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Testing the safety of non-invasive transcranial ultrasound stimulation in people with essential tremor

Submission date
26/08/2026

Recruitment status
Not yet recruiting

Registration date
26/08/2026

Overall study status
Ongoing

Last Edited
26/08/2026

Condition category
Nervous System Diseases

[X] Prospectively registered
[_] Protocol
[_] Statistical analysis plan
[_] Results
[_] Individual participant data
[X] Record updated in last year

Plain English summary of protocol

Background and study aims
Essential tremor is the most common movement disorder, causing involuntary shaking, most often of the hands, that can significantly affect daily life. Medication and surgery help many people, but a substantial proportion do not get adequate relief or cannot tolerate side effects. Transcranial ultrasound stimulation (TUS) uses low-intensity focused sound waves, delivered through the intact skull, to temporarily alter brain cell activity. It is non-invasive, and unlike established focused ultrasound treatments it does not destroy brain tissue. This study investigates whether TUS delivered by a helmet-shaped device called Meridian can safely target the ventral intermediate nucleus of the thalamus, a deep brain structure involved in controlling tremor, and whether stimulation produces any measurable change in tremor. This is a first-in-patient study; it is not designed to provide lasting tremor relief, and any effects are expected to be temporary.

Who can participate?
Men and women aged 18 to 80 years with essential tremor affecting both hands for at least 3 years, whose tremor medications have not worked adequately, have caused unacceptable side effects, or who prefer not to take them.

What does the study involve?
Participants attend a screening visit including a brain MRI scan, a single stimulation session lasting approximately 2.5 to 3 hours, and a telephone follow-up call the next day. During the stimulation session, participants sit in a chair wearing the Meridian device while small motion sensors on the hands measure tremor. Stimulation is delivered in four periods; one of the four is an inactive (sham) period, included so that any tremor changes can be attributed to the stimulation itself. Tremor is then monitored for up to 60 minutes.

What are the possible benefits and risks of participating?
Participants are not expected to receive any direct health benefit, but the results may help develop new non-invasive treatments for essential tremor. TUS has been used in research studies involving over 700 people with no serious adverse events reported. Possible side effects

are mostly mild and short-lived, including headache, scalp discomfort or tingling, clicking or buzzing sounds during stimulation, and temporary changes in tremor. The MRI scan and device fitting may cause mild discomfort or claustrophobia.

Where is the study run from?
National Hospital for Neurology and Neurosurgery, University College London Hospitals NHS Foundation Trust (UCLH), London, UK

When is the study starting and how long is it expected to run for?
September 2026 to April 2027

Who is funding the study?
NeuroHarmonics Ltd and UK Research and Innovation (UKRI)

Who is the main contact?
Dr Anna Latorre, a.latorre@ucl.ac.uk

Contact information

Type(s)
Public, Scientific, Principal investigator

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Additional identifiers

Integrated Research Application System (IRAS)
365666

Central Portfolio Management System (CPMS)
74798

Study information

Scientific Title
Safety and Target Engagement of Transcranial Ultrasound Stimulation of the Ventral Intermediate Nucleus for Essential Tremor: A First-in-Patient Proof-of-Concept Study

Acronym
VIM-TUS-ET

Study objectives
1. To evaluate the safety and tolerability of transcranial ultrasound stimulation (TUS) targeting the ventral intermediate nucleus (VIM) of the thalamus in patients with essential tremor
2. To assess preliminary evidence of target engagement by evaluating whether TUS of the VIM produces measurable changes in tremor power compared with baseline and with sham stimulation

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 30/06/2026, West of Scotland REC 3 (West of Scotland Research Ethics Service) (Admin Building, Level 2, Gartnavel Royal Hospital, 1055 Great Western Road, Glasgow, G12 0XH, United Kingdom; +44 141 211 3600; ggc.wosrec3@nhs.scot), ref: 26/WS/0096

Primary study design
Interventional

Allocation
Randomized controlled trial

Masking
Blinded (masking used)

Control
Placebo

Assignment
Single

Purpose
Device feasibility

Study type(s)

Health condition(s) or problem(s) studied
Essential tremor

Interventions
Participants receive a single session of low-intensity transcranial ultrasound stimulation (TUS), delivered with the Meridian device and targeting the ventral intermediate nucleus (VIM) of the thalamus in one hemisphere (left or right, randomised 1:1 using a computer-generated sequence). The session comprises four stimulation conditions, one of which is a sham (control) condition; participants are not told which condition is the sham. Hand tremor is measured by accelerometers during the session and for up to 60 minutes afterwards. Participants attend a screening visit including a brain MRI scan (Visit 1), the stimulation session lasting approximately 2.5 to 3 hours (Visit 2), and a telephone follow-up approximately 24 hours later (Visit 3); total participation is approximately 2 to 4 weeks.

Intervention Type

Device

Phase
Not Applicable

Drug/device/biological/vaccine name(s)
Meridian transcranial ultrasound stimulation system

Primary outcome(s)
1. Safety measured using adverse event and device deficiency recording (incidence, nature, severity, and relationship to device or procedure) at each study contact from consent to the 24-hour follow-up (Visit 3)

2. Target engagement (tremor modulation) measured using log-transformed accelerometer-derived tremor band power (3-12 Hz) in the hand contralateral to the stimulated hemisphere, comparing the pre-stimulation baseline with the active stimulation and post-stimulation periods, pooled across the active conditions and compared with sham at the single intervention session (Visit 2)

Key secondary outcome(s)
1. Time course and durability of tremor modulation measured using accelerometer-derived tremor amplitude at 5-minute intervals for up to 60 minutes during the post-stimulation follow-up (Visit 2)

2. Laterality of effect measured using accelerometer-derived tremor amplitude in the ipsilateral hand (within-subject control) compared with the contralateral hand at the intervention session (Visit 2)

3. Clinical tremor severity measured using the TETRAS Performance Subscale and Archimedes spiral drawing at baseline and post-intervention (TETRAS), and after each stimulation condition and at 30 and 60 minutes during follow-up (spirals) (Visit 2)

4. Participant experience and tolerability measured using participant-reported sensations, a tolerability questionnaire, and the Patient Global Impression of Change at the end of each stimulation condition and the end of the session (Visit 2), and the 24-hour telephone follow-up (Visit 3)

Completion date
21/04/2027

Eligibility

Key inclusion criteria
1. Adults aged 18-80 years
2. Clinical diagnosis of essential tremor according to Movement Disorder Society consensus criteria
3. Tremor affecting both upper limbs, defined as TETRAS Performance Subscale item 4 (upper limb tremor) score >=1.5 in both upper limbs
4. Tremor duration of at least 3 years
5. Suboptimal response to, intolerance of, contraindication to, or preference not to use at least one first-line medication (propranolol, primidone)

6. Stable dose of tremor medication for at least 2 weeks prior to screening, or medication-naive
7. Able to maintain a postural hold position for tremor assessment (repeated blocks of 30 seconds)
8. Able to provide written informed consent, comply with study procedures, and communicate in English

Healthy volunteers allowed
No

Age group
Mixed

Lower age limit
18 Years

Upper age limit
80 Years

Sex
All

Total final enrolment
0

Key exclusion criteria
1. Any condition which results in significant movement of the head during a 30 second postural hold of the arms, including clinically apparent cervical dystonia, tics affecting the head, or head tremor (TETRAS Performance Subscale item 1 score >1)
2. Unable to achieve proper device fit due to head circumference exceeding 62 cm, or hair circumference exceeding 80 cm
3. Contraindications to MRI:
3.1. Metallic implants incompatible with MRI
3.2. Cardiac pacemaker or implantable cardioverter-defibrillator
3.3. Cochlear implants
3.4. Implanted medication infusion device (e.g., insulin pump, intrathecal pump)
3.5. Severe claustrophobia
3.6. Other standard MRI contraindications
4. Contraindications to transcranial ultrasound stimulation:
4.1. Previous cranial surgery or skull defects
4.2. Intracranial metallic implants, clips, or devices
4.3. History of epilepsy or unprovoked seizure
4.4. History of severe head trauma
4.5. History of unexplained syncope
4.6. Prior intracranial haemorrhage
4.7. Structural lesion at or near VIM target (tumour, cavernoma, AVM, large infarct)
4.8. Space-occupying lesion
4.9. Stroke (ischaemic or haemorrhagic in past 6 months)
4.10. MI (in past 6 months) and severe cardiac disease
4.11. Uncontrolled hypertension (systolic >180)
4.12. Current use of medications associated with a substantially increased seizure risk (clozapine or bupropion). Other medications with potential to lower seizure threshold will be reviewed at

screening. Stable use of standard antidepressants and other psychotropic medications at usual therapeutic doses is permitted unless, in the opinion of the investigator, overall seizure risk is materially increased.
4.13. Electroconvulsive therapy (ECT) within the past 6 months
5. Pregnancy or breast-feeding
6. Previous surgical treatment for tremor (deep brain stimulation, thalamotomy, focused ultrasound ablation)
7. Other neurological conditions that could affect tremor assessment or confound results: Parkinson's disease; dystonia; multiple sclerosis; stroke affecting motor function; other movement disorders
8. Scalp condition that would prevent device placement (e.g., open wounds, severe dermatitis, psoriasis)
9. Recent scalp or cranial surgical procedure, biopsy, or hair transplant/follicle extraction within the past 6 months
10. Unable to tolerate sitting still for the duration of the intervention (approximately 120 minutes)
11. Participation in another interventional clinical trial within the past 30 days
12. Any condition that, in the opinion of the investigator, would make participation unsafe or compromise data quality

Date of first enrolment
21/09/2026

Date of final enrolment
21/03/2027

Locations

Countries of recruitment
United Kingdom

England

Study participating centre
National Hospital for Neurology and Neurosurgery
Leonard Wolfson Experimental Neurology Centre, University College London Hospitals NHS Foundation Trust, Queen Square
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Sponsor information

Organisation
NeuroHarmonics Ltd

Funder(s)

Funder type

Funder Name
NeuroHarmonics Ltd

Funder Name
UK Research and Innovation

Alternative Name(s)
UKRI

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location
United Kingdom

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not expected to be made available