



# MASSACHUSETTS

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## Medical Policy Navigated Transcranial Magnetic Stimulation

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### Policy Number: 596

BCBSA Reference Number: 2.01.90 (For Plan internal use only)

NCD/LCD: N/A

### Related Policies

Intraoperative Neurophysiologic Monitoring (Sensory- Evoked Potentials, Motor-Evoked Potentials, EEG Monitoring), [#211](#)

### Policy

#### Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity Medicare HMO Blue<sup>SM</sup> and Medicare PPO Blue<sup>SM</sup> Members

Navigated transcranial magnetic stimulation is **INVESTIGATIONAL** for all purposes, including but not limited to the preoperative evaluation of individuals being considered for brain surgery, when localization of eloquent areas of the brain (eg, controlling verbal or motor function) is an important consideration in surgical planning.

### Prior Authorization Information

#### Inpatient

- For services described in this policy, precertification/preauthorization **IS REQUIRED** for all products if the procedure is performed **inpatient**.

#### Outpatient

- For services described in this policy, see below for products where prior authorization **might be required** if the procedure is performed **outpatient**.

	Outpatient
Commercial Managed Care (HMO and POS)	This is <b>not</b> a covered service.
Commercial PPO and Indemnity	This is <b>not</b> a covered service.
Medicare HMO Blue <sup>SM</sup>	This is <b>not</b> a covered service.
Medicare PPO Blue <sup>SM</sup>	This is <b>not</b> a covered service.

## CPT Codes / HCPCS Codes / ICD Codes

*Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.*

*Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.*

### CPT Codes

There is no specific procedure code.

## Description

### Management of Brain Tumors

Surgical management of brain tumors involves resecting the brain tumor and preserving essential brain function. "Mapping" of brain functions, such as body movement and language, is most accurately achieved with direct cortical stimulation (DCS), an intraoperative procedure that lengthens operating times and requires a wide surgical opening. Even if not completely accurate compared with DCS, preoperative techniques that map brain functions may aid in planning the extent of resection and the surgical approach. Although DCS is still usually performed to confirm the brain locations associated with specific functions, preoperative mapping techniques may provide useful information that improves patient outcomes.

### Noninvasive Mapping Techniques

The most commonly used tool for the noninvasive localization of brain functions is functional magnetic resonance imaging (fMRI). Functional MRI identifies regions of the brain where there are changes in localized cortical blood oxygenation, which correlate with the neuronal activity associated with a specific motor or speech task being performed as the image is obtained. The accuracy and precision of fMRI depend on the patient's ability to perform the isolated motor task, such as moving the single assigned muscle without moving others. This may be difficult in patients in whom brain tumors have caused partial or complete paresis. The reliability of fMRI in mapping language areas has been questioned. Guissani et al (2010) reviewed several studies comparing fMRI with DCS of language areas and found large variability in the sensitivity and specificity rates of fMRI.<sup>1</sup> Reviewers also pointed out a major conceptual point in how fMRI and DCS "map" language areas: fMRI identifies regional oxygenation changes, which show that a particular region of the brain is involved in the capacity of interest, whereas DCS locates specific areas in which the activity of interest is disrupted. Regions of the brain involved in a certain activity may not necessarily be required for that activity and could theoretically be safely resected.

Magnetoencephalography (MEG) is also used to map brain activity. In this procedure, electromagnetic recorders are attached to the scalp. Unlike electroencephalography, MEG records magnetic fields generated by electric currents in the brain, rather than the electric currents themselves. Magnetic fields tend to be less distorted by the skull and scalp than electric currents, yielding an improved spatial resolution. MEG is conducted in a magnetically shielded room to screen out environmental electric or magnetic noises that could interfere with the MEG recording. (See evidence review 6.01.21 for additional information on MEG and magnetic resonance imaging.)

Navigated transcranial magnetic stimulation (nTMS) is a noninvasive imaging method for evaluating eloquent brain areas. Transcranial magnetic pulses are delivered to the patient as a navigation system calculates the strength, location, and direction of the stimulating magnetic field. The locations of these pulses are registered to a magnetic resonance image of the patient's brain. Surface electromyography electrodes are attached to various limb muscles of the patient. Moving the magnetic stimulation source to various parts of the brain causes electromyography electrodes to respond, indicating the part of the cortex involved in particular muscle movements. For evaluation of language areas, magnetic stimulation areas that disrupt specific speech tasks are thought to identify parts of the brain involved in speech function. Navigated TMS can be considered a noninvasive alternative to DCS, in which electrodes are directly applied to the surface of the cortex during craniotomy. Navigated TMS is being evaluated as an

alternative to other noninvasive cortical mapping techniques (eg, fMRI, MEG) for presurgical identification of cortical areas involved in motor and language functions. Navigated TMS, used for cortical language area mapping, is also being investigated in combination with diffusion tensor imaging tractography for subcortical white matter tract mapping.

## Summary

### Description

Navigated transcranial magnetic stimulation (nTMS) is a noninvasive imaging method for evaluating eloquent brain areas (eg, those controlling motor or language function). Navigated TMS is being evaluated as an alternative to other noninvasive cortical mapping techniques for presurgical identification of eloquent areas.

### Summary of Evidence

For individuals who have brain lesion(s) undergoing preoperative evaluation for localization of eloquent areas of the brain who receive nTMS, the evidence includes systematic reviews, controlled observational studies, and case series. Relevant outcomes are overall survival (OS), test accuracy, morbid events, and functional outcomes. Several small studies have evaluated the distance between nTMS hotspots and direct cortical stimulation hotspots for the same muscle. Although the average distance in most studies is 10 mm or less, this does not take into account the error margin in this average distance or whether hotspots are missed. It is difficult to verify nTMS hotspots fully because only exposed cortical areas can be verified with direct cortical stimulation. Limited studies of nTMS evaluating language areas have shown high false-positive rates (low specificity) and sensitivity that may be insufficient for clinical use. Several controlled observational studies have compared outcomes in patients undergoing nTMS with those (generally pre-nTMS historical controls) who did not undergo nTMS. Findings of the studies were mixed. A meta-analysis of observational studies found improved outcomes with preoperative nTMS mapping in patients with motor-eloquent brain tumors. However, in individual observational studies, outcomes were not consistently better in patients who underwent presurgical nTMS. For example, OS did not differ significantly between groups in 2 studies. The controlled observational studies had various methodologic limitations and, being nonrandomized, might not have adequately controlled for differences in patient groups, which could have biased outcomes. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

## Policy History

Date	Action
8/2022	Annual policy review. No references added. Policy statement terminology changed from "patients" to "individuals"; intent unchanged.
9/2020	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
8/2019	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
1/2018	Clarified coding information.
7/2017	Annual policy review. New references added.
7/2016	Annual policy review. New references added.
2/2015	Annual policy review. Policy title changed (acronym deleted).
5/2014	New medical policy describing investigational indications. Effective 5/1/2014.

## Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information:

[Medical Policy Terms of Use](#)

[Managed Care Guidelines](#)

[Indemnity/PPO Guidelines](#)

[Clinical Exception Process](#)

[Medical Technology Assessment Guidelines](#)

## References

1. Mangraviti A, Casali C, Cordella R, et al. Practical assessment of preoperative functional mapping techniques: navigated transcranial magnetic stimulation and functional magnetic resonance imaging. *Neurol Sci*. Sep 2013; 34(9): 1551-7. PMID 23266868
2. Opitz A, Zafar N, Bockermann V, et al. Validating computationally predicted TMS stimulation areas using direct electrical stimulation in patients with brain tumors near precentral regions. *Neuroimage Clin*. 2014; 4: 500-7. PMID 24818076
3. Rizzo V, Terranova C, Conti A, et al. Preoperative functional mapping for rolandic brain tumor surgery. *Neurosci Lett*. Nov 07 2014; 583: 136-41. PMID 25224631
4. Forster MT, Limbart M, Seifert V, et al. Test-retest reliability of navigated transcranial magnetic stimulation of the motor cortex. *Neurosurgery*. Mar 2014; 10 Suppl 1: 51-5; discussion 55-6. PMID 23842557
5. Kato N, Schilt S, Schneider H, et al. Functional brain mapping of patients with arteriovenous malformations using navigated transcranial magnetic stimulation: first experience in ten patients. *Acta Neurochir (Wien)*. May 2014; 156(5): 885-95. PMID 24639144
6. Weiss C, Nettekoven C, Rehme AK, et al. Mapping the hand, foot and face representations in the primary motor cortex - retest reliability of neuronavigated TMS versus functional MRI. *Neuroimage*. Feb 01 2013; 66: 531-42. PMID 23116812
7. Schmidt S, Bathe-Peters R, Fleischmann R, et al. Nonphysiological factors in navigated TMS studies; confounding covariates and valid intracortical estimates. *Hum Brain Mapp*. Jan 2015; 36(1): 40-9. PMID 25168635
8. Sollmann N, Ille S, Boeckh-Behrens T, et al. Mapping of cortical language function by functional magnetic resonance imaging and repetitive navigated transcranial magnetic stimulation in 40 healthy subjects. *Acta Neurochir (Wien)*. Jul 2016; 158(7): 1303-16. PMID 27138329
9. Sollmann N, Tanigawa N, Tussis L, et al. Cortical regions involved in semantic processing investigated by repetitive navigated transcranial magnetic stimulation and object naming. *Neuropsychologia*. Apr 2015; 70: 185-95. PMID 25731903
10. Picht T, 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*. Sep 2011; 69(3): 581-8; discussion 588. PMID 21430587
11. Forster MT, Hattingen E, Senft C, et al. Navigated transcranial magnetic stimulation and functional magnetic resonance imaging: advanced adjuncts in preoperative planning for central region tumors. *Neurosurgery*. May 2011; 68(5): 1317-24; discussion 1324-5. PMID 21273929
12. 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*. Aug 2012; 117(2): 354-62. PMID 22702484
13. Krieg SM, Shiban E, Buchmann N, et al. Utility of presurgical navigated transcranial magnetic brain stimulation for the resection of tumors in eloquent motor areas. *J Neurosurg*. May 2012; 116(5): 994-1001. PMID 22304452
14. Picht T, Krieg SM, Sollmann N, et al. A comparison of language mapping by preoperative navigated transcranial magnetic stimulation and direct cortical stimulation during awake surgery. *Neurosurgery*. May 2013; 72(5): 808-19. PMID 23385773
15. Tarapore PE, Findlay AM, Honma SM, et al. Language mapping with navigated repetitive TMS: proof of technique and validation. *Neuroimage*. Nov 15 2013; 82: 260-72. PMID 23702420
16. Hendrix P, Senger S, Simgen A, et al. Preoperative rTMS Language Mapping in Speech-Eloquent Brain Lesions Resected Under General Anesthesia: A Pair-Matched Cohort Study. *World Neurosurg*. Apr 2017; 100: 425-433. PMID 28109861
17. Krieg SM, Sabih J, Bulbasova L, et al. Preoperative motor mapping by navigated transcranial magnetic brain stimulation improves outcome for motor eloquent lesions. *Neuro-oncology*. Sep 2014; 16(9): 1274-82. PMID 24516237
18. Krieg SM, Sollmann N, Obermueller T, et al. Changing the clinical course of glioma patients by preoperative motor mapping with navigated transcranial magnetic brain stimulation. *BMC Cancer*. Apr 08 2015; 15: 231. PMID 25884404
19. Frey D, Schilt S, Strack V, et al. Navigated transcranial magnetic stimulation improves the treatment outcome in patients with brain tumors in motor eloquent locations. *Neuro-oncology*. Oct 2014; 16(10): 1365-72. PMID 24923875

20. Picht T, Schulz J, Hanna M, et al. Assessment of the influence of navigated transcranial magnetic stimulation on surgical planning for tumors in or near the motor cortex. *Neurosurgery*. May 2012; 70(5): 1248-56; discussion 1256-7. PMID 22127045