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INPLASY

Effects of transcranial magnetic stimulation on neurological impairment and functional activity after surgery for primary intracranial brain tumors: a systematic review protocol

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ADMINISTRATIVE INFORMATION

Support - Self Supported.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 2 October 2026 and was last updated on 2 October 2026.

INTRODUCTION

Review question / Objective To systematically evaluate the effectiveness, feasibility, functional effects, and safety of post-operative transcranial magnetic stimulation in adults who have undergone surgery for a primary intracranial brain tumor.

Rationale Neurological impairment and reduced functional activity are important postoperative complications after surgery for primary intracranial brain tumors. Patients may develop motor weakness, aphasia, cognitive impairment, reduced mobility, limitations in activities of daily living, and reduced quality of life after surgery for primary intracranial brain tumors . Transcranial magnetic stimulation is a non-invasive neuromodulation technique that may influence cortical excitability, interhemispheric inhibition, and neuroplasticity during postoperative recovery and rehabilitation.The available literature include randomized controlled trials, non-randomized comparative studies, prospective proof-of-concept studies, observational studies, case series, and case reports. The interventions vary in stimulation frequency, intensity, cortical target, number of sessions, timing after surgery, and combination with physiotherapy, occupational therapy, or speech therapy. Outcomes may vary, including motor scales, functional scales, language assessments, cognitive measures, quality-of-life measures, patient perception, and safety outcomes.
Therefore a systematic review is needed to summarize the available evidence, distinguish comparative effectiveness evidence from uncontrolled feasibility evidence, identify clinically relevant TMS parameters, and determine whether postoperative TMS appears safe and useful for improving neurological impairment and functional activity after primary intracranial brain tumor surgery.

Condition being studied Postoperative neurological impairment and reduced functional activity following surgery for a primary intracranial brain tumor patient.

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METHODS

Search strategy We will conduct a systematic review search across major bibliographic data base to identify recent literatures investigating the effect of repetitive transcranial magnetic stimulation on primary intracranial brain tumors, after surgery and post-operative rehabilitation .Electronic database will be searched including in MEDLINE via PubMed, Embase, web of science, APA, Pedro, Cochrane centrals, MLA and retrieval system online, international prospective register of systematic reviews and directory of open access journals. The search strategy will combine controlled vocabulary and free-text terms related to transcranial magnetic stimulation, primary intracranial brain tumors, surgery, and postoperative rehabilitation.
Authors used medical key words including "Transcranial Magnetic Stimulation" OR "transcranial magnetic stimulation" OR TMS OR rTMS OR "repetitive transcranial magnetic stimulation" OR "navigated TMS" OR nrTMS OR "theta burst stimulation" OR iTBS OR cTBS AND "brain tumor" OR "brain neoplasm" OR "intracranial tumor" OR "intracranial tumour" OR "intracranial neoplasm" AND postoperative OR post-operative OR postsurgical OR "after surgery" OR craniotomy OR resection OR rehabilitation OR functional recovery.
The date range for the article search was January,1st 2000 and November, 30th 2026. We will use same strategy adapted for each database using the appropriate subject headings and also searched grey literature on google scholar and hand searched reference list of few relevant papers.
The strategy will be adapted for each database using the appropriate subject headings and search syntax. The complete electronic search strategies will be reported in the final review.

Participant or population Adults aged 18 years or older who have undergone surgical resection or craniotomy procedure for a primary intracranial brain tumor. Eligible tumors may include glioma, glioblastoma, oligodendroglioma, astrocytoma, meningioma, and other primary intracranial neoplasms.Participants may have postoperative motor, language, cognitive, emotional, or other neurological impairment, or may be receiving TMS as part of postoperative functional rehabilitation.

Intervention Any therapeutic transcranial magnetic stimulation intervention administered after surgery for a primary intracranial brain tumor. Eligible interventions include repetitive transcranial magnetic stimulation, navigated repetitive transcranial magnetic stimulation, neuronavigated TMS, low-frequency TMS, high-frequency TMS, intermittent theta-burst stimulation, continuous theta-burst stimulation, and combined or individualized TMS protocols.
TMS may be delivered as a standalone intervention or together with physiotherapy, occupational therapy, speech-language therapy, cognitive rehabilitation, or usual postoperative rehabilitation. The protocol, stimulation frequency, intensity, cortical target, number of pulses, number of sessions, timing after surgery, and treatment duration will be extracted.

Comparator Eligible comparators include sham TMS, no TMS, standard rehabilitation, contalateral vs ipsilateral stimulation, Conventional physiotherapy, or another TMS protocol. For case series and case report studies will have no comparator, so will be reported as uncontrolled pre-post observations.

Study designs to be included The review will include randomized controlled trials, quasi-randomized trials, non-randomized controlled trials, controlled clinical trials, comparative cohort studies, prospective pre-post studies, retrospective cohort studies, case series, and case reports. Reviews, editorials, letters without primary data, conference commentaries, animal studies, cadaveric studies, studies involving only healthy participants, and studies using TMS exclusively for preoperative or postoperative mapping, diagnosis, or prognosis without therapeutic stimulation will be excluded.

Eligibility criteria Studies will be eligible if they include
1. Include adults who underwent surgery for a primary intracranial brain tumor.
2. Evaluate therapeutic TMS after surgery.
3. Report at least one outcome related to neurological impairment, functional activity, independence, quality of life, patient acceptability, or adverse events.
4. Use a randomized, controlled, comparative, prospective pre-post, retrospective, case-series, or case-report design.
5. Provide sufficient information to identify the population, intervention, and outcome.
Studies will be excluded if they
1. Include only secondary brain metastases without separately extractable data for primary tumors.
2. Use TMS only for motor mapping, language mapping, diagnostic assessment, or prediction of recovery.
3. Do not administer therapeutic TMS after surgery.

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4. Do not report a relevant functional, neurological, patient-reported, or safety outcome.
5. Are reviews, editorials, protocols, conference commentaries, or non-human studies.
If multiple publications report the same participant, the most complete report will be used as the primary record, with other publications used for supplementary information.

Information sources The following electronic databases will be searched from inception to the date of the final search:
PubMed/MEDLINE.
Cochrane Central Register of Controlled Trials.
Scopus.
Web of Science
Following trial registries will also be searched:
ClinicalTrials.gov.
World Health Organization International Clinical Trials Registry Platform.
Few reference lists of included studies and relevant systematic reviews will be screened manually. If possible Forward citation searching will be performed. Authors may be contacted to clarify eligibility, obtain missing outcome data, or discover additional publications.

Main outcome(s) 1. Motor impairment- Measured using the Fugl-Meyer Assessment, Medical Research Council or British Medical Research Council muscle-strength grading, grip strength, motor evoked potentials, or another validated motor measure.
2. Functional activity and independence- Measured using the Functional Independence Measure, Barthel Index, modified Rankin Scale, AM-PAC, mobility measures, activities of daily living scales, or other validated functional measures.
3. Language impairment- Measured using validated aphasia, naming, comprehension, speech fluency, or language-function assessments.
4. Cognitive impairment- Measured using validated cognitive, attention, memory, or executive-function tests.
5. Health-related quality of life- Measured using instruments such as EORTC QLQ-C30, EORTC QLQ-BN20, or other quality-of-life measurements.

Additional outcome(s) 1. Depression
2. Anxiety
3. Fatigue
4. Emotional well-being.

Data management Search results will be imported into reference-management software such as EndNote, Zotero, or Mendeley. Duplicate records will be identified and removed before screening. Two reviewers will independently screen titles and abstracts. Eligible articles will undergo independent full-text assessment. Reasons for full-text exclusion will be recorded. Two reviewers will independently extract data using a piloted standardized data-extraction form.

Quality assessment / Risk of bias analysis 1. Risk of bias in randomized controlled trials will be assessed using the Cochrane Risk of Bias 2 tool.
2. Risk of bias in non-randomized comparative studies will be assessed using ROBINS-I.
3. Risk of bias in pre-post comparative studies will be assessed using NIH pre-post studies with no control group.
4. Risk of bias in case series studies will be assessed using NIH case series studies.
5. Risk of bias in case report will be assessed using JBI case report studies.
Two reviewers will independently perform the assessment, with disagreements resolved by consensus or third-reviewer adjudication.

Strategy of data synthesis The evidence will be synthesized according to study design and outcome domains.
Randomized and controlled studies will form the primary effectiveness synthesis. Prospective pre-post studies, retrospective studies, case series, and case reports will be summarized separately as non-comparative evidence regarding feasibility, functional change, and safety. Study characteristics, TMS parameters, comparator interventions, outcome domains, direction of effect, follow-up duration, and methodological limitations will be tabulated.
Different study designs will not be pooled together. Randomized and controlled studies will be analyzed separately from uncontrolled pre-post studies.

Subgroup analysis Subgroup analyses will be conducted only when sufficient clinically comparable data are available. Planned subgroups include:
1. Randomized or controlled studies versus uncontrolled studies.
2. Motor impairment versus language, cognitive, or other neurological impairment.
3. Low-frequency TMS versus high-frequency TMS.
4. Contralesional stimulation versus ipsilesional stimulation.
5. Navigated or neuronavigated TMS versus non-navigated TMS.

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6. TMS alone versus TMS combined with physiotherapy, occupational therapy, or speech therapy.
7. Follow-up at the end of treatment, approximately 1 month, approximately 3 months, and beyond 3 months.

Sensitivity analysis Sensitivity analyses will be performed where sufficient data are available. Planned sensitivity analyses include:
1. Excluding studies judged to have high or critical risk of bias.
2. Excluding non-randomized studies from the primary effectiveness analysis.
3. Excluding uncontrolled pre-post studies from pooled quantitative analysis.
4. Excluding case reports and case series from any quantitative synthesis.
5. Excluding studies with unclear intervention details or incomplete outcome data.
6. Excluding studies with substantial baseline imbalance

Sensitivity analyses will be interpreted cautiously because the expected number of studies and sample sizes will be small.

Language restriction No language restrictions will be applied during the search. Non-English studies will be translated when feasible. If an eligible study cannot be translated, this will be documented as a limitation.

Country(ies) involved India.

Keywords Transcranial magnetic stimulation; repetitive transcranial magnetic stimulation; postoperative brain tumor; primary intracranial neoplasm; motor impairment; neurological impairment; functional activity; neuro-rehabilitation.

Dissemination plans The findings will be submitted for publication in a peer-reviewed journal in neuro-rehabilitation, neurology, neurosurgery, neuro-oncology, or rehabilitation medicine. The findings may also be presented at national and international scientific conferences. The registration record and any protocol amendments will be cited in the final publication.

Contributions of each author

Author 1 - Siddhartha Sankar Gantayat - 1. Conceptualization and design of the review question
2. Literature search and database screening
3. Study selection and eligibility assessment
4. Data extraction from included studies
5. Risk-of-bias/quality assessment
6. Drafting of the manuscript
7. Final approval of the version to be submitted.
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Author 2 - Sowjanya Maruboyina - 1. Conceptualization and methodology oversight
2. Resolving discrepancies in study selection or data extraction (if two reviewers screened independently)
3. Critical revision of the manuscript for important intellectual content
4. Supervision
5. Final approval of the version to be submitted.
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