Navigated transcranial magnetic stimulation indications

While gaining importance in the preoperative planning process in motor eloquent regions, its usefulness for reliably identifying language areas is still being discussed.

Preoperative nTMS results correlate well with direct cortical stimulation (DCS) data in the identification of the primary motor cortex. Repetitive nTMS can also be used for mapping of speech-sensitive cortical areas.

Navigated transcranial magnetic stimulation for language mapping

see Navigated transcranial magnetic stimulation for language mapping.

It has become established as an accurate noninvasive technique for mapping the functional motor cortex for the representation areas of upper and lower limb muscles, facial muscles in the lower part of the face. Instead of using the motor threshold (MT) of the abductor pollicis brevis, the stimulus intensity during mapping should be proportioned to the MT of a facial muscle [1].

Its functional information benefits surgical decision making and changes the treatment strategy in one-fourth of cases [2].

Magnetic resonance images are being increasingly deployed in conjunction with navigated transcranial magnetic stimulation (nTMS) to account for inter-individual differences in brain anatomy as well as to reduce the variability of mapping findings.

Navigated transcranial magnetic stimulation (nTMS) has been recently established as a reliable tool for distinguishing resectable from nonresectable cortical tissue in the motor areas [3] [4].

Within the primary motor cortex, navigated transcranial magnetic stimulation (nTMS) has been shown to yield maps strongly correlated with those generated by direct cortical stimulation (DCS).

Provides crucial data for preoperative planning and surgical resection of tumors involving essential motor areas. Expanding surgical indications and extent of resection based on nTMS enables more patients to undergo surgery and might lead to better neurological outcomes and higher survival rates in brain tumor patients [5].

Tractography implementation

The implementation of tractography based on nTMS increases the accuracy of fiber tracking. Moreover, this combination of methods has the potential to become a supplemental tool for guiding electrode implantation [6].

1)

Säisänen L, Julkunen P, Kemppainen S, Danner N, Immonen A, Mervaala E, Määttä S, Muraja-Murro A, Könönen M. Locating and Outlining the Cortical Motor Representation Areas of Facial Muscles With Navigated Transcranial Magnetic Stimulation. Neurosurgery. 2015 Sep;77(3):394-405. doi: 10.1227/NEU.0000000000000798. PubMed PMID: 26035404.

2)

Takahashi S, Vajkoczy P, Picht T. Navigated transcranial magnetic stimulation for mapping the motor cortex in patients with rolandic brain tumors. Neurosurg Focus. 2013 Apr;34(4):E3. doi: 10.3171/2013.1.FOCUS133. Review. PubMed PMID: 23544409.

3)

Picht P, Schmidt S, Brandt S, et al. Preoperative functional mapping for rolandic brain tumor surgery: comparison of navigated transcranial magnetic stimulation to direct cortical stimulation. Neurosurgery 2011;69(3):581-589.

4)

Tarapore PE, Tate MC, Findlay AM, et al. Preoperative multimodal motor mapping: a comparison of magnetoencephalography imaging, navigated transcranial magnetic stimulation, and direct cortical stimulation. J Neurosurg 2012;117(2):354-362.

5)

Frey D, Schilt S, Strack V, Zdunczyk A, Rösler J, Niraula B, Vajkoczy P, Picht T. Navigated transcranial magnetic stimulation improves the treatment outcome in patients with brain tumors in motor eloquent locations. Neuro Oncol. 2014 Jun 12. pii: nou110. [Epub ahead of print] PubMed PMID: 24923875.

6)

Forster MT, Hoecker AC, Kang JS, Quick J, Seifert V, Hattingen E, Hilker R, Weise LM. Does Navigated Transcranial Stimulation Increase the Accuracy of Tractography? A Prospective Clinical Trial Based on Intraoperative Motor Evoked Potential Monitoring During Deep Brain Stimulation. Neurosurgery. 2015 Jun;76(6):766-776. PubMed PMID: 25988930.