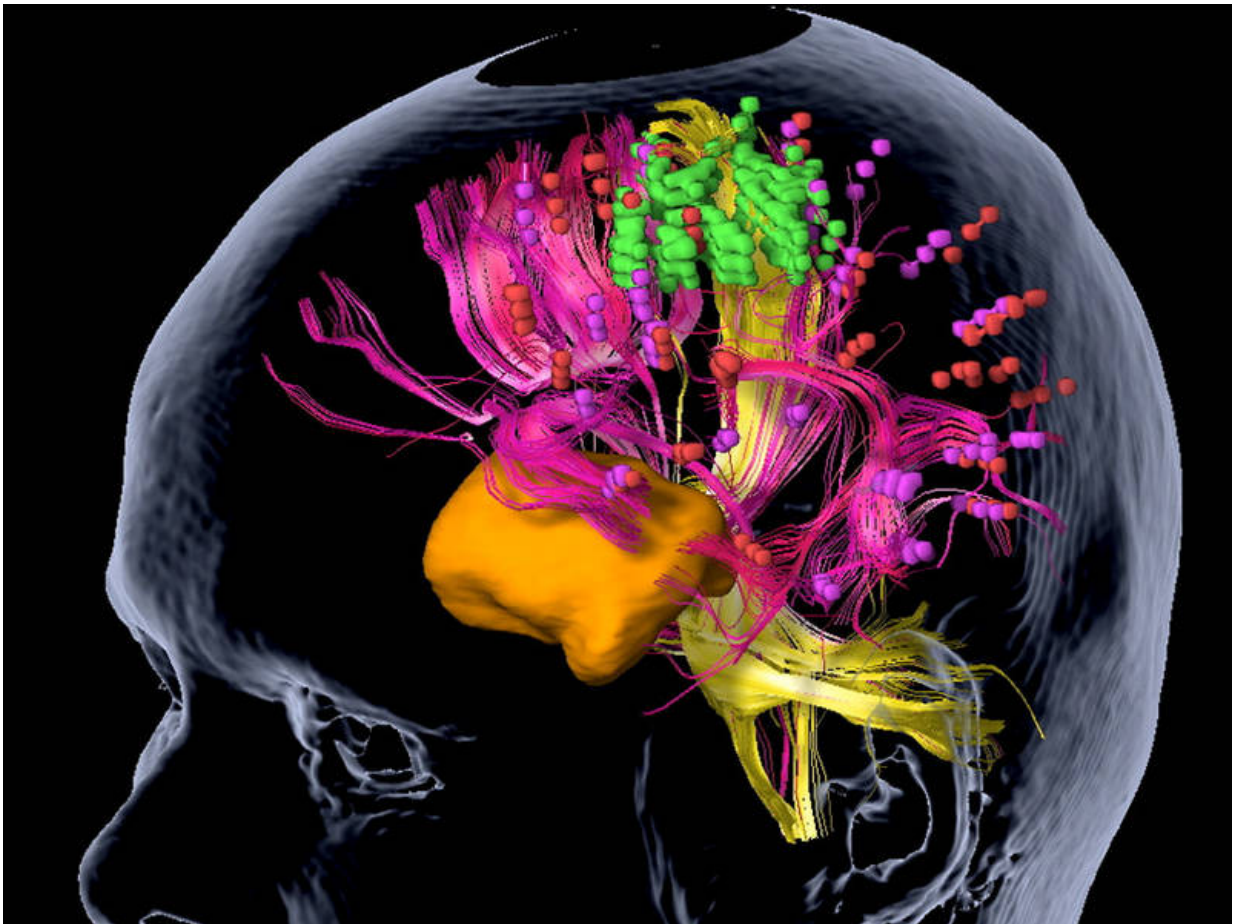


Brain tumors: Mapping of motor areas in the brain by magnetic stimulation

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nTMS mapping of a tumor (orange): Neural pathways and essential position points for language regions are shown in pink, important points for motor areas in green, and neural pathways for motor areas in yellow. Credit: Sandro Krieg / TUM

A method known as navigated transcranial magnetic stimulation (nTMS) has been gaining importance in neurosurgery for some time now. Among other applications, it is used to map brain tumors before an operation and to test whether important regions of the brain, for example motor and language areas, are affected. Doctors at the Technische Universität München (TUM) have now shown that preoperative nTMS analysis of motor areas improves the prognosis of patients with malignant brain tumors.

With the help of nTMS, it is possible to identify what areas of the brain control motor or language function to an accuracy of four millimeters. "That's particularly important, as it enables the removal of tumors from patients without affecting functional areas while at the same time removing as much of the malignant tissue as possible," explains Dr. Sandro Krieg, working group leader at the Department of Neurosurgery of TUM University Hospital Klinikum rechts der Isar and head of the study. Mapping must be performed separately for each patient, as tumors can displace important brain areas from their original sites.

Map for important motor areas

To determine motor areas with the nTMS technique, the physician scans points at defined positions on the patient's head using a coil. The coil induces brief painless electrical pulses in the brain, which stimulate brain neurons at those positions. If the pulses at a given position point activate neurons that trigger muscle movements, the scientists are able to measure the muscle activities with the help of electrodes fastened to the patient's arms and legs. That position is then regarded as an essential location for motor activity.

Up to 150 individual position points per patient can be analyzed and mapped. "In this way, we can draw up a map of important motor areas and nerve pathways in the vicinity of the tumor. During the operation,

this data is a good guide as to where we can and cannot cut," explains Krieg. The method has been used at Klinikum rechts der Isar since 2010.

nTMS analysis improves prognosis

In their recent study, Sandro Krieg and his team scanned and mapped motor areas in patients with high-grade gliomas (HGG), which are usually associated with a poor prognosis. They compared two groups: 70 subjects who underwent preoperative nTMS analysis and 70 patients who underwent tumor surgery before nTMS became a standard procedure in the hospital.

The results of the study show the advantage of nTMS mapping for patients compared to the control group: smaller openings in the skull had to be made in patients who underwent nTMS tumor analysis, and residual tumor tissue was left behind less frequently. In addition, their average hospitalization period was two days shorter. Because the general state of health of the nTMS-treated patients was also better, an increased number of them were subsequently able to receive radiotherapy. Above all, those patients survived several months longer than the control group.

"Of course, we need to confirm the findings in larger patient groups, but one important thing is clear: preoperative tumor mapping positively influences many aspects of the procedure," Krieg says about the results, adding: "Some tumors that are otherwise thought to be inoperable can be removed by this method."

Refining protocols for nTMS

The scientists now aim to improve standard protocols for nTMS and, for example, the mapping of language areas. In a recent study, they showed that an object-naming test is the best method for analyzing language

centers. "Language areas can already be mapped with nTMS, but they're much more complex than motor areas. We want to create higher standards in order to help [patients](#) with tumors in these regions as effectively as possible," the scientist says.

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