EDITORIAL

Resting-state fMRI for the masses**Daniel A. Orringer, MD**

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FUNCTIONAL MRI (fMRI), based on the detection of the blood oxygenation level–dependent (BOLD) effect, can be used to localize key functional areas by detecting changes in cortical blood flow in response to neural activity. Task-based fMRI, in which regional cortical BOLD changes are observed in response to specific commands, is utilized in modern neurosurgical practice for preoperative localization of language and motor function. However, the accuracy of fMRI for localization has been debated extensively and highly depends on a cooperative patient collaborating with a skilled imaging team to produce reliable results.

Resting-state fMRI (rs-fMRI) utilizes low-frequency BOLD signal fluctuations that occur in a coordinated fashion at rest in linked areas of the brain essential for specific functions, such as attention, visual processing, somato-motor, and language function. Resting-state fMRI often reveals more information about the cortical networks involved in cerebral function than task-based fMRI. In addition rs-fMRI does not require completion or compliance with a given task by the patient since imaging data are collected at rest.

Leuthardt and colleagues at Washington University are among the pioneers in the implementation of rs-fMRI for use in preoperative planning.¹ They currently use rs-fMRI to guide the use of electrophysiological mapping and determine the least morbid surgical approach to a lesion. In their practice, rs-fMRI data eliminate the need for awake direct cortical mapping in some cases. While automated and efficient at their institution, the historically complex, fragile, and labor-intensive workflow for creating rs-fMRI maps that can be used for surgical planning has prevented wide dissemination.

In this issue of the *Journal of Neurosurgery*, Zacà et al.² report the development of a new software tool to simplify the collection and use of rs-fMRI data for use in

neurosurgical planning. The software pipeline they have developed, ReStNeuMap, was validated in 4 glioma patients and 2 cavernoma patients undergoing resection by comparing rs-fMRI data with direct cortical stimulation mapping results. The ReStNeuMap software requires only that the user input the location of anatomical T1-weighted and rs-fMRI DICOM files. Coregistration of anatomical and functional data sets, as well as the computational processes required to identify functional cortical regions from fMRI data, occurs in an automated fashion.

In the patients studied, there was tight spatial correlation (typically < 1 cm) between regions essential for visual, motor, and language function predicted by rs-fMRI data processed through ReStNeuMap and direct cortical stimulation. The authors are to be commended for executing a rigorous comparison of imaging data and gold-standard electrophysiological mapping data.

Given that the value of ReStNeuMap rests largely in demonstrations of its reproducibility, this study would have been strengthened by validation of the performance of the software executed across a wider array of disease states (including those that induce profound edema, like metastases) and on image data sets from other institutions utilizing MRI hardware produced by other manufacturers. In addition, the authors do not provide correlation between task-based fMRI and rs-fMRI, making it difficult to evaluate how rs-fMRI data compare with widely implemented protocols for fMRI in neurosurgical planning. Consequently, larger, multiinstitutional studies, incorporating both fMRI and rs-fMRI and comparing the findings of both modalities to electrophysiological mapping data, will be essential in defining the impact of tools such as ReStNeuMap. If such studies confirm the findings of Zacà and colleagues, rs-fMRI may become an essential tool in planning operations involving eloquent cortex.

<https://thejns.org/doi/abs/10.3171/2018.5.JNS181058>

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Disclosures

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