

Peak alpha frequency as a neural marker of postoperative pain outcomes in spinal fusion surgery [Abstract]

Amelie Grandjean, Fares Komboz, Tatiana Chacon, Lukas Weiser, Wolfgang Lehmann, Angelina Nazarenus, Dorothee Mielke, Veit Rohde, Ali Mazaheri, Tammam Abboud

Angaben zur Veröffentlichung / Publication details:

Grandjean, Amelie, Fares Komboz, Tatiana Chacon, Lukas Weiser, Wolfgang Lehmann, Angelina Nazarenus, Dorothee Mielke, Veit Rohde, Ali Mazaheri, and Tammam Abboud. 2026. "Peak alpha frequency as a neural marker of postoperative pain outcomes in spinal fusion surgery [Abstract]." *Brain and Spine* 6 (Supplement 2): 107084. <https://doi.org/10.1016/j.bas.2026.107084>.

Nutzungsbedingungen / Terms of use:

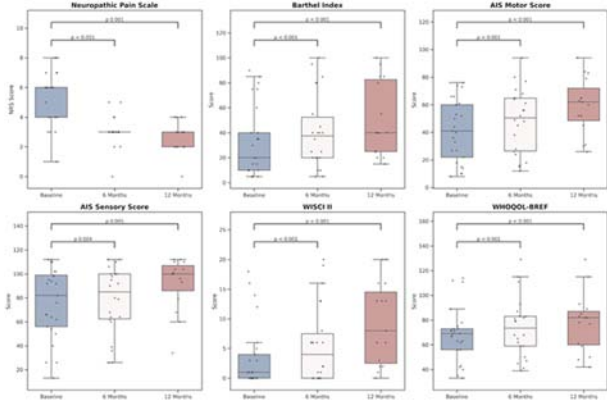
CC BY-NC-ND 4.0



dependent effect across all measures. Notably, prognostic factor analysis revealed that older age was associated with higher motor scores ($\beta=0.38$, $p=0.049$), while a higher BMI correlated with better functional independence ($\beta=2.09$, $p=0.027$).

Conclusions: ESCS is associated with significant and sustained improvements in motor function, sensory function, pain management, and quality of life in patients with chronic SCI. Our findings support the efficacy of ESCS as a restorative intervention that facilitates long-term functional gains. Future studies should investigate patient-specific factors to further optimize stimulation protocols.

Optional Image



<https://doi.org/10.1016/j.bas.2026.107082>

106
Session 129: Treating pain and restoring function, October 4, 2026, 9:30 AM - 10:30 AM
Brain and Spine 6 (2026) 107083
Trigeminal Ganglion Stimulation Modulates Pathological Thalamo-Somatosensory Connectivity in Trigeminal Neuralgia: A Longitudinal fMRI Study

Chenglong Cao^{1,2}, Ashwini Oswal², Hao Chen³, Xiaofeng Jiang¹, Ying Wang¹
¹The First Affiliated Hospital Of Ustc, Division Of Life Sciences And Medicine, University Of Science And Technology Of C, Hefei, China; ²MRC Brain Networks Dynamics Unit, University of Oxford, Oxford, United Kingdom; ³Department of Radiology, The First Affiliated Hospital of USTC, Division of Life Sciences and Medicine, University of Science and Technology of China, Hefei, China

Trigeminal neuralgia (TN) is a debilitating neuropathic pain disorder. While first-line pharmacotherapy often suffers from tolerance and side effects, invasive interventions such as Microvascular Decompression (MVD) — though potentially curative — carry significant procedural risks and do not apply to all TN subtypes. Consequently, there is a pressing need for practical, minimally invasive therapeutic alternatives with clearly elucidated central mechanisms. Trigeminal Ganglion Stimulation (TGS) has emerged as a promising neuromodulatory approach, yet its impact on key thalamocortical pain-processing circuits remains poorly characterised.

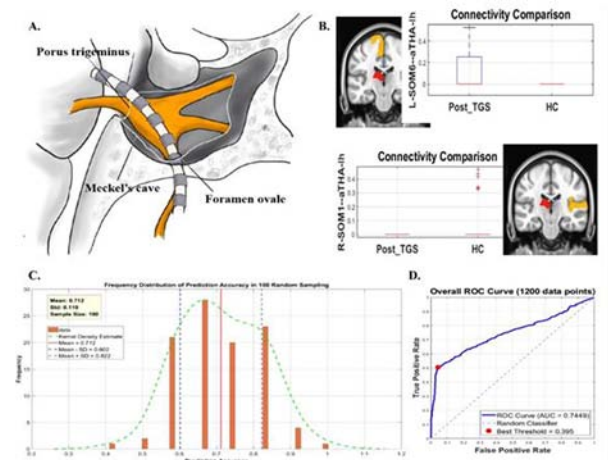
Methods: We conducted a longitudinal fMRI study in 29 TN patients and 30 healthy controls (HCs). Resting-state fMRI was acquired before and after TGS. Seed-based functional connectivity (FC) analysis was performed between thalamic and somatosensory regions. An SVM classifier was trained on significant FC features to distinguish pre- and post-TGS states across 100 iterations.

Results: Patients showed significant pain reduction post-TGS (BNI scores improved from V to I, $p<0.001$). Pre-TGS, TN patients exhibited elevated thalamo-somatosensory FC compared to HCs. TGS significantly reduced this pathological hyperconnectivity. Notably, post-TGS FC changes were region-specific: connectivity between left somatosensory cortex and left anterior thalamus remained elevated above HCs, while right somatosensory-left thalamus connectivity was suppressed below HC levels. The SVM classifier reliably distinguished pre- from post-TGS states (mean accuracy: 71.2%; precision: 92.7%; AUC: 0.74).

Conclusions: TGS modulates thalamo-somatosensory connectivity through a bidirectional, region-dependent mechanism, partially normalising pathological circuits while inducing compensatory inhibitory adjustments. These FC signatures, validated using machine learning, highlight the thalamosomatosensory

circuit as a central therapeutic target and support the development of neuroimaging biomarkers for personalised neuromodulation in TN.

Optional Image



A. The trigeminal ganglion lead is positioned in Meckel's cave. It enters Meckel's cave via the foramen ovale and exits through the porus trigeminus. The lead functions to activate the trigeminal ganglion. B. TGS reduces pathological thalamo-somatosensory hyperconnectivity in a region-specific manner. C. Bar chart summarising key classification metrics (accuracy, precision, recall, F1-score) from 100 training-test iterations. D. ROC curves displaying both the average AUC from individual tests and the overall AUC from all pooled predictions, with the optimal decision threshold indicated.

<https://doi.org/10.1016/j.bas.2026.107083>

1463
Session 129: Treating pain and restoring function, October 4, 2026, 9:30 AM - 10:30 AM
Brain and Spine 6 (2026) 107084
Peak Alpha Frequency as a Neural Marker of Postoperative Pain Outcomes in Spinal Fusion Surgery

Amelie Grandjean¹, Fares Komboz², Tatiana Chacon², Lukas Weiser³, Wolfgang Lehmann³, Angelina Nazarenus², Dorothee Mielke^{2,4}, Veit Rohde², Ali Mazaheri¹, Tammam Abboud²
¹School of Psychology, Centre for Human Brain Health, University of Birmingham, Birmingham, United Kingdom; ²Department of Neurosurgery, Universitätsmedizin Göttingen, Göttingen, Germany; ³Department of Orthopedics and Plastic Surgery, Universitätsmedizin Göttingen, Göttingen, Germany; ⁴Department of Neurosurgery, University Hospital Augsburg, Augsburg, Germany

Despite advances in imaging and surgical techniques, structural indicators used to guide spinal fusion surgery often show a limited relationship with postoperative pain outcomes, and many patients do not experience meaningful pain reduction. This mismatch highlights the need for objective neurophysiological measures. Peak alpha frequency (PAF), defined as the dominant frequency within the alpha band, has been proposed as a trait-like neural characteristic linked to pain-related processes. However, its relevance for postoperative pain outcomes beyond early recovery remains unclear. This study investigated whether preoperative PAF is associated with longer-term postoperative pain reduction following spinal fusion surgery.

Methods: Seventeen adults undergoing cervical or lumbar fusion surgery were included. Resting-state, eyes-closed EEG was recorded preoperatively and at multiple postoperative visits. PAF was extracted from central electrodes using the centre-of-mass method. Pain intensity was assessed longitudinally using the visual analogue scale (VAS), numerical rating scale (NRS), verbal rating scale (VRS), and the Brief Pain Inventory (BPI). Receiver operating characteristic (ROC) analyses evaluated the ability of preoperative PAF to discriminate treatment responders, defined as a $\geq 50\%$ reduction in pain.

Results: Preoperative PAF was not associated with early postoperative pain change, but higher preoperative PAF was associated with greater pain reduction by 3 months. Consistent effects were observed across VAS, NRS, VRS, and BPI Worst Pain subscale. Associations reached statistical significance for VRS (Spearman $\rho = 0.56$, $p = 0.048$) and BPI-Worst (Spearman $\rho = 0.54$, $p = 0.038$). VAS and NRS showed moderate-to-strong effects that approached significance

with non-parametric analyses and were significant for VAS when treated as an approximately interval measure (Pearson $r = 0.63$, $p = 0.022$). ROC analyses indicated modest discrimination of pain responders by preoperative PAF.

Conclusions: These findings suggest that preoperative PAF may represent a trait-like neural marker associated with longer-term postoperative pain outcomes following spinal surgery. As an EEG-derived measure, PAF is non-invasive and easily acquired, and may complement existing clinical and imaging-based predictors of pain. Further validation in larger cohorts is warranted.

<https://doi.org/10.1016/j.bas.2026.107084>

121

Session 130: Diverse abstracts session, October 4, 2026, 9:30 AM - 10:30 AM

Brain and Spine 6 (2026) 107085

Location-specific cognitive profiles and quality of life in newly diagnosed glioma

Maximilian Schwendner¹, Leonie Kram¹, Sandro M. Krieg¹, Sebastian Ille¹

¹ Heidelberg University Hospital, Germany

Cognitive dysfunction in glioma patients is frequently underrecognized in routine practice, where evaluation often focuses on overt neurological deficits. This study systematically assessed preoperative patient reported quality of life and domain specific cognitive performance in relation to tumor location in newly diagnosed glioma.

Methods: Between January 2024 and May 2025, 115 patients with newly diagnosed glioma underwent structured preoperative assessment including standardized quality of life questionnaires and comprehensive domain specific neuropsychological testing.

Results: On the group level, impaired performance defined as z-scores exceeding 1.65 standard deviations was most pronounced in patients with parietal lesions ($n=15$, 13.0%). Impairments affected 7 of 10 cognitive subtests encompassing processing speed, attention and executive function, visuospatial performance, and fine motor coordination. The most severe deficits across all tumor locations were observed in parietal glioma for Trail Making Test Part A (6.23 ± 6.58), Bells Test time (2.16 ± 1.50), Bells Test accuracy coefficient (-2.60 ± 2.39), Bells Test asymmetry score (1.67 ± 2.39), and Nine Hole Peg Test (4.67 ± 3.49).

No group level cognitive impairments were observed in patients with temporoparietal lesions ($n=7$, 6.1%).

Patient reported quality of life demonstrated a location dependent pattern, with lowest global health status reported in parietal (35.6 ± 19.0) and frontotemporal lesions (36.1 ± 4.8), and highest in frontoparietal (62.5 ± 31.5) and frontoparietal lesions (60.2 ± 13.7).

Self reported cognitive functioning was lowest in frontoparietal (37.5 ± 34.4) and frontotemporal lesions (38.9 ± 25.5), and highest in frontoparietal (75.0 ± 50.0) and frontoparietal lesions (68.5 ± 24.2).

Conclusions: Glioma location is associated with distinct preoperative cognitive and quality of life profiles. Parietal lesions exhibit the greatest cognitive impairment and the lowest global health scores. These findings support a location informed, function oriented framework of eloquence to identify patients with substantial disease burden already prior to glioma treatment.

<https://doi.org/10.1016/j.bas.2026.107085>

264

Session 130: Diverse abstracts session, October 4, 2026, 9:30 AM - 10:30 AM

Brain and Spine 6 (2026) 107086

Cognitive Reserve as a Stable Determinant of Perioperative Cognitive Performance in Patients with Intracranial Tumors

Kirsten Heckmann¹, Matthias Simon¹, Tunc Faik Ersoy¹

¹ University Hospital OWL, Evangelisches Klinikum Bethel, Bielefeld, Germany

Cognitive deficits are common in patients with intracranial tumors. Cognitive reserve (CR), reflecting lifelong cognitive enrichment, has been proposed as a resilience factor for brain injury and may explain interindividual variability. While previous studies suggest that higher CR is associated with better cognitive performance before surgery, its role in shaping perioperative cognitive trajectories remains unclear.

Methods: 80 prospectively enrolled patients with supratentorial tumors (48

intraaxial, 32 extraaxial; mean age = 53.2 ± 14.6 years; mean KPS = 93.5 ± 11.0) underwent neuropsychological assessment of attention, memory, and executive functions preoperatively, one week postoperatively, and at three months. CR was quantified using the Cognitive Reserve Index Questionnaire. Repeated-measures ANCOVAs examined associations between CR and cognitive performance over time, controlling for age, functional status, tumor volume, hemispheric lateralization, tumor type (intra- vs. extraaxial), and preoperative seizures.

Results: Across all domains, but foremost in memory (mean 1.2 SD below normative data), we observed a significant cognitive decline one week after surgery, followed by recovery to baseline at three months (all $p < .001$). After adjusting for clinical parameters, CR emerged as the strongest predictor of cognitive performance across all domains (partial $\eta^2 = .25-.28$; all $p < .001$). Age, tumor volume and KPS were also robust predictors, whereas lateralization and intraaxial location showed only domain-specific effects. Preoperative seizures were not associated with cognitive performance. No CR x Time interactions were identified, indicating a stable performance advantage in patients with higher CR across all assessments.

Conclusions: CR represents a robust and stable determinant of cognitive functioning in neuro-oncological patients, extending beyond the preoperative phase into the postoperative course. Patients with higher CR consistently perform better, yet they also experience transient postoperative decline. Given substantial interindividual variability, perioperative neuropsychological assessment remains essential for individualized patient care.

<https://doi.org/10.1016/j.bas.2026.107086>

646

Session 130: Diverse abstracts session, October 4, 2026, 9:30 AM - 10:30 AM

Brain and Spine 6 (2026) 107087

TTFields Disrupt Prothrombotic Signaling In Glioblastoma Cells And Blood

Thomas Freitag¹, Claudia Maletzki¹, Adrian Hempelmann¹, Annabell Wolff¹, Thomas M. Freiman¹, Sae-Yeon Won¹, Dirk Koczan¹, Sina Sender¹, Florian Gessler¹, Daniel Dubinski¹

¹ University Medical Center Rostock, Rostock, Germany

Glioblastoma (GBM) is a highly aggressive and therapy-resistant brain tumor associated with hypercoagulability and microvascular thrombosis. Tumor Treating Fields (TTFields) have demonstrated significant survival benefits. Notably, TTFields-treated patients often exhibit distinct recurrence patterns compared to those receiving standard therapy, suggesting a local interaction between TTFields and tumor biology. As coagulation is closely linked to tumor progression and the inflammatory microenvironment, this study investigated whether TTFields modulate blood coagulation dynamics in the context of GBM. **Methods:** Peripheral blood and patient-derived GBM cells were exposed to TTFields (250 kHz, 1 h/24 h). Coagulation was analyzed using ClotPro® viscoelastometry (EX/FIB-test). Plasma coagulation factors (FII, FVIII, FXIII, fibrinogen) were quantified. Extracellular vesicles (EVs) were assessed for size, concentration, and tissue factor (TF) content. Transcriptomic profiling was performed on TTFields-treated GBM cell lines. Additionally, an allogeneic tumor-blood co-culture model was used to study combined effects.

Results: TTFields significantly prolonged coagulation time in both healthy donor and GBM patient blood. Clot firmness was reduced in both groups, with decreased platelet contribution to clot stability observed in GBM patients. TTFields lowered prothrombotic activity of EVs specifically in GBM patients, reflected by reduced TF content and prolonged clotting time. In tumor cells, TF abundance increased via phosphatidylserine-mediated surface translocation. Transcriptomic analysis revealed modulation of coagulation-related genes (THBS1↓; TXNIP↓; ITGA2↑).

Conclusions: TTFields modulate coagulation in GBM through interference with the extrinsic pathway, platelet function, and TF. These findings support a dual therapeutic role of TTFields in tumor control and thrombosis mitigation, with implications for optimizing anticoagulation strategies in GBM patients.

<https://doi.org/10.1016/j.bas.2026.107087>