

Cortical stimulation indications

The gold standard for [cortical mapping](#), direct electrocortical stimulation (DECS), has a long history of application in the practice of neurosurgery. Its utility in improving functional outcomes in brain tumor surgery has been demonstrated, but potential side effects remain a significant concern. Specifically, after-discharges, seizures and distant-site stimulation may result in poor functional localization. Although several less invasive alternatives to DECS have been explored, such as fMRI and PET, they are not yet practical enough for widespread routine use.

Cortical stimulation [mapping](#) (often shortened to CSM) is a type of [electrocorticography](#) that involves a physically invasive procedure and aims to localize the function of specific brain regions through direct [Electrostimulation](#) of the cerebral [cortex](#).

It remains one of the earliest methods of analyzing the brain and has allowed researchers to study the relationship between cortical structure and systemic function.

There is significant variation in how patients respond to cortical Electrostimulation. It has been hypothesized that individual demographic and pathologic factors, such as age, sex, disease duration, and MRI findings, may explain this discrepancy.

Intraoperative cortical stimulation

Intraoperative cortical stimulation increased tumor removal while preserving the functional status of the patients but also opens a window to cognitive neuroscience. Observations during such interventions and their correlation with both pre - and postoperative neuropsychological examinations and functional neuroimaging is progressively leading to new insights into the complex functional anatomy of the human brain. Furthermore, it broadens our knowledge on cerebral network reorganization in the presence of disease-with implications for all disciplines of clinical neuroscience¹⁾.

While the fundamental and clinical contribution of direct [Electrostimulation](#) (DES) of the brain is now well acknowledged, its advantages and limitations have not been re-evaluated for a long time.

DES is highly sensitive for detecting the cortical and axonal [eloquent](#) structures. Moreover, DES also provides a unique opportunity to study brain connectivity, since each area responsive to stimulation is in fact an input gate into a large-scale network rather than an isolated discrete functional site

Cortical stimulation mapping is used for a number of clinical and therapeutic applications, and remains the preferred method for the pre-surgical mapping of the motor cortex and language areas to prevent unnecessary functional damage.

There are also some clinical applications for cortical stimulation mapping, such as the treatment of epilepsy. Cortical stimulation, either transcranial or by means of electrodes implanted epidurally or subdurally, is used increasingly to treat neuropsychiatric diseases. In cases where transcranial stimulation gives only short-term success, implanted electrodes can yield results that are similar but long-term.

Direct Electrostimulation (DES) at 60 Hz is used to perform real-time functional mapping of the brain during wide-awake neurosurgery. The electrophysiological effects of DES are largely unknown, locally and at a more remote distance. Here, by lowering the DES frequency to 10 Hz and by using a differential recording mode of electro-corticographic (ECoG) signals to improve the focality, we were able to record cortico-cortical evoked potentials easily with standard current amplitude of stimulation (2 mA). DES applied at 10 Hz and differential recording of ECoG could be used to map on-line the connectivity between different sub-cortical and cortical areas with a higher spatial accuracy ²⁾.

Intraoperative direct electrocortical stimulation for glioma surgery

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Surbeck W, Hildebrandt G, Duffau H. The evolution of brain surgery on awake patients. Acta Neurochir (Wien). 2014 Oct 29. [Epub ahead of print] PubMed PMID: 25352088.

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Vincent M, Rossel O, Duffau H, Bonnetblanc F, Guiraud D. A measure of cortico-cortical potentials evoked by 10 Hz direct Electrostimulation of the brain and by means of a differential recording mode of electrocorticographic signals. Conf Proc IEEE Eng Med Biol Soc. 2016 Aug;2016:4543-4546. doi: 10.1109/EMBC.2016.7591738. PubMed PMID: 28269287.

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