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"Neuroimaging-Based Targeting Algorithms for Personalized Transcranial Magnetic Stimulation"

Abstract:

A high degree of precision is required to deliver targeted brain stimulation into a specific neural network. However, standard clinical methods for targeting the dorsolateral prefrontal cortex (DLPFC) for transcranial magnetic stimulation (Beam F3, 5cm rule) do a poor job of regularly locating the DLPFC. These techniques are even more ill-suited for attempting to target specific networks within the DLPFC.

Targeting TMS stimulation with individualized brain connectivity maps shows great promise for improving the efficacy and durability of TMS treatments.

In a series of clinical trials with patients suffering from treatment-resistant depression, we deployed a personalized TMS targeting algorithm designed to optimally identify DLPFC-subgenual cingulate anti-correlations that could be strengthened with TMS. The algorithms utilized high spatial-resolution resting state functional connectivity data and a hierarchical agglomerative clustering method to perform individualized DLPFC and subgenual cingulate parcellations. A correlation matrix of activity amongst these parcellations formed the basis for identifying a DLPFC target with an anti-correlation relationship with the subgenual cingulate that could be strengthened with TMS. TMS stimulation was delivered using an accelerated intermittent theta burst (aiTBS) strategy in 10 ten-minute sessions. Sessions were delivered hourly per day for 5 consecutive days.

The personalized aiTBS approach strengthened DLPFC anti-correlations and dramatically increased the antidepressant response.

New and innovative TMS targeting approaches paired with high spatial resolution neuroimaging methods present a golden opportunity to magnify the efficacy and durability of TMS treatments across a spectrum of psychiatric and neurological disorders.