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Resting-state Functional MRI for Functional Neurosurgery: Seeing the Light?

Constantin Tuleasca^{1,2,3,4,5}, MD-PhD, Jean Régis⁶, MD, Elena Najdenovska⁷, PhD, Tatiana Witjas⁸, MD, Nadine Girard⁹, MD, Jean-Philippe Thiran^{2,3,10}, PhD, Meritxell Bach Cuadra^{3,7}, PhD, Marc Levivier^{1,2}, MD, PhD, IFAANS, AND Dimitri Van De Ville^{11,12}, PhD

¹Neurosurgery Service and Gamma Knife Center, Lausanne University Hospital (CHUV), Lausanne, Switzerland

²Université de Lausanne (Unil), Faculté de Biologie et de Médecine (FBM);

³Signal Processing Laboratory (LTS 5), Swiss Federal Institute of Technology (EPFL);

⁴Sorbonne Université, Faculté de Médecine, Paris, France;

⁵Assistance Publique-Hôpitaux de Paris, Hôpitaux Universitaires Paris Sud, Centre Hospitalier Universitaire de Bicêtre, Service de Neurochirurgie, Le Kremlin-Bicêtre, France;

⁶Stereotactic and Functional Neurosurgery Service and Gamma Knife Unit, CHU Timone, Marseille, France;

⁷Medical Image Analysis Laboratory (MIAL) and Department of Radiology-Center of Biomedical Imaging (CIBM), Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland;

⁸Neurology Department, CHU Timone, Marseille, France;

⁹AMU, CRMBM UMR CNRS 7339, Faculté de Médecine and APHM, Hopital Timone, Department of Diagnostic and Interventional Neuroradiology, Marseille;

¹⁰Centre Hospitalier Universitaire Vaudois, Department of Radiology;

¹¹University of Geneva, Faculty of Medicine, Switzerland;

¹²Medical Image Processing Laboratory, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland;

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Corresponding author:

Constantin Tuleasca, MD-PhD, Assistance Publique-Hôpitaux de Paris, Hôpitaux Universitaires Paris Sud, Centre Hospitalier Universitaire de Bicêtre, Service de Neurochirurgie, Le Kremlin-Bicêtre, France- 78, Rue Général Leclerc, 94270, Le Kremlin-Bicêtre, France; Sorbonne Université, Faculté de Médecine, Paris, France; Tel: +41-21-314-26-02; Fax: +41-21-314-11-99; e-mail: constantin.tuleasca@gmail.com;

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Dear Editor,

We read with great interest the recent article by Lehner⁵ et al., discussing the corpus callosotomy performed by laser interstitial thermal therapy (LITT), in a small cohort of 5 patients, in the context of a multimodal approach. The authors additionally used resting-state functional MRI (rs-fMRI) to assess the outcome of this functional neurosurgery intervention. While prior to LITT brain activity showed robust interhemispheric functional connectivity, it was greatly reduced following callosotomy, with intrahemispherical functional connectivity being largely maintained.

Understanding how brain rewiring after functional neurosurgery procedures impacts brain activity is essential for our understanding and for providing future developments in this extraordinary and continuously expanding field. In that context, rs-fMRI is particularly useful given its possibility to map various functional networks simultaneously with minimal patient compliance.

Boerwinkle et al¹ have recently suggested that using rs-fMRI might improve outcomes using MRI-guided stereotactic laser ablation for hypothalamic hamartomas. We have demonstrated before how stereotactic radiosurgical thalamotomy for drug-resistant essential tremor (ET) correlates with changes within large-scale brain networks (Figure 1)⁶⁻¹⁰. Comparison of pre- and post-interventional imaging allowed confirming the role of the ventro-intermediate nucleus target region in the tremor network^{7,8}. Then, more surprisingly, a visually-sensitive structural and functional network was shown to be involved in tremor generation and further arrest after the intervention, thus pointing towards potential new surgical targets for tremor such as the right extrastriate visual cortex^{6,7,9,10}. We specifically coined the term «cerebello-thalamo-visuo-motor network»⁷ to describe these observations². In trigeminal neuralgia, Dou et al³ demonstrated how a specific measure of functional connectivity (e.g., regional homogeneity), would change in specific parts of the brain after percutaneous radiofrequency thermocoagulation. More recently, Fox and colleagues elegantly discussed how relating symptoms with brain connectomics leads to lesion network mapping⁴.

In conclusion, an important expenditure of rs-fMRI is its further application to interventional studies in clinical realm, particularly, in the functional neurosurgery domain. Whether this would allow us to see the light for better understanding of both the pre- and post-therapeutic state remains also to be confirmed by future studies.

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Figure legend:

Figure 1: Upper part, from left to right: artistic representation of Vim SRS-T; structural MRI alterations within Brodmann areas (BA) 19 and further 18 as depicted by structural (voxel-based morphometry) studies by our group; functional resting-state fMRI changes, using different methodologies, such as independent component analysis and seed-to-voxel; Lower part, left- artistic illustration of the eye-hand coordination, necessary for sensory guidance of movements, as a new concept for tremor generation in ET; right- artistic illustration suggesting the extrastriate cortex as a new potential target for drug-resistant ET.