

Methods: Retrospective analyasis of patients presented with focal cortical dysplasia (FCD), Dysembryoplastic neuroepithelial tumors (DNET), mesial temporal sclerosis (MTLE), and hypothlamic hamartoma (HH) treated by two different modalities; Gamma Knife Surgery and Cyberknife Surgery. Patients underwent extensive preoperative workup and postoperative follow up.

Results: Signigifacnt improvment in seizures frequency with satisfactory Engel outcome to be Engel I in 1 patient presented with FCD, Engel I-II with 3 patients presented with DNET, 80% Engel I-II for 15 patients presented with HH, Engel II with 1 patient presented with MTLE. No complications either visual, endocrinal or cognitively through STANFORD test.

Conclusions: Cyberknife and Gamma Knife option for FCD, DNET, HH, and MTLE could be an alternative option in selectied cases and especially FCD seizure-freedom.

Keywords: radiosurgery, Focal, Epilepsy

EP109 / #327

Topic: *AS02. Epilepsy*

FUNCTIONAL HEMISPHERECTOMY IN ADULTS WITH DRUG-RESISTANT EPILEPSY

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Introduction: Purpose of this study to evaluate the efficacy and safety of transsylvian peri-insular functional hemispherectomy in an adult group of patients based on 3 clinical cases.

Methods: Three clinical cases are presented involving patients aged over 18 with drug-resistant epilepsy who underwent transsylvian peri-insular functional hemispherectomy at the Burdenko Neurosurgical Center. The MRI studies revealed severe brain lesions in the affected hemisphere, including atrophy, gliosis, and consequences of stroke. The seizure onset zone in the damaged hemisphere was identified through video EEG monitoring. Based on this data, a decision was made to perform a functional transsylvian peri-insular hemispherectomy. During the preoperative phase, two patients underwent a Wada test to determine the localization of speech functions in the healthy hemisphere. All patients exhibited mild to moderate hemiparesis in the contralateral damaged hemisphere in their neurological status.

Results: Three patients underwent transsylvian peri-insular functional hemispherectomy. The follow-up period ranged from 8 months to 6 years. All three patients showed Ia outcomes on the Engel scale. Hemiparesis increased from mild to moderate in one patient, while the other two exhibited no negative dynamics. Post-surgery, all patients retained independent mobility, and none experienced speech impairment.

Conclusions: Functional transsylvian peri-insular hemispherectomy emerges as a highly effective surgical treatment for patients with drug-resistant epilepsy, severe hemisphere brain lesions, and hemiparesis.

Keywords: epilepsy seizures, epilepsy surgery, functional hemispherectomy

EP110 / #44

Topic: *AS02. Epilepsy*

ROLANDIC CORTEX EPILEPSY SURGERY. OUR EXPERIENCE

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Introduction: Resection or disconnection of epileptogenic foci in the central, precentral and postcentral sulcus with or without adjacent cortex presents a high risk of post-surgical neurological deficit and has classically been associated with a high percentage of non-control of seizures.

Methods: Patients undergoing open resective surgery at the Hospital Universitari i Politècnic La Fe from 2010 to 2023. We analyzed demographic factors, location of the lesion, pathological anatomy, Engel scale after surgery and morbidity.

Results: 33 patients were operated on, the most frequent pathological anatomy was cortical dysplasia, 24 patients remained in Engel I after the first surgery, and 28 after two surgeries, with 6% of reinterventions, and 96% of favorable results (Engel I and II). Only one patient presented mild permanent paresis of the hand, 8 presented some temporary deficiencies, in 3 of them it was resolved on admission (less than 1 week) and 5 in the first 12 months.

Conclusions: Safe technique with good seizure control and low morbidity that requires a good study of the seizure topography, use of neuronavigation and intraoperative neurophysiology. Careful assessment of cases for second resection, usefulness of pre-surgical 3D printing of the lesion

Keyword: rolandic epilepsy, surgery, engel

EP111 / #434

Topic: *AS02. Epilepsy*

CLINICAL EFFICACY AND SAFETY OF ANTERIOR THALAMIC DEEP BRAIN STIMULATION FOR INTRACTABLE DRUG RESISTANT EPILEPSY.

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Introduction: Drug resistant epilepsy (DRE) may affect about 30% of patients suffering from epilepsy. Deep brain stimulation of the anterior nucleus of the thalamus (ANT DBS) is a neuromodulation therapy for patients with refractory focal seizures evolving into bilateral tonic-clonic seizures. The aim of the present study was to describe our results regarding the efficacy and safety of ANT DBS in 12 patients suffering from DRE.

Methods: We prospectively analyzed the clinical data of 12 patients with DRE who underwent ANT DBS between May 2020 and April 2023 at the Neurosurgical Department of Institute of Psychiatry and Neurology in Warsaw, Poland. All studied patients submitted to ANT DBS had poorly controlled seizures, despite AEDs, and were not candidates for surgical resection of an identifiable focus or foci. The same form of diagnostic procedure, operative technique, DBS hardware implanted and clinical assessment were used in all patients. The patients were operated on in general anesthesia using Leksell G stereotactic system (Leksell G, Stokholm, Sweden). Surgical planning was achieved using the Stealth Station S8 frame-based DBS software (Medtronic, Minneapolis, Minn., United States). The primary outcome measure was the change of the median seizure count in 3 months preceding ANT DBS to seizure counts after ANT DBS at scheduled follow-up visits.

Results: Mean duration of DRE was 26.7 years, (range 16-41 years). The median seizure count in 3 months period preceding surgery (baseline seizure count) was 40.5 (range, 4-150). ANT DBS caused seizure reduction 3 months after procedure as well as at last follow-up (mean 28 months, range 10-46 months) by 58.2 % and 70.5 %, respectively. No patient suffered transient or permanent neurological deficits.

Conclusions: The ANT DBS caused seizure reduction at last follow-up by 70.5 %. All 24 DBS leads implanted in 12 patients through transventricular approach did not missed the ANT. ANT DBS is a safe and efficacious treatment for DRE.

EP112 / #512

Topic: *AS02. Epilepsy*

TRENDS AND MOST-CITED ARTICLES ON HEMISPHEROTOMY: A BIBLIOMETRIC ANALYSIS

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Introduction: Hemispherotomy is a multistep, highly effective, radical surgical procedure to treat drug-resistant epilepsy due to extensive unilateral hemispheric disease. Bearing in mind the numerous articles that have been published on hemispherectomy and hemispherotomy, we aimed to highlight the top 100 cited and impactful articles to create familiarity with the topic. We anticipate that this will be a helpful guide to clinicians and academics navigating the literature on this subject.

Methods: A Scopus title-based search for the top 100 most-cited articles on “hemispherectomy” and “hemispherotomy” was performed in September 2023 with no restrictions. The top 100 most-cited articles were retrieved. The article title, first author, first author’s specialty, country of origin, first author’s institution at the time of publication, journal of publication, year of publication, citation count, and citations per year were collected. The Google Scholar database citation count for each paper was added for correlation and comprehensive coverage.

Results: The top 100 most-cited articles were cited 92 times per paper, on average. The publication dates ranged from 1949 to 2016. The most frequently cited article (“Clinical outcomes of hemispherectomy for epilepsy in childhood and adolescence,” with 307 citations) was published by A.M. Devlin et al. in 2003 in the journal Brain. The United States was the highest-publishing country (41 articles). The highest-publishing journal was Neurology. The most prolific first authors were A. Smith, J. Schramm, and J. Villemure, each with four publications. The institution with the most contributions was McGill University and its affiliated Health Centers, with nine publications in total. Neurosurgery was the most common specialty among first authors. Most of the included studies were cohort studies and case series.

Conclusions: We identified the top 100 cited articles on hemispherectomy and hemispherotomy using the Scopus database and supplemented our results with Google Scholar. We highlighted the most prominent authors, institutions, countries, journals, and study designs and illuminated the historical development of hemispherectomy and hemispherotomy procedures and landmark papers, in addition to currently trending papers.

Keyword: bibliographic databases; Hemispherectomy; Hemispherotomy; Bibliometric Analysis

EP113 / #117

Topic: *AS02. Epilepsy*

ABLATIVE SURGERY IN MEDICALLY REFRACTORY EPILEPSY

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Introduction: Several potential stereotactic targets have been suggested for the treatment of medically refractory epilepsy, such as the medial parts of temporal lobes, caudate nucleus, cerebellum, centromedian nucleus of the thalamus, subthalamic nucleus, and anterior thalamic nucleus (ATN). Electric modulation of epileptic neural circuits is a palliative option to decrease seizure frequency and to improve quality of life. The efficacy of ablative surgery have also same outcome as compared with the use of neuromodulation. The use of DBS in epilepsy surgery tend to be expensive and difficult to implement in the LMIC setting. Therefore, ablative surgery using radio frequency is a cost effective surgical treatment for LMIC as Nepal.

Methods: We performed a retrospective review of 111 cases who had undergone surgery for intractable epilepsy at Annapurna Neurological Institute and Allied Sciences between January 2002 and December 2023. Among them 3 of them had underwent bilateral lesioning of ATN in 2 cases while 1 had ipsilateral ATN under intraoperative EEG monitoring and 3 cases of Gelastic seizure with hypothalamic hamartoma underwent stereotactic ablation. We used the thermal lesioning machine of Cosman RF generator generator and the voltage, impedance and rate of the thermal coagulation were set. The lesioning electrode of 1 mm diameter and 2 mm exposed tip was used.

Results: The study included 3 male patients who underwent ATN surgery with age ranging between 15 and 50 years. There was 2 male and 1 female with age ranging from 8 and 11 years in patients of hypothalamic hamrtoma. Among them, 2 cases of hypothalamic hamartoma with Gelastic seizure had an Engel classification Class I and one case had class II. While the 3 cases who recently had underwent ATN surgery had 60% reduction in seizure frequency in an early follow up.

Conclusions: ATN represents a promising target because of their widespread projections to various cortical and subcortical structures and involvement in the process of generation and spreading of epileptic activity. RF thermocoagulation provides an excellent results in Hypothalamic hamartoma.

Keywords: Lesioning, ATN, Hypothalamic hamartoma

EP114 / #78

Topic: *AS02. Epilepsy*

REASONS FOR THE UNDERUTILIZATION OF EPILEPSY SURGERY

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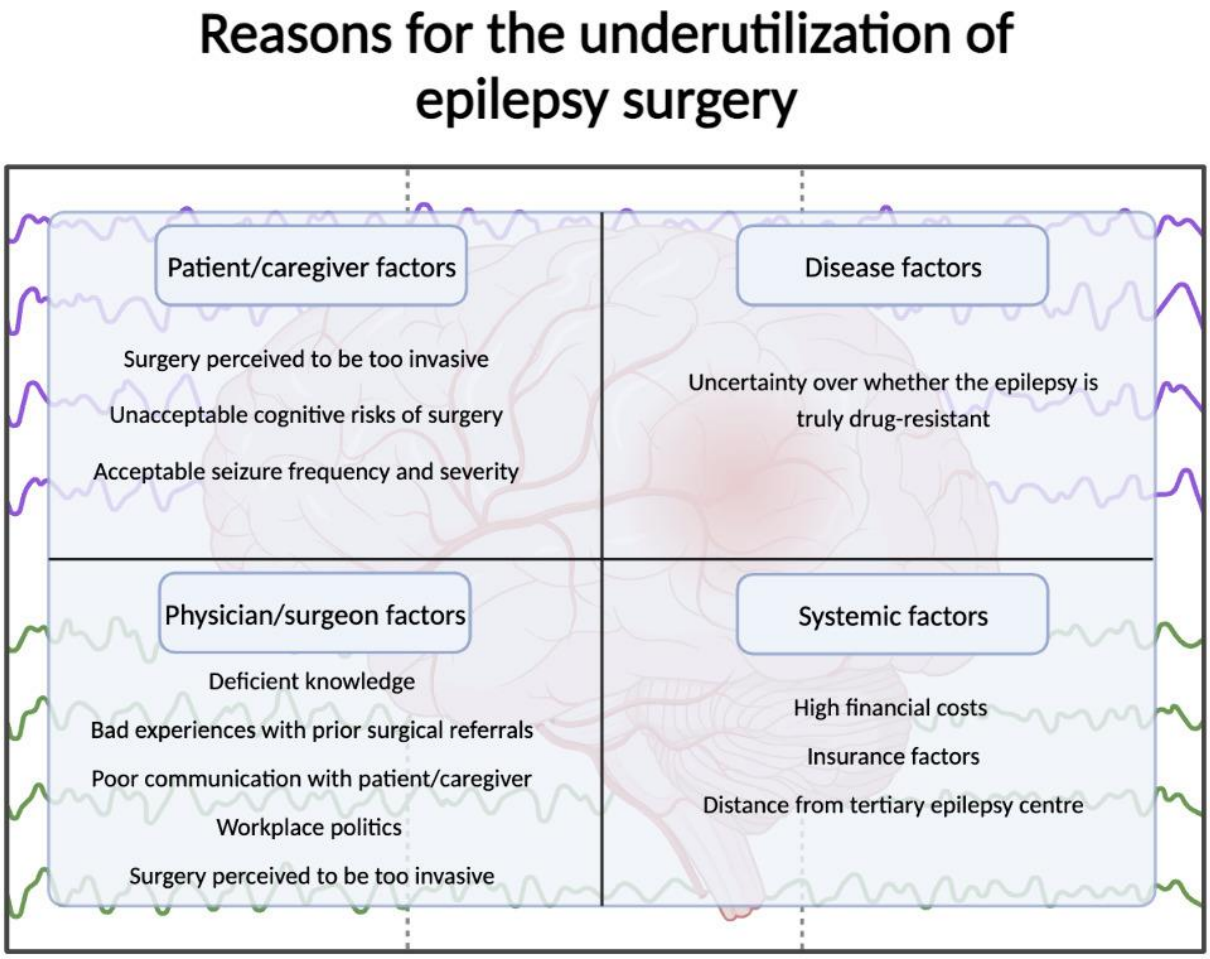
Introduction: Surgery is safe and efficacious in selected patients with drug-resistant epilepsy (DRE) but continues to be heavily underutilized. This paper explores the factors contributing to the underutilization of epilepsy surgery, providing a foundation for strategic interventions.

Methods: The literature was reviewed for studies that reported on the factors contributing to the underutilization of epilepsy surgery. The findings of the studies were summarized qualitatively.

Results: We find that the reasons for the underutilization of epilepsy surgery can be divided into patient/caregiver, disease, physician/surgeon, and systemic factors. Patient/caregiver factors include concerns about invasiveness and cognitive risks, coupled with a perceived tolerability of seizures. Disease factors involve physician hesitation due to uncertainty over whether the epilepsy is truly drug-resistant. Physician/surgeon factors include deficient knowledge, past negative experiences impacting referrals, poor communication with the patient or caregiver, workplace politics, and concerns over the invasiveness of surgery among physicians. Systemic factors encompass high financial costs, insurance challenges, and geographical distance from centers offering epilepsy

surgery.



Conclusions: Despite expert recommendations, epilepsy surgery remains severely underutilized, with barriers at multiple levels. A comprehensive and multi-faceted approach is imperative to tackle the perennial issue of epilepsy surgery underutilization and enhance patient outcomes.

EP115 / #52

Topic: *AS03. Pain*

EFFICACY OF POSTERIOR-SUPERIOR INSULA DEEP BRAIN STIMULATION FOR TREATING PAIN: RESULTS OF A CROSS-OVER, RANDOMIZED CONTROLLED TRIAL

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Introduction: Neuropathic pain treatments may only improve a little more than half of patients and there has been significant interest in new neuromodulation targets for treating it. The posterior-superior insula (PSI) has been implicated in nociceptive pain processing, and its high-frequency stimulation by non-invasive neuromodulation (NIN) was shown to alleviate pain in patients with refractory peripheral neuropathic pain (PNP). Here, we report data from a phase-II trial on the use of PSI deep brain stimulation (DBS) as a mean to reach similar effects to PSI-NIN.

Methods: Ten PNP patients that was true responders to PSI-NIN were included in a double-blind, sham-controlled, randomized crossover trial. Unilateral DBS lead was implanted to the PSI contralateral to side of pain (NCT04279548). Patients were randomized to active DBS or sham for three months and then were switched to the other corresponding condition for more three months. After, the participants underwent for more three-month in single-blind evaluations followed by six months in open-label stimulation as extension study. The primary outcome was number of responders (≥ 30% reduction of average pain intensity assessed on a numerical rating scale ranging from 0-10) during the six first months of treatment. Quality of life, adverse events, and cognitive were assessed throughout the study.

Results: Ten patients (44.5±10.0ys.) were included (n=8 had brachial plexus avulsion, and n=2 had postherpetic neuralgia). All underwent PSI-DBS and all participated in the entire 15-month follow-up. Bayesian analysis showed that the probability that active PSI-DBS decreases pain by more than 30% compared to sham was 82.3% (95% CrI 0.1 to 1.312) during the first six months. The hypothesis of physical health score from SF-12 improvement after single-blind phase was 98.2% and after open-label phase was 98.7%, both phases with active PSI-DBS compared to baseline. There were no deaths or serious adverse effects during surgery or the follow-up period, no pain aggravation in this condition, and cognitive tests were no changes compared to pre-surgery scores.

Conclusions: This study suggest that PSI-DBS may offer potential analgesic benefit for patients experiencing refractory peripheral neuropathic pain. Moreover, the approach appears to be reproducible and safe, providing valuable insights for implementation of larger-scale trials

Keyword: Deep brain stimulation, Neuropathic Pain

EP116 / #244

Topic: *AS03. Pain*

EFFICACY OF CLASSICAL TONIC SCS IN PATIENTS WITH POSTHERPETIC NEURALGIA IN THE LONG-TERM FOLLOW-UP PERIOD

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Introduction: It has been observed that the occurrence of postherpetic neuralgia (PHN) among individuals with an acute herpes infection is between 8 and 19%. Our study sought to examine the long-term outcomes of tonic spinal cord stimulation (SCS) in the treatment of chronic postherpetic neuralgia that did not respond to conservative therapy.

Methods: All 32 patients underwent test SCS, following which they were given indications for installation of a permanent system. The average duration of the pain syndrome was 4.34 years, ranging from 1 to 36 years. The questionnaires and scales used to assess the efficiency of spinal stimulation included the visual analog scale (VAS), Short Form Health Survery (SF-36), and Patient Global Impression of Change (PGIC). After the implantation, the patients were followed up for an average period of 63.375 months, ranging from 12 to 84 months.

Results: During the stimulation trial, the tonic SCS was effective in 16 patients (50%), showing a pain reduction of more than 50% from the initial level according to VAS scores. 14 received a permanent stimulator implant. During the long-term follow-up, we observed a significant pain reduction of more than 50% from the baseline in 10 out of the 14 implanted patients (71.4%). One of these patients experienced complete pain resolution with the SCS. Overall, the average VAS scores decreased from 8 to 3.285 points. The results obtained from the completion of the SF-36 questionnaire before and after surgery showed a notable increase in the quality-of-life index for physical health (SF PH) by an average of 14.7 points and mental health component (SF MH) - average increase of 9.85 points. According to the results of the PGIC questionnaire patients reported a score of 5 (on a scale of 1 to 7) for their perception of global change. Patients with tonic SCS experienced a significant decrease in the need for analgesic drugs during the follow-up period, with the average MQS III score decreasing from 7.37 to 2.79. Four patients no longer required any analgesics.

Conclusions: Our clinical study has demonstrated that tonic SCS effectively improved symptoms in half of the patients with refractory PHN.

Keywords: Spinal Cord Stimulation, postherpetic pain, Neuropathic pain

EP117 / #334

Topic: *AS03. Pain*

TRIGEMINAL NERVE LENGTH AS A PREDISPOSING FACTOR FOR CLINICALLY SIGNIFICANT NEUROVASCULAR CONFLICT IN TRIGEMINAL NEURALGIA

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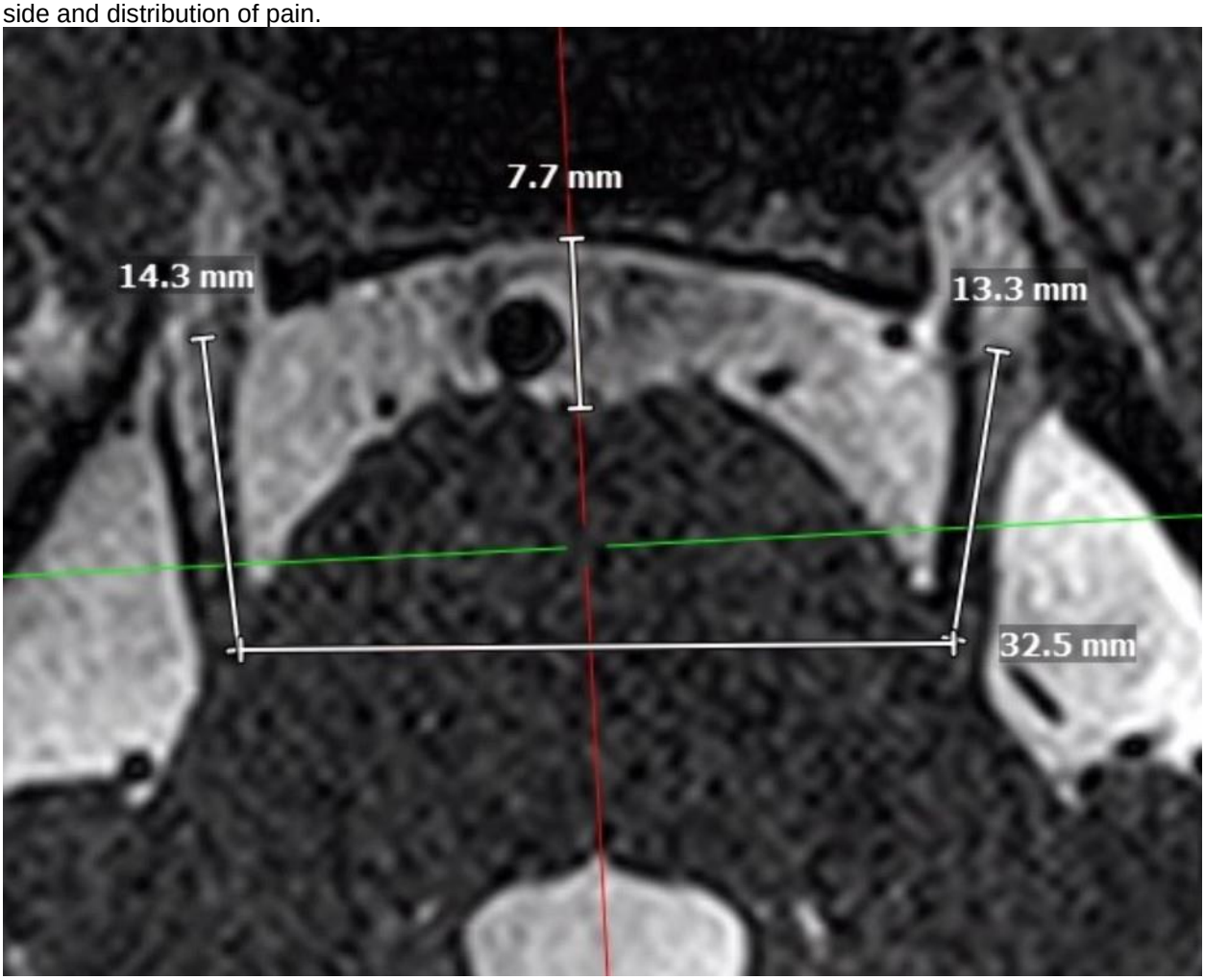
Introduction: Understanding the mechanisms behind trigeminal neuralgia (TN), particularly how neurovascular conflict or trigeminal nerve distortion triggers pain, remains a challenge. This study aimed to explore whether the anatomical configuration of the trigeminal nerve and its surrounding structures could predispose individuals to clinically significant neurovascular conflict in TN.

Methods: A retrospective analysis was conducted involving 70 patients diagnosed with idiopathic TN and 70 healthy participants, utilizing Constructive Interference in Steady State (CISS) magnetic resonance imaging. Measurements included the length of both trigeminal nerves from the nerve root entry zone to the entrance into Meckel's cave, inter trigeminal distance, prepontine distance, and sagittal angle on each nerve at the level of the porus trigeminus. Correlations were drawn between the length and sagittal angle of the nerve on the painful and non-painful sides. Intraoperative findings, such as arterial compression, venous compression, and arachnoid membranes distorting the nerve, were documented alongside the

side and distribution of pain.



Results: The mean age at surgery was 56 years (ranging from 19 to 91 years). Arterial compression was the most prevalent intraoperative finding (88.8%), followed by arachnoid adhesions distorting the nerve (73.8%), and venous compression (50%). A statistically significant difference was observed in the mean length of the trigeminal nerve on the pain side compared to the non-pain side (10.6 vs. 10.3). Patients with TN exhibited shorter trigeminal nerves compared to the control group on both the left (11.3 vs. 11.9 mm) and right sides (9.9 vs. 10.4 mm). However, no statistically significant difference was noted in the inter trigeminal distance, sagittal angle, and prepontine distance between the two groups. Furthermore, a shorter trigeminal nerve correlated with a higher incidence of intraoperative findings, particularly venous compression and arachnoid adhesions.

Conclusions: Our findings lend support to the hypothesis that a shorter trigeminal nerve may increase susceptibility to clinically significant neurovascular conflict in trigeminal neuralgia.

Keywords: pain, Microvascular decompression, trigeminal neuralgia

EP118 / #543

Topic: *AS03. Pain*

REAL- WORLD DATA COLLECTION USING REMOTE PROGRAMMING FOR DRG AND SCS PATIENTS

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Introduction: Objective Spinal cord and dorsal root ganglion stimulation (SCS and DRG-S) are standard of care for patients with chronic neuropathic pain. Travel times, lack of financial resources and transportation options strongly influence the individual's decision on seeking healthcare. Telehealth in general refers to the exchange of medical information through electronic communication. However, it is usually restricted to video conferences, without interfering with implanted medical devices. A digital platform was recently introduced to enable remote programming in Neuromodulation. It is accessible via tablets/smartphones and allows direct contact between a patient and their doctor/pain nurse.

Methods: We designed a prospective cohort to evaluate safety and performance of remote care in patients with SCS or DRG-S. Between January and October 2023, 28 patients were included. We assess up pain scores (VAS), EQ5D, pain Detect, Patient Global Impression of Care (PGIC) and telehealth usability questionnaire (TUQ) to evaluate the preoperative status, the status at implantation of the system, and the postoperative course. The postoperative data are assessed in the context of video conferences for remote programming.

Results: This is an ongoing study. No travel or waiting time was assessed, since all patients received their appointment right in time at their home. The overall satisfaction with the telehealth system is high. TUQ 7/7 in all pats., mean PGIC 5 (4-6), mean VAS baseline/6mo (9/3). No lack of efficacy of stimulation or pain relief was found. In two out of the SCS patients, a mechanical problem was suspected, which led to an additional on-site visit, which was solved. Two patients reported technical difficulties dialing in due to limited abilities with smart devices.

Conclusions: Conclusion The general convenience with the system is high, which is conform to previously published data regarding telehealth in general. Previous publications showed that wearables can be used for an objective quantification of symptoms without the need for clinic facility time. The use of remote programming offers. reduced travel times and costs, which allow simplified and more frequent programming. Especially in a pandemic or in case of travel limitations, it is a very helpful tool

Keywords: scs, remote programming, DRG

EP119 / #239

Topic: *AS03. Pain*

DIFFERENT SCALE, DIFFERENT PAIN? DISCORDANT PAIN MEASUREMENTS AFTER SURGERY FOR TRIGEMINAL NEURALGIA

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Introduction: Trigeminal neuralgia (TN) has been described as one of the worst pains known to humankind. However, the severity of pain and disruption to quality of life (QoL) experienced by TN patients have been measured using several different scales, resulting in difficulty comparing illness burden and, in particular, response to TN surgery across studies.

Methods: In this cross-sectional study, a cohort of 39 TN patients treated with surgery were evaluated with three pain measurement instruments: Visual Analog Pain Scale (VAS), Brief Pain Inventory–Facial Pain (BPI-F), and the Barrow Neurological Institute Pain Intensity Score (BNI). Scores were transformed into a 0-10 scale, and grouped into five severity categories (none, mild, moderate, severe, worst). Scores were compared between scales to establish concordance. Discordant patients were those classified in different severity categories by at least two pain measurement instruments. Level of agreement was assessed with the intraclass correlation coefficient (ICC) and pairwise linear weighted Cohen's kappa.

Results: Almost 50% of patients (18/39) had at least one categorical discordance when comparing all three scores. We found 30% discordance between VAS and BPI, 33% discordance between BPI and BNI, and 35% discordance between VAS and BNI. The highest discordance between BNI and VAS or BPI occurred in patients with moderate pain (BNI IIIb). Comparison of all three scores yielded moderate reliability (ICC = 0.72). VAS and BNI only reached "fair" agreement (kappa 0.568), while BNI and BPI as well as BPI and VAS reached "substantial" agreement (kappa 0.612 and 0.713 respectively).

Conclusions: TN patients with residual moderate pain after surgery are often discordantly classified depending on the pain measurement scale used. Caution needs to be exercised when interpreting reported rates of response to surgery in the TN literature. New patient reported outcome measurement tools validated for TN patients with pain persisting after surgery are needed to better quantify the durable efficacy of operative treatments.

Keywords: trigeminal neuralgia, pain

EP120 / #166

Topic: *AS03. Pain*

GAMMA KNIFE RADIOSURGERY FOR INTRACTABLE TRIGEMINAL NEURALGIA - COMPARATIVE STUDY BETWEEN SINGLE VERSUS TWO ISOCENTER TARGETS

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Introduction: Assess the safety and efficacy of using Two isocenter targets in Gamma Knife Radiosurgery (GKRS) for treating trigeminal neuralgia (TN) versus a single isocenter target solely at the root entry zone (REZ).

Methods: A retrospective study was conducted at Neurospinal and cancer care Postgraduate Institute, Karachi, Pakistan. The study involved 171 patients with severe facial pain caused by TN. Pain intensity was measured using pre/post-BNI scale. Group A (85 patients) received 90 Gy using single isocenter at REZ with a 4mm collimator, while Group B (86 patients) received 90 Gy at two isocenters of the REZ and distal cisternal segment. Statistical analyses were done to assess differences between post-BNI scores and pain-free durations in the groups.

Results: Both groups had a mean patient age of 50 years. Group A had longer presurgical pain duration (98 months) than Group B (78 months). In Group A, 33% reported pain relief to BNI class II and 67% to class III, while in Group B, 70% reported pain relief to BNI class I and 30% to BNI class II. Group A had a 40% 8-week pain relief rate, while Group B had a higher percentage of pain-free durations of 6-7 weeks (21%) and 9 weeks (39%). Group B had a higher incidence of post-op facial numbness (27% vs. 14% in Group A). Significant differences existed between post-BNI pain intensities and pain-free durations in both groups.

Conclusions: Patients who received 90 Gy radiation at two isocenters had better outcomes than those with a single isocenter for GKRS. While Group B experienced earlier pain relief, Group A had fewer side effects. Twoisocenter GKRS is a safe and effective alternative for TN patients with a better pain management profile but an increased risk of facial hypoesthesia.

Keywords: Gamma Knife Radiosurgery (GKRS), Trigeminal Neuralgia (TN), Isocenter, REZ (root entry zone), Barrow Neurological Institute (BNI) Pain Scale

EP121 / #108

Topic: *AS03. Pain*

SURGICAL TREATMENT OF TRIGEMINAL NEURALGIA COMBINED WITH TUMORS OF THE CEREBELLOPONTINE ANGLE

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Introduction: One of the causes of Trigeminal neuralgia (TN) are tumors of the cerebellopontine angle (CPA), which have a direct or indirect effect on the trigeminal nerve root (TNR). The optimal surgical approach in such cases depends on the anatomical relationship between the TNR and the tumor and vascular structures.The aim of the study was to evaluate the relationship between the anatomical variants of the TNR and the outcomes of using various surgical methods to treat TN in CPA tumors.

Methods: We performed a retrospective analysis of 53 patients with TN and ipsilateral tumors of the CPA: 29 with apical petrous meningiomas, 11 with epidermoid tumors, 10 with vestibular schwannomas, 1 with haemangioma, 1 with cavernoma, and 1 with lipoma

Results: 6 variants of the anatomical relationships of the TNR to CPA tumors and the adjacent vascular structures were identified: where the TNR is completely surrounded by the tumor; where the tumor compresses and displaces the TNR; where the tumor is located inside the TNR; where the tumor, together with the blood vessel, compresses the TNR; where the tumor displaces the TNR towards the vessel; and where the tumor is not in contact with the TNR, but the TNR is compressed by the blood vessel. The neurovascular conflict caused by arterial and venous vessels was identified in 16 subjects. Complete regression of TN in the immediate postoperative period was observed in 51 patients. A percutaneous radiofrequency trigeminal rhizotomy was performed in 1 subject with an epidermoid tumor, to eliminate the intense pain paroxysms that persisted for a week. No recurrent growth of CPA tumors or relapses of TN were observed during the subsequent follow-up period of 2–10 years.

Conclusions: TN can be caused by direct compression and deformation of the TNR and brainstem by CPA tumors and vascular structures. A detailed examination of the TNR after tumor removal is necessary to evaluate the neurovascular relationships. In cases of vascular compression of the TNR, various methods of microvascular decompression can be used to treat TN.

Keywords: trigeminal neuralgia, cerebellopontine angle tumor, facial pain

EP122 / #151

Topic: *AS03. Pain*

MULTIMODAL SURGICAL MANAGEMENT PROGRAM OF MULTIPLE SCLEROSIS-RELATED MEDICALLY REFRACTORY TRIGEMINAL NEURALGIA: A SINGLE CENTER EXPERIENCE

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Introduction: Trigeminal neuralgia (TN) is the most common craniofacial pain disorder that frequently affects patients with multiple sclerosis (MS). Common surgical treatments for MS associated TN include radiofrequency ablation (RFA) and subcutaneous trigeminal nerve field stimulation (sTNFS). Studies regarding therapies for MS-associated TN are limited; furthermore, these therapies are rarely offered in a center with multimodal surgical treatment.

Methods: In this retrospective study over two years, all patients who have been treated with surgical therapy were analyzed for pre- and postoperative pain intensity, frequency of attacks, complications, and side effects of therapy.

Results: The N=12 MS associated TN patients were with a mean age of 59 years significantly younger than patients with classic TN (p=0.037). MS association resulted in higher initial pain intensity in TN according to VAS scale compared to other types of TN (p=0.032). The mean VAS was reduced from 9 to 4 postoperatively. RFA was the most common therapy in N=10 patients. For MS-associated medically refractory TGN, RFA was the first line therapy compared to other types of TN (p=0.001). Patients with MS related TN received repeated surgical therapy significantly more often than other types of TN (p=0.026). N=1 (8.3%) patient had a surgical complication.

Conclusions: RFA remains the first-line intervention for MS-associated medically refractory TN, providing good pain reduction, but will most likely need to be repeated several times over the course of the patient's life.

Keywords: multiple sclerosis, radiofrequency ablation, trigeminal neuralgia

EP123 / #97

Topic: *AS03. Pain*

TRANSPOSITION TECHNIQUES IN MICROVASCULAR DECOMPRESSION FOR GLOSSOPHARYNGEAL NEURALGIA: UTILIZING FIBRIN-GLUE COATED TEFLON SLING

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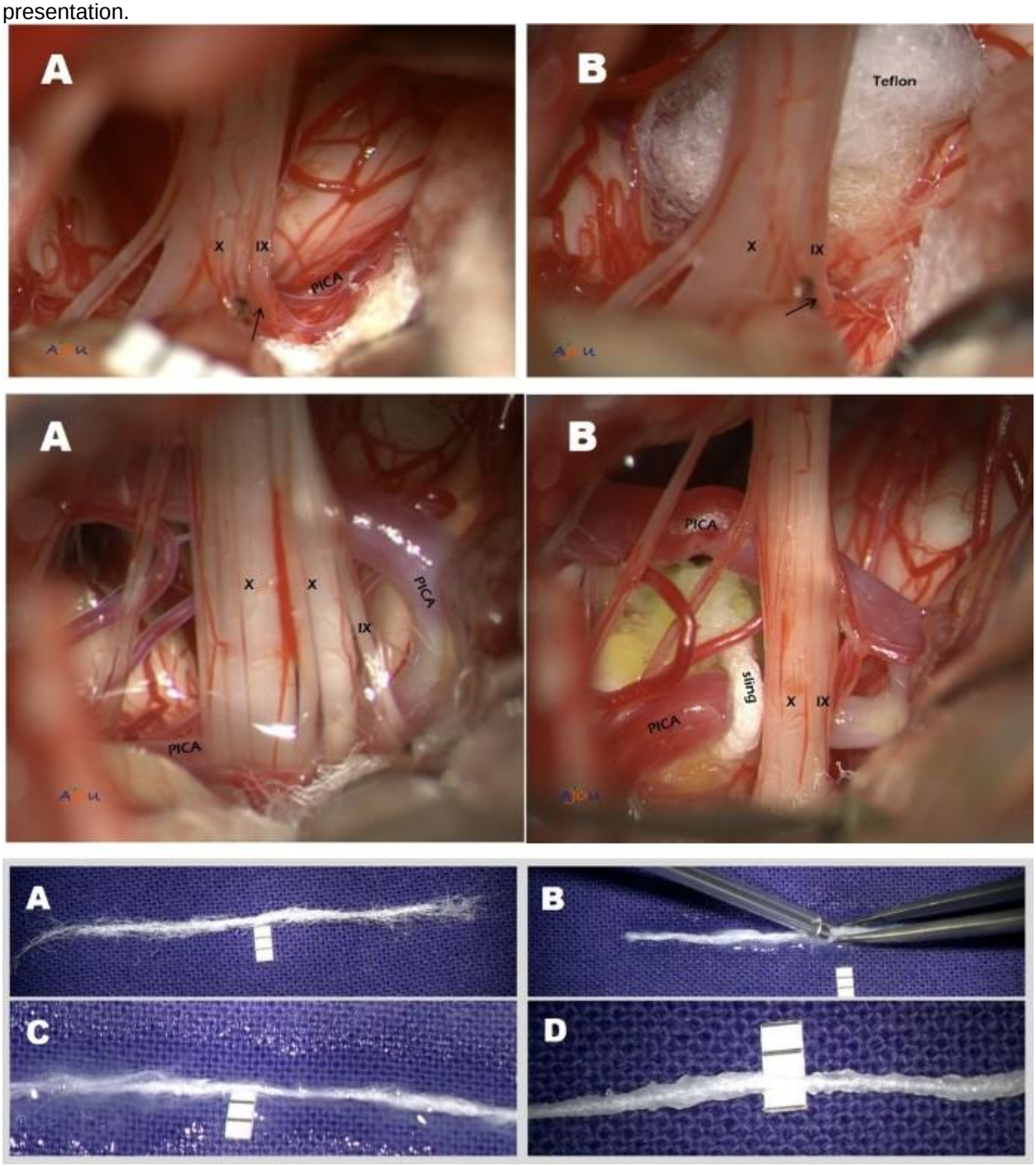
Introduction: Glossopharyngeal neuralgia presents a therapeutic challenge, often necessitating microvascular decompression (MVD) as the primary curative intervention for debilitating pain. This retrospective review evaluates the outcomes of MVD procedures aimed at targeting the "off the Root Entry Zone (REZ)" to achieve secure decompression and prevent recurrence.

Methods: Among various decompression techniques, transposition with either a Teflon piece or a Teflon sling coated with fibrin glue was predominantly utilized to achieve secure decompression "off the REZ." The choice of technique depended on the nature of vascular impingement, with the fibrin-glue coated Teflon sling offering advantages in cases where simple transposition was not feasible due to anatomical constraints. The coating of the Teflon sling with fibrin glue facilitated manipulation, rendering it lint-free, sleek, soft, and flexible. Additionally, it increased tension, thereby enhancing safety and ease of use.

Results: Microscopic photos illustrate two types of transposition techniques employed. Figure 1 demonstrates simple transposition using Teflon pieces, while Figure 2 depicts transposition using a Teflon sling. Figure 3 outlines the technique for creating a glue-coated Teflon sling. Further detailed descriptions will be provided in the poster

presentation.



Conclusions: Overall, MVD utilizing transposition techniques proves to be a safe and effective curative treatment for glossopharyngeal neuralgia, with minimal complications and a low recurrence rate. The incorporation of a fibrin-glue coated Teflon sling offers distinct advantages in achieving secure decompression, particularly in challenging anatomical scenarios, thereby contributing to the overall success of MVD procedures.

Keywords: Glossopharyngeal neuralgia, Microvascular decompression, Transposition technique

EP124 / #15

Topic: *AS03. Pain*

COMPARISON OF SURGICAL TREATMENTS FOR TRIGEMINAL NEURALGIA: LONG-TERM EFFICACY STUDY

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Introduction: Trigeminal neuralgia (TN) poses challenges in treatment efficacy and outcome assessment. Our objective is to compare microvascular decompression (MVD), radiofrequency rhizotomy (RF), and stereotactic radiosurgery (SRS) for long-term pain management. We will present a summary of recently published results (Pain Pract. 2023 Dec 9. doi: 10.1111/papr.13327) as well as newer unpublished findings from our research.

Methods: In a non-randomized design with both prospective and retrospective data collection, including control groups without pre-tests, we evaluated outcomes from RF (n=10) SRS (n=9), and MVD (n=33). Pain intensity, pain relief, quality of life, and treatment satisfaction were assessed using visual analog score(VAS), The SF-36 Health Survey, and the Patient Global Impression of Change scale over a 5-year period. Statistical analysis utilized the Kruskal–Wallis test, the effect size was calculated by Epsilon-squared (ε), Kaplan–Meier survival analyses, log-rank test, and Cox regression analysis.

Results: MVD demonstrated superior pain control outcomes compared to neuroablative procedures. Significant differences ($p < 0.05$) were observed in pain intensity immediately post-op (ε 0.14) and at 6 months (ε 0.2), 1 year (ε 0.4), 2 years (ε 0.27), and 3 years (ε 0.28). Additionally, RF and SRS groups showed increased risk of pain recurrence (Relative risk 3.1, 95% CI 1.3–7.4; p=0.009; and Relative risk 4.2, 95% CI 1.7–10.2; p=0.001, respectively) compared to the MVD cohort. In survival analysis, the median time to pain recurrence (VAS ≥1) was longer in the MVD group (24 months) compared to neuroablative procedures (6 months) ($p < 0.001$, log-rank test). Multivariate analysis identified preoperative symptom duration as a significant predictor of pain recurrence in the MVD group. Quality of life, treatment satisfaction, and complication rates showed no significant differences, although complications were more frequent in the MVD group.

Conclusions: MVD demonstrates superior long-term pain control compared to RF and SRS for TN. Preoperative symptom duration predicts MVD outcome. Standardized outcome measures aid in comparison.

Keywords: treatment outcome, trigeminal neuralgia, chronic pain

EP125 / #32

Topic: *AS03. Pain*

EFFECTIVENESS AND SAFETY OF MOTOR CORTEX STIMULATION FOR THE TREATMENT OF POST-STROKE PAIN: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Post-stroke pain, often resistant to conventional treatments, can significantly impede rehabilitation and daily functioning. Motor cortex stimulation (MCS) presents a promising alternative, leveraging neurostimulation to alleviate such pain. Our systematic review aims to investigate the efficacy and safety of MCS, offering insights into its therapeutic potential for those suffering from this debilitating condition.

Methods: A systematic search was performed in PubMed, Embase, SCOPUS, Cochrane Central, WOS and EBSCO for studies conducted up to September 11th, 2023. Studies aiming to assess the efficacy and safety of MCS in Post stroke patients were included. In addition, observational studies, case series and case reports written in English, Spanish and Portuguese were included. Quality assessment was performed using the Newcastle-Ottawa scale for observational studies and the JBI scale for case series and case reports. A single arm, random effect meta-analysis was performed for the mean difference of Pre and Post VAS scores.

Results: A total of 460 studies were screened after the elimination of duplicates. A total of 24 studies were included, representing a total of 387 patients. The mean age was 58.1 ± 8.9 for all the participants. The most common procedure reported was Epidural Motor cortex Stimulation (n=11/24), followed by rTMS (n=9/24) and TDCS (n=4/24). Moreover, the most common site of infarction was the thalamus (n=14/24), followed by the motor cortex (n=7/24). Other sites of infarction include the Putamen, pons and the anterior cingulate gyrus. Besides the most common site of stimulation was M1 (n=10/24), other sites included DLPFC, PRG, S1, C3, C4. The adverse effects reported were pain (n=7/24), seizures (n=3/24), infection (n=2/24) and subdural haematoma (n=1/24). The MCS intervention led to a reduction of VAS score -2.45 CI 95% [-3.65;-1.25].

Conclusions: Motor cortex stimulation is a promising intervention for Post stroke pain; however more comparative research is needed.

Keywords: Motor cortex stimulation, Poststroke pain, Neuromodulation

EP126 / #167

Topic: *AS03. Pain*

REOPERATION OF LONG-TERM RECURRENCE AFTER MICROVASCULAR DECOMPRESSION FOR PRIMARY TRIGEMINAL NEURALGIA: WHAT WE SEE AND WHAT WE GOT?

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Introduction: Microvascular decompression (MVD) is currently the first-line surgical treatment for primary trigeminal neuralgia (PTN). The risk factors associated with short-term or medium-term recurrence following MVD as well as the therapeutic strategy had been reported in the previous literature. The present study focused on the rarely reported PTN cases with long-term recurrence after MVD, aiming to summarize and provide single-institute experience for PTN treatment.

Methods: The medical records of a series of PTN patients with long-term recurrence after MVD admitted to our institute for reoperation from January 2021 to December 2022 have been retrospectively reviewed. Baseline characteristics, distribution and duration of PTN, radiological studies, intraoperative findings, and surgical outcome have been recorded and analyzed.

Results: There were 18 patients included in this study, with a mean age of 62±6.8 years old. The mean duration of recurrence is 8.3±2.2（6.3-10.8）years, and the most affected branches are the maxillary and mandibular nerves. The second MVD was performed by the same neurosurgeon in our institute. Intraoperative findings included severe adhesion of the subarachnoid membrane to the vasa vasorum of trigeminal nerves, the nerve per se, and the penetrating vessels. The decompression materials could be recognized despite the adhesion and possible displacement. Removal of the decompression materials was performed by carefully sharp dissection. Immediate pain relief was achieved in all the patients, and no recurrence was reported at the last visit. The average duration of follow-up is 20±7.2 months.

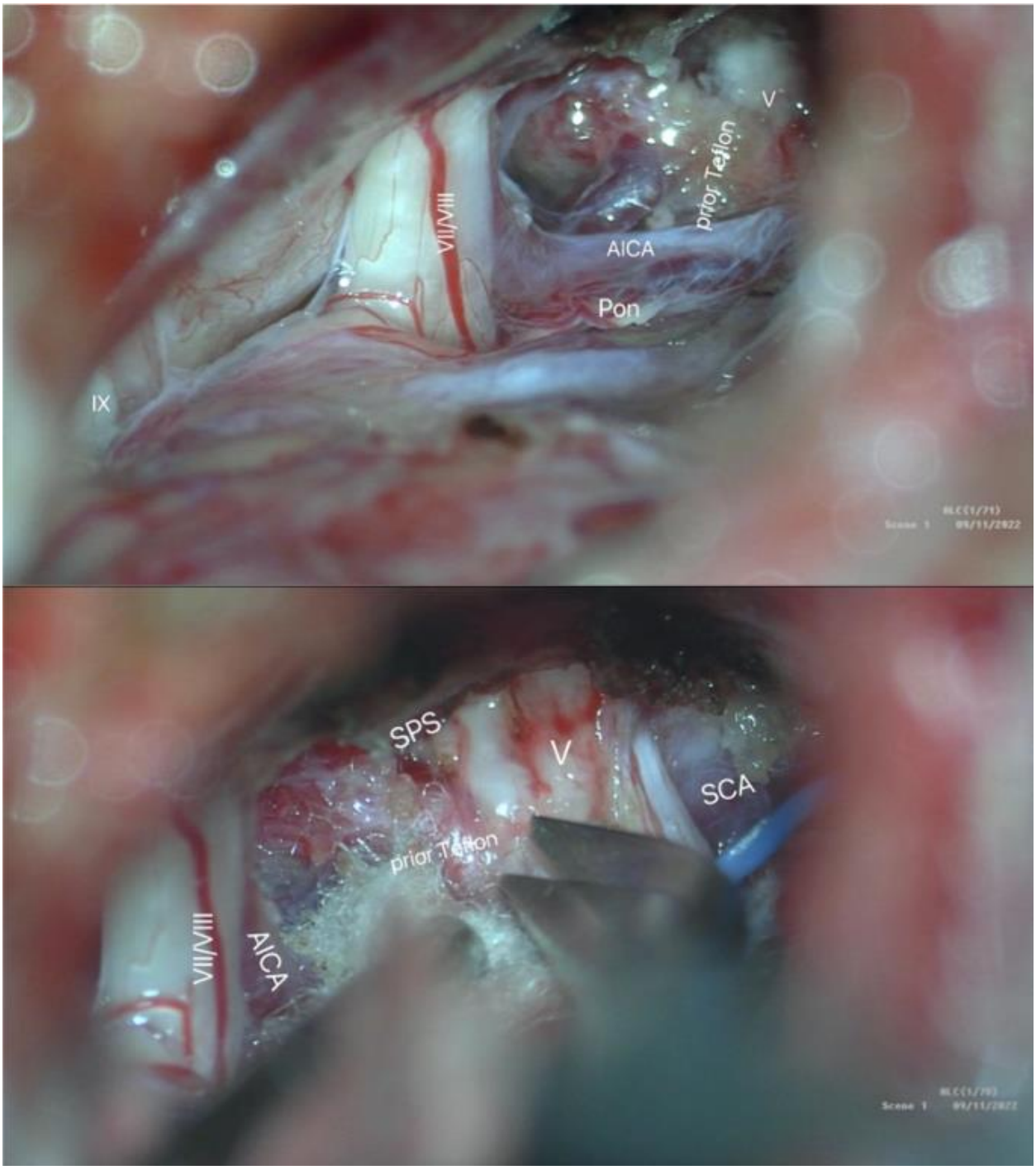

Figure1. Intraoperative image of a patients with recurrent PTN 10 years after the first MVD.

Conclusions: The diagnosis of long-term recurrence after microvascular decompression for primary trigeminal neuralgia should be made according to the medical history and the clinical characteristics, which include the same distribution and features of pain as the initial attack. The offending vessels and the relationship between vessels and nerves can barely be recognized on preoperative radiological images. Comprehensive knowledge of the history of the first MVD and other surgical treatment (e.g., percutaneous treatment) is of importance for reoperation for patients with long-term recurrence. Complete dissection of the adhesive arachnoid membrane, and re-recognition and re-decompression of neurovascular compression are the keys to a successful outcome.

Keywords: trigeminal neuralgia, long-term recurrence, Microvascular decompression

EP127 / #505

Topic: *AS03. Pain*

SYNERGISTIC EFFECTS OF VIRTUAL REALITY AND SPINAL CORD STIMULATION IN CHRONIC PAIN MANAGEMENT

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Introduction: Chronic pain significantly impacts societal well-being, demanding effective, non-pharmacological treatment modalities. Spinal Cord Stimulation (SCS) and Virtual Reality (VR) therapy individually offer promising results in chronic pain management. This narrative review explores the feasibility of integrating VR with SCS to enhance chronic pain therapy.

Methods: This narrative review assessed the efficacy and feasibility of combining VR as an adjunctive therapy to SCS in chronic pain. Further, also review the broader field of virtual reality therapy for acute and chronic pain, including a novel examination of patient and cost considerations within the Canadian healthcare system.

Results: Preliminary findings indicate that combining VR and SCS could offer a synergistic effect, showing promising effects for short-term
reductions in chronic pain. While early results show promise, there are unexplored aspects of spinal cord stimulation combined with virtual reality
therapy, particularly long-term effects on analgesia, anxiolysis, and implications on the effectiveness and longevity of spinal cord stimulation.

Conclusions: While early evidence supports the potential synergistic benefits of VR and SCS in chronic pain management, further research is essential. Investigating long-term effects, patient acceptability and economic implications will be crucial for understanding the therapeutic potential, efficacy and logistics of this integrative approach.

Keywords: Virtual reality, Spinal Cord Stimulation, chronic pain

EP128 / #111

Topic: *AS03. Pain*

TRIGEMINAL NEURALGIA AND HEMIFACIAL SPASM ASSOCIATED WITH VERTEBROBASILAR ARTERY TORTUOSITY

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Introduction: The tortuous vertebrobasilar artery (TVBA) often causes neurovascular conflicts in patients with trigeminal neuralgia (TN) and hemifacial spasm (HFS). Implementation of microvascular decompression (MVD) in these circumstances is hindered due to stiffness of the enlarged and dilated arteries and is often accompanied by poor outcomes. The surgical strategy in cases of trigeminal neuralgia and hemifacial spasm associated with the TVBA should be clarified in order to achieve good outcomes

Methods: The TVBA as a compressing vessel was identified in 33 cases (14 cases of TN, 18 cases of HFS, and 1 patient with painful tic convulsif). All patients underwent MVD and a retrospective analysis of clinical outcomes

Results: Compression caused by the vertebral artery was found in all HFS patients and 4 TN patients, and compression caused by the basilar artery was observed in 10 TN cases. Additional compression of the cranial nerve root entry/exit zone by cerebellar vessels was observed in 21 cases. The TVBA was mobilized by dissection of arachnoid adhesions between the vessel and the brainstem and retracted laterally. Then, the TVBA was retracted from the brainstem to the caudorostral direction. These manipulations resulted is “spontaneous” decompression of the cranial nerves without placing prostheses between the artery and the nerve root entry/exit zone. In all cases (except two), the displaced TVBA was fixed between the enlarged artery and brainstem using pieces of the patient’s muscle and adipose tissues, followed by application of fibrin glue. A cylindrical silicone prosthesis was used in 1 case. In another case, the TVBA was retracted using a fascial loop fixed to the dura mater of the petrous pyramid by means of a suture. After application of MVD, TN and HFS symptoms completely regressed. There were several transient complications and 2 cases of permanent hearing loss. No clinical symptom recurrence was observed.

Conclusions: MVD is the most effective surgical treatment of TN and HFS caused by the TVBA. The TVBA should be retracted from the brainstem without placing prostheses in the nerve root entry/exit zone.

Keywords: hemifacial spasm, tortuous vertebrobasilar artery, trigeminal neuralgia

EP129 / #165

Topic: *AS03. Pain*

SCS FOR BRACHIAL PLEXOPATHIC PAIN

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Introduction: Brachial injury pain is sometimes accompany neuroma, causalgia, etc. Surgical management consisted with DREZ op, SCS, DBS surgery.

Methods: 4 brachial plexopathy pain patients were identified who underwent spinal cord stimulation. All patients were referred for spinal cord stimulation from a multidisciplinary pain clinic having completed at least 6 months of conservative treatment with physical therapy, pain medications, epidural blocks, etc. All paients were screemed with a tempoary electrode system in order to estabilish satisfactory relief of pain before internalization of permanent system. 4 (100%) proceeded to undergo permanent implantation pre- and postoperative pain levels were based on the administrations of visual analogue scale (VAS). A modifed outcome scale was used to compare the long-term efficacy of spinal cord stimulation.

Results: Visual analogue scale (VAS) decreased an average of 5.5 for patients undergoing specify SCS placement. Specify electordes exhibited good or excellent outcome in 100%. There was no mortality directly associated with surgery. One brachial plexopathy patient developed right same side leg weakness and recoveryed later

Conclusions: Spinal cord stimulation is a safe, useful, minimally invasive procedure for the treatment of intractable brachial pexopathic pain.

Keyword: SCS for brachial plexopathic pain

EP130 / #47

Topic: *AS03. Pain*

REALIZED EFFECTS OF LOW BACK PAIN THERAPY

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Introduction: The treatment of low back pain is very complex and requires a multidisciplinary approach including the assessment of patients' attitudes, beliefs. The aim of the work was to estimate the connection between patients' expectations and achieved therapeutic effects.

Methods: The study included 63 patients, mean age 48.97 ± 10.49 years, 30 (47.6%) men and 33 (52.4%) women, who were treated for low back pain. Average duration of pain before the treatment was 6.7 ± 2.2 weeks. Patients were treated with standard physical procedures during 4.4 ± 0.5 weeks. Based on the own expectations and opinions about the effectiveness of therapy and improving of their physical and work capacity patients were at the start divided into two groups: the "optimistic" who expected recovery of over 50% (43, ie. 68.3% of patients) and "pessimistic" group (20, ie. 31.7%) who believed that their current state will be improved up to 50% or less. To evaluate the efficacy of treatment two questionnaires were used: visual analog scale (VAS) and the Oswestry Disability Questionnaire (ODQ), and the results were compared between the above mentioned two groups.

Results: Before treatment the values of VAS and ODQ were not significantly different in the two groups. After completion of therapy the results were significantly better in both groups of patients than before the treatment. In the "optimistic" group initially VAS value was 7.2 ± 1.7 and after treatment 1.8 ± 0.5 ($p < 0.01$), and ODQ was 53.7 ± 7.3 respectively 23.7 ± 5.4 ($p < 0.01$). In the "pessimistic" group the values were: VAS before treatment 7.4 ± 1.8, and after therapy 2.9 ± 1.1 ($p < 0.01$) and ODQ 55.4 ± 8.9 vs 30.8 ± 6.5 ($p < 0.01$).

Conclusions: The results after therapy were significantly better in both groups than before treatment. However, after the treatment in the "optimistic" group results were better than in the “pessimistic” group. It can be concluded that pessimism, in patients with chronic low back pain, may reduce the therapeutic efficacy and may also indicate the presence of negative psychosocial factors that need to be corrected or removed.

Keywords: Low back pain, physical therapy, treatment efficacy

EP131 / #276

Topic: *AS03. Pain*

SPINAL CORD STIMULATION FOR CHRONIC NEUROPATHIC PAIN IN ADRENOMYELONEUROPATHY

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Introduction: Adrenomyeloneuropathy (AMN) is a phenotypic subtype of the rare genetic disorder adrenoleukodystrophy. Primarily an axonal sensorimotor neuropathy, AMN can present as a progressive, painful peripheral neuropathy, but no consensus exists regarding treatment options. With recent approval of spinal cord stimulation platforms for painful diabetic neuropathy, neuromodulation appears to be a promising option to treat pain in AMN. However, the application of SCS for AMN has not yet been reported. Here, we present a case of successful treatment of pain in AMN with SCS.

Methods: A 33 year old male with 10-year history of progressive neuropathic pain in bilateral lower extremities was treated with SCS after failure of multiple medications and therapy. After a successful percutaneous trial, a thoracic spinal cord stimulator was placed. Visual analog scale (VAS) and 36-Item Short Form Survey (SF-36) were used to assess pain and quality of life preoperatively, as well as 3- and 12-months postoperatively.

Results: Pain scores by VAS decreased from 8.5/10 preoperatively to 5/10 at 3-months postoperatively, and was rated at 7/10 by 12-months. Notable improvements were seen on SF-36 in domains of physical functioning, limitations due to emotional problems, energy/fatigue, emotional well-being, and pain at 3- and 12-months postoperatively.

Conclusions: We report here a case of successful treatment of pain and improvement in quality of life in AMN using SCS. Despite the similarities to painful diabetic neuropathy, no consensus exists for treatment of pain in AMN, and little literature supports the use of SCS. We therefore advocate for prompt referral to pain specialists for further workup and management of pain in AMN, including consideration of SCS.

Keywords: Adrenomyeloneuropathy, Spinal Cord Stimulation, Neuropathic pain

EP132 / #487

Topic: *AS03. Pain*

SPHENOPALATINE GANGLION BLOCK IN A PATIENT WITH TRIGEMINAL NEURALGIA REFRACTORY TO OTHER INTERVENTIONS: A CASE REPORT

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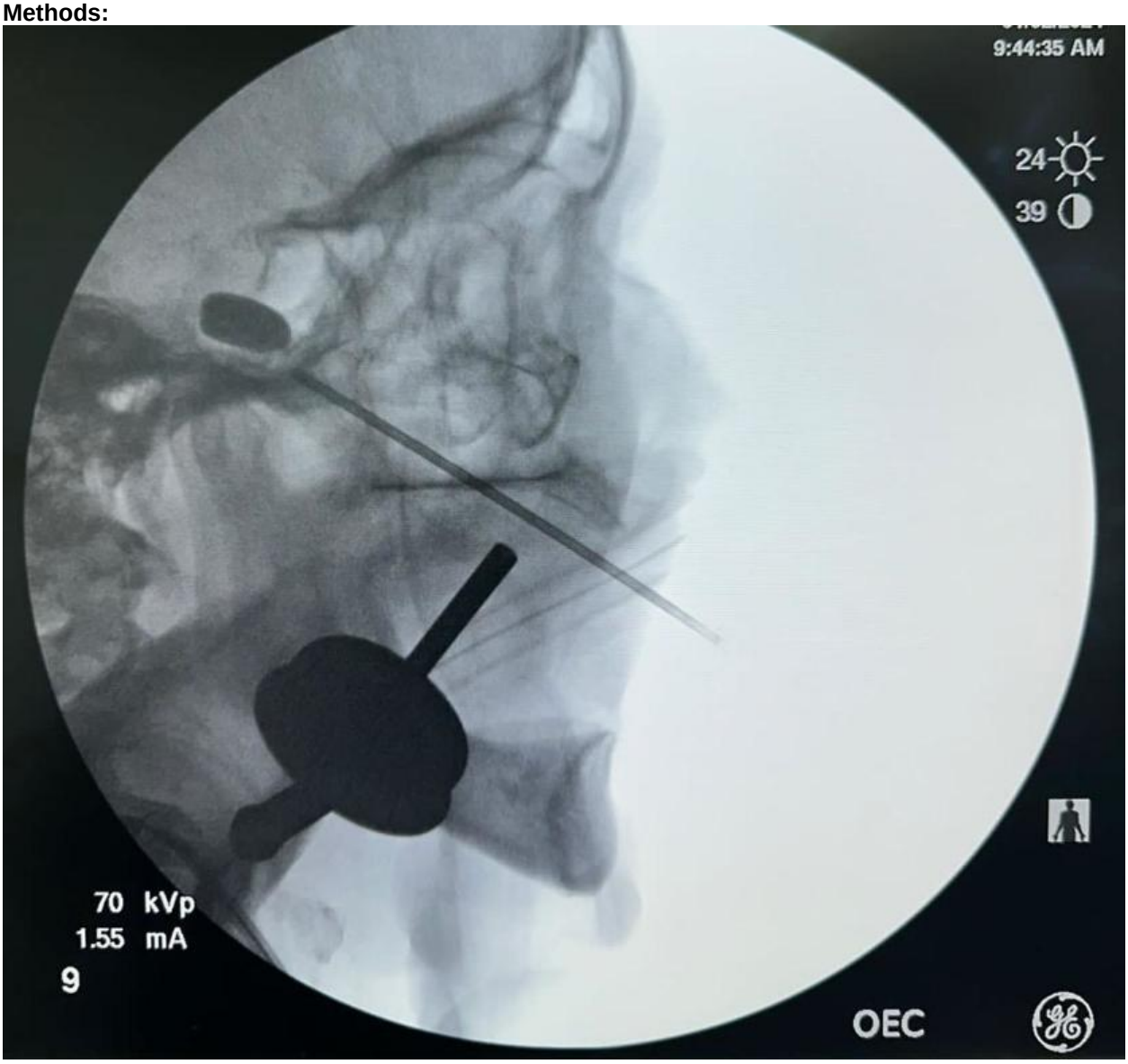
Introduction: Trigeminal neuralgia (TN) is a pathology characterized by paroxysmal facial pain. This condition can involve onr ot more divisions of the trigeminal nerve. TN treatment can range from pharmacologic therapy to vascular decompression surgery. The invasive procedures used as an option in the treatment of TN are: rhizotomy with thermocoagulation, chemical injection, or mechanical balloon compression, botulinum toxin (TB),radiosurgery, peripheral neurectomy, and nerve block and in cases of vascular compression as the etiology of pain, microvascular decompression can be used. Sphenopalatine ganglion block (SGB) can also be performed for patients suffering from chronic facial pain and in cases of a positive response, radiofrequency (RF) for sphenopalatine ganglion can be used as a final treatment.

Methods:



Female, with a history of more than 10 years of presenting experiencing TN with episodes of intense electric shock-like pain in the right side of the face, VAS=10. Treatment with Carbamazepine and tricyclic antidepressants was initiated, requiring a combination of Pregabalin and CBD (maximum dose). However, the treatment was found to be ineffective and TB administration was then proposed. With painful symptoms persisting, US-guided peripheral trigeminal blockade procedures and quarterly TB was then performed but were also found to be ineffective. Percutaneous balloon rhizotomy was then performed, but again, the treatment was futile.

Results: As the patient did not have favorable clinical responses to microvascular decompression, the SGB procedure was then carried out, guided by fluoroscopy, with an injection of 2 ml of Ropivacaine. Immediate improvements were seen after the procedure, VAS=1 and reduction in daily crises. Given the positive outcome of the case after the SGB procedure, RF was recommended as the final form of treatment and the patient is awaiting it

Conclusions: In this case report, we demonstrated the low risk and effectiveness of the SGB procedure in the treatment of TN, especially in a patient with symptoms that were not responsive to other types of treatments. After the SGB, the patient displayed considerable improvement in pain relief and quality of

life. New studies and case-reports like these are needed to further prove how safe and effective this type of treatment is for TN.

Keywords: pain, Sphenoplatine ganglion block, trigeminal neuralgia

EP133 / #181

Topic: *AS03. Pain*

PERIPHERAL NERVE STIMULATION USING FAST TM- FAST ACTING SUBPERCEPTION THERAPY- FOR NUMMULAR HEADACHE

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Introduction: Nummular headache, also known as “coin-shaped cephalgia,” is a relatively new diagnosis first described in 2002. It refers to localized scalp pain in a fixed round or elliptical region occupying a 1–6 cm diameter. Previously we had reported a case of nummular headache which was successfully managed with percutaneous electrical nerve stimulation (PENS) treatment. A permanent peripheral nerve stimulator (PNS) implant has not been reported thus far. This report describes successful management of nummular headache with a permanent PNS implant utilising the fast acting suppression therapy FAST™ (Boston Scientific).

Methods: A 45-year-old man was referred with 4 year history of pain in the right temple. MR scan of the head was normal with no evidence of any trigeminal neurovascular conflict. The pain was present in a coin shaped area in the right temple and a diagnosis of nummular headache was made. He suffered a background pain with severity of 3/10 on the numerical rating scale with exacerbations of sharp electrical shock-like pain of 7 to 10/10. There was extreme hypersensitivity cause by cold wounds and touch. After failed conservative treatment, he was managed with several sessions of PENS therapy over a period of four years, each providing him with few months of pain relief. Due to recurrence of pain, despite having some cumulative effect with PENS treatment, a decision was made to proceed with permanent PNS implant. This was done in July 2023 using two linear ST percutaneous leads and Wavewriter Implantable Pulse Generator (Boston Scientific).

Results: The stimulation induced paraesthesia was overlying the painful area of the nummular headache. He had tried both the fast acting suppression therapy (FAST™) program as well as paraesthesia based program and currently uses a combo session program which alternates between FAST 30 (Fast Acting sub perception therapy) for 6 minutes and 2 low frequency programs 100hz for 3 minutes and a 2hz for 3 minutes. At 7 months postop, he is completely pain-free and the stimulator has made significant improvement in the quality of his life.

Conclusions: We report the first case of use of PNS implant for nummular headache.

Keywords: NUMMULAR HEADACHE, FAST SCS, PNS

EP134 / #503

Topic: *AS03. Pain*

LONG-TERM RELIEF OF MORTON'S NEUROMA PAIN AFTER ULTRASOUND-GUIDED RADIOFREQUENCY ABLATION (RFA) TREATMENT

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Introduction: Morton's Neuroma (MN) is a pathology where tissue thickening occurs around the plantar nerves, mainly the 3rd and 4th interdigital nerves of the foot, which leads to symptoms of acute pain in the dorsal region of the foot, a burning sensation and paresthesia between the fingers. It affects more women than men and is often associated with inappropriate use of shoes and behavioral measures. Treatment includes changing habits, analgesics/anti-inflammatories, physiotherapy and in refractory cases, radiofrequency (RF) or surgical resection of the neuroma may be necessary.

Methods:

Female, teacher, with a history of 13 years, presented with sharp pain and shock of strong intensity, VAS 8, in the intermetatarsal region of the left foot, between the 3rd and 4th toe. On MRI of the left forefoot, an oval image was seen, with intermediate signal intensity on T1 and T2 located on the plantar surface between the heads of the 2nd, 3rd, and 4th metatarsals, with enhancement by paramagnetic contrast, with a non-specific appearance, which may represent a Morton's neuroma depending on clinical

correlation. The patient received a multidisciplinary treatment with physiotherapy, physical activity to strengthen muscles, as well as drug treatment, however, without benefit. On 19/04/23, she went through a randomized pulsed radiofrequency using a 10mm sharp needle, guided by ultrasound. It was applied for 8 minutes at 50v. infiltration with Triamcinolone 20 mg, Glucose 5% 1 ml and Ropivacaine 7.5 mg 1 ml, under sedoanalgesia. VAS was obtained pre and postoperatively.

Results: In the first post-operative period, the patient was pain-free, VAS=0 and walked without assistance. After 11 months, the patient is oligosymptomatic, with significant improvement in pain, with some episodes of shock sensation in the left foot when stepping on the floor but maintains VAS 4/10 and remains asymptomatic on most days.

Conclusions: Although there are few reports of long-term pain improvement in patients with Morton's Neuroma, we report an exceptional case, with 11 months of good evolution after pulsed radiofrequency. RF is a safe and efficient procedure for treating MN, but more studies like this are needed to demonstrate long-term efficacy and safety.

Keywords: Morton's neuroma, pain, Radiofrequency

EP135 / #209

Topic: *AS03. Pain*

COMBINED USE OF BURSTDR DORSAL ROOT GANGLION STIMULATION (DRGS) WITH PADDLE ELECTRODES AND BURSTDR SPINAL CORD STIMULATION (SCS): A REPORT OF TWO CASES

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Introduction: Dorsal root ganglion stimulation (DRGS) is established for focal neuropathic pain treatment. Lead migration and fracture are recognised complications which can necessitate multiple lead revisions. The resultant scarring can preclude percutaneous reimplantation. In this eventuality, one option is replacement with a spinal cord stimulator (SCS) but this is not always as efficacious. Unlike with SCS, there is no dedicated DRGS paddle electrode that can be used to salvage percutaneous migrations.

Methods: We describe two illustrative patient cases where paddle DRGS was successfully performed utilising SCS hardware, highlighting technical considerations and outcomes. The first patient suffered from chronic post-incisional pain. Unusually, this required combined SCS (at T5-T7) and DRGS (T9 -T12) for adequate symptom control. Unfortunately both systems required explantation due to erosion. Given her extensive scarring, percutaneous DRGS reimplantation was not possible. We thus describe the surgical implantation of four contact paddle electrodes (Resume TL, Medtronic), intra-foraminally via hemi-laminectomy, combined with an adaptor and SCS IPG to deliver BurstDR stimulation directly to the DRG. The second patient underwent L1 DRG stimulation to good effect for right sided chronic scrotal content pain (CSCP). Unfortunately he suffered a lead fracture and multiple revisions until percutaneous DRG re-implantation was no long feasible at either L1 or L2. Using one four contact and one eight contact SCS paddle (S4 and 44 Lamitrode, both Abbott) he also underwent paddle DRGS insertion at L1 and L2.

Results: Both patients ultimately achieved excellent control of their target pains. In the first case pain decreased from 8 – 10/10 on NRS to 0/10 off all medications and she was able to eat and drink orally again which had not been previously possible. No migration or relapse was seen at 36 months follow up. The second patient similarly had pain score reduction from 10/10 to 0/10 and was able to return to work.

Conclusions: We demonstrate the use of surgical paddle electrodes for DRG stimulation is technically feasible and represents an additional option in challenging revisional cases. It further permits newer waveforms such as BurstDR for DRG stimulation which we have employed to good effect.

Keywords: DRG stimulation, Paddle DRG, scs

EP136 / #22

Topic: *AS04. Psychiatric Disorders*

BNST-NAC DEEP BRAIN STIMULATION FOR TREATMENT-RESISTANT DEPRESSION: A RANDOMIZED CLINICAL TRIAL

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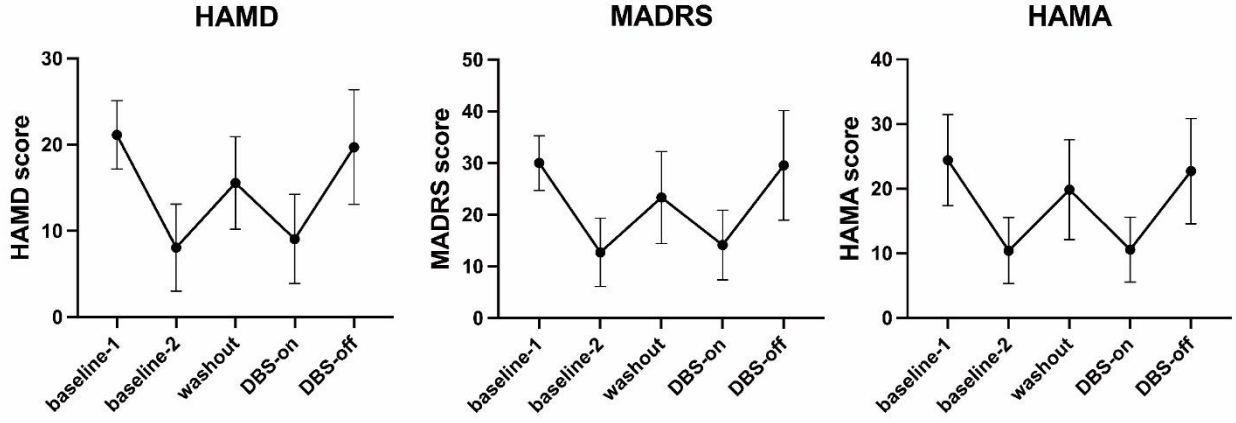
Introduction: With the prevalence of 4.4%, depression is one of the most common mental disorders worldwide. More than 30% of depression patients response poorly to antidepressants, and are defined as treatment-resistant depression (TRD). In the treatment of TRD, deep brain stimulation (DBS) is still in the exploratory stage. Therapeutic effects vary greatly among different clinical centers, and finding the optimal stimulation targets is the most concerning issue in clinical work. DBS may be an effective and safe treatment for TRD patients, but the placebo effect needs to be excluded. In this study, we chose bed nucleus of the stria terminalis (BNST) and nucleus accumbuns (NAc) as DBS target. To assess the efficacy of BNST-NAc DBS, we controlled placebo effects with active and sham stimulation phases.

Methods: 14 TRD patients received surgery of BNST-NAc DBS at Ruijin hospital in China. Patients first entered the phase of DBS programming until a stable response was achieved. Before entering the double-blind crossover phase, a 2-day DBS wash-out period was set up to eliminate the long-term impact of DBS. Then, randomized, double-blind, 4-week crossover period was performed on patient: active stimulation followed by sham stimulation, or vice versa. The outcome was evaluted by the change in the score of 17-item Hamilton Depression Scale (HAMD), 14-item Hamilton Anxiety Scale (HAMA) and Montgomery-Asberg Depression Rating Scale (MADRS). The symptom assessment was conducted before DBS surgery, after DBS programming, after the wash-out, after crossover phase 1 and after crossover phase 2.

Results: Of 14 patient in this study, the mean age was 32.8±10.8 years. In the open-label phase, mean HAMD score significantly decreased from 21.1±4.0 before surgery (baseline-1) to 8.1±5.0 after DBS programming (baseline-2) ($P<0.0001$). In the double-blind crossover, patients scored significantly lower in HAMD at DBS-on phase (9.1±5.2) than at DBS-off phase (19.7±6.7, $P=0.0002$). Changes in score of HAMA and MADRS presented the same result as
HAMD.



Conclusions: BNST-NAc DBS significantly alleviated depressive symptoms in 14 TRD patients. The result of randomized crossover study confirmed that the relief of symptoms of TRD patients received BNST-NAc DBS was not caused by placebo effects, but the treatment effect itself of DBS.

Keywords: Deep Brain Stimulation, Treatment-resistant depression, Randomized Clinical Trial

EP137 / #409

Topic: *AS04. Psychiatric Disorders*

MODULATING DEPRESSION-RELATED BRAIN REGIONS: THE IMPACT OF MULTI-LEAD DEEP BRAIN STIMULATION

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Introduction: In the USA around 2.8 million patients are diagnosed with TRD annually [1]. Given the limitations of existing treatments for TRD, and considering DBS's mixed outcomes [2], [3], [4], [5], we posit that tailoring DBS to the individual's depressive phenotype could significantly improve efficacy[6]. Our hypothesis suggests that by employing multi-lead stimulation targeting the subcallosal cingulate (SCC) and ventral capsule/ventral striatum (VCVS), and adjusting the stimulation parameters and temporal patterns, we may achieve a more profound and nuanced modulation of neural activity within depression-related areas. Our investigation aims to explore the hypothesis that activation of SCC and VCVS, through carefully calibrated electrical stimulation, can modulate neural signals within regions implicated in depression, potentially in an additive, supra-additive, or infra-additive manner.

Methods: Monopolar stimulation was delivered to the stimulation targets in random order and neural activity was recorded using ten sEEG leads. After re-referencing, the power spectrum of LFPs was calculated using continuous wavelet transform. Wilcoxon signed-rank test was used to determine if there is a significant difference between the normalized average power at each frequency band during pre-stimulation compared to stimulation and post-stimulation period and to determine if there is a significant difference between change in multi-lead power and change in summation of single-lead powers at different frequency bands.

Results: ~16% of the comparisons showed statistically significant (pValue<0.001) change in power during the stimulation period and ~4% during the post-stimulation. The significant increase in power during stimulation occurs mostly in the beta and gamma bands and the decrease mostly in the alpha, beta, and theta bands. Bilateral VCVS stimulation seems to be mostly additive and supra-additive, while multi-lead SCC stimulation seems to have approximately similar levels of infra-additivity compared to supra-additivity/additivity.

Conclusions: This suggests that simultaneous stimulation of right and left VCVS is likely more efficient than individual activation of them. While simultaneous stimulation of the right and left SCC is likely less effective than activating them individually. This research not only promises to advance our theoretical knowledge of brain stimulation effects but also holds the potential to translate into more effective, personalized treatment strategies for individuals grappling with treatment-resistant forms of depression.

Keywords: DBS, TRD

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Topic: *AS04. Psychiatric Disorders*

EFFECT OF SUBTHALAMIC STIMULATION ON ELECTROENCEPHALOGRAPHIC MARKERS OF DETECTION AND CONFIDENCE IN OBSESSIVE COMPULSIVE DISORDER

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Introduction: Most research on perceptual decision-making and metacognitive monitoring is focused on the cortex. However, beyond its role in motor control, the subthalamic nucleus (STN) is known to be also involved in perceptual decision-making. Here, we investigated the causal role of the STN in perceptual decision and metacognitive monitoring using a visual detection task followed by confidence judgements

Methods: We took the opportunity of an ongoing clinical trial of Deep Brain stimulation targeting the antero-ventral part of the STN to treat Obsessive Compulsive Disorders (OCD). We compared the behavioral and electroencephalographic responses of 14 patients with OCD implanted in the STN with a stimulation device, on- and off- stimulation, to 18 matched healthy control volunteers, while they attempted to detect face stimuli in a stream of visual noise, and then reported the confidence in their response

Results: At the behavioral level, we found that patients off-stimulation used the confidence scale less optimally than controls, even though stimulus detectability was similar between the two groups (weak evidence in favor of an interaction between group, response and stimulus intensity on confidence estimate = 0.90 [0.14 1.65], BF = 2.56). This difference was reflected at the electrophysiological level (weak evidence in favor of an interaction between group, intensity and response, estimate = 0.90 [0.14 1.65], BF = 2.56), revealing that ERP associated with confidence tracked less the intensity of detected stimuli in patients than in controls. Comparing OCD individuals on- and off-stimulation, we found no behavioral difference effect regarding stimulus detection nor confidence judgements; however, we found electrophysiological differences regarding stimulus detection.

Conclusions: While OCD patients experience a metacognitive deficit reflected in the cortical activity, and are improved by chronic STN stimulation, we did not observe any acute effect of the stimulation on perceptual decision and related confidence .

Keyword: deep brain stimulation; obsessive compulsive disorder; confidence; EEG

EP139 / #501

Topic: *AS04. Psychiatric Disorders*

RADIOFREQUENCY CINGULOTOMY AS A TREATMENT FOR INCOERCIBLE PAIN: FOLLOW-UP FOR 6 MONTHS

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Introduction: Pain is defined as an unpleasant sensory and emotional experience, associated with actual or potential tissue injury according to the International Association for the Study of Pain . prognostic factor: good prognosis (visceral, bone or soft tissue pain, non-irruptive, without emotional distress. However, it does not say what to do when it does not respond to pharmacologicalical treatment, or which combinations are the most effective; for this, the WHO scale ontreatment, or which combinations are the most effective; for this, the WHO scale on pain handling is necessary , where invasive methods are necessary.cingulotomy are considered for the treatment of incoercible pain in step IV of the WHO. This is defined as a section of fibers that reacheThis is defined as a section of fibers that reaches and exits the anterior cingulate gyrus .

Methods: An observational, longitudinal, retrospective, and analytical study was carried out on a case series in which bilateral cingulotomy was performed due to incoercible pain. Follow- up was performed 6 months after hospitalization through outpatient clinic consultations at the Neurotraumatology Clinic between 2020 and 2022. All individuals were cared for by a multidisciplinary team comprising neurologists, neurosurgeons, psychiatrists, anesthesiologists, and neuropsychologists.

Results: Six patients took part in this study, and none of them experienced relapses after the cingulotomy surgery.g at 61% reduction in the probability of medication reducing after intervention. Patientes scored lower on the VAS score (IRR=0.18) indicating at 82% reduction in pain perception due to the intervention. Spearman’s correlation between medication and VAS score was significant ($p < 0.05$), reflecting a very strong association (rho = 0.83).

Conclusions: Bilateral cingulotomy decreases incoercible pain, which was measured after 6 months according to the visual analog scale, and likewise, it decreases the need for pain medication along with its adverse effects.

Keyword: cingulotomy; neurosurgery; incoercible pain; analgesia; anterior cingulate cortex

EP140 / #189

Topic: *AS04. Psychiatric Disorders*

DEEP BRAIN STIMULATION AND DEPRESSION: A DISSECTION THROUGH THE PATHWAYS THAT INTERCONNECT THE SUBGENUAL CINGULATE GYRUS (BA25).

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Introduction: Deep brain stimulation over the subgenual cingulate gyrus (SCG) is currently proposed as a target for major depressive disorder. The white matter connections underlying the SCG are still under study and we believe that its knowledge can help us to clarify the fiber network that participates in the mechanism of action of DBS and, in turn, contribute to refine the targeting for electrode placement. Our objective is to carry out a deep investigation of the anatomic connections of the SCG region by presenting a tractography study and the second and most extensive cadaveric study of the anatomical connections of this region.

Methods: Tractographies were performed by using DSI Studio software on a template of 1065 healthy human brains. A one-ROI approach was used, thus a spherical ROI was placed on the ventromedial frontal cortex. The different tracts were observed in a three-dimensional plane. The results were compared with cadaveric dissections performed in 12 healthy human brain hemispheres according to the Klingler technique.

Results: In our study, we found seven main connections (Figs 1-2): 1- Fibers of the cingulum, originating at the level of the SCG and terminating at the medial aspect of the fronto-parietal lobe (Ci). 2- Fibers of the uncinate fasciculus, connecting the orbitofrontal with the anterior temporal region (UC). 3- Fibers from the forceps minor connecting both frontal lobes (FM). 4- Fronto-striatal fibers (F-St). 5- Fibers running more laterally, converging onto the ventral striatum (Accumbofrontal Fasciculus - AF). 6- Fibers connecting both amígdalas running through the forceps minor (Amg). 7- Fibers of the deeper portion of the IFOF.

Conclusions: The SCG presented a large number of white matter connections to the limbic system, the prefrontal area, and mesotemporal areas. In this study we described 3 consistent white matter bundles that were not taken into account in previous studies that could be useful to improve the electrode implantation.These findings can help to explain the role of the SCG in DBS for psychiatric disorders.

Keywords: Deep Brain Stimulation, Subgenual cingulate gyrus, Treatment resistant depression

EP141 / #250

Topic: *AS04. Psychiatric Disorders*

DEEP BRAIN STIMULATION FOR OBSESSIVE-COMPULSIVE DISORDER: UMBRELLA REVIEW AND A META-ANALYSIS

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Introduction: Deep brain stimulation (DBS) for otherwise treatment-refractory obsessive-compulsive disorder (OCD) represents an emerging therapy. This umbrella review and meta-analysis aims to provide a comprehensive summary of studies published in the literature on the outcomes of DBS in the context of OCD.

Methods: In adherence to PRISMA guidelines, an umbrella review and meta-analysis was conducted in October 2023, systematically searching PubMed, Medline, Embase, and Web of Science for meta-analyses on the treatment of OCD with DBS. Individual studies within the included meta-analyses, along with new studies from 2023, were meticulously reviewed, and duplications were removed. They were further categorised based on stimulation targets. Their results were collected and pooled to generate forest plots. The primary outcome was the relative change in Y-BOCS, HAM-A, HAM-D and Global Assessment of Functioning (GAF) scores at last available follow-up after DBS.

Results: This umbrella review encompassed seven meta-analyses evaluating the outcomes of DBS in patients with OCD published between 2014 and 2022. The analysis, including 40 studies, revealed a significant overall improvement in OCD symptoms following DBS, as measured by Y-BOCS (mean difference (MD)=1.94, 95%CI=1.70, 2.18, $p<0.00001$, $I^2=43\%$), HAM-A (MD=24.56, 95%CI=23.41, 25.72, $p<0.00001$, $I^2=99\%$), HAM-D (MD=9.36, 95%CI=7.94, 10.77, $p<0.00001$, $I^2=45\%$), and GAF scales (MD=-4.87, 95%CI=-5.58, -4.16, $p<0.00001$, $I^2=99\%$).

Conclusions: DBS is safe and effective for OCD. Careful patient selection according to clear definitions of “treatment refractoriness” is recommended. Further research is essential to better understand and assess the treatment's efficacy, as well as to determine the most optimal brain targets for OCD.

Keywords: Obsessive–compulsive disorder, Deep Brain Stimulation, Meta-analysis

EP142 / #145

Topic: *AS05. Neuro Restoration or Injury*

EVALUATION OF THE LONG-TERM EFFECT OF SELECTIVE TIBIAL NEUROTOMY FOR THE TREATMENT OF THE SPASTIC FOOT USING A PERSONAL GOAL-CENTERED APPROACH

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Introduction: The objective of the study is to evaluate the long-term effectiveness of selective tibial neurotomy (STN) for the treatment of the spastic foot using a goal-centered approach.

Methods: Between 2011 and 2018, adult patients with a spastic foot (regardless of etiology), who received STN followed by a rehabilitation program were included. The primary outcome was the achievement of individual goals defined preoperatively (T_0) and compared at 1-year (T_1) and 5-year (T_5) follow-up, using the Goal Attainment Scaling methodology (T-score). The secondary outcomes were the presence of spastic deformities (equinus, varus, and claw toes), the modified Ashworth scale (MAS) in the targeted muscles, and the modified Rankin score (mRS) at T_0, T_1 and T_5.

Results: Eighty-eight patients were included. At T_5, 88.7% of patients had achieved their goals at least "as expected". The mean T-score was significantly higher at T_1 (62.5 ± 9.5) and T_5 (60.6 ± 11.3) than at T_0 (37.9 ± 2.8, $p< 0.0001$), and was not significantly different between T_1 and T_5 ($p = 0.2$). Compared to T_0, deformities (equinus, varus, and claw toes, $p < 0.0001$), MAS ($p < 0.0001$), and the mRS ($p < 0.0001$) were significantly improved at T_1 and T_5. Compared to T_1, only MAS increased slightly at T_5 ($p = 0.05$) but remained largely below the preoperative value. There was no difference between T_1 and T_5 regarding other clinical parameters (deformities, walking abilities, mRS).

Conclusions: This study found that STN associated with a postoperative rehabilitation program can enable patients to successfully achieve personal goals that are sustained within a 5-year follow-up period.

Keywords: selective tibial neurotomy, goal attainment scaling, spasticity

EP143 / #313

Topic: *AS05. Neuro Restoration or Injury*

ASSESSMENT OF THE FIRST 3 YEARS STEREOTACTIC ACTIVITIES IN THE SURGERY OF BRAIN LESIONS IN MALI

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Introduction: Stereotaxic surgery is an image-guided neurosurgical procedure in which a three-dimensional guidance system is used to perform a diagnostic or therapeutic gesture in the brain. This work presents our experience in the first years of practice of this surgical procedure in Mali.

Methods: We carried out a retrospective, descriptive study of all the files of patients operated on by stereotaxy at the Teaching hospital “Hôpital du Mali” in Bamako, from December 2019 to March 2023. Fifty-six patients were included in the study. Forty-four patients (78.57%) were operated for evacuation of spontaneous intraparenchymal hematoma (SIPH) and 12 (21.43%) for stereotactic biopsy.

Results: The male sex represented 58.93% and the female 41.07%. The average age of the patients was 38.84 years. The seat of the lesion was supratentorial in 91.07% and subtentorial in 8.93%. Regarding SIPH, the mean volume of aspirated blood was 49.78cc. Grade II astrocytoma was the most found histology. The number of patients with a Rankin score modified 4 decreased from 73.21% at one month postoperatively to 44.64% at 3 months, evolving towards scores 3 and 2. Complications related to surgery concerned 5.36% of patients (bleeding in the biopsy site and re-bleeding in the SIPH outlet cavity). We recorded 7.71% of deaths after 3 months of follow-up.

Conclusions: Stereotaxy has considerably improved our working conditions.

EP144 / #231

Topic: *AS05. Neuro Restoration or Injury*

SELECTIVE NEUROTOMY OF THE MEDIAN NERVE FOR THE TREATMENT OF THE SPASTIC UPPER LIMB: A TECHNICAL NOTE

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Introduction: Spasticity is caused by the hyperexcitability of the stretch reflex. The median nerve is responsible for the motor innervation of most muscles usually involved in upper limb spasticity. The principle of selective neurotomy surgery in the functional limb is to restore the balance of the muscles by reducing the overactivity of the spastic muscles with the aim of improving limb functional status. There are still few articles about selective median neurotomy for the treatment of spasticity. In this study, the authors describe the surgical technique of selective neurotomy of the median nerve for the spastic upper limb. The technique requires an in-depth understanding of the muscle nerve supply and any possible variations in order to be successful.

Methods: The authors describe the surgical technique and illustrate its application in the case of upper limb spasticity due to a history of right thalamic hemorrhage, including a video demonstrating all the steps to perform this approach. In addition, the authors discuss the advantages and limitations of this technique. The motor branch was identified by using electric stimulation. Selective neurotomy was performed on the motor branch and preserved the sensory branch of the median nerve. The nerve was cut for approximately 5-7 mm. Partial motor neurectomy of the median nerve was performed at the neuromuscular junction with the pronator teres muscle.

Results: The selective neurotomy of the median nerve technique was used to achieve useful, long-lasting tone and gain voluntary movements in spastic wrists and fingers with low morbidity rates, while preserving the sensory nerve safely and effectively.

Conclusions: The selective neurotomy of the median nerve approach is an effective technique. This surgery, removing all or a portion of the motor nerve branches that innervate a specific muscle, can help reduce muscular spasticity. Nerve stimulation assists in the identification of these branches, and an understanding of the variances in motor nerve innervation is necessary to identify all branches.

Keywords: Selective Neurotomy, Median Nerve, Spastic Upper Limb

EP145 / #275

Topic: *AS05. Neuro Restoration or Injury*

MRI DIFFUSION TENSOR IMAGING PARAMETERS AS POTENTIAL PREDICTIVE FACTORS IN THE EVALUATION OF PATIENTS WITH DISORDERS OF CONSCIOUSNESS BEFORE DBS

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Introduction: Neuroimaging progress has yielded new tools which, potentially, can be applied to improve the diagnosis of neurological disorders and predict outcomes. The disorders of consciousness (DOC) are limited to subjective assessment and objective measurements of behavior, with an emerging role for neuroimaging techniques. The study aimed to investigate the clinical application of MRI imaging indicators of diffusion tensor imaging (DTI) for DOC patients.

Methods: MRI with high-resolution T1 MPRAGE and DWI were done on twenty patients with a clinical diagnosis of DOC admitted at the Department of Neurosurgery Dubrava University Hospital to perform neurophysiological testing to confirm whether the patient candidate for deep brain stimulation. Morphometric analysis was done using Freesurfer software. The data for the imaging indicators, fractional anisotropy (FA) and mean diffusivity (MD), were separately collected from three relevant regions of interest (ROIs): brainstem, thalamus, and subcortex.

Results: The indicators were statistically analyzed, and correlation analyses were conducted for the results of the morphometric study and mean values of FA and MD in the ROIs evaluated through clinical Rappaport Disability Rating, Coma/Near Coma scale, and Coma Recovery Scale-Revised scores. Morphometric analysis revealed that the level of brain volume decrease is correlated with the severity of DOC. Furthermore, the more severe the DOC, the higher the MD value and the lower the FA value. The FA and MD values in the ROIs correlated with CRS-R scores, particularly in the thalamus.

Conclusions: Both volumetric and DTI analysis have proved to be a powerful tool as they grant insight into the pathogenesis and specific grey and white matter abnormalities underlying different comatose states, casting light on the neural basis of consciousness and the clinical features associated with DOC.

Keywords: disorders of consciousness, MRI, DBS

EP146 / #297

Topic: *AS05. Neuro Restoration or Injury*

MRI QUALITATIVE AND QUANTITATIVE ANALYSIS IN PATIENTS WITH DISORDERS OF CONSCIOUSNESS: A LONGITUDINAL STUDY

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Introduction: The use of MRI in diagnosing disorders of consciousness (DOC) is critical as it provides unparalleled insights into the brain's structure and function, enabling the detection of subtle abnormalities that may elude other diagnostic modalities. This advanced imaging technique facilitates a deeper understanding of the underlying pathophysiology, guiding more accurate prognoses and tailored therapeutic strategies. This prospective study aims to investigate the utility of magnetic resonance imaging (MRI) in both qualitative and quantitative analyses for assessing patients with DOC.

Methods: We enrolled a cohort of 30 patients diagnosed with DOC following traumatic or anoxic brain injuries. All participants underwent structural MRI scans at the admission and one year after. Quantitative analyses were done using observer-independent software, while qualitative assessments were done using the DOC-MRIDS scale with additional features by two independent observers. Both analyses were done on both initial and control MRI scans. Furthermore, standardized scales correlated these findings with clinical assessments of consciousness levels.

Results: Qualitative MRI analyses revealed significant structural brain abnormalities in patients with higher levels of DOC, including diffuse and focal lesions. Additionally, quantitative analyses showed reduced volume compartments and cortical thickness. Morphometric analysis revealed that the level of brain volume decrease is correlated with the severity of DOC. Furthermore, a subset of patients showing signs of recovery over the study period demonstrated significant changes in quantitative MRI metrics, suggesting potential biomarkers for consciousness recovery.

Conclusions: MRI provides a powerful tool for both qualitative and quantitative analysis of brain structure and function in patients with DOC. Our findings highlight the potential of MRI metrics as biomarkers for the assessment of consciousness levels and prognosis in this patient population. Future studies with larger cohorts and longitudinal designs are warranted to further validate these results and explore the utility of advanced MRI techniques in guiding therapeutic interventions for individuals with DOC.

Keywords: volumetric, disorders of consciousness, MRI

EP147 / #124

Topic: *AS06. Radiosurgery*

INITIAL EXPERIENCE WITH ZAP-X STEREOTACTIC RADIOSURGERY FOR TRIGEMINAL NEURALGIA

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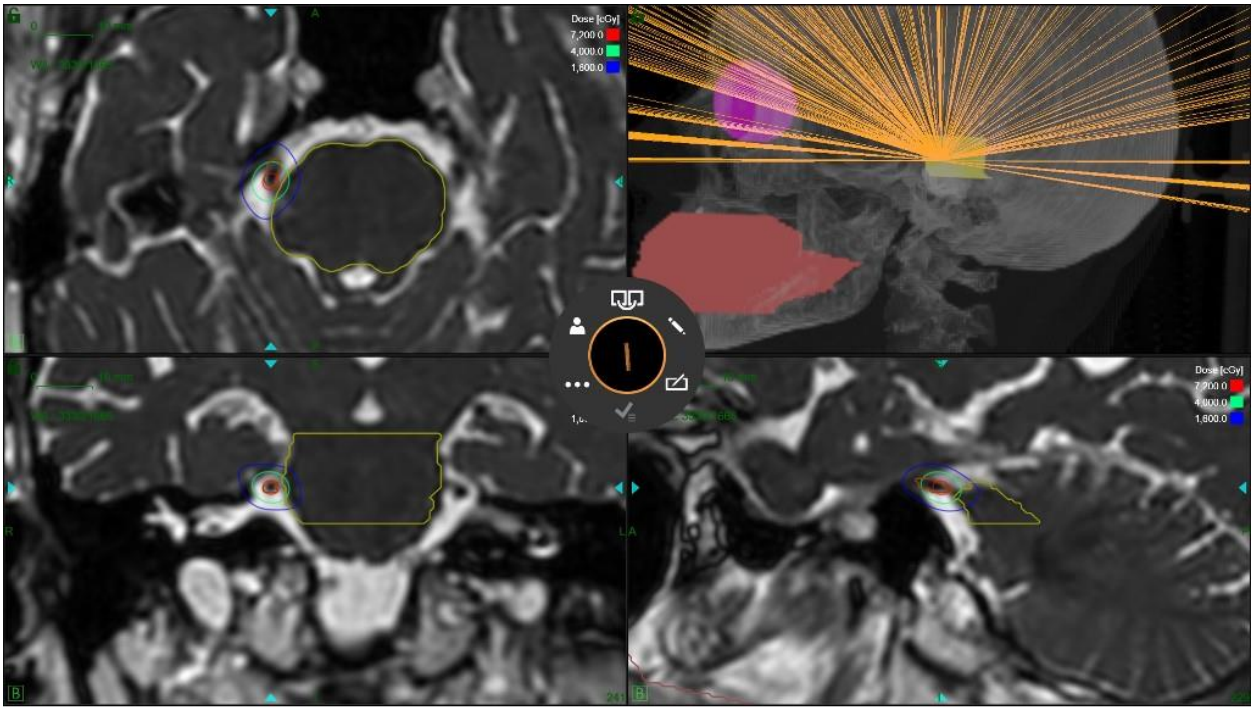
Introduction: The ZAP-X is the newest cranial stereotactic radiosurgery (SRS) platform. There are few reports describing its use or outcomes in trigeminal neuralgia (TN). In this study, dosimetric parameters and procedural techniques are analyzed for ZAP-X TN SRS along with initial clinical outcomes.

Methods: Seven patients were treated with ZAP-X TN SRS. A single isocenter was utilized with a 5 mm collimator and 80-90 Gy prescribed to the 100% isodose line at the trigeminal nerve entry zone, such that the 50% isodose line contacted the brainstem. Forward planning was performed, limiting dose to the eyes and oral cavity (maximum dose ≤ 200 cGy). An independent second monitor unit check was performed utilizing tissue phantom ratio calculations. Patient specific quality assurance (QA) was performed with SRS MapCHECK employing gamma analysis metrics of 10% low-dose threshold, 1% distance-to-agreement, and 2% dose difference. Machine QA was performed utilizing functional, Winston-Lutz, and output tests. Patient facial pain was classified using Barrow Neurological Institute (BNI) pain intensity scale with positive outcomes defined as less than presentation BNI
scale.



ZAP-X TN SRS with a target covering 0.03 cc of the trigeminal nerve in the entry zone location. A single isocenter was placed in the target prescribing 80 Gy to the 100% isodose line such that the 50% isodose line contacted the brainstem.

Results: All patients underwent successful treatment without machine related issues. Average maximum dose to the eyes, oral cavity, and brainstem were 109 ± 20 cGy, 33 ± 40 cGy, and 5869 ± 1200 cGy respectively. Average number of beams was 280 ± 40. Average beam time was 38 ± 2 minutes. Average secondary check maximum dose accuracy was 99.0 ± 1.5%. Gamma passing rate for all patients was 100%. All machine QA tests were within recommended tolerances. Initial one-month follow-up demonstrated positive patient outcomes, with all patients experiencing decreased pain intensity.

ZAP-X TN SRS patient characteristics and initial follow-up results.

Patient	TN Type	Location	Pre-BNI	1-Month BNI
A	Typical	Right, V2	IIIb	II
B	Typical	Right, V2, V3	IV	II
C	Typical	Right, V2	IIIb	IIIa
D	Typical	Left, V1, V2, V3	IIIb	IIIa
E	Typical	Right, V1	IIIb	IIIa
F	Typical	Left, V2, V3	IIIb	II
G	Atypical	Right, V1, V2	IIIb	IIIa

Conclusions: These results demonstrate the successful use of ZAP-X TN SRS. Although requiring further investigation, such studies are needed to define long-term efficacy of this new technical approach.

Keywords: stereotactic radiosurgery, ZAP-X, trigeminal neuralgia

EP148 / #56

Topic: *AS06. Radiosurgery*

SHOULD POST-OPERATIVE STEREOTACTIC RADIOSURGERY BE THE STANDARD OF CARE IN CRANIOPHARYNGIOMA PATIENTS?

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Introduction: This study aims to analyse the clinical and radiological outcomes in patients receiving adjuvant gamma knife radiosurgery (GKRS) for residual/recurrent craniopharyngiomas. It compares these outcomes with patients who did not receive any post-operative radiotherapy.

Methods: In this retro-prospective case-control study, we enrolled all consecutive patients who received adjuvant GKRS for recurrent/ residual craniopharyngiomas from 2011 to 2019, with a minimum 12 month radiological follow-up. Consecutive surgically treated craniopharyngioma patients between 2018 and 2019, who did not receive any post-operative radiotherapy constituted the control group. The clinical, and radiological outcomes were compared between the two groups.

Results: A total of 79 patients were analyzed. 35 patients received GKRS in the post-operative period, with a median age of 21 years (range 6-55 years). At a median follow up of 60.1 months (range 24 to 118 months), the tumor control rate was 91.4% (n=32). In the control group there were a total of 44 patients, with a median age of 16 years (range 3-48 years), and a median follow-up of 47.4 months (range 12.7 to 61.7 months). Kaplan-Meier analysis, and log-rank tests showed better progression free survival (PFS) (3-year PFS of 92.3% vs. 77.7%, p=0.03), and overall-survival (OS) rates (3-year OS of 97.1% vs. 74.6%, p=0.009) for patients who received post-operative GKRS. Cox proportional-hazards results showed post-operative GKRS (HR = 0.055, 95% CI = 0.008- 0.363) to be an independent prognostic factor for OS in craniopharyngioma patients.

Conclusions: This study shows that GKRS offers improved clinical and radiological outcomes as compared to surgery alone, and should be considered in all patients with residual disease.

Keywords: radiosurgery, Craniopharyngioma, gamma knife

EP149 / #478

Topic: *AS06. Radiosurgery*

GAMMAKNIFE RADIOSURGERY FOR PITUITARY ADENOMA

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Introduction: For the treatment of pituitary adenoma, surgical resection via transsphenoidal approach is the most reliable treatment modality. Two aspects of treatment goals are usually achieved through complete resection: (1) reduction of tumor mass to protect surrounding structures from compression, and (2) the endocrinological cure of the symptoms caused by hormone secreting tumors. However, complete surgical resection is very challenging in the case of tumor invasion of cavernous sinus. In this case, Gammaknife radiosurgery could be alternative treatment option for residual tumor.

Methods: Eighty-eight pituitary adenoma patients who underwent Gamma knife radiosurgery in our institute were enrolled in this study. Males were 38 patients, and females were 50. The mean age of the patients enrolled was 54.77±15.52 years old. All the patients were post-surgical resection cases. Functional pituitary adenomas were 15 among 88 cases. The patients enrolled were followed up for at least 2 years. The median follow-up duration was 66.85±3.32 months. The median duration from surgical resection to radiosurgery was 16.97±27.78 months.

Results: The tumor control rate was 100% in nonfunctional pituitary adenoma cases. However, in functional pituitary adenoma cases, 2 out of 7 growth hormone-secreting tumor cases and 2 out of 8 prolactin-secreting tumor cases were controlled endocrinologically. Residual or recurrent pituitary adenoma cases in our study need spoiled gradient recalled acquisition in the steady state(SPGR) MRI sequences to visualize the tumor portion.

Conclusions: Gamma knife radiosurgery is established as a valuable treatment option for residual pituitary tumors. To achieve a better outcome, we need to follow up on the tumor growth and endocrinological normalization. In performing radiosurgery, the pathological status in the case of secreting tumors and the radiation dose to the normal pituitary gland and surrounding structure were carefully considered.

EP150 / #51

Topic: *AS06. Radiosurgery*

LINAC-BASED AND CYBERKNIFE FRACTIONATED STEREOTACTIC RADIOSURGERY FOR OPTIC NERVE SHEATH MENINGIOMAS: A SINGLE INSTITUTION EXPERIENCE

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Introduction: Optic nerve sheath meningiomas (ONSM) are rare entity which irreversibly leads to vision loss. Treatment options are observation, microsurgery, or standard fractionated radiotherapy. With the increasingly available frameless radiosurgery, the possibility of precise radiation is established using a multisession treatment with doses below the tolerance dose of the optic nerve, and sufficient to achieve local control of the disease with no side effects.

Methods: Multisession radiosurgey was offered to five patients with ONSM. Patient age ranged from 43 to 73 years (mean 54 years). The diagnosis was based on MR neuroimaging. The patients underwent thin-slice (1.00- mm-thick) CT scanning and volumetric MR imaging. The median pretreatment tumor volume was 1.96 mL (range, 0.5-5.6 mL). One patient was treated using the Cyberknife S7 machine, four were treated with Linac-based SRS with the Varian Edge RapidArc technique. An 80% prescribed isodose of 25 Gy was delivered in 5 sessions of 5 Gy. Patients were evaluated for tumor growth control and visual function. Mean follow-up duration was 16 months (6 to 25 months).

Results: On MR no changes in lesion size were observed in four patients and minimal regression in one. Visual function was stable in two and improved in three patients. No patients had worsening of visual function. No radiation-induced toxicities were observed. Furthermore, we made a dosimetric comparison between Cyberknife and LINAC-based stereotactic radiosurgery. Both techniques yielded good gross tumor volume coverage and organs at risk sparing. The conformity index was better in RapidArc (1.13 ± 0.35) compared to CyberKnife (1.48 ± 0.43). RapidArc also had a better dose gradient index (73.47 ± 27.98) compared to CyberKnife (55.76 ± 23.94). CyberKnife demonstrated lower maximum doses to some organs at risk such as lens, optic nerve and eye, and RapidArc delivered lower doses for chiasm. For normal brain tissues, V12Gy was lower with RapidArc (3.17 ± 9.69) compared to CyberKnife (5.49 cc ± 10.40). Tretment time was lower for RapidArc.

Conclusions: Multisession radiosurgery for ONSMs is safe and effective. The results from our series, in terms of growth control, visual function improvement, and toxicity, are promising without significant differences between Linac-based and Cyberknife techniques.

Keywords: stereotactic radiosurgery, optic nerve sheath meningioma, Cyberknife

EP151 / #459

Topic: *AS06. Radiosurgery*

CLINICAL OUTCOME OF GAMMA KNIFE RADIOSURGERY FOR RECURRED TRIGEMINAL NEURALGIA AFTER MICROVASCULAR DECOMPRESSION SURGERY.

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Introduction: Microvascular decompression (MVD) for trigeminal neuralgia (TN) is known to be the most effective surgical method. After surgery, most patients achieve favorable outcomes. However, it is difficult to determine a treatment method if pain recurs after surgery. In this study, we present the clinical results of Gamma knife radiosurgery (GKS) to patients with recurrent pain after surgical treatment for TN.

Methods: Since September 2010, eleven patients underwent GKS for recurred pain after surgery for TN at our hospital. We analyzed these patients. The mean age is 62.5 years old, there are 3 males and 8 females. Eight patients underwent surgery at our hospital and three patients underwent surgery at another hospital. The mean duration of GKS after surgery was 28.9 months.

Results: The mean follow-up period after gamma is 19 months. In the last outpatient BNI evaluation, 3 patients were II, 5 patients IIIA, 2 patients IIIB, and 1 patient IV. The patient with IV had pain recurrence 2 months after GKS and additionally received RFA. The average marginal dose was 43.9 Gy and the maximal dose was 86 Gy. Most patients targeted the anterior part of the trigeminal root.

Conclusions: It is difficult to determine a treatment method for medical refractory recurrent pain after MVD. For these patients, GKS can be helpful. However, because of the post-operative changes in image, planning must be careful.

Keywords: trigeminal neuralgia, gamma knife Radiosurgery, recurrent

EP152 / #65

Topic: *AS06. Radiosurgery*

TITLE: SHOULD POST-OPERATIVE STEREOTACTIC RADIOSURGERY BE THE STANDARD OF CARE IN CRANIOPHARYNGIOMA PATIENTS?

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Introduction: To analyse the clinical and radiological outcomes in patients receiving adjuvant gamma knife radiosurgery (GKRS) / radiotherapy (RT) for residual and recurrent craniopharyngiomas, and compare outcomes with patients who did not receive any postoperative radiotherapy.

Methods: In this retro-prospective case-control study, we enrolled all consecutive patients who received adjuvant RT or GKRS for recurrent/ residual craniopharyngiomas over 9 years (January 2011- December 2019), with a minimum radiological follow up of 12 months. Consecutive surgically treated craniopharyngioma patients over two years (January 2018- December 2019). who did not receive any postoperative radiotherapy constituted the control group . The clinical, and radiological outcomes were compared between the two groups.

Results: A total of 79 patients were enrolled for this study. 35 patients received GKT or RT, with a median age of 21 years (range 6-55 years). At a median follow up of 60.1 months (range 24 to 118 months), the tumor control rate was 91.4% (n=32). In the control group there were a total of 44 patients, with a median age of 16 years (range 3-48 years), and a median follow-up of 38.8 months; The mortality rate was 5.71% (n=2) in the group that received GKT/RT, compared to 25% (n=11) in the operative group, including a perioperative mortality of 11.4% (n=5). Kaplan-Meier analysis, and log-rank tests showed longer progression free survival (PFS) and overall-survival (OS) rates for patients receiving post-operative GKT/RT (5-year PFS of 92.3% vs 77.4%, p=0.03, and 5-year OS of 92.0% vs 74.6%, p=0.01) . Cox proportional-hazards results showed adjuvant GKRS/RT (HR = 0.158, 95% CI = 0.033-0.757) to be an independent prognostic factor for overall survival in craniopharyngioma patients.

Conclusions: This study shows that Gamma Knife radiosurgery offers improved clinical and radiological outcomes as compared to only surgery, and should be considered in all patients with residual/ recuurent disease.

Keyword: craniopharyngioma, radiosurgery, gamma-knife

EP153 / #59

Topic: *AS06. Radiosurgery*

RADIOSURGICAL DECOMPRESSION OF TRIGEMINAL NERVE AND ITS CORRELATION WITH FUNCTIONAL OUTCOME IN TUMOR RELATED TRIGEMINAL NEURALGIA

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Introduction: Introduction The target selection during gammaknife radiosurgery(GKRS) in cases of tumor related trigeminal neuralgia(TRTGN) is always debatable. Here we discuss the correlation of regression of tumor size, degree of release of the nerve after GKRS with long term pain control.

Methods: Total 58 cases of TRTGN were treated with GKRS (tumor was targeted) during the period March 2012 and March 2023. Post GKRS radiology was categorised in to three types (Type 1 – tumor volume remained same/reduced, additional segment of nerve not seen, Type 2 – tumor volume reduced, additional segment of trigeminal nerve seen but tumor still adherent to the nerve, Type 3 – tumor volume reduced, adjacent nerve seen completely separated from tumor). Pre and post GKRS pain score (BNI I to III –good, BNI IV&V – poor) was correlated with the above subgroups.

Results: At a median follow up of 52.5 months 23 cases have type 1, 26 showed type 2 and 9 showed type 3 radiological response. Thirteen (56.5%) patients with type 1, 17 (65.38%) with type 2 and 7(77.8%) with type 3 responses had good pain control. The outcome among these three was not statistically significant(p=0.518). Five patients in group3 were off medication which was statistically better than group1 with three (p = 0.013) and group2 with two patients(p = 0.002). Sixteen (59.25%) patients with meningioma, 14 (73.68%) with vestibular schwannoma and 2 (50%) With cavernous sinus lesion had good pain control. The median percentage of tumor volume reduction in meningioma was 28.5%, vestibular schwannoma was 50.7% and cavernous sinus lesion was 22%. Though the tumor volume reduction and good pain control was better among patients with vestibular schwannoma, but the difference in clinical outcome (better pain control) among these three histological sub types of tumor was not statistically significant (p=0.120).

Conclusions: Post GKRS tumor volume reduction may show good pain control in TRTGN. Primarily the tumor can be considered for upfront GKRS in patients with tumor related trigeminal neuralgia.This further allows visualization of additional segment of nerve that can be targeted in the second session for treating recurrent of failed cases.

Keywords: trigeminal neuralgia, Gammaknife radiosurgery, vestibular schwannoma

EP154 / #482

Topic: *AS06. Radiosurgery*

THE FEASIBILITY OF SINGLE-FRACTION RADIOSURGERY FOR SPINAL METASTASIS

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Introduction: The purpose of this study was to investigate the effectiveness and safety of single-fraction radiosurgery (SFR) in treating spinal metastasis.

Methods: In this single-institution study, 75 patients with 86 spinal metastases were treated between November 2018 and November 2022. The prescribed dose was 18Gy as a single fraction. We investigated pain intensity ratings (Visual Analog Scale: VAS), disability status (Oswestry Disability Index: ODI), concomitant pain medications, and adverse effects after SFR.

Results: The median follow-up period was 11 months (6-38 months). Primary tumor origin included lung (34.4%), prostate (18.8%), liver (12.5%), kidney (12.5%), and other (21.8%). Spinal metastases were found in the thoracic region (42.1%), followed by the lumbar region (36.8%). Tumor volume ranged from 2.3-383 cm^3 (mean, 32.3cm^3). The local control rate was 32 of 38 (84.2%) lesions. Cancer pain improvement occurred in 28 of 32 (87.5%) patients. Primary tumor origin has no significant correlation with prognostic factors for initial pain relief. We observed 1 patient with radiation myelopathy.

Conclusions: SFR was found to be feasible, safe, and clinically effective for the treatment of spinal metastases. The results indicate the potential of SFR in the treatment of patients with spine metastases to improve pain and local control.

Keywords: single-fraction, radiosurgery, spinal metastasis

EP155 / #519

Topic: *AS06. Radiosurgery*

DEEP LEARNING SUPER RESOLUTION TECHNIQUE BASED ON MAGNETIC RESONANCE IMAGING FOR APPLICATION OF IMAGE GUIDED DIAGNOSIS AND SURGERY OF TRIGEMINAL NEURALGIA

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Introduction: This study aimed to implement a deep learning based super resolution (SR) technique that could assist in the diagnosis and surgery of trigeminal neuralgia (TN) using magnetic resonance imaging (MRI).

Methods: Experimental methods applied SR to MRI data examined with five techniques, including T2-weighted image (T2WI), T1-weghted image (T1WI), contrast enhancement T1WI (CE-T1WI), T2WI turbo spin echo series volume isotropic turbo spin echo acquisition (VISTA), and proton density (PD), from patients diagnosed with TN. Performance was evaluated through peak signal to noise ratio (PSNR), structural similarity index measure (SSIM), and Leksell coordinate system using gamma knife radiosurgery (GKRS).

Results: The results showed higher values in PSNR and SSIM induced by SR compared to conventional image post processing techniques, with no difference seen in the coordinates.

Conclusions: The SR demonstrated remarkable effects in improving image quality without discrepancy in the coordinate system, confirming its potential as a useful tool in the diagnosis and surgery of TN.

Keywords: Deep learning; Super resolution, trigeminal neuralgia, Artificial intelligence

EP156 / #451

Topic: *AS06. Radiosurgery*

TREATMENT OF PITUITARY AND CAVERNOUS SINUS METASTASES WITH STEREOTACTIC RADIOSURGERY. A REWIEV.

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Introduction: Pituitary and cavernous sinus metastasis are rare, representing 0.4-0.9% of all intracranial metastases; the clinical symptoms can be serious. We conducted a literature review to evaluate the safety and usefulness of radiosurgery for the treatment of these metastasis.

Methods: A literature search was conducted on PubMed, Scopus, Cochrane library. Inclusion criteria were studies regarding case series on pituitary and/or cavernous sinus metastases treated with Gamma Knife, studies that were not case reports, studies in English. The indicators used to identify safety and usefulness were: deficits existing at the time of Gamma Knife and their progression after radiosurgery, adverse effects and complications post treatment, disease progression or death despite Gamma Knife, survival.

Results: Nine papers corresponding to the selection criteria from 2004 to 2023 were identified in the literature: three series concerning the treatment of cavernous sinus metastases, four series for pituitary metastases, and two series focused on both sites (pituitary and sinus cavernous metastases) for a total of 161 patients. About complications after Gamma Knife, it emerged that 12 patients suffering from hypo/panhypopituitarism showed no improvement, while diabetes insipidus improved in 5 patients (pre 9); of the 20 patients with visual deficits before the treatment 9 improved; trigeminal nerve deficits improved in 16 patients (pre Gamma Knife 39). About oculomotor function: 8 patients showed an improvement in the oculomotor nerve (32 patients affected before treatment), 3 patients showed an improvement in the trochlear nerve compared to 11 patients pre-treatment and 12 of 30 patients showed improvement in the abducens nerve. Complications due to Gamma Knife treatment affected three patients. Local disease progression was the cause of death in 16 patients (data available on a total of 104 patients). Sex, age, site and histology of primary tumor, tumor volume, presence of other cerebral metastases, marginal dose do not appear to be associated with survival. The average survival after Gamma Knife has more than doubled over the years maybe also thanks to the advancement of systemic therapies.

Conclusions: Stereotactic radiosurgery appears to be a safe and effective therapy for the treatment of pituitary and cavernous sinus metastases and contributes to improving patients' quality of life.

Keywords: stereotactic radiosurgery, Pituitary metastasis

EP157 / #452

Topic: *AS06. Radiosurgery*

MONITORING COGNITIVE FUNCTION OVER TIME IN PATIENTS UNDERGOING GAMMA KNIFE RADIOSURGERY: PRELIMINARY DATA FROM GK-CHECK 23 PROJECT.

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Introduction: The Gamma Knife is a type of stereotactic radiosurgery which employs high doses of radiation in a targeted way, with the aim of preserving as much healthy brain tissue as possible. For this reason, Gamma Knife is recommended for the treatment of brain metastases. To date, few studies employing a comprehensive battery of neuropsychological tests have investigated the effects of Gamma Knife treatment on cognitive functions over time. These studies suggest that tests related to auditory-verbal memory and executive functions are the most sensitive to cognitive changes following Gamma Knife treatment. Nevertheless, the results obtained on the effects of Gamma Knife radiosurgery on long-term cognitive function are controversial. The aim of this study is to track cognitive function of patients with brain metastases undergoing the Gamma Knife radiosurgery over time. The following are preliminary data.

Methods: Eleven patients (mean age = 62.1; standard deviation = 10.7) with brain metastases were recruited during neurosurgical outpatient examinations at the Poliambulanza Foundation (Brescia, Italy). A standard neuropsychological battery was administered to the patients few days before Gamma Knife treatment (T0) (mean = 5.5, standard deviation = 3.57) and three months after radiosurgery (T1).

Results: To compare the performance obtained by the patients at T0 and T1, paired-samples t-tests were conducted. The analysis showed no statistically significant differences in performance on auditory-verbal memory tests (Rey AVLT immediate recall, $p = 0.482$; Rey AVLT delayed recall, $p = 0.493$) or executive function tests (TMT B $p = 0.157$; phonemic verbal fluency $p = 1$; digit span backward $p = 0.588$).

Conclusions: Gamma Knife does not appear to have a worsening effect on the cognitive function of patients suffering from brain metastases three months after radiosurgery. However, longer follow-ups and larger sample size are required before drawing conclusions in this regard.

Keywords: brain metastasis, neuropsychological tests, stereotactic radiosurgery

EP158 / #158

Topic: *AS06. Radiosurgery*

LONG-TERM OUTCOME OF UNILATERAL ACOUSTIC NEUROMAS WITH OR WITHOUT HEARING LOSS: OVER 10 YEARS AND BEYOND AFTER GAMMA KNIFE RADIOSURGERY

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Introduction: Since the long-term outcomes of 162 patients who underwent gamma knife radiosurgery (GKS) as an initial or adjuvant treatment for acoustic neuromas (ANs) with unilateral hearing loss were first reported in 1998, there has been no report of a comprehensive analysis of what has changed in GKS practice.

Methods: We performed a retrospective study of the long-term outcomes of 106 patients with unilateral sporadic ANs who underwent GKS as an initial treatment. The mean patient age was 50 years, and the mean initial tumor volume was 3.68 cm^3 (range, 0.10 – 23.30 cm^3). The median marginal tumor dose was 12.5 Gy (range, 8.0 – 15.0 Gy) and the median follow-up duration was 153 months (range, 120 –216 months).

Results: The tumor volume increased in 11 patients (10.4%), remained stationary in 27 (25.5%), and decreased in 68 patients (64.2%). The actuarial 3, 5, 10, and 15-year tumor control rates were 95.3 ± 2.1%, 94.3 ± 2.2%, 87.7 ± 3.2, and 86.6 ± 3.3%, respectively. The 10-year actuarial tumor control rate was significantly lower in the patients with tumor volumes of ≥ 8 cm^3 (P = 0.010). The rate of maintaining the same Gardner-Robertson scale grade was 28.6%, and that of serviceable hearing was 46.4%. The rates of newly developed facial and trigeminal neuropathy were 2.8% and 4.7%, respectively. The patients who received marginal doses of less than 12 Gy revealed higher tumor control failure rates (P = 0.129) and newly occurred facial or trigeminal neuropathy rates (P = 0.040 and 0.313, respectively).

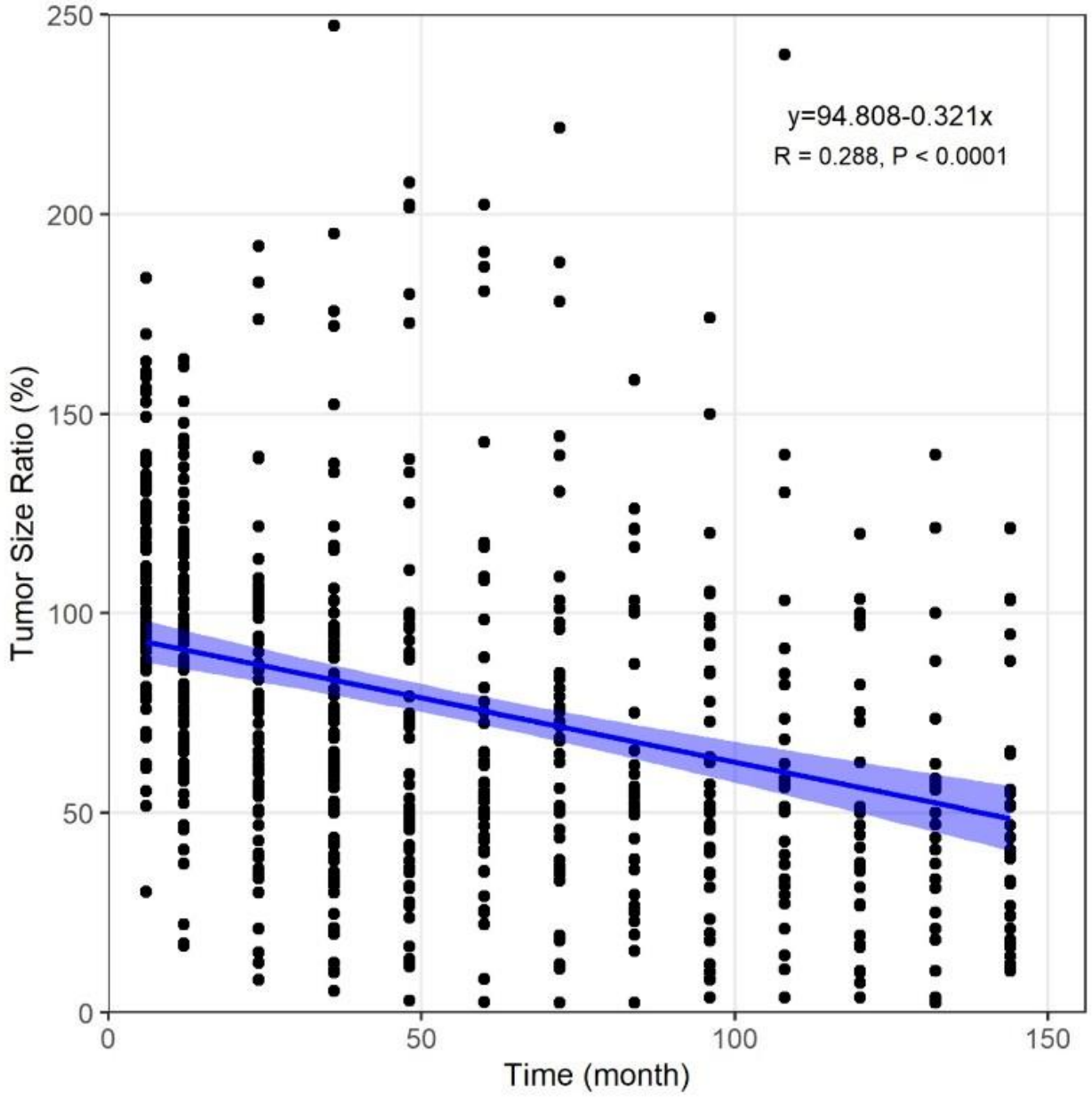

Fig. 1. Chronological tumor volume plotting of all 126 patients with imaging follow-up of at least 2 years

Conclusions: GKS as an initial treatment for ANs could be helpful in terms of tumor control, the preservation of serviceable hearing, and the prevention of cranial neuropathy. It is recommended to perform GKS as soon as possible for hearing preservation for unilateral ANs with or without hearing loss.

Keywords: radiosurgery, Acoustic Neuroma, Outcome

EP159 / #282

Topic: *AS06. Radiosurgery*

THE INFLUENCE OF MUTATION TYPE AND TYROSINE KINASE INHIBITOR GENERATION ON CLINICAL OUTCOMES AFTER GAMMA-KNIFE RADIOSURGERY IN LUNG ADENOCARCINOMA HARBORING EGFR MUTATION

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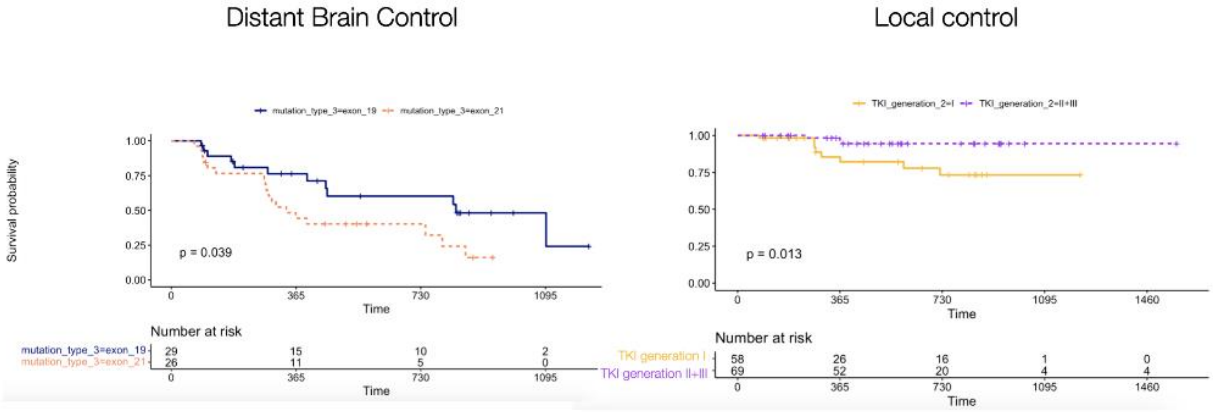
Introduction: This retrospective study investigates the efficacy of gamma-knife radiosurgery (GKRS) in managing lung adenocarcinoma with exon mutations, focusing on differences in distant brain control and local control based on the type of mutation and prior treatment regimens. Specifically, the study explores the impact of exon 19 deletion (exon 19del) and the generation of tyrosine kinase inhibitors (TKIs) on GKRS outcomes in lung adenocarcinoma patients.

Methods: The study cohort comprises 57 patients with lung adenocarcinoma harboring exon mutations, totaling 136 cases. Univariate/multivariate cox analysis and Kaplan Meiyer curve analysis was used. Patient records were analyzed retrospectively to evaluate the influence of exon 19del and TKI generation (I, II, and III) on distant brain control and local control after GKRS.

Results: Notably, lung adenocarcinoma patients with exon 19del exhibited superior distant brain control following GKRS compared to exon 21 mutation (p= 0.039). Additionally, the study observed improved local control after GKRS in patients treated with TKI II and III generations, surpassing those treated with TKI I generation
(p=0.013).



Conclusions: The current study demonstrates a noteworthy difference in distant brain control, favoring exon 19del, and local control, favoring TKI II and III generations, following GKRS. These findings

contribute valuable insights into tailoring treatment strategies for lung adenocarcinoma patients with specific exon mutations, enhancing the precision and effectiveness of therapeutic interventions.

Keywords: mutation, Gamma-knife, Lung adenocarcinoma

EP160 / #162

Topic: *AS06. Radiosurgery*

GAMMAKNIFE SURGERY OF UPPER CERVICAL SPINAL CORD TUMORS

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Introduction: Upper cervical area are surgical complex area. The low limit of GammaKnife Surgery was called foramen magnum. In oriental people , the head is short but wide. We treated in this area tumors with GammaKnife.

Methods: We treated 20 tumor patients whose lesion was extending to cervical 4 th. The 29 patients were comprised of seven males and 22 females, their ages ranging form 26 to 75 years(mean 52.2 years). The diagnosis was 3 hemangioblastomas, 10 astrocytomas, 9 meningiomas, 3 schwannomas, 1 hemangioma, 1 ependymoma. Pre GKS, surgical intervention was performed in 6. Mean maximal dose was 21.2 Gy(20-23.38 gy), mean marginal dose was 10.5 Gy(10-11.69 Gy).

Results: Mean follow up period was 46.6 months(8-152 months). 15 tumors had decreased in size on follow up MRI. The other cases were stationary. There was no complication.

Conclusions: For lesions in the cervical spinal cord , G frame may increase the range of targets that can be treated effectively using Lekesell Gamma Knife Perfexion(C 4) or Icon(C 1)

Keyword: cervical spinal cord, Gamma Knife

EP161 / #163

Topic: *AS06. Radiosurgery*

GAMMA KNIFE RADIOSURGERY FOR PINEAL GLAND TUMORS

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Introduction: Pineal region tumors represent the entire spectrum of neoplasia, with germ cell, glial, meningeal, and pineal parenchymal with behaviors ranging from benign to highly malignant, being the cells of origin. We assessed Gamma Knife Radiosurgery (GKS) for tumors in the Pineal region.

Methods: Pineal region tumors represent the entire spectrum of neoplasia, with germ cell, glial, meningeal, and pineal parenchymal with behaviors ranging from benign to highly malignant, being the cells of origin. We assessed Gamma Knife Radiosurgery (GKS) for tumors in the Pineal region.Between October 1994 and December 2023, 26 patients with pineal gland tumors were treated with GKS. 11 patients (42.3 %) had germinomas, 4 patients (15.3 %) had astrocytomas, 2 patient (7.6 %) had lymphoma, 2 patient (7.6 %) had choriocarcinoma, 1 patient (3.8 %) had meningiomas, 1 patient (3.8 %) had pineocytoma, 1 patient (3.8 %) had teratoma, 1 patient (3.8 %) had pineal parenchymal tumor of intermediate differentiation. The mean tumor volume was 14.3 (range 0.4-72 ml). The mean dose delivered to the tumor center was 26.5 Gy (range 20-45 Gy) and to the tumor margin was 13.6 (10-21Gy).

Results: All patients underwent serial brain MRI with a mean duration of imaging follow-up 110 months (range 6 - 274 months). Imaging in 10 patients (38.5 %) displayed complete response, 6 patient (23.1 %) demonstrated partial response, 5 patients (19.2 %) showed stable response, and 4 patients (15.4 %) displayed recurred. Among the 11 germinoma patients, 10 were treated with GKS and booster radiotherapy, and 1 patient were treated with GKS only. In 6 patients the tumors were complete response, 2 patients the tumor were partial response, 2 patients showed partial response and one patient recurred . Recurred germinoma, right basal ganglia tumor was recurred after 105 months later. Recurred cases were 1 lymphoma, 1 germinoma, 1 pineocytoma, 1 teratoma.

Conclusions: In cases of germinomas and choriocarcinomas, treatment combining GKS with radiotherapy showed better results than the GKS only. Intraarterial chemotherapy can effectively deliver chemoagenmts within the lesion while minimizing damage to normal tissues.

Keyword: pineal region tumors, Gamma Knife

EP162 / #444

Topic: *AS07. Tumor*

OUTCOMES OF GLOMUS JUGULARE TUMORS TREATED WITH GAMMA KNIFE RADIOSURGERY – SINGLE-CENTER STUDY OF 48 CASES

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Introduction: This study aims to assess outcomes and complications of Glomus Jugulare tumors treated with gamma knife radiosurgery at the Neurospinal and cancer care postgraduate institute Karachi Pakistan.

Methods: A retrospective study was conducted at the Neurospinal and Cancer Care Institute in Karachi from 2008 to 2022, encompassing 48 consecutive treated patients. Data on treatment parameters (volume, prescribed dose, maximum dose) and baseline characteristics (age, gender) were collected. Tumor classification used the Fisch grading system. Complete neurological assessments were conducted prior to treatment. Follow-up included neurological examinations and contrast-enhanced MRI brain scans, occurring at 6 months during the first post-radiosurgery year and subsequently on an annual basis. Recorded outcomes encompassed tumor control rate, symptom resolution, and complications. Ethical approval was granted by the Institutional Ethical Committee.

Results: Among the 48 patients undergoing gamma knife surgery for glomus tumors, the median clinical and radiological follow-up period was 6 months. Tumor characteristics included a mean volume of 15.96cm3, mean tumor peripheral dose of 13 Gy, mean isodose curve of 48.77%, and mean maximum tumor dose of 29.03Gy. Notable results included 48% demonstrating significant tumor size reduction, another 48% exhibiting local tumor control without size increase, and a single patient requiring repeat radiosurgery due to tumor size increase. Throughout a median clinical follow-up of 60 months, most subjects maintained stable cranial nerve function. Tumor progression-free survival post-GKRS was 96%.

Conclusions: Given the challenges posed by Glomus tumors' location, invasiveness, and vascularity, their management involves various options such as microsurgery and radiosurgery. Gamma Knife treatment offers good tumor control and reduced complications, making it a valuable approach.

Keyword: Glomus Jugulare Tumor (GJT), Gamma Knife Radiosurgery (GKRS).

EP163 / #45

Topic: *AS07. Tumor*

STEREOTACTIC RADIOSURGERY VERSUS OBSERVATION WITH SERIAL IMAGING FOR INCIDENTALLY DIAGNOSED INTRACRANIAL MENINGIOMAS: AN UPDATED REVIEW INFORMING PATIENT COUNSELING FOR NEUROSURGEONS

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Introduction: Meningiomas are slow growing extra-axial tumors derived from arachnoid cap cells that can cause symptoms due to mass effect. They are the most common intracranial tumor, and the incidence of meningiomas has been on the rise due to improvements in imaging technology coupled with recent emphasis on screening protocols following head injury. The increased use of head imaging has led to a rise in diagnosis of asymptomatic meningiomas. This systematic review was performed to provide further insight into expected outcomes with upfront stereotactic radiosurgery (SRS) or upfront observational monitoring for asymptomatic meningiomas.

Methods: A systematic review of the literature was performed through the PubMed, Scopus, and Embase databases according to PRISMA guidelines using predefined search terms. Specifically, we sought to identify all primary prospective trials and retrospective series comparing outcomes associated with upfront SRS management or observation for the management of asymptomatic meningiomas.

Results: Five studies reporting outcomes for 794 patients remained eligible for inclusion in the present meta-analysis. Mean follow-up durations ranged from 42-63 months, and the cohort was >80% female. Mean age across the studies varied from 44-64 years. Overall quality was assessed as high. Serial observation was slightly more prevalent among the patients included in this analysis. With respect to mean tumor volume (in cm^3), initiation of SRS was associated with larger meningioma size (MD 0.42, 95% CI 0.10, 0.75, I^2=43%, p=0.030). In terms of clinical outcomes, patients undergoing serial observation were more likely to experience radiographic progression or clinical signs of progression (36.7% vs. 1%, respectively, pooled OR 0.02, p<0.001). While there was no significant difference in the rate of patients exhibiting neurological decline between observation and SRS (2.8% vs. 3.2%, pooled OR 0.71, p=0.430) in the short-term (<5 years), observation was a significant predictor of subsequent requirement for surgical intervention (12.2% vs. 1.9%, pooled OR 0.16, p<0.001).

Conclusions: Overall, SRS remains a safe and effective treatment that prevents radiologic progression so that patients can avoid invasive surgical intervention. Its cost at a patient and societal level should be taken into consideration in clinical practice and policy formation, respectively.

Keywords: meningioma, surveillance, radiosurgery

EP164 / #376

Topic: *AS07. Tumor*

ANALYSIS OF MOTOR WEAKNESS AFTER OPERATION AND MEP CHANGES DURING OPERATION IN MENINGIOMA PATIENTS

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Introduction: Meningiomas are the most common primary brain tumor arising from meningocytes, and intraoperative motor evoked potential(MEP) monitoring is useful tool of monitoring motor function of patients during surgery. We assessed results of intraoperative MEP monitoring and motor grade in Meningioma patients.

Methods: Between February, 2022 and October, 2013, 27 patients with meningiomas were treated surgical resection with intraoperative MEP monitoring. 9 cases were located convexity and falx meningioma was 7 cases, parasagittal meningioma was 2 cases. 3 cases were in sphenoid ridge and 6 cases were in posterior fossa. Mean age of patients was 57.3 years (40-81 years) and male and female ratio was 10:17.

Results: There was absence MEP changes during operation in all patients. In 19 patients, motor grade change was not observed at immediate postoperative state and discharge. In one patient, left hemiparesis that had persisted pre- and immediate postoperative state improved at discharge. In 7 patients, motor grade was worsened immediate postoperative state comparison with preoperative state. Among these patients, 4 patients were recovered preoperative state at discharge and 3 patients were remained motor complication permanently. There were 5 falx meningiomas and 1 parasagittal and 1 posterior fossa meningioma in motor grade worsened patients.

Conclusions: Intraoperative MEP monitoring is useful tool of monitoring motor function of patients during surgery, but motor weakness could occur in patients with absence MEP changes. So, more careful procedure may be necessary during operation, especially in falx and parasagittal meningiomas.

Keywords: motor weakness, MEP, meningioma

EP165 / #64

Topic: *AS07. Tumor*

ROLE OF BEVACIZUMAB IN GIANT PROGRESSIVE VESTIBULAR SCHWANNOMAS IN NF2 PATIENTS FOLLOWING GAMMA KNIFE RADIOSURGERY

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Introduction: To study the effect of Bevacizumab on tumor volume in cases of Giant progressive Vestibular Schwannomas in NF2 patients following gamma Knife Radiosurgery.

Methods: This prospective study included Patients of NF2 with bilateral vestibular schwannoma who underwent Gamma-knife therapy from 1st January 2009 to 31st December 2021 at AIIMS, New Delhi. All patients in whom tumour progression (>20% increase) was seen on radiological follow up were given Bevacizumab (10mg/kg infusion) over 6 cycles and followed up clinico-radiologically. Patients needed to have at least 24 months of clinical and radiological follow-up after gamma-knife surgery and at least 2 follow up MRI scans 6 months apart following bevacizumab therapy to be included in the study.

Results: A total of 122 patients (156 schwannomas) with NF2 underwent GKRS for vestibular schwannoma during study period. 31 patients (42 schwannomas) had increase in tumor size, of which 18 patients (26 schwannomas) received Bevacizumab therapy. The median volume of tumor(s) treated was 11.809 (range 0.894 to 19.960 cc). Average duration of follow up after bevacizumab therapy was 12.55 (+/-9.127) months. At 3 months follow up, 40.09% of the tumors had responded to the therapy (> 20% decrease in tumor volume), with 59.09% tumors remaining stable. At 12 months follow up, 50% of the tumors had responded to therapy, 7 (43.75%) were stable and one tumor (6.25%) had increased in size.

Conclusions: Our study is the largest study in the world to evaluate the role of bevacizumab in giant progressive vestibular schwannomas (average tumor volume 11.8 cc) associated with NF2 patients, as well as those with ‘biologically aggressive’ subset of NF2 patients

Keyword: NF2, Vestibular schwannoma, Bevacizumab, gamma-knife

EP166 / #406

Topic: *AS08. Stereotactic Procedures*

INCREASED FUNCTIONAL CONNECTIVITY FOLLOWING DEEP BRAIN STIMULATION OF THE MEDIAL FOREBRAIN BUNDLE FOR TREATMENT-RESISTANT DEPRESSION

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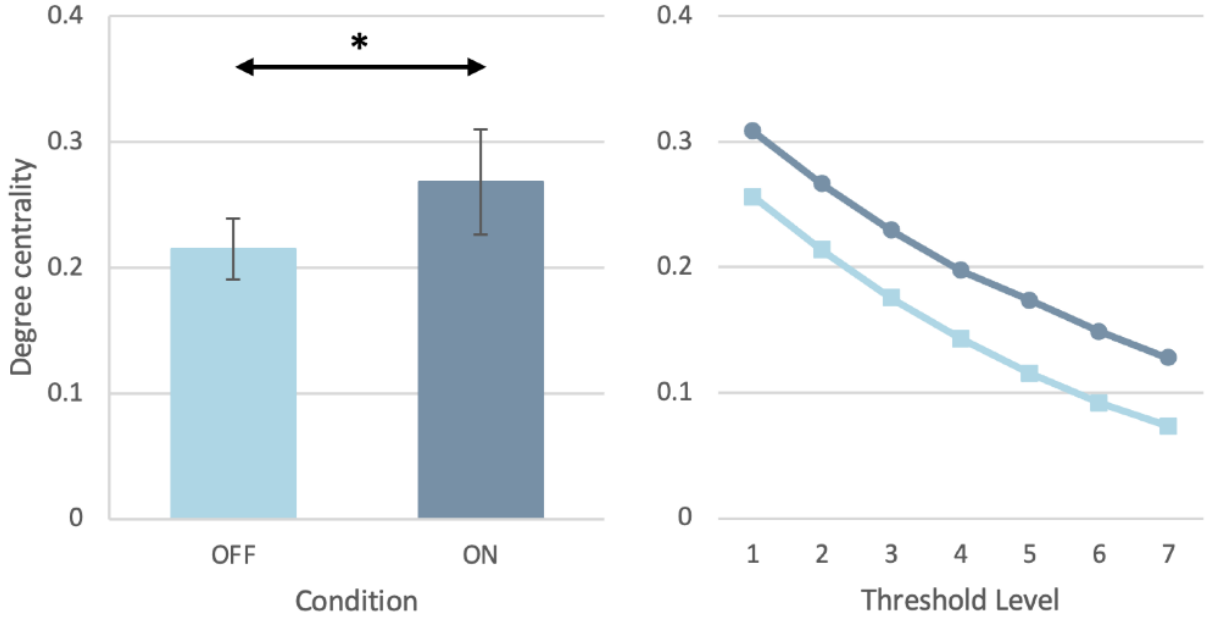
Introduction: Deep Brain Stimulation of the superolateral branch of the medial forebrain bundle (MFB-DBS) is an effective intervention for treatment-resistant depression (TRD; Fenoy et al, Mol Pysch, 2022), and is associated with a significant treatment-induced functional network. The purpose of this study is to investigate the treatment-induced reorganization of the functional MFB-DBS-related pattern (fMFB-DBSRP).

Methods: We analyzed resting-state functional MRI (rs-fMRI) scans from 7 TRD patients treated with MFB-DBS under DBS on and off conditions. We parcellated the fMFB-DBSRP using the Automated Anatomical Labelling (AAL) atlas, then computed correlations between the rs-fMRI time courses of each pair of regions to obtain edge weights. We applied a range of thresholds to these and computed degree centrality, characteristic path length, and clustering coefficient for the resulting graphs for each subject at each threshold. Differences between groups were considered significant at $p<0.05$, paired Student's t-test (two-tailed).

Results: Significant changes in functional connectivity were observed following MFB-DBS. Normalized degree centrality, a measure of the average number of connections per node, increased after treatment ($p<0.05$; Fig 1, left). This increase was seen at all the measured thresholds (Fig 1, right), indicating the robustness of the effect. By contrast, changes to the clustering coefficient and characteristic path length did not meet the threshold for significance ($p>0.05$). The change in degree centrality indicates the development of new functional connections after intervention, leading to an overall more highly connected

network.



Conclusions: MFB-DBS was associated with significant functional reorganization of the previously identified fMFB-DBSRP. Treatment-induced changes increased functional connectivity, creating higher connectional density compared to the off-stimulation state. Our study illuminates a potential biological mechanism for the effectiveness of MFB-DBS in treating TRD. Obtaining network parameters for an individual patient could identify likely responders a priori, as well as quantify treatment response in a robust manner independent of clinical metrics.

Keywords: Treatment-resistant depression, resting-state functional magnetic resonance imaging, Deep Brain Stimulation

EP167 / #24

Topic: *AS08. Stereotactic Procedures*

PHANTOM AND IN-VIVO VALIDATION OF A NOVEL CONTACTLESS REGISTRATION METHOD FOR ROBOT-ASSISTED SEEG SURGERY

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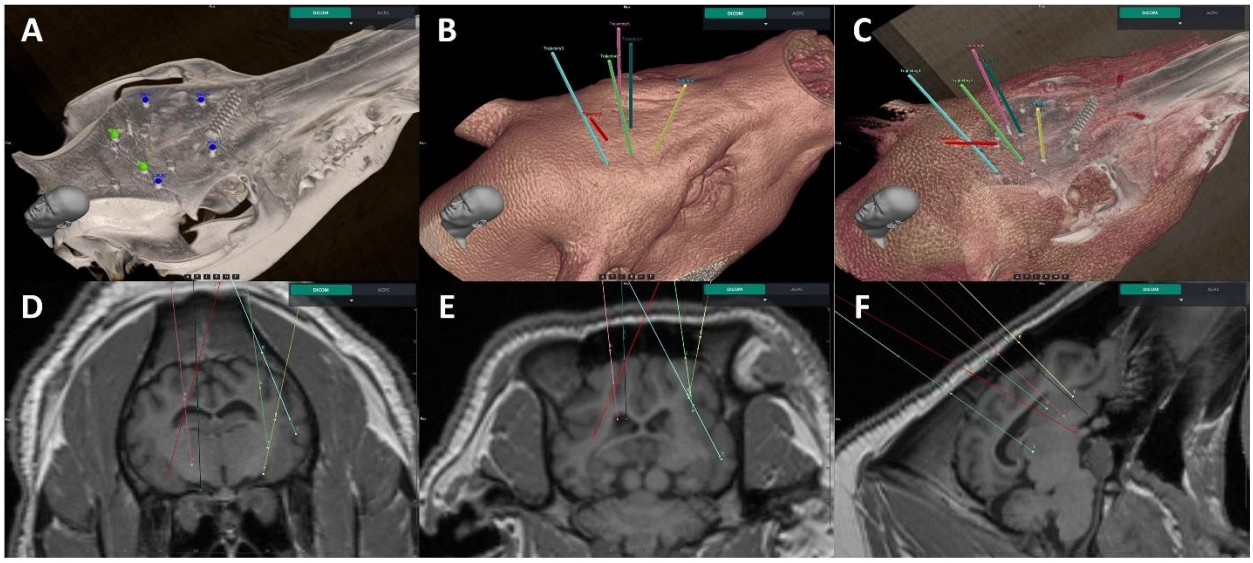
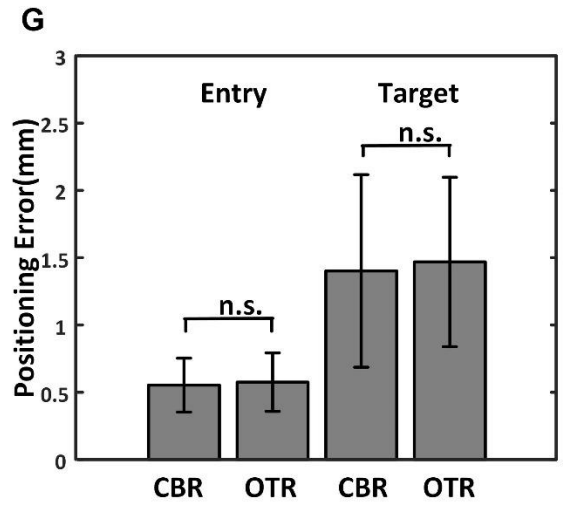
Introduction: This study aimed to compare the accuracy and convenience of bone-fiducial contact registration (CBR) and contactless optical tracking registration (OTR) in a Bama mini-pig model using a stereotactic neurosurgery-assisted robot to perform stereo-electroencephalogram (SEEG) acquisition.

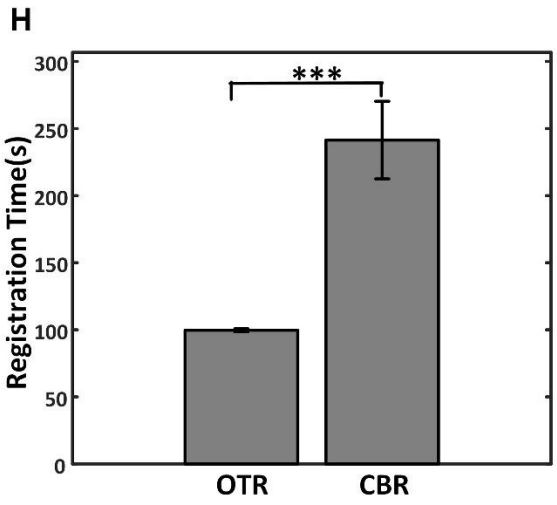
Methods: 12 Bama pigs (Sus scrofa domestica) were selected for the study, with 6 under CBR and 6 under OTR. A total of 72 electrodes were implanted bilaterally in the Bama pigs. The errors in Lm and Ln axes were recorded and used to calculated Euclidean distances to indicate positioning errors. The registration time of the OTR group and CBR group were recorded and compared. 2 new users were selected for learning curve analysis of the robot system and the novel registration method.

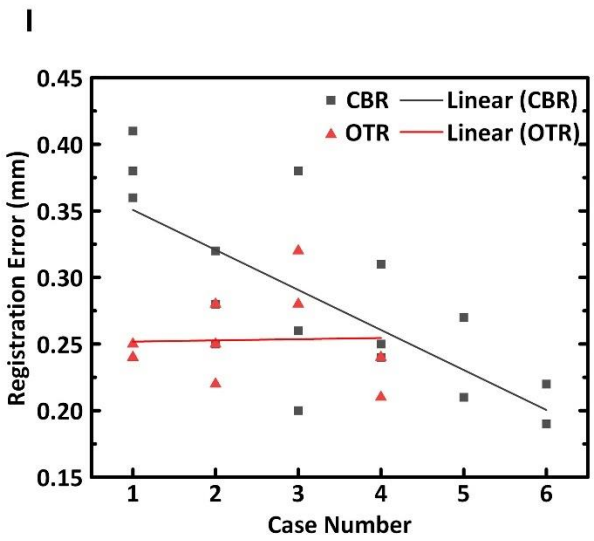
Results: The mean positioning errors in OTR group of the target and entry points were 1.68±0.80 mm and 0.76±0.39 mm. And in CBR group, mean positioning errors of the target and entry points were 1.49±0.79 mm and 0.70±0.33 mm. The registration time of OTR method (99.71±1.08 s) was significantly shorter than that using CBR method (241.29±28.95 s) (p-value < 0.001). Compared to the CBR, it needs less trajectories for learning and practicing when using OTR. And it is earlier for the users to go under OTR than CBR to reach a preferable entry error of

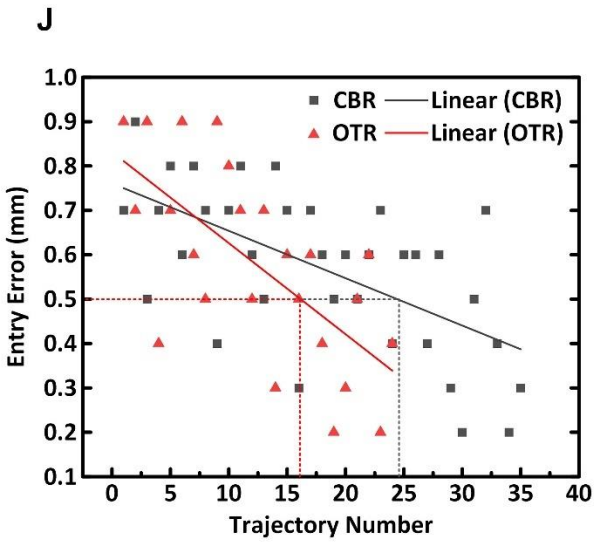
0.5mm.











Conclusions: The contactless tracking optical registration methods maintain consistent accuracy, reduce the time required for registration, simplify the procedure and shorten the clinician's learning curve compared to traditional contact registration methods.

Keywords: Stereoelectroencephalography, Contactless Optical Registration, Frameless Robotics

EP168 / #55

Topic: *AS08. Stereotactic Procedures*

EFFICACY AND SAFETY OF ROBOTIC-ASSISTED STEREOTACTIC NEUROSURGERY: A SYSTEMATIC ANALYSIS OF RECENT ADVANCES

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Introduction: The integration of robotic systems into stereotactic neurosurgery has been a significant advancement in the field. This study aims to systematically review and analyze the efficacy and safety of robotic-assisted techniques in various neurosurgical procedures.

Methods: A comprehensive literature search was conducted, focusing on studies published from 2010 to 2023. Key studies included were from Beijing's Tiantan Hospital (700 robotic biopsies), Chongqing Sanbo Jiangling Hospital (151 stereotactic biopsies), and a report on robot-assisted stereoelectroencephalography (SEEG) procedures in 100 patients. The review also considered a study assessing the prevalence and future directions of robotic neurosurgery, and a critical review of various robotic systems in stereotactic neurosurgery.

Results: The studies consistently showed that robotic-assisted procedures offer high accuracy, with Beijing's Tiantan Hospital reporting a mean entry point error of 0.99 mm and target error of 1.13 mm. The comparative study from Chongqing Sanbo Jiangling Hospital found no significant difference in diagnostic yield between robotic-assisted and traditional methods, but noted shorter operation times and higher accuracy in the robotic group. In robot-assisted SEEG, a median entry point error of 1.2 mm and a target point error of 1.7 mm were observed, with a low complication rate of 4%.

Conclusions: Robotic-assisted stereotactic neurosurgery demonstrates increased precision, efficiency, and safety. This systematic review underlines the growing role of robotics in neurosurgery, supporting their broader application in clinical practice. Further research is needed to expand on these findings and explore long-term outcomes.

Keywords: Robotics, stereotactic

EP169 / #67

Topic: *AS08. Stereotactic Procedures*

ACCURATE LEAD PLACEMENT IN DBS SURGERY USING INTRAOPERATIVE O-ARM USING THE NOVEL NAVINETICS HEADFRAME

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Introduction: The present Deep Brain Stimulation (DBS) surgery procedure involves several transitions between the operating room and the imaging facility. Unfortunately, this process complicates the workflow, leading to increased operational time. Medtronic O-arm imaging, a fluoroscopic method, offers intraoperative localization of lead placement, eliminating the need for pre-operative and postoperative CT scans to establish coordinates. However, the compatibility and accuracy of O-arm fluoroscopy with the new stereotactic headframe in DBS surgery remain unassessed. We propose that intraoperative O-arm scanning could enhance efficiency without compromising the accuracy of both single and dual-stage DBS procedures using the stereotactic headframe.

Methods: We tested (1) whether the O-arm imaging was compatible and (2) accurate for the DBS lead placement in the DBS surgical workflow. We first compared the O-arm images to the traditional CT MR fused image to verify the accuracy of the image registration. After the verification, 16 patients underwent dual-stage bilateral intracranial DBS depth electrode implantation, using the O-arm image modality and bypassing the post-operative CT image scan. We evaluated the accuracy of the lead placement in both post-operative CT and O-arm fluoroscopy.

Results: Less than 0.1mm difference was reported between the O-arm imaging technique and classical MR CT image fusion for localization of the stereotactic headframe in DBS surgery. Successful lead placements were confirmed by postoperative CT imaging with an accuracy of 0.3mm on the left and 0.2mm on the right. Of the total of 16 patients who underwent the dual-stage DBS surgery with intraoperative O-arm imaging without postoperative CT, the targets included bilateral ventral intermediate nucleus (VIM) (16 leads), bilateral GPi (4 leads), and STN (12 leads). The mean ± standard deviation radial error in the probe's eye view was 0.714 ± 0.332 mm for n = 32 leads with no surgical complication including intracranial bleeding.

Conclusions: The intraoperative O-arm fluoroscopic imaging can be used safely and effectively for stereotactic registration with the stereotactic headframe in both the awake and asleep DBS for movement disorders. The accuracy of our small series was 0.714 ± 0.332 mm for n = 32 leads, which is comparable to the existing literature.

Keywords: stereotactic headframe, Deep Brain Stimulation, O-arm imaging

EP170 / #221

Topic: *AS08. Stereotactic Procedures*

TOWARD PARKINSON'S DISEASE DEEP BRAIN STIMULATION OUTCOME PREDICTION USING QUANTITATIVE SUSCEPTIBILITY MAPPING RADIOMICS

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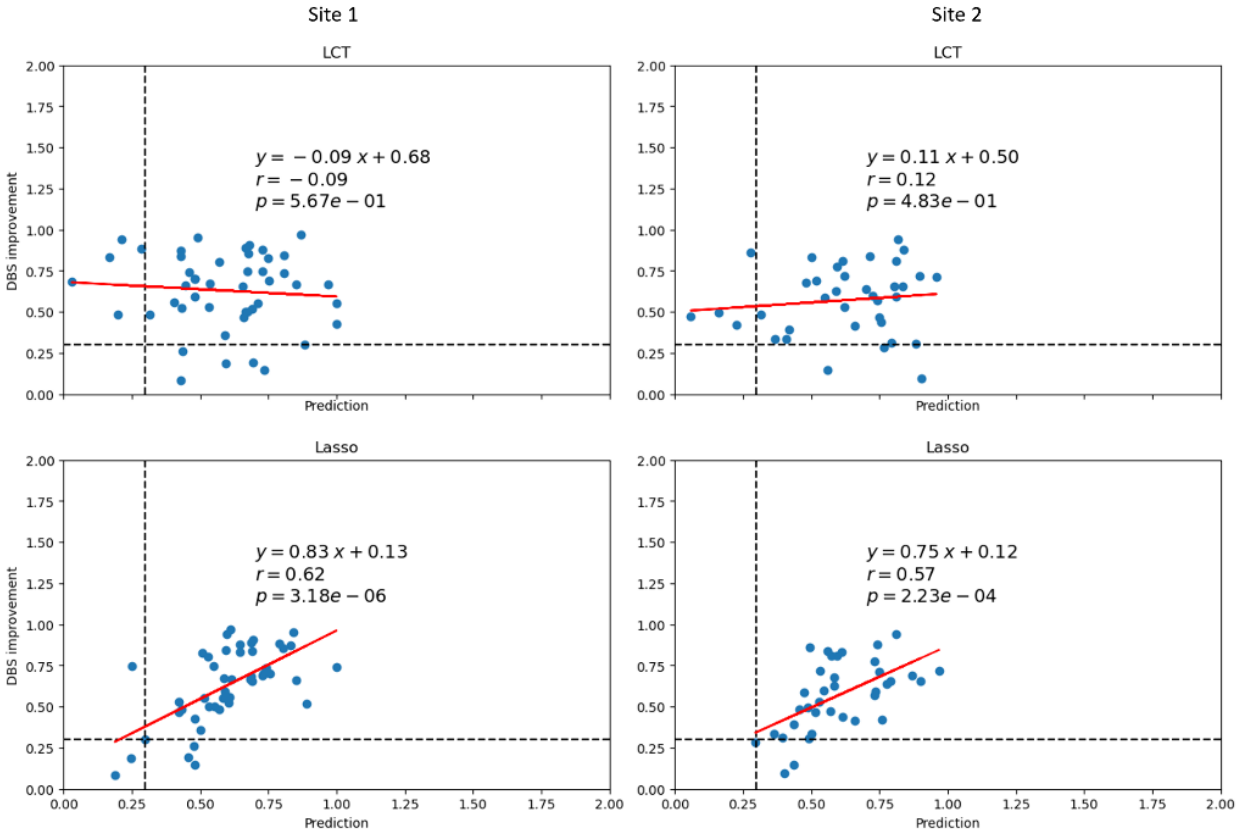
Introduction: Deep brain stimulation (DBS) is a treatment for motor symptoms in advanced Parkinson's disease (PD).[1] Current patient selection is determined by the preoperative levodopa challenge test (LCT),[2] an inconsistent predictor for DBS improvements,[3,4] this prediction is outcome is an unmet clinical need. Correlation has been demonstated between radiomic features in quantitative susceptibility maps (QSM)[5-7] and DBS dichotomous outcomes.[8]As DBS outcomes are measured on an interval scale, such as the UPDRS-III score, this work aims to demonstrate that QSM radiomic features can inform DBS numerical outcomes.

Methods: Outputs are predicted from least absolute shrinkage and selection operator (LASSO) model of the form: $w^* = \text{argmin}\ (1/2N)\ ||U\text{-}Xw||_2^2 + \lambda||w||_1$ Where N: sample size, U: target prediction, X: feature matrix and w: weights. Reconstruction of the training data nearest neighbor X_{NN} of test data X_T is given by $\rho = X_{NN}w^*$. QSM from patients prior to surgery was collected across 2 sites using a multi-echo gradient echo sequence[6,9]: n=48, 0.5mm, and n=37, 0.9mm (isotropic), respectively. QSMs were reconstructed using MEDI-L_1,[10] and features were extracted[11,12] from the substantia nigra, subthalamic nucleus, red nucleus, and dentate nucleus. A LASSO[13] model was implemented[14] for each patient, cross validated to select the regularization λ in the above equation, trained on the remaining N-1 cases, and tested on each omitted patient. The 2900 and 4100 highest correlated features were selected for Site 1 and 2 respectively. Inspired by a LASSO-kNN ensemble for classification,[15] models with close ($\Delta X > 36$) nearest neighbor reconstruction errors above 0.1 were replaced by the nearest neighbor target y_{NN}. The predictive power of LCT and LASSO was evaluated using linear regression (correlation r, significance p).

Results: At both sites, LASSO outperforms the conventional LCT prediction. Both Site 1 ($r=0.62$, $p\sim0$) and Site 2 ($r=0.57$, $p\sim0$) show significant correlation, while LCT predictions show no significant correlation (Figure 3). Dotted lines indicate the success threshold, indicating LASSO correctly identifies several of the poor outcomes while LCT does

not.



Conclusions: Radiomic features on QSM improve the accuracy of DBS outcome prediction compared to the conventional LCT. Future directions include incorporation of learned undersampling,[16] super-resolution techniques[17-22] on QSM, and encoded latent features.[23]

Keywords: Parkinsons, Machine Learning, Quantitative Imaging

EP171 / #264

Topic: *AS08. Stereotactic Procedures*

INTRAOPERATIVE VENOUS AIR EMBOLISM IN THE SEMI-SITTING POSITION IN FUNCTIONAL NEUROSURGERY

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Introduction: Precise electrode placement is crucial in deep brain stimulation (DBS). This may be compromised by brain shift caused by cerebrospinal fluid leaking or pneumocephalus. Therefore, it is an option to utilize the semi-sitting position. The semi-sitting position, however, carries an inbound risk of venous air embolism. Here we analyze the occurrence and management of this complication in a large consecutive series of patients.

Methods: We performed a retrospective analysis in a series of 634 functional stereotactic operations in the semi-sitting position. Surgery was performed while the patient were awake in 567 instances. Any clinical signs for air embolism such as increased throat clearing, coughing and circulatory problems were scrutinized.

Results: A total of 263 women and 371 men with a median age of 55 years were operated. The majority of patients underwent DBS (614), while a subset had radiofrequency lesioning procedures (20). There were several instances of increased throat clearing and slight coughing which stopped after sealing the burrhole with wax. Three patients (0.47%) had clinically relevant intraoperative venous air embolism: a 76-year- old man with PD, a 54-year- old man with tremor and a 50-year- old woman with a cervical dystonia. All three patients were circulatory stable and the surgery could be finished without further complications after sealing the burrhole, flushing the site with fluid, and tilting the upper part of the operation table backwards.

Conclusions: Stereotactic functional surgery in a semi-sitting is a generally safe procedure with a low risk for intraoperative venous air embolism. Immediate reaction to the signs of venous air embolism allow the procedure to be completed.

Keywords: venous air embolism, semi-sitting position, functional neurosurgery

EP172 / #110

Topic: *AS08. Stereotactic Procedures*

CLINICAL TRIALS IN NEUROMODULATORY TREATMENT OF DRUG-RESISTANT HYPERTENSION: A SYSTEMATIC REVIEW

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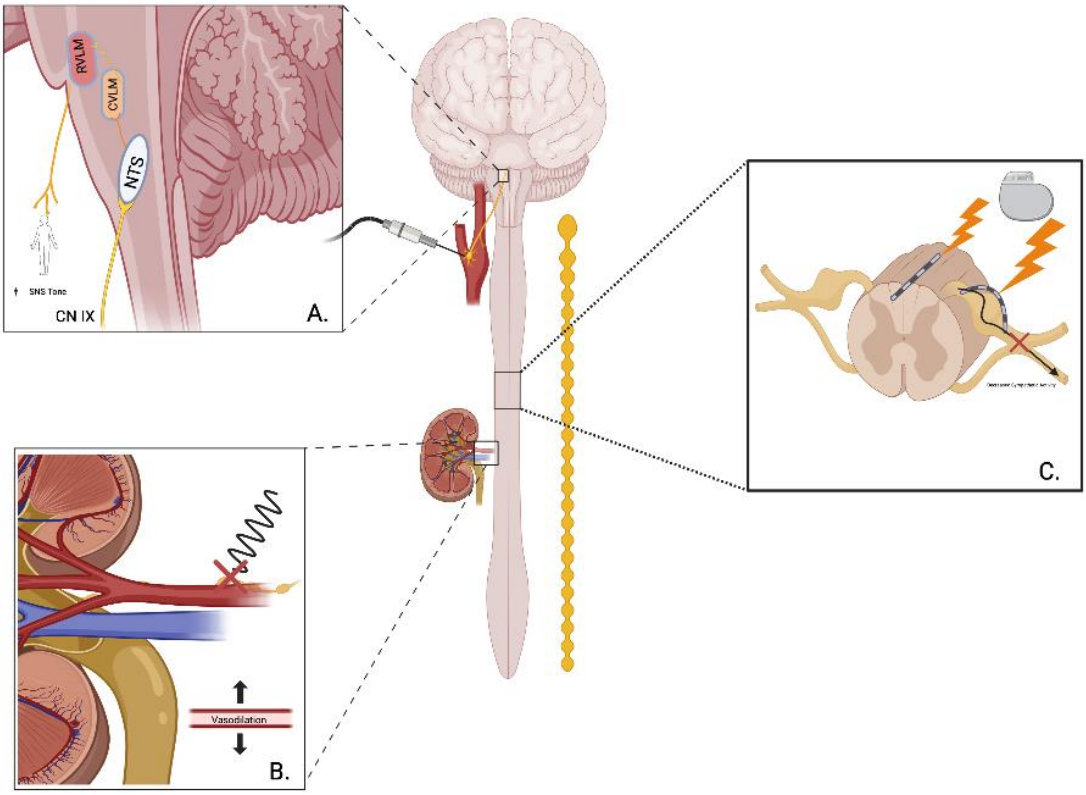
Introduction: Drug-resistant hypertension (DRH) affects somewhere between 9-18% of the U.S. hypertensive population. Recognized as hypertension (HTN) that is resistant to three or more medications, DRH can lead to fatal sequelae, such as heart failure, aortic dissection, and other systemic disease. DRH can be treated procedurally using carotid body stimulation, renal denervation, sympathectomies, dorsal root ganglia (DRG) stimulation, and more recently spinal cord stimulation (SCS) have all been utilized in the treatment of
DRH.



Methods: A systematic review of the literature was performed on 10/26/2023 in PubMed using PRISMA guidelines. A total of 275 articles were exported and were screened to find the primary source of the clinical trials. There were 25 primary unique articles of clinical trials for the treatment of DRH found and reported in this review.

Results: Renal denervation and carotid body stimulation have both shown promising results with multiple clinical trials, while sympathectomies have been retired due to the irreversible adverse effects. SCS

utilized low frequency (LF) and high frequency (HF) stimualation. Patients in the SCS trial with BP greater than 140/90 experienced a systolic blood pressure (SBP) drop of 7 (+/-8) in the HF group and 8 (+/-14) in the LF group. Diastolic blood pressure did not undergo significant changes. Patients with high blood pressures responded better than those with lower blood pressure, such a those in with a BP of more 130/80, which had a SBP changes of 3 (+/-8) in HF SCS while the normal control group exhibited an increase of SBP by 5 (+/-13).

Conclusions: SCS stimulation is a novel treatment of DRH that shows promising results but requires further investigation and prospective studies of the treatment to provide guidelines for future SCS DRH treatment. While there is only 1 current clinical trial registered for treatment of DRH with SCS, other modes of treatment have been thoroughly explored. Further basic science research is also needed to further illuminate the mechanism of action behind SCS effect on blood pressure control. This review summarizes the clinical trials for neuromodulatory treatment of DRH following PRISMA guidelines and suggests future directions in the treatment of DRH using SCS.

Keywords: Neuromodulation, Spinal Cord Stimulation, Drug-Resistant Hypertension

EP173 / #201

Topic: *AS08. Stereotactic Procedures*

STIM-IMA SEEG TOOLBOX: A NEW 3D SLICER EXTENSION FOR SEEG MULTIMODAL NEUROIMAGING PROCESSING

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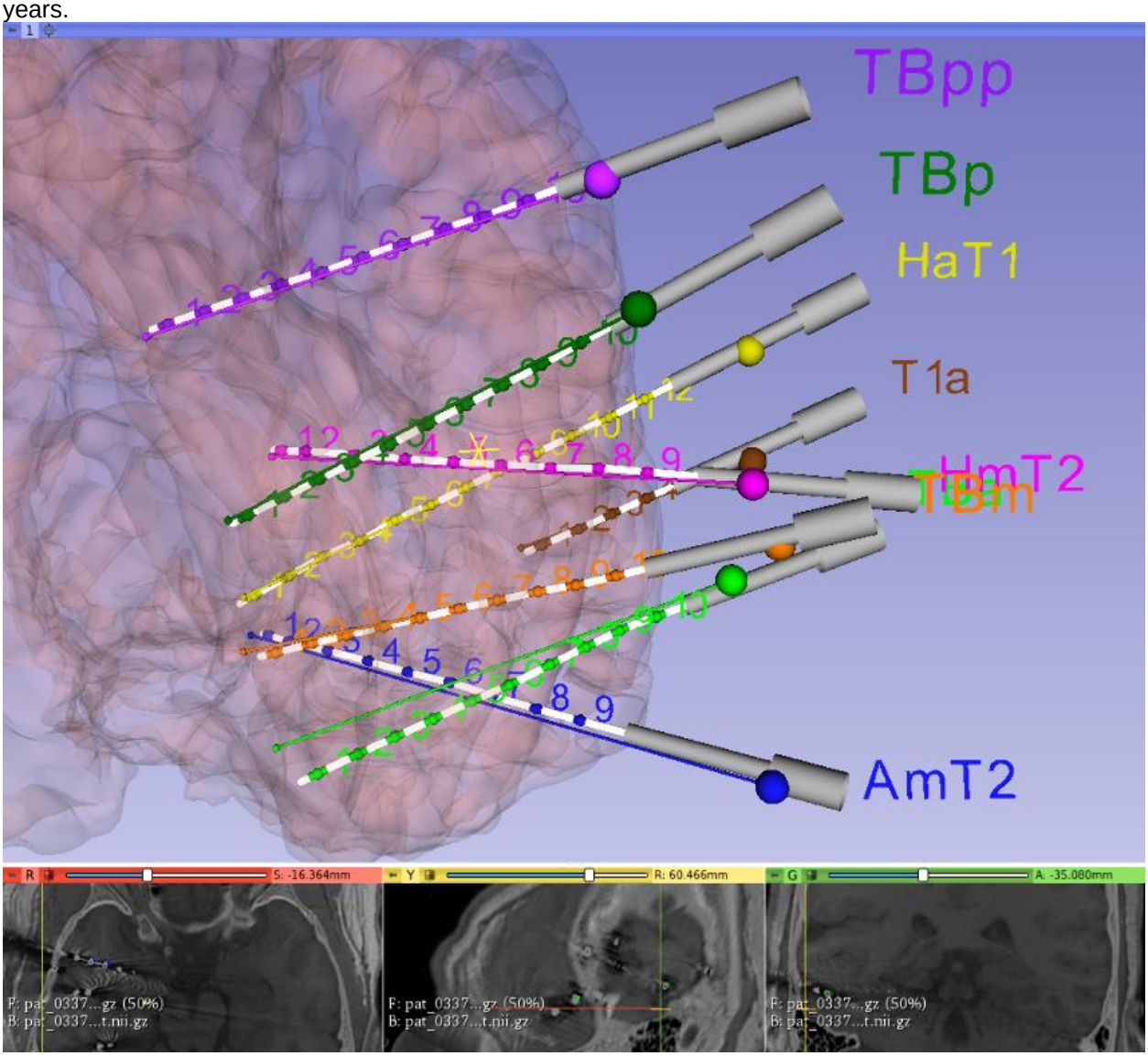
Introduction: Over the past 8 years, we've developed at the ICM / Pitié-Salpêtrière Hospital a new 3D Slicer extension (https://www.slicer.org) to support clinicians and researchers in processing the neuroimaging data necessary for SEEG procedures. This software was developed to assist users all along the multiple SEEG-related steps, ranging from patient inclusion to electrode localization and anatomical characterization ([1],[2],[3]). The STIM-IMA SEEG toolbox consolidates, enhances, and introduces new utilities, automating processes in a user-friendly manner, and offering them in an easily installable package.

Methods: Initially, we packaged automatic processing modules and their dependencies into Docker containers. The 3D Slicer Extension STIM-IMA SEEG comprises various 3D Slicer modules for distinct tasks, providing access to containers for automatic data processing through new user interfaces. The Imaging Data Manager Module imports patient neuroimaging sequences, enabling coregistration and visualization in a shared reference space, supporting DICOM, nifti, and BIDS formats. The Anatomical Model Module performs segmentation tasks and constructs an anatomical model of the subject's brain. The SEEG Surgical Procedure Planning module, based on previous work [2], adapts to our new data model and the latest 3D Slicer versions. Additionally, the Epiloc and Electrode Viewer modules, initially introduced in [3], have been upgraded. Two new modules are introduced: the Normalization Module offering various normalization methods and the Export Module for exporting processed data to other formats.

Results: Our tools have been used by clinicians and ICM research teams to process all neuroimaging data for SEEG procedures at Pitié-Salpêtrière Hospital for the past 8

years.



Conclusions: The STIM-IMA SEEG toolbox has reached sufficient development and enhancement for effective utilization by others. Its modules have been rigorously tested, optimized, and are now valuable to a wider audience. We are prepared and willing to share the toolbox with a broader user base. [1] Lehongre K. Long-term deep intracerebral microelectrode recordings in patients with drug-resistant epilepsy: Proposed guidelines based on 10-year experience. Neuroimage 2022. [2] Fernandez-Vidal S. Modular stereotactic planning toolbox for SEEG procedures. WSSFN 2019. [3] Pérez-Garcia F. Automatic segmentation of depth electrodes implanted in epileptic patients; a modular tool adaptable to multicentric protocols. 31st International Epilepsy Congress.

Keywords: Neuroimaging, Software Platform, SEEG

EP174 / #164

Topic: *AS08. Stereotactic Procedures*

CHALLENGES OF DEVELOPING STEREOTACTIC AND FUNCTIONAL NEUROSURGERY IN NEPAL, REVIEW OF CURRENT SERVICES AND FUTURE PERSPECTIVES

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Introduction: Functional and stereotactic neurosurgery is an essential branch of neurosurgery. The burden of disease amenable to this form of treatment in Nepal is largely unknown. Though other branches of neurosurgery such as trauma, vascular, spine have been progressing in Nepal, functional neurosurgery is still scarcely used. Countries like Nepal may benefit from utilization of these techniques. However due to lack of formal training and difficulties in acquiring the necessary logistics, this form of technique hasn't been utilized in Nepal.

Methods: This is a descriptive cross sectional study describing the current status of stereotactic and functional surgery in Nepal, the challenges and sustainability. Primary and secondary data have been collected and the available logistics, human and financial resources have been described. The future possibilities and the lacking in the services have been discussed. Options for sustainability of the services in Nepal have been discussed.

Results: Stereotactic frame is available in only one government hospital of Nepal. Cosman Roberts Well (CRW) stereotactic frame was acquired in National Academy of Medical Sciences in 2016. The first frame based biopsy was performed in a patient with thalamic mass in 2016. Total forty five biopsy cases have been performed till now. The most common reasons for performing stereotaxy was for biopsy of deep seated lesions. The results were positive in more than ninety percent of cases. Despite acquiring the frame, starting deep brain stimulation and other functional procedures have been a major challenge. The major challenges include lack of uniform protocol for performing the surgery and referral of cases for performing functional neurosurgery. The other reason being the unavailability of trained functional neurosurgeons and appropriate training facilities. Apart from frame, unavailability of other gadgets for performing the procedure, the difficulty in acquiring extensive and expensive resources remain other challenges.

Conclusions: Stereotactic and functional neurosurgery is an underutilized form of treatment in Nepal. Proper development of human, logistics and financial resources is essential. But significant challenges still remain and should be addressed.

Keywords: functional neurosurgery, NEPAL, Stereotactic Neurosurgery

EP175 / #238

Topic: *AS08. Stereotactic Procedures*

STEREOTACTIC FRAME-BASED TARGETING OF THE POSTERIOR FOSSA: A SYSTEMATIC WORKFLOW

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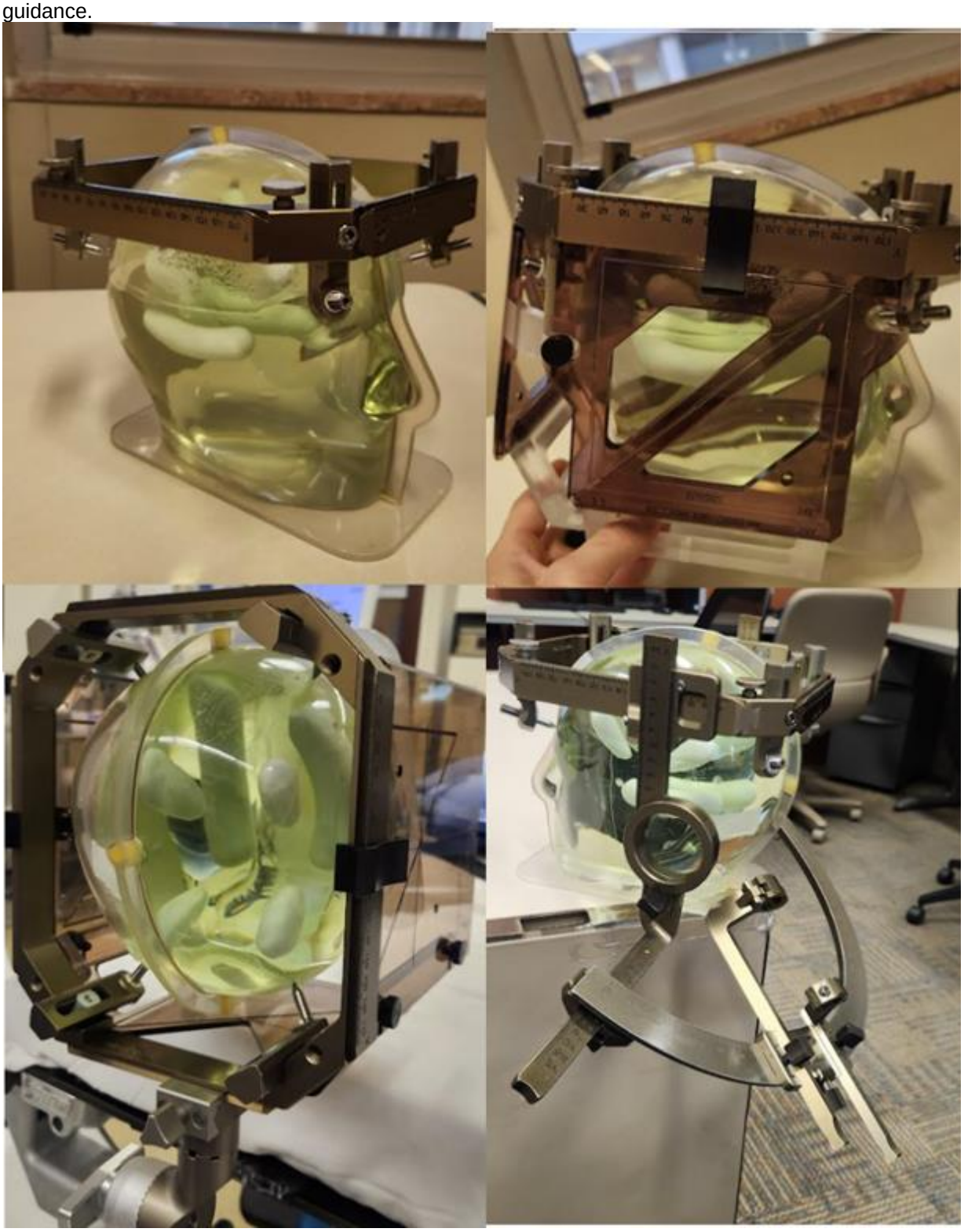
Introduction: Cerebellar deep brain stimulation (DBS) is gaining traction as an experimental treatment for movement disorders, genetic ataxias, and to promote recovery after stroke. Despite the superior safety and accuracy of frame-based approaches to the posterior fossa, unconventional frame placement may be necessary to allow for low posterior fossa trajectories and short-necked and kyphotic patients. Furthermore, real-time MRI-guided workflow is not available at all neurosurgical centres. Current literature lacks a comprehensive protocol detailing the nuances of inverted stereotactic frame placement and methodology of cerebellar DBS targeting. We detail a step-by-step protocol including frame placement of a fully inverted frame, imaging fusion, target planning, and insertion of bilateral dentate nucleus (DN) leads in a small series of index patients with medically intractable genetic ataxias

Methods: An inverted Leksell G Frame is placed on the upper part of the skull using four short posts and reusable pins. The frame origin is on the patient's left (X), anterior (Y), and superior (Z). A CT scan is performed with an open-topped fiducial box. After accurate fusion is confirmed on neuronavigation, direct targeting of the DN is performed on the MRI using FGATIR sequences, and frame coordinates are extracted. After induction, the patient is positioned prone and the stereotactic arc is mounted in the lateral-right orientation, with the Z-bars applied upside-down, and the coordinates are input onto the inverted frame. Trial navigation to the scalp fiducial is performed before skin incision. Linear suboccipital incisions and burrholes are made with advancement of the lead with intraoperative CT

guidance.



Results: Safe and accurate targeting of bilateral DN was confirmed on post-operative 3D reconstruction in two patients, with the distal contacts within dentate nucleus, and the proximal contacts in white matter. The patients were at neurological baseline theree months postoperatively.

Conclusions: Our standardized operating protocol provides stereotactic neurosurgeons with a flexible platform for posterior fossa DBS insertion that allows for low trajectories and multiple electrodes. Unlike conventional upright frame placement, an unobstructed view of the subocipital entry sites is given by the inverted frame approach. If planned meticulously, only a conventional frame and no additional mathematical calculations are needed.

Keywords: cerebellum, stereotaxy, spinocerebellar ataxia

EP176 / #273

Topic: *AS08. Stereotactic Procedures*

IMPORTANCE OF STEREOTACTIC-GUIDED BRAIN BIOPSY FOR BUTTERFLY WINGS GLIOMAS

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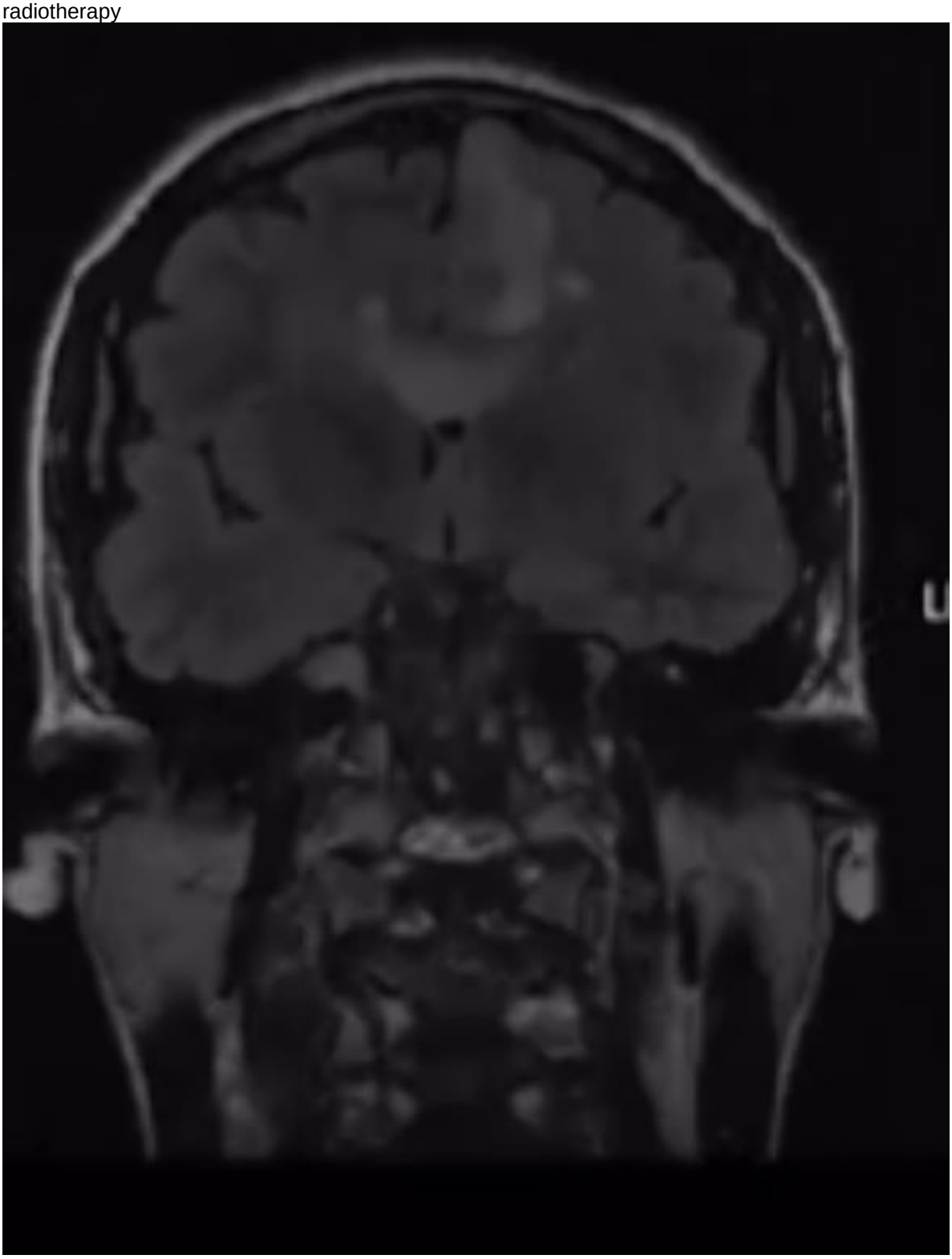
Introduction: Diffuse gliomas constitute approximately 80% of all malignant brain tumors; grade IV glioblastoma being the most common and aggressive tumor entity in this group. Slow tumor growth often becomes symptomatic with symptoms ranging from epileptic seizures or acute deficits and rapid clinical deterioration. Brain biopsy using stereotaxy instead of resection is used as a surgical strategy in cases of deep lesions or with large extension in eloquent areas or with diffuse characteristics in both brain lobes; In only 10% to 20% of patients, the diagnosis of glioma has been obtained by open/stereotactic biopsy. Treatment should be tailored to each person based on their risk and potential benefit. Surgery, radiation therapy (RT), chemotherapy, and any combination thereof are the most important tumor-specific treatment modalities. Systemic chemotherapy is of central importance at the time of first diagnosis and during the course of the disease.

Methods: A 30-year-old woman with no previous history, with tonic-clonic seizures and recovery without neurological deficit, was protocolized and an MRI was obtained, an altered area in the signal involving the corpus callosum at the level of the knee with a diffuse anterior appearance of the trunk. expansive and with low signal on T1, high signal on T2 with an apparent "butterfly wing" configuration, Lesion dependent on Courpus Callosum suggestive of Astrocytoma figure 1. A stereostatic biopsy was performed, which resulted in a diffuse low-grade astrocytoma. For oncology and radiotherapy it consists of chemotherapy with Temozolamide and 27 sessions of 540cGY

radiotherapy



Results: We present the case of a patient with seizures and a diffuse lesion at the bifrontal level. In MRI, the first option is the stereotaxic biopsy which is performed from the frontal region towards the corpus callosum where greater cell density is seen, the timely diagnosis and Adequate planning is vital to provide early management and improve the prognosis in these patients.

Conclusions: Diffuse lesions in butterfly wing configuration MRI studies are suggestive of astrocytoma lesions, whose prognosis depends on complementary oncological management. Taking biopsies from places with denser cellularity is important for early diagnosis in a high-risk disease. progression to glioblastoma.

Keywords: Stereotactic biopsy, BUTTERFLY WING GLIOMA, Diffusestrocytoma

EP177 / #214

Topic: *AS08. Stereotactic Procedures*

SINGLE-LEAD THREE-TARGET DBS FOR TARDIVE DYSTONIA AND TREMOR

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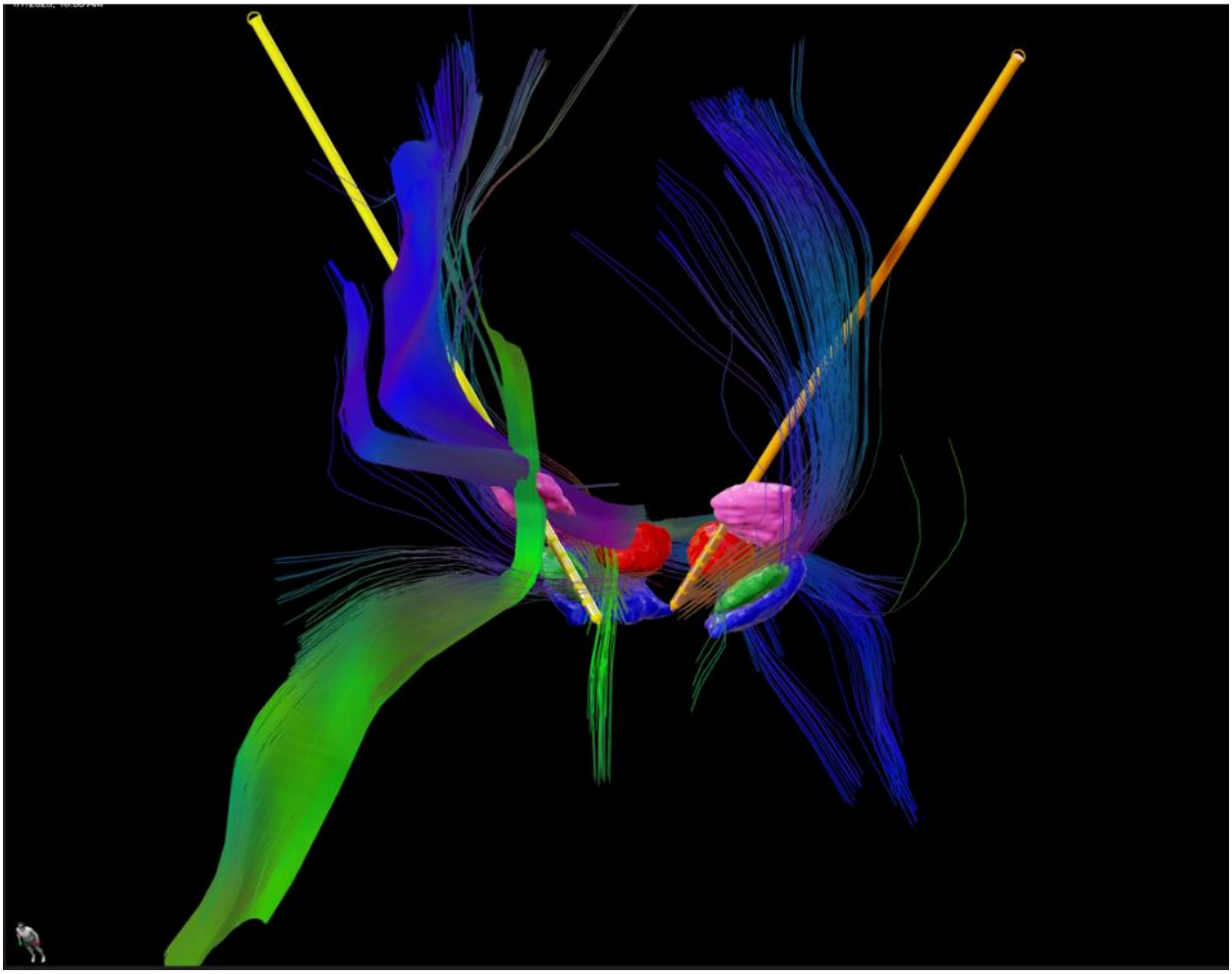
Introduction: Deep brain stimulation (DBS) targets the pallidothalamic tract (PTT) for delayed onset dystonia and the ventralis intermedius nucleus (Vim) for tremor. DBS has also been reported to be effective in treating depression by stimulating the medial forebrain bundle (MFB). In this case report, we present a male patient in his 50s who underwent bilateral DBS using a single electrode targeting Vim-PTT-MFB for tardive dystonia, tremor, and depression.

Methods:



Twelve years after beginning treatment for depression, the patient developed tremors in their extremities and trunk. They were diagnosed with tardive dystonia and referred to our department for surgery. The patient's dystonia symptoms were evaluated using the Burk-Fahn-Marsden Dystonia Rating Scale (BFMDRS)-Movement Scale (36/120) and Disability Scale (13/30). The patient's tremor symptoms were evaluated using the Fahn-Tolosa-Marin Tremor Rating Scale (FTM-TRS) (76/144). The Beck Anxiety

Inventory (BAI) and Beck Depression Inventory (BDI) scores were 37/63 and 41/63, respectively, indicating significant psychiatric symptoms. Bilateral DBS was performed through the Vim, PTT, and MFB points using 8-contact leads inserted through the parietal lobes. Postoperatively, stimulation of the PTT improved dystonia symptoms, and additional stimulation of the Vim resulted in tremor improvement. At 1 month after the operation, the patient scored 1 on the BFMDRS-Movement Scale and 1 on the BFMDRS-Disability Scale. The FTM-TRS score was 0, while the BAI and BDI scores were 31 and 36, respectively.

Results: Although Double-Target DBS with Vim and GPi has been reported to be effective for dystonic tremor, targeting these two points requires one lead per target. In this study, we targeted PTT for dystonia, which enabled us to place two targets on one lead. The MFB tract was found to be in close proximity to the PTT and within the range of stimulation. Multiple pathways are possible in the usual single-lead-single-target DBS. However, a two-point pathway is naturally defined as one straight line and requires more rigorous preoperative planning.

Conclusions: Three-target DBS with Vim-PTT-MFB may be an effective approach for the treatment of tardive dystonia and tremor with psychiatric symptoms.

Keywords: Tardive dystonia, Depression, DBS

EP178 / #36

Topic: *AS08. Stereotactic Procedures*

IMPORTANCE OF STEREOTACTIC BIOPSY IN PATIENTS WITH HEMATOLOGICAL CANCER AND SOLID BRAIN METASTASES IN THE POSTERIOR FOSSA

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Introduction: Brain metastases are the most common brain tumor in adults, representing 80% of all brain tumors, arise mainly from lung, breast, melanoma, gastrointestinal tract and others. When primary tumor is unknown, brain biopsy is better option for diagnosis in case of deep and solid lessions and/or inaccessible brain regions. The treatment of brain metastases depends on wheter those are unique or multiple, the patients functional status and the diagnosis and control of the primary tumor. Brain metastases from hematologic malignancies, particularly leukemias, tend to be diffuse in subarachnoid space or infiltrate the meninges. The terms synchronous and metachronous are used to describe two kind of tumors in different location.Synchronous tumors are those that appears in first six months after diagnosis of the primary tumor, metachronous tumors in the case of lesions that appeaars after six months

Methods:

Case:63-year-old male with history of prostate adenocarcinoma treated with open radical prostactectomy seven years ago, also Leuprolide/Bicalitamide hormone therapy. Ph-positive chronic myeloid leukemia was diagnosed one year ago, managed with Imatinib chemotherapy. He presents for about 2 weeks symptoms of vomiting and alteration of gait due to right hemiparesis 4/5. MRI result shows a lesion that involves the posterior fossa in the IV ventricle associated with deposits of hemosiderin and extracellular

methemoglobin, that could be related to secondary involvement (images).Additional studies were carried out in search of a second primary due to the solid characteristics of the brain tumor, these being negative. Paresis improved with steroids,

Results: Due to the location of the lesion, a guided brain biopsy was carried out after posterior fossa stereotaxy (figure), The patient had an adequate evolution without post-surgical complications.Pathology report was metastatic large cell carcinoma with change to clear cells.After six months, the patient presented respiratory symptoms (cough and dyspnea), and a month later a lung injury was documented as primary tumor.

Conclusions: This patient presented a metachronous oncological disease with solid brain metastases not expected for hematological cancer, in this case leukemia. Stereotactic biopsy is an important tool for diagnosis in search for a second primary malignancie in a patient with good general condition, and screening for primary unknow.

Keywords: brain biopsy, stereotactic, brain metastasis

EP179 / #341

Topic: *AS08. Stereotactic Procedures*

INTRACRANIAL HEMORRHAGIC COMPLICATIONS IN PATIENTS UNDERGOING DEEP BRAIN STIMULATION: A SINGLE-CENTER RETROSPECTIVE STUDY BASED ON MICROELECTRODE RECORDING AND MACROSTIMULATION.

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Introduction: At present, the implantation of electrodes for DBS entails potential complications, with intracranial hemorrhage (ICH) being particularly perilous. Hemorrhagic complications (HCs) are related to patient-specific as well procedural-specific factors. Among researchers, a consensus is lacking in defining unequivocal risk factors for ICH in both these categories. One factor causing considerable controversy is the application of microelectrode recording (MER) during functional neurosurgical procedures. The primary objective of the current study was to evaluate the incidence of HCs associated with microrecording (MER) and without MER.

Methods: The study design involves a retrospective analysis of all consecutive patients who underwent DBS surgery for movement, drug resistant epilepsy, and neuropsychiatric disorders at the Department of Neurosurgery, Institute of Psychiatry and Neurology in Warsaw, Poland, from November 2008 to June 2023. The analytical framework involves a comprehensive examination, featuring both graphical and descriptive representations, of cases manifesting ICH during the outlined period. Data collected included demographics, clinical details and the information of MER and the number of MER trajectories in each operation. Additional information regarding the known risk factors for HCs were gathered. The HCs were assessed by studying the postoperative computed tomography CT images.

Results: A total number of 618 patients with 1120 DBS leads implanted were included. A collective of 340 (56.29%) patients underwent surgery with the application of MER, while 264 (43.71%) patients were operated with macrostimulation solely. Considering the surgical approaches utilized, interventions involving MER demonstrated significantly higher bleeding rate at 7.35%, accounting for 25 out of 27 recorded hemorrhages. Conversely, among patients subjected to procedures involving macrostimulation only, the bleeding rate was notably lower at 0.76%, contributing to 2 of the 27 recorded hemorrhages.

Conclusions: In our experience significant associations with ICH were identified and included MER-based procedures and simultaneous bilateral DBS leads implantation.

EP180 / #106

Topic: *AS08. Stereotactic Procedures*

THE USE OF TWIST DRILL CRANIOSTOMY IN FRAME BASED STEREOTACTIC SURGERY FOR BRAIN TUMORS: SINGLE INSTITUTION EXPERIENCE

Fadi Almahariq, Domagoj Dlaka, Marin Lakić, Dominik Romić, Anđelo Kaštelančić, Darko Chudy
Neurosurgery, Dubrava University Hospital, Zagreb, Croatia

Introduction: Although CT and MRI are main measures for the diagnosis of intracranial lesions, sometimes for an accurate pathological diagnosis it is necessary to take a biopsy of the lesion tissue. Thus, stereotactic brain biopsy is an integral part of the clinical diagnosis of intracranial lesions. According to the need of microinvasive surgery there have been made some modifications to the technique of biopsy. An important modification is the usage of twist-drill craniostomy instead of the conventional burr-hole open stereotactic procedure. In this method the sclap incision is not necessary. Twist-drill craniostomy is a simple, minimally invasive standard procedure in neurosurgery. Its is most often used for the drainage of chronic subdural hematomas or for the placement of ventricular drains. The aim of the study was to evaluate the new technique for brain biopsies at our institution utilizing the twist drill craniostomies and comparing with older burr hole craniostomies.

Methods: Twist drill craniostomy was compared with standard burr hole craniostomy in a prospective nonrandomized study. A total amount of 150 patients was included. The inclusion criteria were computed tomographic (CT) evidence of intracranial lesions and requirement for brain biopsy for pathological diagnosis. Every patient underwent stereotactic supratentorial biopsy. The biopsies were performed as frame based twist drill craniostomies. Afterwards, the results were compared with the conventional burr-hole open craniostomy performed in our institution.

Results: Diagnosic tissue was obtained in all cases. There was no operative mortality or morbidity, and there were no complications such as bleeding, infection or CSF leakage. We have two complications due to the thermal lesion on the wound. The time needed in this procedure was less than 10minutes. The bone hole with 2.5mm diameter does not effect the integrity of the skull in a way which would predict the position of the possibly following craniostomy necessary for the tumor reduction surgery.

Conclusions: Our experience with this type of procedure proved it to be simple,efficient,faster and more convenient for the patient comparing to the burr hole craniostomy. The twist drill craniostomy allows more liberty for the choice of the position of the craniostomy involved into the possibly following tumor reduction surgery

Keywords: Twist drill, Stereotactic biopsy, Brain tumors

EP181 / #230

Topic: *AS08. Stereotactic Procedures*

ROBOTIC STEREOTACTIC SURGERY IN PEDIATRIC PATIENTS: 8 YEARS SINGLE-CENTER EXPERIENCE

Santiago Candela-Cantó[1], Jordi Rumià[1], Jordi Muchart[2], Mariana Alamar[1], Diego Culebras[1], Victoria Becerra[1], Carlos Valencia[1], María Hernández[1], David Artés[3], Darío Ortigoza[4], Javier Aparicio[5], José Hinojosa[1]
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Introduction: In April 2016, our pediatric hospital integrated a robotic arm into our surgical procedures for epilepsy and movement disorders. This work aims to provide an overview of our experience with this innovative tool, focusing on its efficacy and any associated complications.

Methods: We conducted a prospective collection of all surgeries performed at our institution utilizing the Neuromate® robotic arm (Renishaw®) from 2016 to February 2024. Parameters such as indications, accuracy, outcomes, and complications were meticulously recorded.

Results: During this period, a total of 140 procedures were conducted, encompassing MRI-guided laser interstitial thermal therapy (MRgLITT) for various conditions including hypothalamic hamartomas, disconnective surgeries, focal lesion resections causing epilepsy, stereoelectroencephalography (SEEG), deep brain stimulation (DBS), and brain biopsies. Patient ages ranged from 15 months to 18 years. The average accuracy at the target point (TPLE) was 1.59 mm. Significant proportions of patients achieved favorable outcomes, with 89% of hypothalamic hamartoma cases, 75% of disconnective surgery cases, and 86% of focal lesion cases being seizure-free at the last follow-up. Of the patients who underwent SEEG (n=32), 15 attained Engel I status after ressective surgery. Furthermore, 18 patients underwent radiofrequency thermocoagulation (RFTC) after SEEG, resulting in eight patients becoming seizure-free. Notably, nearly all dystonic patients (excluding three cases) exhibited improvement following DBS, albeit with varying success rates based on etiology. Complications encountered included electrode deviation leading to hematoma in a SEEG patient, and tragically, one fatality due to a subdural hematoma from a fiducial anchoring screw in a 5-year-old dystonic patient. Other complications stemmed from surgical techniques, such as deep migration of an SEEG anchoring screw, inadvertent ablation of the laser catheter trajectory in two cases, and instances of oculomotor (III) palsy and panhypopituitarism post-hypothalamic hamartoma ablation. Additionally, the compromised preoperative condition of three patients may have contributed to DBS system infections necessitating removal.

Conclusions: Our experience demonstrates the utility and accuracy of the robotic arm in treating epilepsy and dystonia in our pediatric population. Despite encountering complications, many of which were associated with our learning curve, our analysis aims to enhance the safety profile of these surgical interventions.

Keywords: Deep Brain Stimulation, robotic arm, epilepsy surgery

EP182 / #285

Topic: *AS08. Stereotactic Procedures*

THE ACCURACY OF DIRECT TARGETING USING FUSION OF MR AND CT IMAGING FOR BILATERAL DEEP BRAIN STIMULATION OF STN IN PATIENTS WITH PARKINSON'S DISEASE

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Introduction: The Deep Brain Stimulation (DBS) of the subthalamic nucleus (STN) is a one of the evidence-based treatment options for the PD. The clinical efficacy of DBS is directly linked to the accuracy and precision of the electrode placement within the STN. Although the precise and accurate placement of the electrode within the STN is crucial for a good clinical outcome of DBS in PD patients, there is still no consensus among experts on optimal site for the STN stimulation. To assess and validate the precision and accuracy of the STN direct targeting approach using preoperative MR and stereotactic CT image fusion combined with intraoperative stereotactic CT and postoperative MR imaging.

Methods: We analyzed 33 PD patients who underwent bilateral STN DBS using direct targeting approach. Preoperative MR and CT images were merged and used for planning the lead trajectory and final position, combined with intraoperative CT as well as postoperative MRI for the validation of the final electrode position. The changes in the UPDRS III score and the levodopa daily dose (LDD) and appearance of adverse side-effects were assessed in order to evaluate the successfulness of the procedure

Results: The mean Euclidian distance error (ED) in the left STN was 1,69± 0,82 mm and in the right STN was 2,12 ± 1,00. The individual differences between planned and final position in every direction were less than 2 mm (Figure 3). These results are comparable with the reported errors when using microelectrode recording approach (MER) and other direct targeting approaches. This resulted in the reduction of UPDRS III score of more than 75% and LDD of more than 45%. Only few patients experienced complication, such as postoperative infection, or unwanted side-effects, such as emotional instability.

Conclusions: Direct targeting of a STN could be a valid method for planning and placement of the DBS electrode. One important step for the successful direct targeting is post-operative MR verification of the lead placement. The use of immediate postoperative stereotactic CT scan for the lead position validation provides possible option for the centers that do not have access to the designated intraoperative MR.

Keywords: Accuracy, Fusion, MR and CT

EP183 / #34

Topic: *AS08. Stereotactic Procedures*

ADJUSTING THE BEN-GUN ARRAY INCREMENTS ACCORDING TO RADIO-MORPHOLOGY OF INTERNAL GLOBUS PALLIDUS

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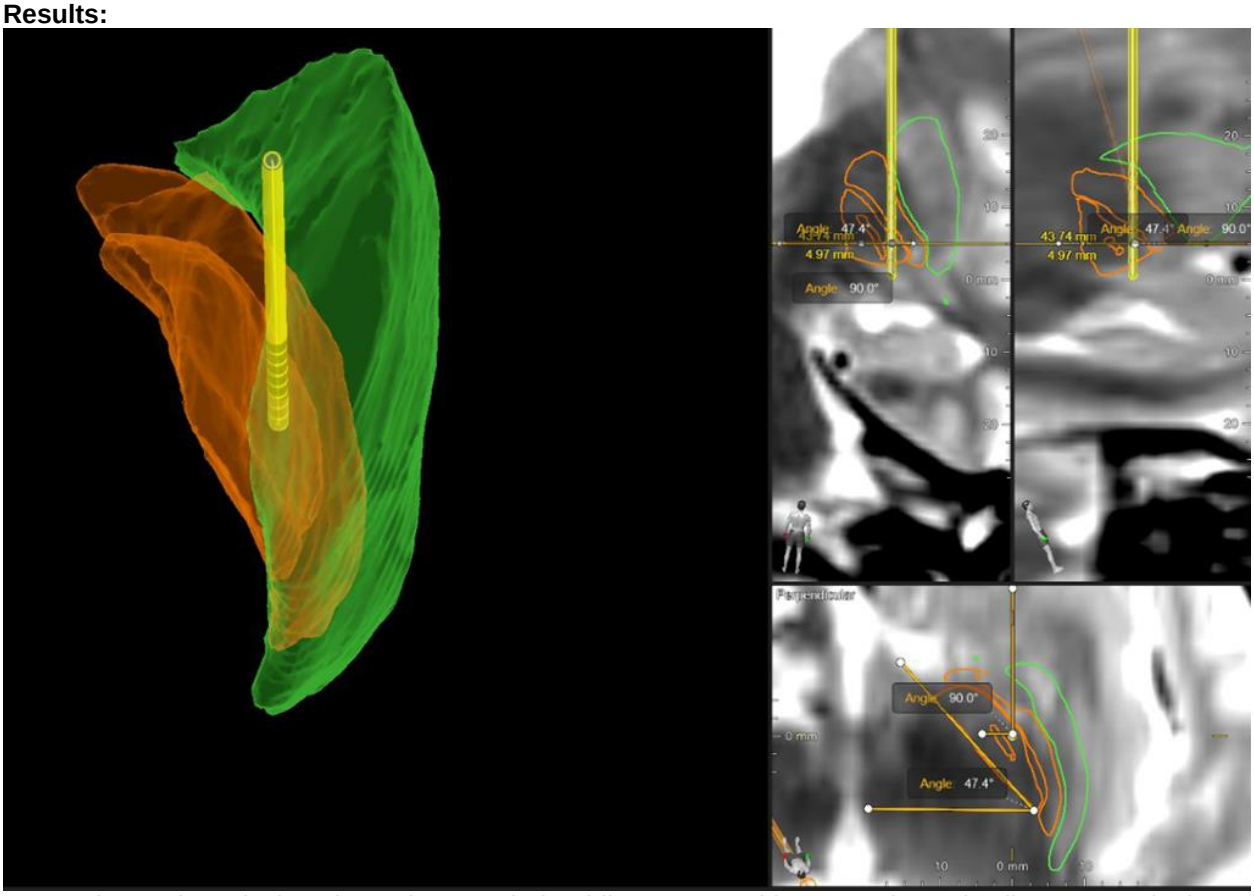
Introduction: The internal Globus Pallidum (GPi) is one of the main targets for Parkinson Disease in DBS surgeries. Intraoperative macrostimulation technique provides instant understanding of electrode's position in the substructural homunculus of the nuclei and its proximity to the surrounding tissues like internal capsule. MR studies and intraoperative stimulation techniques have provided us with better understanding of the basal ganglia and its radio-anatomical morphology. It is of great importance for surgeons to place electrodes exactly the therapeutical areas in which much beneficial and less side effects can be produced. This procedure may require intraoperative electrode re-positioning to avoid strong side effects and produce stronger beneficial effects. Postero-anteriorly, the latero-medial projections of the GPi nuclei, pave the way for approximating the internal capsule when electrodes move posteriorly and vice versa.

Methods: MRI scans of one patient, operated for Parkinson Disease, were investigated. Patient received GPi electrodes. Both patients operated using Leksell Stereotactic Frame, Ben-Gun Microdrive Array and S8 Medtronic targeting software. Each target central, and 2mm off-set Ben-Gun Array alternative trajectories calculated in S8 both with and without 45-degree increment and vice versa. All anterior, antero-medial for, posterior and posterolateral electrode positions tested intraoperatively with same monopolar current configurations.

Results:



For GPi targeting, placing electrodes anteriorly while Ben-Gun drive neutral to Leksell Frame sagittal axis, produce less beneficial effects without causing strong capsular effects compared to central electrode which indicates medial projection of the nucleus postero-anteriorly. When posterior electrode was stimulated, capsular side effect profile increased. When medial 45-degree increment performed using Ben-Gun Drive, anterior stimulation produced better beneficial effects with tolerably decreased side effect threshold.

Conclusions: When Ben-Gun Microdrive is neutral to the frame, placing the electrode anteriorly results with anterolateral positioning, and posteriorly results with posterior-medially positioning according to GPi. If array is adjusted 45 degrees medially, all electrode positions aligned with GPi morphology. Intraoperative electrode positioning requires knowledge of anatomical and physiological relations of the targeted nuclei and for each nucleus, electrode re-positioning must be made according to their 3D anatomical topography to produce best results with best physiological and anatomical relevance.

Keywords: Ben-Gun Array, Parkinson Disease, Internal Globus Pallidum

EP184 / #219

Topic: *AS08. Stereotactic Procedures*

CLINICAL EFFICACY MULTIFUNCTIONAL TREATMENT IN BRAIN STEM GLIOMA IN CHILDREN

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Introduction: Brainstem glioma is a brain tumor with poor prognosis and difficulty for surgical resection. We sought to analyze and evaluate the clinical efficacy of gamma knife radiosurgery for brainstem gliomas

Methods: From 2010 to 2020, a total of 34 brainstem glioma patients who received gamma knife radiosurgery for brainstem glioma treatment were presented to our hospital. gamma knife radiosurgery was applied consecutively, the median age of the patient was 10.5 years (range, 4.2–17.9 years), with the median prescribed total dose of 26 Gy (14–33 Gy) at three to five fractions, and the median biological equivalent doses of 59.8 Gy (33.6–76.56 Gy). At a median follow-up of 58 months. The progression-free survival after SRS was 91.7, 82.8, and 70.8% at 1, to 5 years.

Results: With a median follow-up of 53.5 months, patients with brainstem gliomas had a median overall survival of 19 months. The primary endpoints of the 1- and 2-year overall survival rates were 87.5 and 52.4%, respectively. Four patients developed radiation complications. Grade 2 radiation-related toxicity were observed in three patients and one patient with grade 3.

Conclusions: Navigating the intricate terrain of gliomas in the brain involves understanding the nuances of their types and grades, with specific considerations for age groups. Among the diverse gliomas, their peril varies not just by type but also by their intricate location within the brain. The efficacy of gamma knife radiation shines particularly bright when tackling high-grade tumors, exhibiting its prowess in both adult and pediatric cases. As the medical narrative unfolds, we learn that the success of radiation therapy is intricately linked to the size of the tumor. In adults, a substantial 3cm is the threshold for commencing this therapeutic journey.

Keywords: brainstem gliomas, pediatric population, gamma knife Radiosurgery

EP185 / #527

Topic: *AS08. Stereotactic Procedures*

STEREOTACTIC SURGERY FOR IDIOPATHIC INTRACRANIAL HYPERTENSION

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Introduction: Lumboperiotneal shunting for csf diversion are the classic way to treat idiopathic intracranial hypertension. List of complications could alter the such decision such as migration, fracture, malfunction, radiculopathy, arachnoiditis, infertility, and others. Alternative routes for CSF diversion could be less risky and more efficeint to be explored. Slit-like tiny ventrcile is very challenging for insertion of the ventricular catheter.

Methods: Retrospective analysis of patients presented with lumboperitoneal shunt malfucntion and complications underwent surgery for ventricul-atrial and ventricuo-peritoneal shunt. frame-base and frame-less stereotactic procedures for placement of the ventricular catheter in the slit-like ventricle. Vacular access and flourscopic guided insertion of the distal end throught the right atrium.

Results: All patients were alleviated from lumboperitoneal complications even infertitily disappeared in one patient. no complications were reproted in 12 patients excpet posoperative fits in one child. Headachea nd visual troubles improved in all patients.

Conclusions: Lumboperionteal shunt failure and complications could be avoided by stereotactic guided plavement of ventricular catheter in the tiny slit-like ventricle with or without flourscopic guided insertion of the distal end into the atrium.

Keywords: idiopathic intracranial hypertension, stereotactic, surgery

EP186 / #305

Topic: *AS09. Gene Therapy and Neuronal Transplant*

PHASE I STUDY OF THE FEASIBILITY AND SAFETY OF INVESTIGATIONAL CELL THERAPY IMPLANTATION TO THE SUBSTANTIA NIGRA IN PATIENTS WITH SYNUCLEINOPATHIES

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Introduction: Over the last decade, our group has been carrying out a series of open-label, single-center Phase I clinical trials to examine the capability of using regenerative peripheral nerve tissue (PNT – taken from a participant's own sural nerve) to help in the repair of damaged central nervous system cells and possibly alter or slow the progression of Parkinson's disease (PD) in patients undergoing deep brain stimulation (DBS) surgery. We are beginning a pilot feasibility and safety double-blind, single center Phase I trial of bilaterally implanting autologous PNT into the substantia nigra in participants with a diagnosis of PD or multiple system atrophy (MSA). The primary outcome is to determine our ability to recruit, enroll, execute a randomized study intervention, and follow participants with PD or MSA, for 1 year under masked conditions.

Methods: Seven participants with idiopathic PD or MSA will be enrolled. The first participant will be an open-label, bilateral delivery of PNT to the substantia nigra. The remainder of the study will be a double-blind, randomized, placebo-controlled design to actively follow participants. Participants will be followed for 12 months to monitor safety and clinical efficacy including quality of life and activities of daily living.

Results: The Primary Endpoint is the ability to recruit, enroll, and assign participants to the trial within 9 months of the trial opening. The Secondary Endpoints are number of adverse events and serious adverse events associated with bilateral PNT deployment to the substantia nigra, the number of deployment attempts required to deliver bilateral PNT, the duration of the procedure, the length of hospital stay (days), percent of study visits completed, the number who elect to receive DBS before the 1-year study visit, and mean change (with 95% confidence interval) in clinical outcomes (MDS-UPDRS, MDS-UMSARS, PDQ-8, Modified Schwab and England scale) at 12 and 6 months compared to baseline.

Conclusions: With the completion of this study, we will better understand our capabilities and limitations of executing a larger Phase II trial designed to assess a disease-modifying strategy in patients with synucleinopathies.

Keywords: Parkinson's disease, Cell Therapy, Disease Modifying

EP187 / #299

Topic: *AS10. Novel Therapies*

MODELING OF PARKINSON'S DISEASE AT THE INITIAL PHASE AS A DEVICE FOR STUDYING THE MECHANISMS OF NEUROPLASTICITY

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Introduction: Parkinson's disease (PD) is categorized by long-term degeneration of nigrostriatal dopaminergic neurons without motor indicators, which is actually explained by compensatory processes. The study was aimed to appraise compensatory processes in the nigrostriatal system at modeling PD at the early stage

Methods: PD at the early stage was modeled in mice by double administration with 2 hours interval (single dose, 6 mg/kg) of 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP). Then, within 24 hours, such indicators were assessed as: (i) the number of tyrosine hydroxylase (TH)-immunoreactive neurons in the substantia nigra, (ii) the number of axons containing only TH or only aromatic L-amino acid decarboxylase (AADC) and axons containing both enzymes (double-immunolabeling) in the striatum, (iii) dopamine content and TH activity (L-DOPA content upon AADC inhibition) (HPLC) in the striatum.

Results: According to our data, only the striatum was changed in MPTP-treated mice. During the first 3-6 hours after MPTP administration, neurodegenerative processes predominate, which is manifested in a decrease in: TH activity, dopamine content, the number of bienzymatic and monoenzymatic TH-axons. Over the subsequent period (6-24 hours), compensatory processes predominate, which manifests in: (i) an increase in TH activity, (ii) stabilization of DA level, (iii) an increase in the number of dopaminergic (bienzymatic) axons and monoenzymatic axons, which, as we showed earlier, synthesize dopamine in cooperation

Conclusions: Our data suggest that the functional insufficiency of the nigrostriatal dopaminergic system at the early stage of PD is compensated by an increase in the number of dopaminergic and monoenzymatic axons, associated with an increase in axonal dopamine synthesis

Keywords: Modeling, Parkinson's disease, neuroplasticity

EP188 / #388

Topic: *AS10. Novel Therapies*

MICROVASCULAR DECOMPRESSION OF THE VIII CRANIAL NERVE FOR THE TREATMENT OF REFRACTORY TINNITUS AND PAROXYSMAL VERTIGO, 2 CASE REPORT AND REVIEW OF THE LITERATURE.

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Introduction: Tinnitus is one of the most frequent causes to seek for attention in the otologic practice, with a prevalence of 10-15% in the general population, 5% of these have disabling and refractory symptoms to pharmacological treatment. The first description of microvascular decompression (MVD) was made by W. James Gardner in 1959 for the treatment of trigeminal neuralgia, later, Peter Jannetta was the one who popularized the technic for trigeminal neuralgia and other neurovascular compression syndromes, Jannetta in 1975 treated 8 patients with refractory tinnitus and vertigo with a MVD of the VIII cranial nerve, like the one he did in trigeminal neuralgia. In the 1980s there were some publications that revealed that tinnitus was caused by a compression of the VIII cranial nerve from the anteroinferior cerebellar artery (AICA), posteroinferior cerebellar artery (PICA) or dolichoectatic arteries.

Methods: 2 cases referred from audiology that had tinnitus associated with paroxysmal vertigo and hypoacusis, without affection of the facial nerve. They were treated for 12 months with the best pharmacological treatment, and which were found to have a vascular loop on magnetic resonance imaging (MRI) in FIESTA sequence making contact in the middle cerebellar complex and were treated with MVD with a good clinical response in the post operative.

Results: The MVD of the VIII cranial nerve in previously selected patients can improve the tinnitus in up to 60% with a complication rate of 5-12%.

Conclusions: The MVD of the VIII cranial nerve can improve tinnitus in up to 60% of the patients, with a low complications rate, between 5-12% that's why it is important to consider this approach when we face a patient with refractory tinnitus. It is important to increase the cases to evaluate more objectively the improvement of vertigo and audition.

Keywords: Microvascular decompression, Tinnitus,, Vertigo

EP189 / #292

Topic: *AS10. Novel Therapies*

MRI-GUIDED FOCUSED ULTRASOUND VENTRO-ORAL THALAMOTOMY FOR WRITER'S CRAMP

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Introduction: Writer's cramp (WC) is a primary adult-onset task-specific focal dystonia characterized by abnormal movements or posturing of the upper limb. Lesioning of the ventro-oral (Vo) nucleus of the thalamus (Vo- thalamotomy) using radiofrequency or deep brain stimulation can cause dramatic improvement in WC symptoms. MRI-guided focused ultrasound (MRgFUS) can make intracranial focal lesions without an incision.

Methods: The three male patients, all of whom were staff of public offices, had severe writing cramp for more than 2 years. All of them successfully received MRgFUS treatment, and the following-up 6-12months. efficacy evaluation was carried out by video recording.

Results: During the follow-up period for the three patients, notable and consistent alleviation of symptoms was observed, demonstrating the efficacy of the treatment interventions. The improvement remained stable throughout the 6 to 12-month follow-up, indicating the enduring positive impact of the interventions. Importantly, no adverse effects were reported during this extended period, affirming the safety profile of the treatments.

Conclusions: Magnetic Resonance Imaging-guided Focused Ultrasound Ventro-Oral Thalamotomy has demonstrated note-worthy efficacy as a therapeutic intervention for the management of Writer's cramp, a condition characterized by involuntary muscle contractions during writing.

Keywords: thalamotomy, MRI-guided Focused ultrasound, Writer's cramp

EP190 / #450

Topic: *AS10. Novel Therapies*

TRIGEMINAL NERVE STIMULATION ALTERED FRONTO-LIMBIC GAMMA FUNCTIONAL CONNECTIVITY UNVEILED BY INTRACRANIAL EEG

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Introduction: Trigeminal nerve stimulation (TNS) is an emerging neuromodulation therapy for neuropsychiatric disorders including attention-deficit/hyperactivity disorder (ADHD) and depression through stimulating the afferent nerve of trigeminal nuclei. Various studies indicated that TNS may improve symptoms by regulating downstream subcortical and cortical structures. The fronto-limbic pathway, containing amygdala, hippocampus and other structures, is implicated in diverse neuropsychiatric disorders. However, whether and how TNS modulating the activity and functional connectivity within the fronto-limbic network is still elusive. The present stereoelectroencephalography (sEEG)-based study aimed to investigate the neurophysiological effects of TNS on fronto-limbic pathway under resting-state recording.

Methods: Eight adult patients, who underwent sEEG implantation for refractory epilepsy, were included in this study. Electrical stimulation (100Hz, 20 minutes) was directly delivered to bilateral supraorbital nerve via acupuncture needle. sEEG was continuously acquired for 140 minutes: 60 minutes pre-, 20minutes during- and 60 minutes post-stimulation. Electrophysiological data was manually inspected to remove artefacts and epileptiform discharge. Absolute power in delta (1-4 Hz), theta (4-8 Hz), alpha (8-12 Hz), beta (12-30 Hz), low frequency gamma (LFG, 30-60 Hz) and high frequency gamma (HFG, 60-200 Hz) bands were evaluated for spectral analysis. Phase-locking value (PLV), as a measure of functional connectivity, was analyzed for each frequency band among amygdala, hippocampus, insula and orbitofrontal cortex (OFC) under different conditions.

Results: PLV connectivity of hippocampus-amygdala, insula-amygdala and hippocampus-OFC in the HFG band significantly increased during TNS compared with pre- and post-stimulation ($p<0.05$). A significant decrease of hippocampus-insula PLV in the LFG band was observed during TNS compared with pre-stimulation ($p<0.05$). No significant effects on absolute power spectra of any band were noticed.

Conclusions: The increased functional connectivity in HFG and decreased functional connectivity in LFG provide basis for altered fronto-limbic network during TNS. These neurophysiological changes may shed light on potential action mechanism of TNS as a clinical treatment for ADHD and other neuropsychiatric disorders.

Keywords: SEEG, Functional connectivity, trigeminal nerve stimulation

EP191 / #337

Topic: *AS11. Basic Science or Technology Development*

THETA-BAND POWER MODULATION IN THE HUMAN INSULA DURING A DIRECT ARM-REACHING TASK

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Introduction: The human insula is traditionally known for its involvement in somatic sensation and cognitive processing. Newer evidence points to a role of the insula in motor control. In our study, we sought to identify the role of theta-band oscillations in the insula during a direct arm-reaching task in human participants.

Methods: 9 participants undergoing seizure localization with stereoencephalography (SEEG) with contacts in the insula were selected (6 right,1 left, 2 bilateral). Local field potential recordings were taken during a direct arm-reaching task with the right hand. Theta-band power (4-8 Hz) was computed during the Fixation and Response phases and compared with a cluster-based permutation test (N = 1,000, significant $p < 0.05$).

Results: 9 of 9 participants (100%) showed a statistically significant change in theta-band power in the Response compared to Fixation phase. 9 of 10 right-sided implants (90%) showed theta-band modulation (30% with decreased, 60% with increased theta power), while 3 of 3 left-sided implants (100%) showed theta-band modulation (33.3% with decreased, 66.67% with increased theta power). 6 of 7 anterior implants (85.7%) showed theta-band modulation (33.3% with decreased, 66.7% with increased theta power), while 6 of 6 posterior implants (100%) showed theta-band modulation (33.3% with decreased, 66.7% with increased theta-band power).

Conclusions: Our study demonstrates the involvement of theta-band modulation in the human insula during movement processing in a direct arm-reaching task. Further studies will be needed to further define the role of the insula in control of voluntary movement.

Keywords: theta-band, modulation, reaching task

EP192 / #457

Topic: *AS11. Basic Science or Technology Development*

LAMINAR ORGANIZATION OF FUNCTIONAL AND PHYSIOLOGICAL PROPERTIES OF HUMAN SINGLE NEURONS AND LOCAL FIELD POTENTIALS IN A HIPPOCAMPAL MICROCIRCUIT USING NEUROPIXEL

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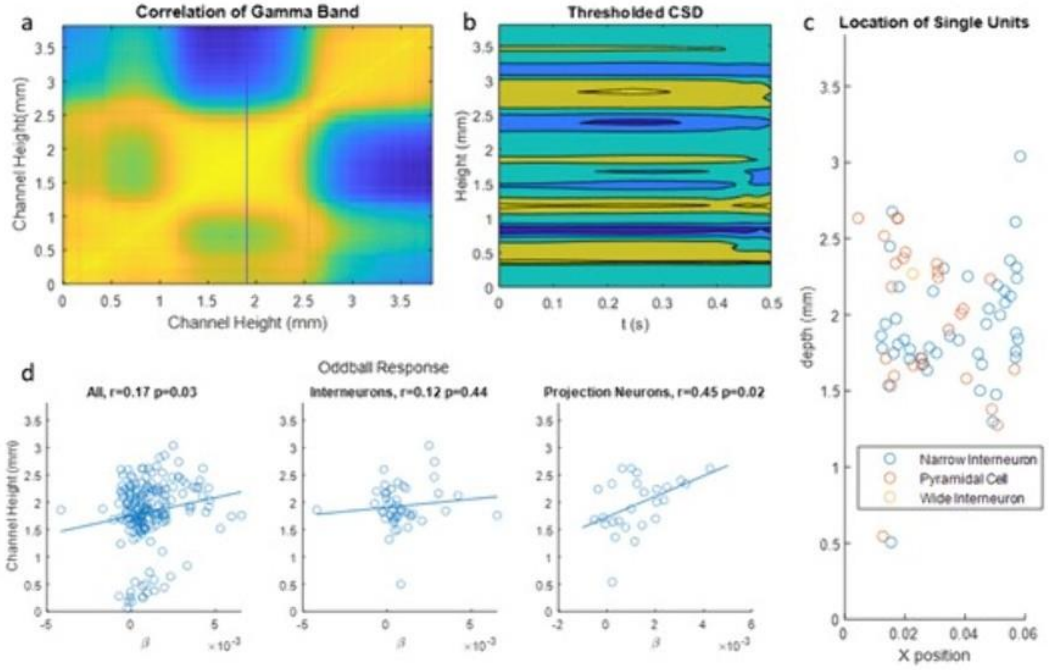
Introduction: Life as we know it is a circuit epiphenomenon, with complex behavior arising from a network of interconnected neurons. While hundreds of neurons working together to coordinate actions have been demonstrated in animal models, technological limitations to date have precluded the direct study of human neuronal networks. Recent advances in silicon probes, however, have allowed for the simultaneous recording of tens to hundreds of single units simultaneously in humans. Our team recorded laminar hippocampal local field potentials and spiking activity in a patient undergoing temporal lobe resection for epilepsy.

Methods: Using the Neuropixel device, we recorded approximately 36 minutes of broadband hippocampal spontaneous and tone evoked activity from contiguous archicortex spanning from just below the ependymal surface to a depth of 3.8mm in an anesthetized volunteer undergoing an anterior temporal lobectomy for epilepsy. Two tones were intermittently played with very different probabilities. Local field potentials were extracted via a bandpass filter and current source density (CSD) was defined as the smoothed 2nd spatial derivative. Single and multiunit activity was extracted via KiloSort 2.5. Putative neuronal subtypes were identified by bursting properties and waveform shape using CellExplorer, a toolbox validated on in vivo mouse recordings.

Results: Continuous layers of approximately 1.2mm were synchronous in the gamma band (Figure 1a), but CSD revealed microstructure only ~0.3mm thick (Figure 1b). Within these regions, we extracted 72 single units and 109 multiunits. The putative projection neurons (pProj) and interneurons (pInt) were evenly distributed and clustered in the center of the recording area (Figure 1c). No spatial dependence was found for basic tone responsivity ($p>0.05$ for correlation between each unit's waveform location and response regression coefficient). However, more superficial neurons were more likely to respond to oddball tones ($r=0.17$, $p=0.03$). This effect was much stronger for pProj ($r=0.45$, $p=0.02$), and not found in pInt ($r=0.12$, $p=0.44$) (Figure

1d).



Conclusions: We report one of the highest resolution studies to date of the laminar organization of tone evoked network activity in the human hippocampus. Future work will examine how the networks form assemblies during different tasks.

Keywords: Human Single Unit, hippocampus, Epilepsy

EP193 / #191

Topic: *AS11. Basic Science or Technology Development*

A NETWORK-BASED FRAMEWORK FOR EPILEPTOGENIC ZONE IDENTIFICATION USING SPECTROTEMPORAL GRAPHS

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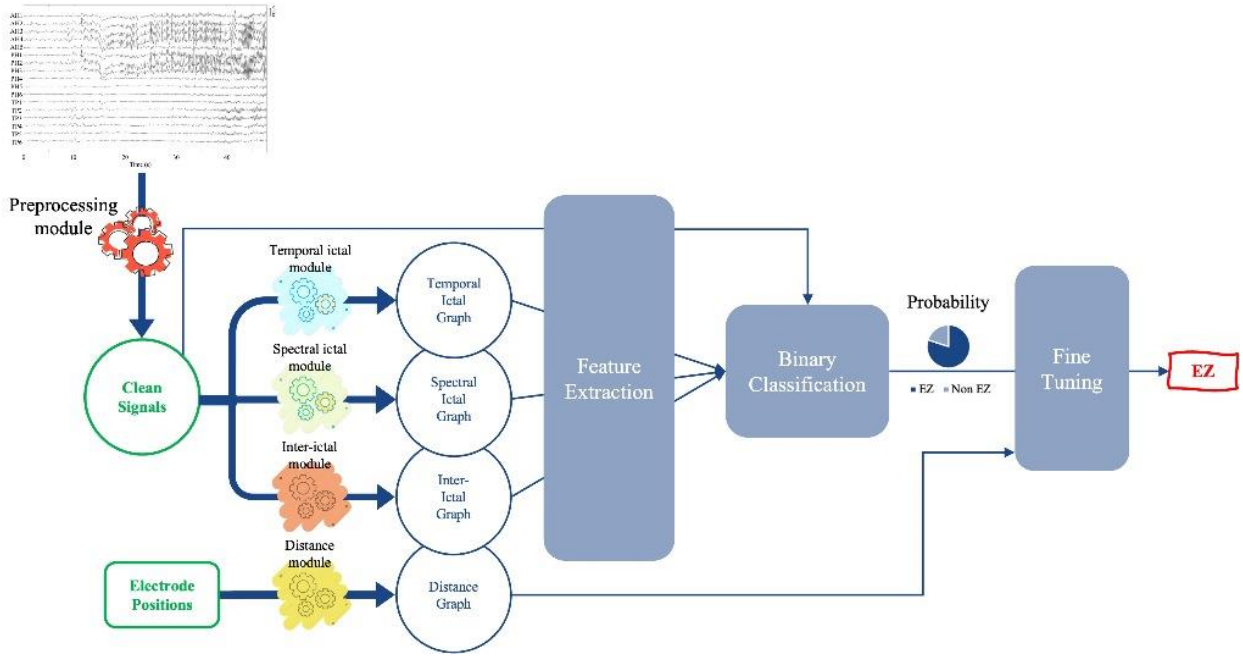
Introduction: The success of resection therapies in patients with drug-refractory epilepsy relies on accurately identifying the epileptogenic zone (EZ), which comprises the specific brain regions contributing to seizure generation. The conventional methodology for EZ identification by clinicians is subjective, time-consuming, and lacks integration of the complex temporospatial dynamic processes involved. The development of an automated network-based EZ detection framework has the potential to not only improve surgery outcomes but also to advance next-generation neurostimulation therapies. Currently, most research in the field is constrained to simple linear network analysis or focuses on modeling only one aspect of these complex connectivities. Our study aims to identify the EZ by utilizing various features derived from comprehensive non-linear graphical models of the epileptogenic network, providing a more holistic understanding of the condition.

Methods: We utilize a dataset including five patients with intractable MTLE who have undergone resective or ablative surgeries following stereo-EEG investigation and remained seizure-free>1 year post-surgery (Engel I outcome). We create three distinct graphical representations that capture the non-linear spectral and temporal connectivities during ictal and inter-ictal intervals. Various features extracted from these graphs are leveraged by machine learning algorithms tasked with detecting the EZ within the modeled networks. This is formulated as a node classification problem, with the nodes corresponding to the recording channels. Finally, spatial attributes of the electrodes are employed to fine-tune the results.
Figure1: Framework
Overview.



Results: The results are obtained using leave-one-out cross-validation, which marks an accuracy of 94.2% and F1-score of 75%. This demonstrates a notable increase compared to other well-known methods, emphasizing the efficacy of our approach. Additionally, we observe a significant decrease in performance when excluding the multigraph-based features or the fine-tuning step, highlighting the importance of utilizing multiple graphs to represent the epileptogenic network and the effectiveness of incorporating the electrodes' spatial properties in detecting the EZ.

Conclusions: We demonstrate that to comprehensively represent the epileptogenic network, it is necessary to model both temporal and spectral aspects of ictal and inter-ictal intervals. Additionally, utilizing advanced tools in network science and graph signal processing is crucial to obtaining insightful properties of these graphs, enhancing the EZ detection performance.

Keywords: Network Science, Epileptogenic Zone, Machine Learning

EP194 / #234

Topic: *AS11. Basic Science or Technology Development*

MAGNETOELECTRIC FILM FOR WIRELESS LOW-FREQUENCY NEUROMODULATION

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Introduction: Wireless neuromodulation techniques are widely investigated to address the challenges associated with conventional neurostimulation devices. Previous research has relied on ultrasound, light and magnetic fields as the modalities for remotely powering neuronal implants. Use of magnetic fields has been promising for wireless neuronal interfaces since they have excellent tissue penetration, unlike light and ultrasound in which the use is limited by the signal attenuation within tissue. Magnetically powered devices typically work with >100 kHz electromagnetic fields and therefore they are heavily dependent on the on-board electronics to regulate output signal. Moreover, use of such high frequency is a limiting factor for safe use, especially in deeper areas due to tissue absorption. Magnetoelectric (ME) approach is a promising method that stems from the magneto-electrical coupling. It is a high throughput approach for power delivery through magnetic fields in low frequency regimes compared to far-field or inductive coupling. To adress the aforementioned challenges, we explored the potential of ME approach at low frequencies (10-25 Hz) to provide a direct neuronal interface without on-board electronics .

Methods: We fabricated ME planar films through laminating magnetostrictive and piezoelectric plates. We characterized the electrical performance by lock-in technique and electrochemical measurements under varying combinations of AC and DC magnetic fields. After optimizing input waveform and magnitude, we used the optimized parameters to investigate neuromodulation through calcium imaging studies in-vitro.

Results: Through the electrical characterization experiments, we optimized the electrode geometry to 1:5 aspect ratio. In electrochemistry measurements, we were able to observe current density of 4-6 μA/cm2 in phosphate-buffered saline environment . Lastly, we investigated neuromodulation potential of the ME films in-vitro. We conducted calcium imaging studies at square and sinusoidal waveforms with varying AC and DC magnetic field magnitudes <3 mT. Our preliminary results show that there is an increased calcium influx in neuron cells with both waveform conditions.

Conclusions: Overall, these results show that ME films are promising candidates of neuronal interfaces for wireless electrical modulation. Future work will be conducted to understand the nature of stimulation further and how the neuronal behaviour is altered at a population level in different frequencies.

Keywords: magnetoelectric, Neuromodulation

EP195 / #287

Topic: *AS11. Basic Science or Technology Development*

EXPLORATION OF ABNORMAL BRAIN CAVITIES: ELECTROPHYSIOLOGICAL PATTERNS, CORTICAL ADAPTATIONS, AND STIMULATION-DRIVEN MODULATIONS

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Introduction: Stroke disrupts both single-unit and population-level brain activity, characterized by an imbalance between excitatory and inhibitory functions, leading to disconnection from downstream circuitry and subsequent motor impairment. Electrophysiological methods provide direct insights into these dynamics. Existing literature suggests that oscillation changes correlate with the stroke stage, particularly low-frequency oscillations influencing motor tasks and recovery outcomes. However, the challenge arises from the absence of sufficient spatial resolution in many studies, hindering the targeted stimulation approaches crucial for stroke treatment. This study addresses this limitation by recording from multiple regions within abnormal brain cavity (aBC) walls, which are fluid-filled spaces that form in the brain following stroke, to elucidate location-specific electrophysiological patterns.

Methods: In rats, by using 32-channel silicon probes, we recorded local field potentials (LFPs), evoked potentials, and single/multiunit activity in the healthy motor cortex (M1), acute aBC walls, and chronic aBC walls. In order to construct a model elucidating dynamics between the somatosensory cortex (S1) and M1 in the presence of injury, we also carried out simultaneous evoked potential recording from these two regions. Recordings were repeated in healthy, acute aBC, and chronic aBC conditions.

Results: Power spectral density (PSD) analysis revealed significant power loss across multiple frequency bands from healthy M1 to acute and healthy M1 to chronic cases, with recovery observed mainly in low-frequency oscillations from acute to chronic. Location-specific predictors were identified for alpha and beta band power changes from different locations in the aBC wall. Evoked potential amplitudes were significantly affected by aBCs, with location and condition serving as predictors. The recovery observed in evoked potential amplitude contrasts with persistent power loss across frequency bands. Notably, the lateral wall exhibited a larger evoked potential response, possibly due to its proximity to the sensory cortex. Similarly, amplitudes of evoked potentials were significantly affected in S1 in the presence of an abnormal brain cavity in M1.

Conclusions: Our research highlights the significance of location-specific electrophysiological patterns within aBC walls and the interplay between somatosensory and motor cortex dynamics post-stroke, providing insights for targeted stimulation and injury marker identification.

Keywords: Stroke, Motor cortex stimulation, electrophysiology

EP196 / #84

Topic: *AS11. Basic Science or Technology Development*

NEUROMODULATION USING TRANSCRANIAL FOCUSED ULTRASOUND ON NEUROMODULATION USING TRANSCRANIAL FOCUSED ULTRASOUND ON THE BILATERAL MEDIAL PREFRONTAL CORTEX

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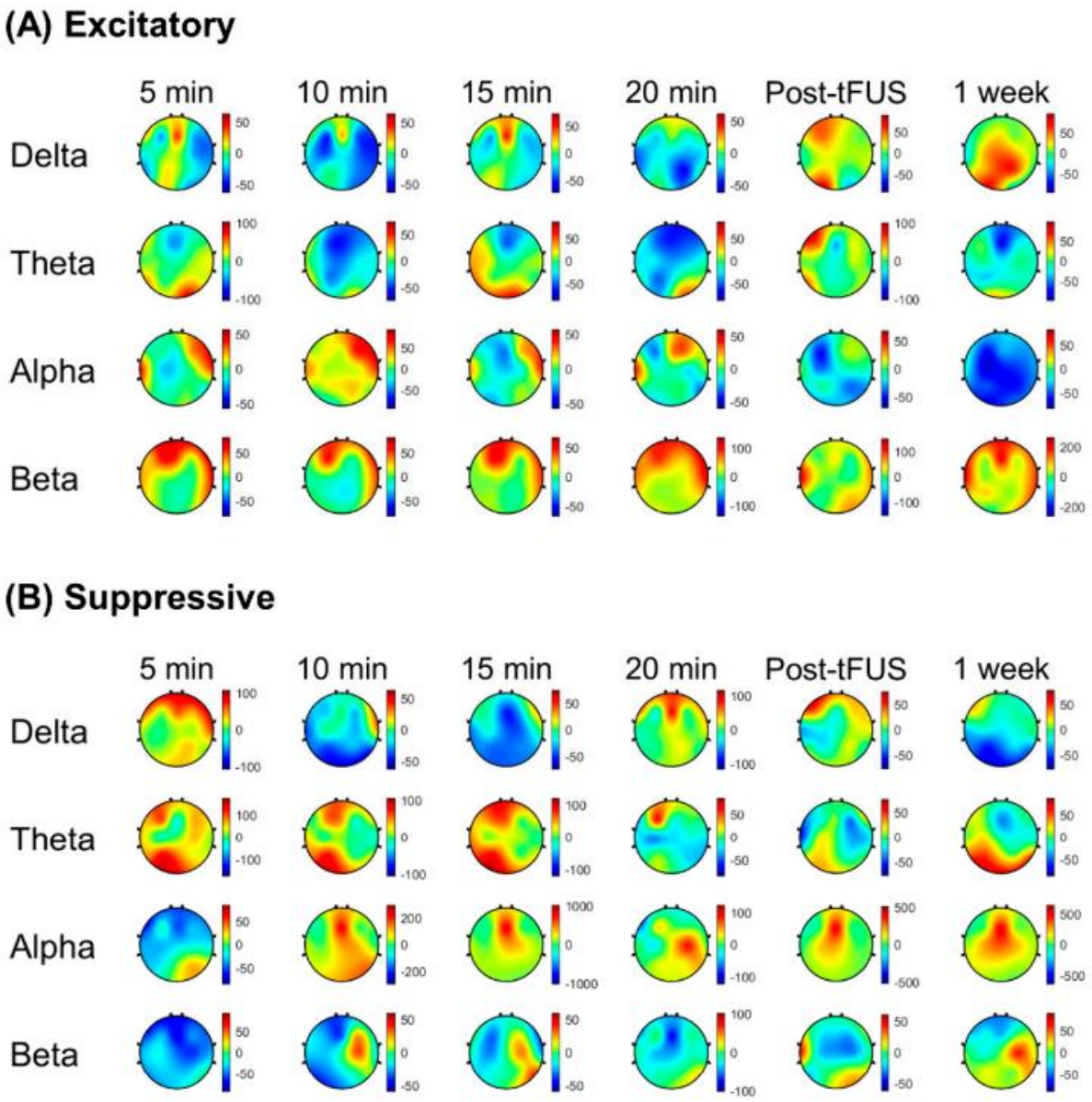
Introduction: Transcranial focused ultrasound (tFUS) is a promising technique of non-invasive brain stimulation for modulating neuronal activity with high spatial specificity. The medial prefrontal cortex (mPFC) has been proposed as a potential target for neuromodulation to prove emotional and sleep qualities. We aim to set up an appropriate clinical protocol for investigating the effects of tFUS stimulation of the bilateral mPFC for modulating the function of the brain-wide network using different sonication parameters.

Methods: Seven participants received 20 min of 250 kHz tFUS to the bilateral mPFC with excitatory (70% duty cycle with sonication interval at 5 s) or suppressive (5% duty cycle with no interval) sonication protocols, which were compared to a sham condition. By placing the cigar-shaped sonication focus on the falx between both mPFCs, it was possible to simultaneously stimulate the bilateral mPFCs. Brain activity was analyzed using continuous electroencephalographic (EEG) recording during, before, and after tFUS. The study design and procedures are described in Figure 1.

Results: We investigated whether tFUS stimulation under the different conditions could lead to distinctive changes in brain activity in local brain regions where tFUS was directly delivered, and also in adjacent or remote brain areas that were not directly stimulated. This kind of study setting suggests that dynamic changes in brain cortical responses can occur within short periods of time, and that the distribution of these responses may differ depending on local brain states and functional brain architecture at the time of tFUS administration, or perhaps, at least temporarily, beyond the stimulation

time.



Conclusions: tFUS could be useful for temporarily modifying regional brain activity, modulating functional connectivity, or reorganizing brain functions associated with various neuropsychiatric diseases, such as insomnia and depression.

Keywords: transcranial focused ultrasound, medial prefrontal cortex, sonication parameters

EP197 / #382

Topic: *AS11. Basic Science or Technology Development*

SEEME: A PLATFORM FOR BRAIN BEHAVIOR SYNCHRONIZATION IN DISORDERS OF CONSCIOUSNESS

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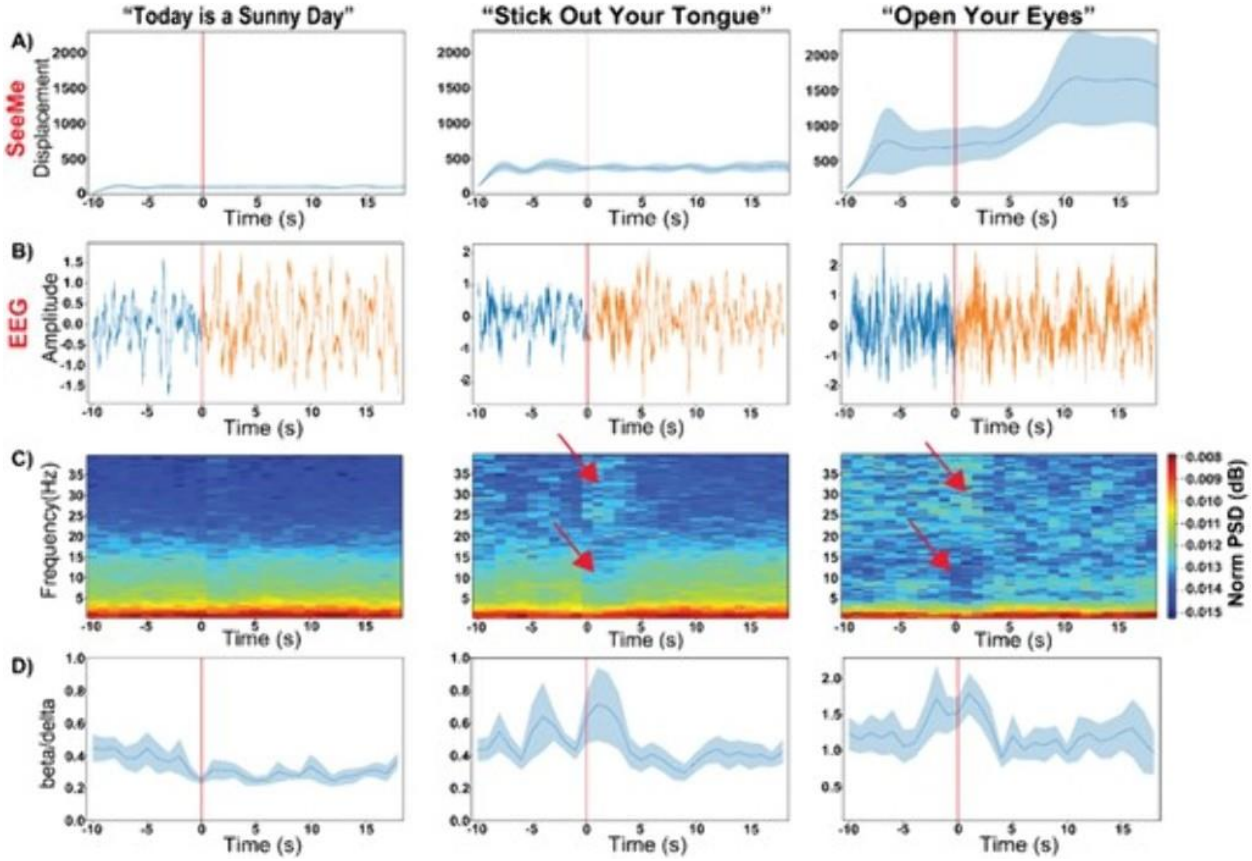
Introduction: Neural activity, represented in scalp electroencephalography (EEG), predicts the return of consciousness after brain injury. Moreover, there are now multiple reports of voluntary modulation of EEG when brain-injured patients are unresponsive. Yet the relationship between EEG activity and behavior after brain injury is unclear. During recovery of consciousness, voluntary movements can be low-amplitude and difficult to detect. We therefore developed SeeMe, a real-time quantitive tool to measure low-amplitude voluntary movements. SeeMe uses computer vision to analyze facial microexpressions in response to auditory commands such as “stick out your tongue.” In the present report, we describe EEG signatures of responses to motor commands analyzed with SeeMe.

Methods: We sought to enroll patients at Stony Brook University Hospital who suffered acute brain injuries (traumatic brain injury, cerebral hemorrhage) and subsequently became comatose (GCS < 8 on admission). While on Natus Xltek EEG, SeeMe played four phrases in 10 trial blocks: a control phrase (“Today is a sunny day.”) and three command phrases (“Stick out your tongue,” “Open your eyes,” “Show me a smile”). EEG was synchronized to SeeMe commands. SeeMe was then used to detect whether patients had motor movements to each phrase.

Results: Four patients were enrolled in this study. This study is registered under the ClinicalTrials.gov ID number NCT06083441 and is approved by the Stony Brook University Institutional Review Board (IRB2019-00199). Informed consent was obtained from each patient’s legally authorized representative. Figure 1 depicts SeeMe and EEG results for one patient. Two patients had significant increases in their F3-C3 beta/delta band power ratio after command phrases. Each of these increases correlated with a detected movement on

SeeMe.



Conclusions: Our results illustrate the relationship between the beta/delta band power ratio and command following and showcase SeeMe as a platform for brain-behavior synchronization.

Keywords: Electroencephalography, Acute Brain Injury, disorders of consciousness

EP198 / #395

Topic: *AS11. Basic Science or Technology Development*

STEREOTACTIC NAVIGATION USING MAXILLARY PROSTHESIS: A NEXT GENERATION OF REGISTRATION TECHNOLOGY TOWARDS IMAGE-GUIDED PRECISION SURGERY

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Introduction: With the imaging modalities advancements such as computed tomography (CT), and magnetic resonance imaging (MRI), stereotactic navigation systems has allowed high-level tracking system and real-time feedback in sensitive anatomic areas. Yet, such systems come with limitations including the skin-based or rigid cranial-based navigation registration systems. Herein, we present our work on an innovative maxillary prosthesis incorporating passive and dynamic fiducials that allow stereotactic navigation for wide array of intracranial and craniomaxillofacial surgery.

Methods: We designed the maxillary prosthesis by utilizing the patient's dentition as an entry point of the skull to reach many anatomical landmarks. This enables stereotactic guidance for a multitude of intra-cranial and craniofacial procedures. We first imported the patient's Digital Imaging and Communications in Medicine (DICOM) files to segment a three-dimensional (3D) skull. A complimentary Intra-oral scan (TRIOS 3) was then used to scan the same dentitions, which eliminates any artifacts. Different biocompatible materials were designed and then 3D printed with incorporating configured fiducial markers. The accuracy of navigation system to reach landmarks was tested using navigation software.

Results: We added fiducials on the 3D-printed Patient-specific maxillary prothesis. These fiducials were used for co-registration with CT imaging and stereotactic navigation. We have eliminated the need for rigid head stabilization, reduced the preparation peri-operative time and addressed the main drawbacks of current navigation technologies, such as their interference with intra-operative imaging.

Conclusions: While retaining the accuracy standards of stereotactic navigation systems, such dental device offers easier surgical flow to the surgeon and allows a complete range of head mobility without interference. In the same way, it will increase patient comfort during awake stereotactic procedures compared to traditional systems. Thus, Dental registration devices offer a reproducible, patient-centered approach, minimizing the need for invasive fiducials and extra registration radiation exposure.

Keywords: Maxillary Prothesis, Stereotactic Navigation System, Image-Guided Precision Surgery

EP199 / #509

Topic: *AS11. Basic Science or Technology Development*

REDUCTION OF ALPHA-SYNUCLEIN OLIGOMERS IN PRECLINICAL MODELS OF PARKINSON'S DISEASE BY ELECTRICAL STIMULATION IN VITRO AND DEEP BRAIN STIMULATION IN VIVO.

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Introduction: Background: Deep brain stimulation (DBS) has been widely used to manage debilitating neurological symptoms in movement disorders such as Parkinson's disease (PD). Despite its well-established symptomatic benefits, our understanding of the mechanisms underlying DBS and its possible effect on the accumulation of pathological proteins in neurodegeneration remains limited. Accumulation and oligomerization of the protein alpha-synuclein (α-Syn) are implicated in the loss of dopaminergic neurons in the substantia nigra in PD, making α-Syn a potential therapeutic target for disease modification. Objective: We examined the effects of high frequency electrical stimulation on α-Syn levels and oligomerization in cell and rodent models.

Methods: High frequency stimulation, mimicking DBS parameters used for PD, was combined with viral-mediated overexpression of α-Syn in cultured rat primary cortical neurons or in substantia nigra of rats. Bimolecular protein complementation with split fluorescent protein reporters was used to detect and quantify α-Syn oligomers.

Results: High frequency electrical stimulation reduced the expression of PD-associated mutant α-Syn and mitigated α-Syn oligomerization in cultured neurons. Furthermore, DBS in the substantia nigra, but not the subthalamic nucleus, decreased overall levels of α-Syn, including oligomer levels, in the substantia nigra.

Conclusions: Taken together, our results demonstrate that direct high frequency stimulation can reduce accumulation and pathological forms of α-Syn in cultured neurons in vitro and in substantia nigra in vivo. Thus, DBS therapy could have a role beyond symptomatic treatment, with potential disease-modifying properties that can be exploited to target pathological proteins in neurodegenerative diseases.

Keywords: synuclein, Parkinson's disease, Deep Brain Stimulation

EP200 / #320

Topic: *AS11. Basic Science or Technology Development*

DBSCOPE: A VERSATILE COMPUTATIONAL TOOLBOX FOR THE VISUALIZATION AND ANALYSIS OF LFP DATA DERIVED FROM DEEP BRAIN STIMULATION

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Introduction: Deep brain stimulation (DBS) is a therapy applied in numerous neurologic diseases, with proven safety and efficiency in currently approved indications. New implantable neurostimulation devices have been approved for clinical application, which are capable of recording brain activity in the form of local field potentials in the vicinity of the electrodes. With this technology widely available, a new window into the neuropathological phenomena has been opened and with it the potential to improve clinical care. Data-driven therapies often rely on tools to process, visualize, and analyze the data. However, existing tools in DBS are stil not fully exploiting the devices' sensing capabilities.

Methods: In the present work, we developped a user-friendly, open-source, MATLAB-based toolbox for the visualization and analysis of LFP data collected by Medtronic's Percept neurostimulator device. Methods were developed to preprocess the data, produce visualizations and analysis of the neurophysiological signatures. The toolbox was enriched with features which promote its usefulness in both clinical and research environments. In parallel, we developed a wearable integrating microelectromechanical systems with inertial measurement units (accelerometers and gyroscopes) to objectively quantify tremor and rigidity, which can easily be integrated with DBScope neurophysiological signal analysis.

Results: The standalone MATLAB-based toolbox, called DBScope, is capable of parsing the data generated by current sensing devices and producing rich visualizations with clinical and research relevance. The toolbox can be operated in two ways: through a user interface, bypassing programming experience requirements; and, programmatically, acting as a library of functions, which can be further adapted to user needs. Practical application of the toolbox is exemplified in two patient datasets. Key features of the toolbox are the option to remove hearth beat artefacts, the possibility to filter the signal in frequency bands, and a wide range of spectral analysis methods.

Conclusions: DBScope is an open-source, versatile toolbox that allows the user to represent the decomposition of the signals and explore possible electrophysiological biomarkers of neurological disorders treated with DBS. We believe that the development and wide use of such tools is essential to improve data-driven DBS therapies.

Keywords: local field potentials, Computational tools, Deep Brain Stimulation

EP201 / #447

Topic: *AS11. Basic Science or Technology Development*

TRAINING SYSTEM IN STEREOTACTIC SURGERY

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Introduction: Simulation technologies are increasingly used in medical education. In stereotactic neurosurgery, phantom tests help to evaluate the accuracy of stereotactic surgeries (Švaco M. et al., 2020). But when students train with such phantoms, they lack realistic situations such as working with neuroanatomy data, selecting targets for surgery depending on disease manifestation, evaluating outcomes, and selecting stereotactic access. In essence, the use of available phantoms is reduced to mechanical repetition of actions when working with stereotactic equipment without taking into account real clinical cases, so they are not so useful for training neurosurgeons. Our team has developed a prototype of a new type of interactive anthropomorphic phantom for practicing functional stereotactic interventions.

Methods: The phantom consists of 3 main components (fig.1): an anthropomorphic phantom head with a non-contact positioning assessment system and a decision making unit, a laptop with pre-installed interactive phantom software (examiner's station) and a tablet computer with a phantom control interface for the surgeon (examiner's
interface).

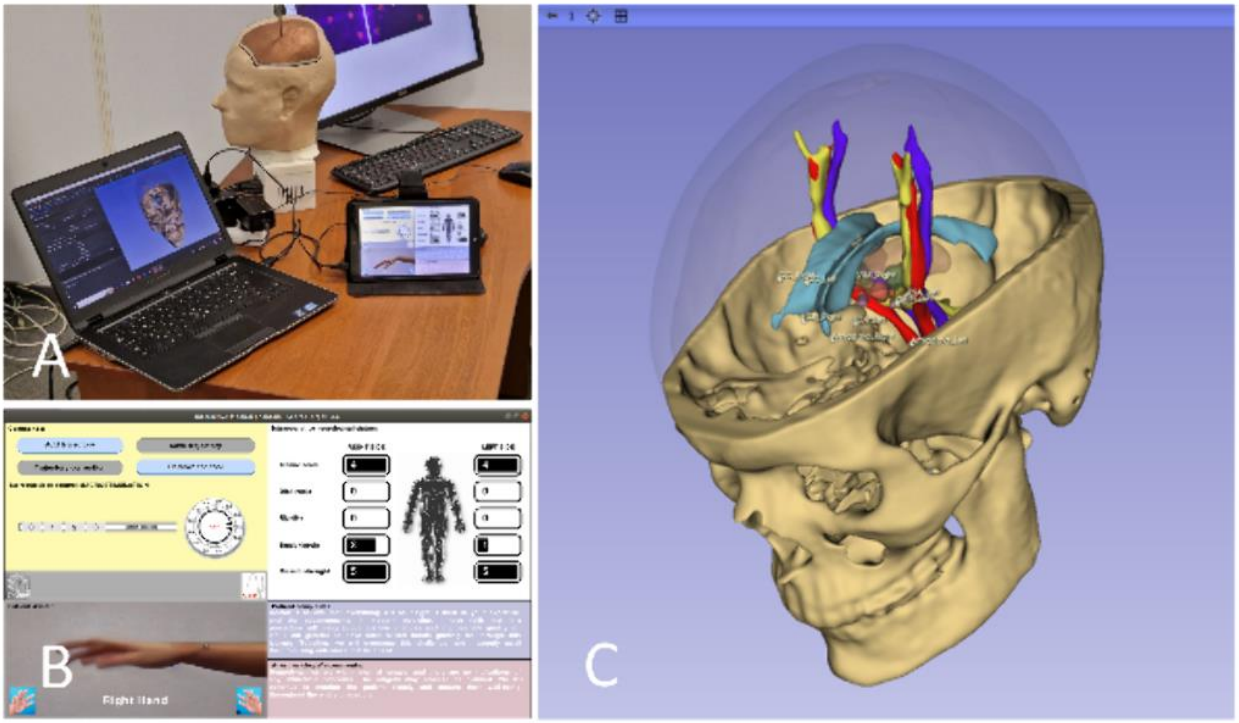

Figure 1. Interactive medical phantom for practicing functional stereotactic interventions. A - main components of the training system; B - an interface to the examiner where real-time information about the virtual patient's condition is displayed; C - virtual brain space with stereotactic targets, functional areas (nuclei, tracts, vessels, brain ventricles) and position of the stereotactic instrument.

Results: A protocol for modification of stereotactic tomography has been implemented, which allows "anthropomorphization" of the phantom tomography. Thus, the surgeon obtains a tomography with the real neuroanatomy of the human head from the clinical task. The modified tomography is further used for surgical planning. The system of non-contact positioning assessment is actually neuronavigation in miniature and provides the possibility to assess the position of the stereotactic instrument in the intracranial space of the phantom and the corresponding space of human brain tomography. The decision-making unit is a system for evaluating the clinical effect of stereotactic treatment on the anatomical structures of the brain in real time. For each of the standard stereotactic brain targets the effects of influence were realized, for example, the dependence of the tremor level in the virtual patient on the position of the stereotactic instrument in relation to the ventral intermediate nucleus of the thalamus. All changes in the clinical status of the virtual patient are reflected in real time on the phantom control interface - the examiner's interface.

Conclusions: Given the capabilities of the phantom, the device can be further used in accreditation centers of neurosurgery.

Keywords: TRAINING SYSTEM, STEREOTACTIC PHANTOM, INTERACTIVE EDUCATION

EP202 / #352

Topic: *AS11. Basic Science or Technology Development*

YEB ATLAS 2024: A THREE-DIMENSIONAL HISTOLOGICAL AND DEFORMABLE ATLAS OF THE BASAL GANGLIA PROVIDED AS A DOCKER, A SAAS AND A 3D SLICER EXTENSION

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Introduction: The YeB Atlas (1) is a three-dimensional deformable atlas of the basal ganglia, built from MR imaging and histological stainings of a post-mortem specimen. Motivation came from the Deep Brain Stimulation (DBS) field, where accurate localization of sub-cortical targets is required . We also designed a deformation strategy that allows the atlas to be adapted to any brain by MR registration between atlas and patient's MRI. Even if the YeB atlas has been developed for DBS, it offers a unique representation of the basal ganglia, including functional sub-territories (limbic, associative and sensorimotor), that can be of interest for many applications. We have used the YeB atlas locally in numerous research studies (2), as well as weekly for every patient undergoing DBS, which has also enabled us to validate it. In recent years, we have been working to make the atlas available to the neuroscience community.

Methods: In the latest version of the YeB atlas, we have increased the intial MRI resolution and added a YeB MNI template (by carefully adapting the YeB atlas to the MNI template). We first packaged the YeB atlas and its dependencies into a Docker container. We also developed the Yeb Atlas Web, a Django SaaS (Software as a Service) that serves the Docker version of the YeB atlas. This SaaS allows all interested users to load MR images (NIFTI format) of their patients and obtain in just a few minutes binary masks (labelmaps) and 3D meshes of the YeB basal ganglia adapted to their patients. Finally, we have also developed a Slicer extension that lets you connect to Docker and use the YeB atlas directly from 3D Slicer.

Results: The Docker is available under resquest : https://registry.gitlab.com/icm-institute/stim/atlasyeb/. The YeB Atlas Web SaaS can be found here: https://yeb-cenir.icm-institute.org/yebatlas. The 3D Slicer extension is avalaible under resquest: https://gitlab.com/icm-institute/STIM/3DSlicerAtlasYEBConnect These tools are meant to be used solely for research purposes.

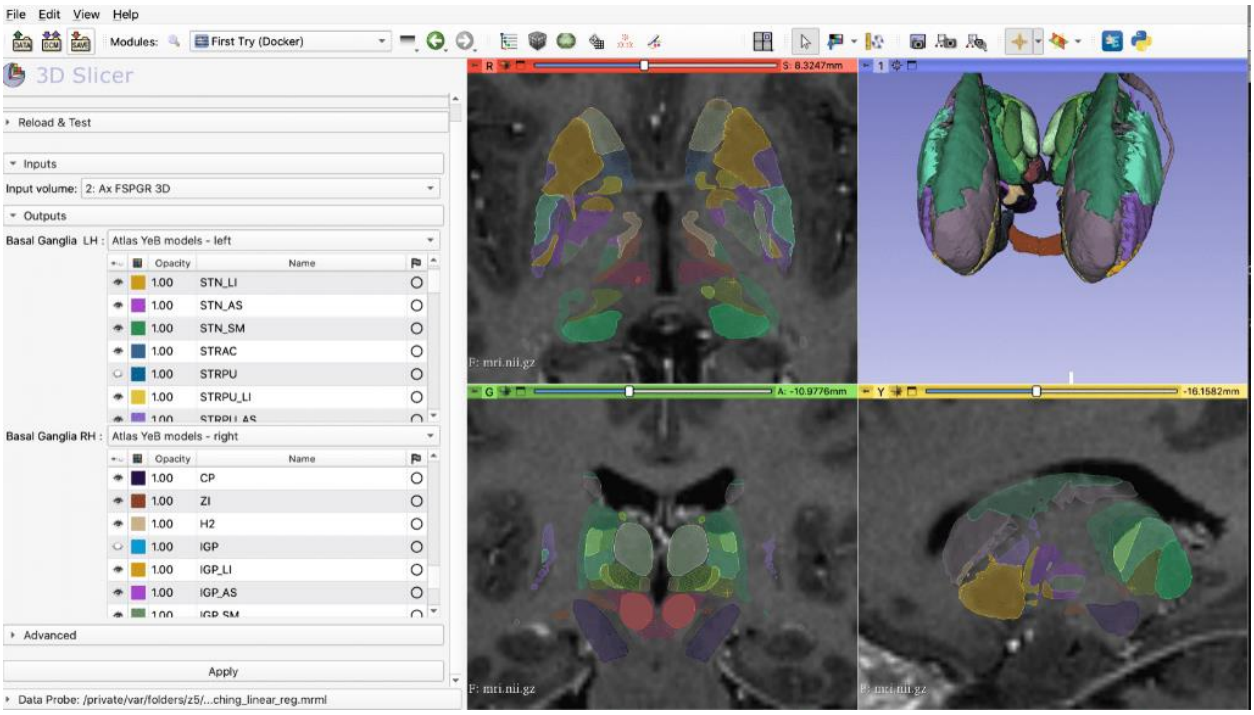

Fig 1: 3D Slicer extension

Conclusions: These developments hopefully will democratize the YeB atlas usage, offering accessible solutions for neuroscientists. References (1) Bardinet et al., J Neurosurg. 2009 Feb;110(2):208-19 (2) Welter et al., Neurology 2014 Apr 15;82(15):1352-61

Keywords: Atlas, Neuroimaging, stereotaxy

EP203 / #202

Topic: *AS11. Basic Science or Technology Development*

DIRECTIONAL ELECTRODES INDICATE SUPERIOR EFFICACY IN POSTERIOR GPI STIMULATION COMPARED TO WHOLE RING STIMULATION IN PARKINSON'S DISEASE

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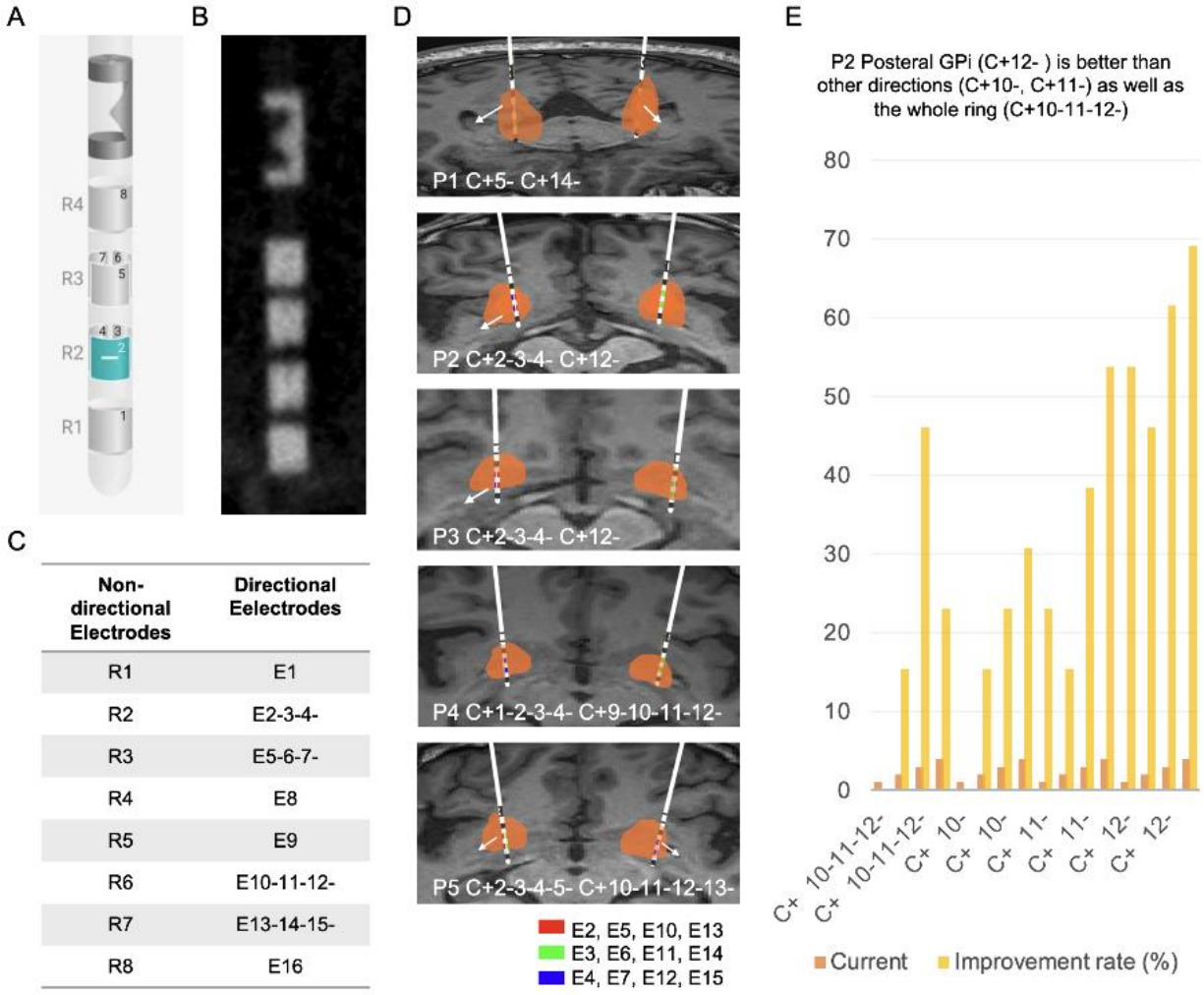
Introduction: The globus pallidus internus (GPi) is a commonly targeted nucleus for Parkinson's disease (PD) treatment due to its larger volume and fewer side effects compared to the subthalamic nucleus (STN). Directional electrodes, widely used in STN, have been reported to reduce stimulation side effects. However, their application in GPi is less common, and it is unknown whether directional electrodes are superior to traditional non-directional electrodes in GPi deep brain stimulation (DBS).

Methods: In a clinical trial validating the safety and efficacy of domestically produced directional electrodes in GPi DBS, we implanted directional electrodes from PINS company in 5 PD patients. During activation, we conducted therapeutic window tests for all contacts at 1-4mA and performed motor assessments using a computer vision-based Unified Parkinson's Disease Rating Scale (UPDRS) assessment tool (MoDAS software, Nervtex, China), without knowledge of the specific orientation of the directional electrodes. The programming physician selected the optimal contacts and therapeutic parameters based on clinical efficacy. Parameter adjustments and motor assessments were conducted at 3 and 6 months postoperatively.

Results: At the 6-month follow-up, 5 out of 10 hemispheres chose directional electrode stimulation, while the remaining 5 continued with ring stimulation. The selected directional electrode contacts were found to be oriented towards the posterior GPi. Surprisingly, the therapeutic window tests during activation revealed that the improvement rate of some directional electrode contacts was significantly higher than that of other directions, even surpassing whole ring stimulation, with fewer side effects.

Conclusions:



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Non-directional Electrodes	Directional Eelectrodes
R1	E1
R2	E2-3-4-
R3	E5-6-7-
R4	E8
R5	E9
R6	E10-11-12-
R7	E13-14-15-
R8	E16

The application of directional electrodes in the GPi is safe and effective, with stimulation of the posterior GPi being the most efficient, even surpassing whole ring stimulation, and with fewer side effects. This suggests that directional electrodes have great potential for application in the GPi.

Keywords: Directional Electrodes, globus pallidus internus, Parkinson's disease

EP204 / #118

Topic: *AS11. Basic Science or Technology Development*

VIABILITY OF NEURO MODULATION IN LOW MIDDLE INCOME COUNTRY.

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Introduction: Evolution of Neuro modulation has had a significant impact in the treatment of movement disorder. Despite its significant achievement, the access to Neuro modulation therapy still remains limited due to high cost, infrastructure and limitation of trained specialist, specially in developing nations. Annapurna Neurological institute and allied sciences started Neuro modulation in 2014 with an aim to provide treatment to local population. The major obstacles for delivering this service was the cost of implant and technology used in this surgery. To overcome this challenge we had to find alternative, which was radio-frequency ablation.

Methods: 151 cases of movement disorder operated at ANIAS from 2014-2024 were included in this study. The patients undergoing DBS as well as radio frequency ablation were included. From 2014-2016 “Komai” stereotactic frame was used, gradually ZD frame from “INOMED” is being used in this surgery. For the patient undergoing DBS implants Abbott and SCENERAY are used while for radio-frequency ablation “COSMAN” radio-frequency generator is used.

Results: Since the begining, our aim has been to provide better service to patient in lower cost. The annual average income of Nepalese population is around $7000. While the cost for a DBS is around $15,000. Due to high cost of DBS, all the patient with movement disorder cannot afford this technology. However lesioning proved more cost effective with average surgical charge of about $2000. With 1/10th the price of DBS, similar results in treatment were obtained through lesioning.Indicating the outcome of lesioning and DBS to be similar, however cost wise there was tremendous gap.

Conclusions: Though DBS is claimed have better result in movement disorder, our study concluded that similar outcome can be achieved in selected cases with low cost technology like lesioning in patients with movement disorder. While the world is moving to laser surgery and MRgFUS, moving back to radio-frequency ablation can help patients to recover from their disease with expenses and have better quality of life.

Keywords: Viability, Neuro Modulation, LMIC

EP205 / #358

Topic: *AS11. Basic Science or Technology Development*

MAYO CLINIC NEURAL ENGINEERING AND PRECISION SURGERY (NEPS) LABORATORY: MULTIDISCIPLINARY COLLABORATIONS FOR THE ADVANCEMENT OF STEREOTACTIC AND FUNCTIONAL NEUROSURGERY

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Introduction: The Mayo Clinic Neural Engineering Laboratory (NEL) was established in 2007. In 2024, the NEL was renamed the Neural Engineering and Precision Surgery (NEPS) Laboratory to reflect its multidisciplinary collaborations with the Mayo Clinic Division of Engineering, the Anatomic Modeling Unit, and the Departments of Neurosurgery, Radiology, Plastic Surgery, Psychiatry, and Neurology. Technologic advancements are paramount to functional neurosurgery; herein, we review the history and current state of NEPS' innovations through the lens of its multidisciplinary infrastructure.

Methods: NEL originally was established to advance knowledge and technology by elucidating the mechanisms of deep brain stimulation (DBS) and to contribute to the next generation of neuromodulation devices. NEPS' current methodology seeks to develop closed-loop DBS systems using electrochemistry and to engineer state-of-the-art stereotactic image-guidance systems. To accomplish these goals, a multidisciplinary team of experts in engineering, radiology, psychiatry, plastic surgery, and neurosurgery was formed.

Results: Efforts in the development of stereotactic image-guidance systems resulted first in a swine head frame (2008), then a non-human primate head frame (2016), and now an FDA-cleared human frame-based stereotactic system that has been utilized in over 100 patients for applications such as DBS surgery, brain biopsy, and ventriculoperitoneal shunt implantation. With plastic and maxillofacial surgery, NEPS currently is developing a maxillary-based fiducial system for next-generation image-guidance. Efforts in elucidating the mechanism of action of DBS yielded the Wireless Instantaneous Neurotransmitter Concentration System (WINCS) (2009), Mayo Investigational Neuromodulation Control System (MINCS) (2013), and human electrochemical recordings during DBS surgery for essential tremor (2012). In 2024, NEPS introduced the WINCS Multiplatform Apparatus for Voltammetry, Electrophysiology, and Neuromodulation (MAVEN), a device that enables real-time, in vivo electrochemical recordings of basal neurotransmitter concentrations with concurrent neurostimulation. MAVEN has been used to investigate neuromodulation mechanisms for psychiatric disorders, including Tourette syndrome, depression, and drug addiction.

Conclusions: Over two decades, NEPS Laboratory has forged multidisciplinary collaborations aimed at elucidating the mechanisms of DBS, engineering novel technologies, and advancing stereotactic and functional neurosurgery. Multidisciplinary collaborations will remain crucial to the fields of neuromodulation and stereotactic image guidance. Future efforts by NEPS will continue to address human neurologic and psychiatric disorders.

Keywords: voltammetry, Neuroengineering, Neuromodulation

EP206 / #188

Topic: *AS11. Basic Science or Technology Development*

SPINAL CORD STIMULATION REDUCES SERUM LEVEL IL-2.

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Introduction: Spinal cord stimulation (SCS) exhibits immunomodulatory and endocrine effects. It has variable effects on interleukins, indicating a reduction in IL-6 and IL-1β and an increase in IL-10 levels. SCS can reduce VEGF levels and elevated expression of neurotrophic factors such as BDNF and GDNF, particularly under burst stimulation. SCS modulates neuroinflammation processes. The assessment of inflammatory cytokine profiles, including IL-1β, IL-6, IFN-γ, TNF-α, IL-10, and TGF-β, presents conflicting findings. The aim of our study was to examine these effects in patients during trial spinal cord stimulation period.

Methods: Serum levels of Il-6, TNF-alfa, INF -gamma, Il-2, BDNF were measured in patients with chronic pain (PSPS/CRPS) who received SCS with electrode lead implanted in percutaneous way before the implantation and after minimum 2 weeks of trial period .

Results: Statistically significant reduction of Il-2 after 2 weeks of trial SCS was demonstrated, no significant changes were observed in other parameters.

Conclusions: SCS has impact on inflammatory process expressed by reduction of Il-2 which is a pro-inflammatory cytokine and induces T lymphocyte proliferation. Supply of a negative charge with the use of SCS can hamper an inflammatory process and activation of T lymphocytes.

Keyword: spinał cord stimulation, interleukin-2, chronić pain

EP207 / #208

Topic: *AS11. Basic Science or Technology Development*

IN-HOUSE INTRAOPERATIVE MONITORING IN NEUROSURGERY IN ENGLAND – BENEFITS AND CHALLENGES

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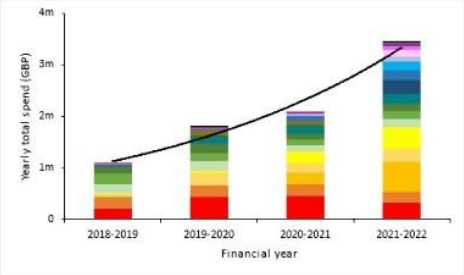
Introduction: Intraoperative neurophysiological monitoring (IOM) is a valuable adjunct for neurosurgical operative techniques, and has been shown to improve clinical outcomes in cranial and spinal surgery. It aids surgical decision-making, planning, and technique, and leads to fewer patient complications and shorter length of stay. Demand has risen and it is not necessarily provided by NHS departments so is outsourced to private companies, at cost to the hospital. The training pathways in intraoperative monitoring are currently undefined. We discuss the benefits and challenges of developing an in-house service.

Methods: We surveyed NHS neurosurgical departments across England regarding expenditure on IOM between January 2018 – December 2022 on cranial neurosurgery and spinal surgery. All 24 units responded to our Freedom of Information requests and 21 provided data. Information on the NHS tariffs and salary costs were compiled for comparison. One unit which provides in-house neuromonitoring provided detailed accounts of the costs per case for cranial, spinal, and brainstem cases.

Results: The total spend on outsourced IOM, across the units who responded, totalled over £8 million for the four years. The annual total increased, between 2018 and 2022, from £1.1 to £3.5 million. The highest single unit yearly spend was £568,462, aside from salaries for staff in neurophysiology or medical physics departments. The costs of in-house monitoring ranges from £1500 to £2000 for spinal and cranial cases



Conclusions: IOM is valuable in surgical decision-making, planning, and technique, having been shown to lead to fewer patient complications and shorter length of stay. Current demand for IOM outstrips the internal NHS provision in many trusts across England, leading to outsourcing to private companies. This is at significant cost. Although there is a learning curve, there are many benefits to in-house provision,

such as stable working relationships, consistent methods, training of the future IOM workforce, and reduced long-term costs, which planned expansion of services may provide. This financial assessment of current practice supports proposition of local, national, and international business cases for expansion and development of in-house IOM services.

Keywords: intraoperative neuromonitoring, economic, financial

EP208 / #281

Topic: *AS11. Basic Science or Technology Development*

ON THE WAY TO VTA-BASED GROUP ANALYSIS: THE CHALLENGE OF PARAMETER SELECTION

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Introduction: With the availability of more user-friendly tools, group analysis has gained importance for the investigation of the optimal Deep Brain Stimulation (DBS) sites, the so-called sweet spots. The objective of the present work is to highlight the different steps necessary to generate such probabilistic stimulation maps (PSM) and to make the users aware of the multitude of parameters to choose.

Methods: Group analysis can be divided into three main steps: 1) simulation of volumes of tissue activated (VTA) on a patient level for specific stimulation parameters and induction of corresponding therapeutic or adverse effect, 2) projection of this data into a common template space after image registration and 3) statistical analysis and visualization of the group data in form of PSMs. Based on the approaches presented in the literature, we describe the different parameter choices that must be made.

Results: Parameters influencing VTA simulations are e.g. tissue conductivity model (homogenous/heterogenous, isotropic/anisotropic), tissue types (grey, white matter, CSF, blood) and type of image or atlas data used for tissue classification. Data can be projected on generic templates e.g. the Montreal Neurological Institute or on cohort specific templates. The quality of these templates is influenced by the type of registration (linear/ non-linear), the registration settings (e.g. number of iterations), the image data available and used for the generation and the cohort of subjects (healthy/diseased, condition and age-matched). Once all VTAs and the corresponding improvements are projected in template space, clusters can be identified on PSMs using statistical methods such as t-test and Wilcoxon test. Resulting clusters depend on the chosen method and on the available patient data (chronic setting, screening data, intraoperative data). The description of the anatomical position of these clusters depends on the available additional anatomical information such as fiber tracts, manually outlined structures or anatomical atlases.

Conclusions: The present work provides an overview of the many parameters influencing group analysis, which should be carefully selected rather than using default settings and workflows. More studies are necessary to evaluate the impact of each of these parameters. Acknowledgements: This work was supported financially by the Swiss National Science Foundation (205320_207491).

Keywords: group analysis, Volume of tissue activated, Deep Brain Stimulation

EP209 / #112

Topic: *AS11. Basic Science or Technology Development*

INTRACRANIAL RECORDINGS OF COGNITIVE CONTROL DURING CONFLICT TRIALS AND ITS PROGRESS TOWARDS BRAIN MAPPING: A SYSTEMATIC REVIEW

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Introduction: Response inhibition allows regulatory loci of the brain to mediate action responses through the motor cortex while performing tasks that require abrupt stopping. This has been extensively studied in the cortical areas involved with cognitive control, but the subcortical regulatory regions are not as well investigated due to the invasive nature of the recording. Intracranial recordings, such as stereo-electroencephalogram (SEEG) and electrocorticograms (ECoG) allow for investigate of the subcortical areas, and also provide greater temporal acuity than other techniques.

Methods: This systematic literature review followed the preferred reporting items for systematic reviews and meta-analyses guidelines (PRISMA). There were 372 articles extracted from PubMed into Covidence. There were 193 duplicates removed, and 89 irrelevant manuscripts found during abstract screening. This left 39 full-text screenings, of which 13 were removed due to no intracranial recording data, leaving 28 manuscripts to extract data from.

Results: We summarize response inhibition using tasks of inhibitory control, such as the stop-signal task, Go/ No-Go task, Stroop task, and Flanker Test. Mediation of response inhibition by the subthalamic nucleus on the thalamic network and inferior frontal gyrus on the presupplemental motor and motor cortex was supported by multiple studies. There were also reports of sex and age differences in response inhibition, such that the ability of impulse control increases with age in adolescence yet began to decrease with age in elderly populations. Females exhibited a higher rate of inhibitory processing speed as well as a decrease in error commission.

Conclusions: This review is the first of its kind to summarize all known intracranial recordings documenting data for response inhibition following the PRISMA guidelines for systematic reviews. With only 28 manuscripts to include for the study after screening, as well as the problem of heterogenous and aggregate data reporting, a meta-analysis was not feasible. A review of all current intracranial findings still assists in brain mapping by providing higher resolution temporal data of the neuronal networks involved in response inhibition. Complete mapping of the neuronal networks involved in response inhibition will require multi-centered prospective registries centered around brain mapping in DBS patients in order to provide adequate amounts of statistically significant data.

Keywords: Intracranial Recording, Response Inhibition, Deep Brain Stimulation

EP210 / #391

Topic: *AS11. Basic Science or Technology Development*

EXTERNAL VENTRICULAR DRAINAGE SIMULATION IN VIRTUAL REALITY FOR JUNIOR NEUROSURGICAL RESIDENTS

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Introduction: Even though extraventricular drainage (EVD) is a fundamental neurosurgical procedure, surgical skills have been acquired through a trial-and-error approach on patients, often resulting in significant safety concerns. Cadaver training aids in mastering the burr hole trephination technique but falls short of guaranteeing accurate EVD catheter insertion. Hence, there's a demand for a novel and secure education environment where trainees can grasp the EVD surgical process, practice precise catheter insertion techniques, and verify catheter tip placement to evaluate the efficacy of their methods.

Methods: A virtual reality (VR) EVD training program was developed using Unity development engine based on preoperative brain CT and MR DICOM data from 10 patients. The VR contents guide the procedure by presenting the shadow instrument for each procedure step. Furthermore, it offers suitable mediolateral and anteroposterior trajectories for catheter insertion while providing a see-through view of the ventricle. A total of 10 interns and neurosurgery junior residents were prospectively recruited. They underwent VR educational sessions about the EVD procedure and participated in three VR EVD surgery tests. The evaluation included assessing the position of the EVD tip, surgical time, and post-trial user satisfaction.

Results: Three interns and seven junior residents participated in the study, with only two having prior EVD experience. None of the participants had used VR devices before. All participants achieved successful ventricle puncture in three consecutive trials. The catheter tip was located in the ipsilateral foramen of Monro in 50% of trials, the ipsilateral lateral ventricle body in 36.7%, the third ventricle in 10%, and the contralateral ventricle in 3.3%. Over successive tests, there was a notable decrease in surgical time ($p = 0.001$). The post-trial survey highlighted that the aspect indicating improved familiarity with the EVD procedure and awareness of critical surgical points received the highest rating. Few complaints of dizziness were recorded in the post-test survey. Areas for improvement included enhancing haptic feedback, increasing surgical maneuverability, and addressing image quality issues.

Conclusions: The EVD VR program was a helpful training tool for junior residents with limited EVD experience to master the EVD procedure.

Keywords: Virtual reality, Resident education, Extraventricular drainage