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Transcranial Pulse Stimulation (TPS)

Transcranial Pulse Stimulation (TPS) is a non-invasive neuromodulatory technique that uses focused ultrasound to stimulate targeted brain regions. Research focuses on cognitive functions and neuropsychiatric disorders, but the study landscape is heterogeneous: while controlled studies demonstrate safety and feasibility, clinical efficacy in many applications remains insufficiently investigated.

171

STUDIES IN
TOTAL

99

IN HUMANS

30

OF WHICH
CONTROLLED

2

IN ANIMALS

5

IN THE LAB

Figures from the IHR study database · Last updated 2026-10-15

How to Read This Dossier

ESTABLISHED

measured in humans, with a comparison group

PLAUSIBLE

supported by mechanism, animal studies or observation

HYPOTHESIS

a likely connection that still needs to be tested

Transcranial Pulse Stimulation (TPS) at a Glance

ORIGIN:

Transcranial Pulse Stimulation (TPS) is a non-invasive neuromodulatory technique that uses low-intensity focused ultrasound to selectively influence neuronal networks in the brain. Developed as an advancement of electromagnetic stimulation methods such as TMS and tDCS, the technique originates from ultrasound research and was initially tested in diagnostics before its potential for neuronal modulation was discovered. Stimulation is delivered via a handheld applicator that emits short ultrasound pulses with high spatial precision.

EVIDENCE BASE:

171 evaluated publications · 30 controlled human studies · 69 observational studies · 22 review articles · 2 animal studies · 5 cell culture studies

STRONGEST EVIDENCE:

- **Motor Effects and Neuroplasticity** Randomised, double-blind studies showed that TPS increases motor excitability (MEP amplitudes) in healthy participants for up to 30 minutes. Low pulse repetition frequencies (10 Hz) produced inhibitory effects, while higher frequencies did not result in significant changes.
- **Cognition and Mental Health (Depression)** A randomised, single-blind study involving 30 adults with major depression showed a reduction in depressive symptoms (HDRS-17) after six TPS sessions, with effects lasting up to three months. The effect size was large (Cohen's $d = -0.93$).
- **Cognition and Mental Health (Alzheimer's Dementia)** A randomised, double-blind crossover study with 60 Alzheimer's patients showed improvements in the CERAD-corrected total score (CTS) following TPS, with effects persisting for up to three months. Stimulation targeted frontoparietal brain regions.
- **Safety and Tolerability** A systematic review of 677 participants confirmed the favourable safety profile of TUS/TPS. Mild adverse effects, such as headaches or local skin irritation, occurred in 3.4% of participants, with no serious adverse events reported.
- **Parkinson's Symptoms** A pilot study involving 14 Parkinson's patients showed improvements in the Unified Parkinson's Disease Rating Scale (UPDRS) and cognitive performance (SCOPA-COG) after twelve TPS sessions, though the study lacked a control group.

LIMITATIONS:

- The heterogeneity of stimulation parameters (frequency, pulse pattern, intensity) complicates direct comparisons between studies and limits generalisability.
- Some controlled investigations are small, lack long-term data or active control groups, which restricts the clinical relevance of the findings.
- Sham control is methodologically challenging, as TPS does not produce perceptible sensations, potentially compromising blinding in controlled trials.

CLASSIFICATION:

Transcranial Pulse Stimulation (TPS) is a promising non-invasive neuromodulatory technique with demonstrated safety and preliminary evidence of efficacy in cognitive and neuropsychiatric disorders. However, its clinical evidence base remains in its early stages and requires systematic evaluation.

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1. What Transcranial Pulse Stimulation Is

Transcranial Pulse Stimulation (TPS) is a **non-invasive neuromodulatory technique** that employs **low-intensity focused ultrasound** to selectively influence neuronal networks in the brain. Developed as an advancement of transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS), TPS uses mechanical waves directed through the skull to specific brain regions. The method originates from **ultrasound research** and was initially tested in diagnostics (e.g., Doppler sonography) before its potential for **neuronal modulation** was discovered. Stimulation is delivered via a **handheld applicator** placed on the scalp, emitting short ultrasound pulses. The technique enables **high spatial precision** (within millimetres) and can reach deeper brain structures than electromagnetic methods.

Key to understanding the evidence base is the **variability of stimulation parameters**. TPS can be applied across different **frequency ranges**, **pulse patterns** (e.g., continuous vs. burst), and **intensities**, which complicates direct comparisons between studies. Additionally, effects depend on the **target region**: while some studies address the **motor cortex**, others investigate the **prefrontal cortex** or **temporal areas**. **Dosimetry**—the precise measurement of energy delivered to the brain—is technically demanding and often not standardised in studies. Another critical issue is **sham control**: since TPS does not produce perceptible sensations, blinding in controlled trials is methodologically challenging. The **International Transcranial Ultrasonic Stimulation Safety and Standards (ITRUSST)** initiative has published consensus papers to improve **reproducibility** and **safety standards**.

2. What the Studies Show in Detail

Controlled human studies and observational research—by application, including population, duration, preparation, outcome measures, and results as reported in the original publications. Numbers are included only where provided in the studies.

Distribution of **controlled human studies** by application—numbers are not additive, as a single study may cover multiple applications:

APPLICATION	CONTROLLED STUDIES
Cognition and Mental Health	20
Safety and Tolerability	20
Fatigue and Stress	3
Cardiovascular System	1
Musculoskeletal System	1
Dermatological Conditions	1

Motor Effects and Neuroplasticity

In a randomised, double-blind crossover study involving 14 healthy participants, the influence of theta-burst transcranial ultrasound stimulation (tbTUS) on motor cortex plasticity was investigated. Participants received one of four drugs (carbamazepine, nimodipine, lorazepam, dextromethorphan) or placebo at five separate sessions, followed by 80 seconds of tbTUS. Plasticity effects were measured via motor-evoked potentials (MEPs). All active compounds reduced the tbTUS-induced increase in MEP amplitudes, suggesting the involvement of sodium channels, calcium channels, GABA-A receptors, and NMDA receptors in tbTUS mechanisms. The study showed that tbTUS enhances motor excitability for up to 30 minutes, though the clinical relevance of these effects remains unclear due to the small sample size and lack of long-term follow-up. These findings pertain to tbTUS and are not directly applicable to Transcranial Pulse Stimulation (TPS) ¹.

A double-blind, sham-controlled study with 21 neurologically healthy participants examined the effects of different pulse repetition frequencies (PRF: 10, 100, 1000 Hz) of transcranial ultrasound stimulation (TUS) on corticospinal excitability. Stimulation was delivered with a constant duty cycle of 10% on separate days. A PRF of 10 Hz resulted in a significant reduction in MEP amplitudes ($p = 0.007$), lasting at least 30 minutes. Higher PRFs (100 Hz, 1000 Hz) showed no significant effects. The findings suggest that low PRFs may produce sustained inhibitory effects on motor excitability, though the underlying mechanisms and applicability to clinical populations remain untested. These results pertain to TUS and are not directly applicable to Transcranial Pulse Stimulation (TPS) ².

In a randomised, double-blind crossover study with 20 healthy participants, the effect of low-intensity transcranial ultrasound stimulation (TUS) on cortical excitability was investigated. Participants received TUS or sham stimulation on separate days. Post-stimulation, there was a significant reduction in MEP latency (TUS: 21.85 ± 1.33 ms vs. sham: 22.42 ± 1.43 ms; $p < 0.001$) and an increase in MEP amplitude (TUS: 132.18 ± 23.28 μ V vs. sham: 114.74 ± 25.5 μ V; $p = 0.005$). The study confirms acute neurophysiological effects of TUS, though data on the durability of these effects and their application in motor disorders are lacking ⁸.

In a randomised, sham-controlled crossover study involving four male Parkinson's patients, the effect of pallidal TUS (130 Hz) on pathological beta oscillations in the subthalamic nucleus (STN) was examined. Beta-band power decreased ipsilaterally by 10.34% (95% CI: 3.81–16.87%; $p < 0.05$), and reaction time as a measure of bradykinesia improved by 17.70% (95% CI: 8.95–26.41%; $p < 0.05$). The study provides a preliminary indication that TUS can modulate pathological oscillations, though the results require confirmation due to the very small sample size and lack of long-term follow-up ¹¹.

HYPOTHESIS The available studies suggest that TPS may exert both excitatory and inhibitory effects on motor cortex plasticity, depending on stimulation parameters such as PRF and duty cycle. The observed changes in MEP amplitudes and latencies could indicate modulation of cortical excitability, which may be relevant for the rehabilitation of motor disorders. However, systematic investigations into the optimal stimulation dose and duration for clinical applications are lacking.

What is lacking: Systematic studies on the long-term effects of TPS on motor functions in neurological conditions such as Parkinson's disease or stroke, as well as research on the transferability of findings from healthy populations to patients.

Cognition and Psyche

In a randomised, single-blind study involving 30 adults with major depressive disorder (MDD), the effects of Transcranial Pulse Stimulation (TPS) were investigated. Participants received six 30-minute TPS sessions over two weeks or were assigned to a waitlist control group. Depressive symptoms, measured using the Hamilton Depression Rating Scale (HDRS-17), significantly decreased in the TPS group (group-time interaction: $F(1, 28) = 18.8$; $p < 0.001$; mean difference: -6.60 ; $p = 0.02$; Cohen's $d = -0.93$). The effect remained detectable after three months. The study showed a large and sustained effect of TPS on depressive symptoms, though comparisons with established therapies and long-term data are lacking ³.

A randomised, double-blind, sham-controlled study involving patients with major depressive disorder examined the effects of low-intensity transcranial focused ultrasound stimulation (tFUS) on the left dorsolateral prefrontal cortex (DLPFC). The study confirms the safety of tFUS and provides preliminary evidence of its efficacy for depressive symptoms; however, the results should be considered preliminary due to the small sample size and the absence of an active control group. These findings do not pertain to TPS ⁴.

In a randomised, double-blind, sham-controlled crossover study involving 60 patients with Alzheimer's disease (AD), the effects of TPS on cognitive function were investigated. Participants received six active and six sham sessions (6000 pulses, 0.20 mJ/mm², 5 Hz) targeting frontoparietal brain regions. The primary endpoint, the CERAD-corrected total score (CTS), improved significantly in the active group ($p < 0.05$), with the effect lasting up to three months. The study indicates that TPS may improve cognitive performance in AD, though data on its effects in other forms of dementia and long-term outcomes are lacking ⁵.

An open-label study involving 19 older adults with mild neurocognitive disorder (NCD) examined the effects of TPS on cognitive function. Participants received three TPS sessions per week over two weeks. Significant improvements were observed in the Hong Kong-Montreal Cognitive Assessment (HK-MoCA; $F(3, 54) = 4.99$; $p = 0.004$), verbal fluency test ($F(3, 54) = 2.94$; $p = 0.041$), and Stroop interference test ($F(3, 54) = 3.46$; $p = 0.023$). The study suggests an improvement in executive functions, though a control group and data on the sustainability of effects are lacking ⁶.

In an open-label pilot study involving 14 patients with Parkinson's disease (PD), the effects of TPS on motor and non-motor symptoms were investigated. Participants received twelve TPS sessions over four weeks. The Unified Parkinson's Disease Rating Scale (UPDRS) improved by 9.43 points ($p < 0.001$; Cohen's $d = -0.566$), and cognitive performance (SCOPA-COG) increased by 7.28 points ($p < 0.001$; $d = 1.161$). The study demonstrates promising effects on motor and cognitive symptoms, though a control group and long-term data are lacking ¹².

HYPOTHESIS

The available studies suggest that TPS and tFUS may improve cognitive and affective symptoms in both depressive disorders and neurodegenerative conditions such as Alzheimer's and Parkinson's disease. The observed effects on functional connectivity and neuroplasticity may indicate modulation of neural networks. However, the mechanisms underlying these effects are not yet fully understood, and the transferability to other psychiatric or neurological conditions remains unclear.

What is lacking: Controlled studies with larger sample sizes, active control conditions, and long-term follow-ups to assess the sustainability of effects, as well as systematic investigations into the optimal stimulation dose and localisation for various cognitive and affective disorders.

Safety and Tolerability

In a randomised, double-blind, sham-controlled pilot study involving 30 adolescents (aged 12–17) with attention-deficit/hyperactivity disorder (ADHD), the safety and efficacy of TPS were investigated. The SNAP-IV scale showed a 30% reduction in symptoms in the TPS group, which persisted for up to three months. No serious adverse effects were reported. The study confirms the safety and preliminary efficacy of TPS in ADHD, though long-term data and comparisons with established therapies are lacking ⁷.

A systematic review of the safety of TUS involving 677 participants across 35 studies (healthy volunteers, patients with chronic pain, dementia, epilepsy, and depression) found no serious adverse effects. Mild symptoms such as headaches, mood deterioration, or local skin irritation were reported in 3.4% of participants. The study confirms the favourable safety profile of TUS, though systematic data on long-term risks and specific patient groups are lacking ¹⁶.

A consensus paper by the International Transcranial Ultrasonic Stimulation Safety and Standards Consortium (ITRUSST) defines safety thresholds for mechanical and thermal effects of TUS. For mechanical effects, a mechanical index (MI) or transcranial MI (MI_{tc}) of ≤ 1.9 is considered safe. For thermal effects, three criteria are specified: a temperature increase of $\leq 2^\circ\text{C}$, an absolute temperature of $\leq 39^\circ\text{C}$, or a thermal dose of ≤ 2 CEM43 in brain tissue. The recommendations are based on expert consensus and serve as guidance but do not replace regulatory requirements ¹⁷.

HYPOTHESIS

The available data suggest that TUS and TPS have a favourable safety profile, particularly when compared to invasive or high-intensity stimulation methods. The reported mild adverse effects are mostly transient and locally limited. However, systematic long-term studies are lacking to assess rare or delayed risks, particularly with repeated use or in vulnerable populations.

What is lacking: Systematic long-term studies on the safety of TUS with repeated use, particularly in clinical populations with comorbid conditions, as well as standardised protocols for the recording and reporting of adverse effects.

Overall Picture

The available studies demonstrate that Transcranial Pulse Stimulation (TPS) and Transcranial Ultrasound Stimulation (TUS) are promising non-invasive methods for modulating neural functions. In the domains of motor function, cognition, and psychiatry, significant effects on cortical excitability, motor function, depressive symptoms, and cognitive performance have been observed. The studies report acute and, in some cases, sustained improvements, particularly in neurodegenerative conditions such as Alzheimer's and Parkinson's disease, as well as in depressive disorders. However, the mechanisms underlying these effects are not yet fully elucidated and appear to depend on stimulation parameters such as pulse repetition frequency, intensity, and target region.

The evidence on the safety and tolerability of TPS is promising but still limited. Some controlled human studies report no or only mild, transient adverse effects. Nonetheless, systematic investigations into long-term effects, particularly with repeated use or in vulnerable populations, are lacking. Additionally, active control conditions, larger sample sizes, and standardised protocols are often absent in controlled studies, limiting the assessment of clinical relevance and generalisability of the findings.

Methodology of the Evidence Base

["Studies on TPS encompass a broad range of designs, including randomised, double-blind, sham-controlled trials, open-label pilot studies, and systematic reviews. Observational studies form a significant part of the evidence base. Typical studies last between two and four weeks, with stimulation sessions of 30 to 60 minutes and follow-up periods of up to three months. Primary endpoints often include neurophysiological measures such as motor-evoked potentials (MEP), functional imaging (fMRI, MEG), or clinical scales (e.g., UPDRS, MADRS, CERAD). However, systematic long-term studies with follow-ups extending over several months or years, active control conditions (e.g., comparisons with established therapies), and standardised stimulation protocols are lacking. Furthermore, sample sizes are often small and heterogeneous, limiting the generalisability of the results."]

TPS: A Promising Approach with Limited Clinical Evidence

TRANSCRANIAL PULSE STIMULATION (TPS)

is frequently described in the literature as a "novel, non-invasive method with high potential." Indeed, controlled studies provide initial evidence of feasibility and safety, particularly in cognitive disorders and neuropsychiatric conditions. However, the clinical evidence base remains limited. The majority of controlled studies are pilot studies with small sample sizes, which, while reporting significant effects, do not permit definitive conclusions. Furthermore, long-term studies investigating sustained effects or risks are lacking. Another issue is the lack of standardisation: varying stimulation parameters, target regions, and outcome measures complicate the comparability of results. While the ITRUSST initiative has proposed guidelines, these have yet to be widely implemented.

A KEY CRITICISM

concerns the transferability of laboratory findings to clinical practice. Many basic research studies demonstrate neural plasticity effects or changes in brain activity patterns, but these do not necessarily correlate with clinical improvements. For example, some studies report changes in theta-wave activity or motor excitability without deriving therapeutic implications. Additionally, sham control in TPS studies is methodologically challenging, as the stimulation does not produce noticeable sensations. This increases the risk of placebo effects or expectation biases, which may distort results. Research in this area is still in its early stages, and larger, multicentre studies are needed to evaluate the clinical relevance of the findings.

3. How Robust the Research Is

The evaluated studies on TPS are distributed across human research, with a focus on observational investigations and controlled trials. Most controlled studies address cognitive functions and safety aspects, followed by applications for fatigue syndromes, cardiovascular diseases, musculoskeletal disorders, and skin conditions. The most cited controlled studies primarily examine depression, Alzheimer’s dementia, and attention deficit/hyperactivity disorder (ADHD), though pilot studies often feature small sample sizes. Review articles and mechanistic studies dominate the most cited publications overall, indicating a strong interest in fundamental scientific questions. Notably, older studies frequently employ observational designs, while controlled trials have only become more common in recent years.

The methodological robustness of TPS research is inconsistent. While controlled studies with randomised, double-blind designs (e.g., on depression or Alzheimer’s) demonstrate high internal validity, long-term data and replication studies are often lacking. Many studies are pilot investigations with small sample sizes, which provide initial insights but limit generalizability. Safety data are robust within the examined parameters: no serious adverse effects have been shown, though long-term consequences remain insufficiently studied. A key issue is the heterogeneity of stimulation protocols, which complicates direct comparisons between studies. The ITRUSST consensus papers on standardised reporting and biophysical safety represent an important step toward improving reproducibility. Nevertheless, the clinical evidence in many application areas remains preliminary.

4. What Is Often Claimed—and What the Data Support

STATEMENT	EVIDENCE
Controlled studies show evidence of short-term effects in Alzheimer’s dementia, but long-term data and replications are lacking. The evidence is preliminary.	Controlled studies indicate evidence of short-term effects, but long-term data and replications are lacking. The evidence remains preliminary.
Safety data from controlled studies are robust for short-term applications, but long-term consequences are insufficiently studied.	Safety data from controlled studies are robust for short-term use, but long-term effects have not been sufficiently investigated.

STATEMENT	EVIDENCE
Pilot studies report significant effects in depression, but direct comparisons with established treatments are lacking. The data are not sufficiently robust .	Pilot studies report significant effects in depression, yet direct comparisons with established methods are lacking. The data are not sufficiently robust .
A controlled pilot study demonstrates short-term effects in ADHD, but long-term data and larger samples are necessary .	A controlled pilot study demonstrates short-term effects in ADHD, but long-term data and larger sample sizes are necessary .

5. The Most Robust Studies

Ranked by evidential strength, not by prominence. The full evaluation includes significantly more studies; only the most reliable are listed here.

Controlled Human Studies

- ¹ Mechanisms of theta burst transcranial ultrasound induced plasticity in the human motor cortex (2023)
- ² The effect of transcranial ultrasound pulse repetition frequency on sustained inhibition in the human primary motor cortex: A double-blind, sham-controlled study (2024)
- ³ Effects of Transcranial Pulse Stimulation (TPS) on Adults with Symptoms of Depression—A Pilot Randomised Controlled Trial (2023)
- ⁴ Effect of Low-Intensity Transcranial Focused Ultrasound Stimulation in Patients With Major Depressive Disorder: A Randomised, Double-Blind, Sham-Controlled Trial (2024)
- Current state of clinical ultrasound neuromodulation (2024)
- ⁵ Ultrasound Neuromodulation With Transcranial Pulse Stimulation in Alzheimer Disease: A Randomised Clinical Trial (2025)
- Inhibition of midfrontal theta with transcranial ultrasound explains greater approach versus withdrawal behaviour in humans (2023)
- ⁶ Transcranial pulse stimulation in the treatment of mild neurocognitive disorders (2023)
- Transcranial pulse stimulation in Alzheimer's disease (2024)
- ⁷ Efficacy and safety of transcranial pulse stimulation in young adolescents with attention-deficit/hyperactivity disorder: a pilot, randomised, double-blind study (2024)
- A retrospective analysis of ultrasound neuromodulation therapy using transcranial pulse stimulation in 58 dementia patients (2025)
- ⁸ Low-intensity transcranial ultrasound stimulation facilitates hand motor function and cortical excitability: A crossover, randomised, double-blind study (2022)
- Evaluating the efficacy and safety of transcranial pulse stimulation on adolescents with attention deficit hyperactivity disorder: Study protocol for a randomised controlled trial (2023)
- Transcranial ultrasound stimulation parameters for neurological diseases: a systematic review (2025)
- Focused low-intensity hippocampal transcranial ultrasound stimulation (TUS) for sleep disturbances in patients with chronic tinnitus: A study protocol (2025)
- ⁹ Neuromodulatory effects of transcranial pulse stimulation (TPS) in neurological and psychiatric disorders: A systematic review and meta-analysis (2025)
- ¹⁰ Effect of transcranial pulse stimulation on the treatment of Alzheimer's disease and its related symptoms (2023)
- ¹¹ Suppression of pathological oscillations with transcranial focused ultrasound in Parkinson's disease (2026)
- ¹² Neuromodulation in Parkinson's disease using transcranial pulse stimulation: Evidence of clinical efficacy and cortical oscillatory changes (2025)

- Commentary: Treating diseases from Alzheimer's to Parkinson's using transcranial pulse stimulation: Mechanistic insights, recent evidence, and ethical considerations (2025)
- A review of transcranial pulse stimulation: Innovations in neuromodulation (2025)
- ¹³ Prefrontal transcranial pulse stimulation for major depressive disorder: A randomised clinical trial (2026)
- ¹⁴ Focused and unfocused transcranial ultrasound stimulation in Alzheimer's disease: A systematic review and meta-analysis of randomised controlled trials (2026)
- ¹⁵ Transcranial Pulse Stimulation for Alzheimer's Patients (2025)

6. Summary

The available studies demonstrate the safety and feasibility of transcranial pulse stimulation (TPS) as a non-invasive neuromodulatory technique. Controlled studies show acute effects on motor excitability, cognitive functions, and depressive symptoms, particularly in Alzheimer's disease and major depression. The spatial precision and ability to reach deeper brain structures distinguish TPS from electromagnetic methods. Safety data confirm a favourable side-effect profile, with mild, transient symptoms such as headaches or local skin irritation reported. However, the methodological quality of the studies varies significantly, and many are pilot studies with small sample sizes, which limits the strength of the findings.

HYPOTHESIS

The observed effects of TPS on motor and cognitive functions may indicate modulation of neuronal networks and neuroplasticity in humans. The dependence of its effects on stimulation parameters such as pulse repetition frequency and duty cycle suggests that TPS can exert both excitatory and inhibitory effects. This could be relevant for the rehabilitation of motor disorders or the treatment of neuropsychiatric conditions. Improvements in functional connectivity in depression and Alzheimer's disease indicate that TPS can selectively influence networks critical for affective and cognitive processes. However, the underlying mechanisms are not yet fully understood, and the generalisability of the results to other diseases or populations remains unestablished. Should the preliminary findings be confirmed in larger studies, TPS could represent a promising adjunct to existing therapeutic approaches, particularly for conditions with limited treatment options.

To strengthen the clinical evidence, systematic studies with larger sample sizes, active control conditions, and long-term follow-ups are required. In particular, there is a lack of research on the sustainability of effects, the optimal stimulation dose and localisation for different applications, and the transferability of results from healthy populations to clinical groups. Standardisation of stimulation protocols and dosimetry, as proposed by the ITRUSST initiative, would be an important step toward improving reproducibility. Furthermore, future studies should investigate the long-term safety of TPS with repeated use in vulnerable populations, such as patients with neurodegenerative diseases or comorbid disorders. Mechanistic studies could help elucidate the neurobiological foundations of the observed effects and develop more targeted applications. Finally, a comparison with established therapeutic approaches would be necessary to contextualise the clinical utility of TPS within existing treatment options.

7. Unresolved Questions

- **Long-term effects:** Are there sustained clinical improvements or risks associated with repeated use?
- **Standardisation:** Which stimulation parameters (frequency, intensity, target region) are optimal for which indication?
- **Mechanisms:** How exactly does TPS modulate neuronal networks, and which biomarkers correlate with clinical effects?

Frequently Asked Questions

Can TPS be used for Parkinson's disease?

Observational studies show **evidence of motor improvements**, but controlled studies are lacking. The **evidence is preliminary** and insufficient to support a **clinical recommendation**. **Randomised, double-blind studies with long-term follow-up** would be crucial.

How does TPS differ from other non-invasive techniques such as TMS or tDCS?

TPS uses **focused ultrasound**, whereas TMS employs **magnetic fields** and tDCS uses **direct current**. TPS offers **higher spatial precision** and can reach **deeper brain structures**. However, the **stimulatory effects** are less well understood than those of TMS or tDCS. The **safety profiles** differ: TPS does **not induce muscle twitches**, which complicates **blinding**.

Are there any contraindications for TPS?

Safety studies show **no serious adverse effects** in the parameters investigated. However, **skull defects, metallic implants in the head region**, or **acute inflammation** are considered **relative contraindications**. The **long-term safety** of repeated use has **not been sufficiently studied**. The **ITRUSST guidelines** recommend an **individual risk-benefit assessment**.

Sources

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International Health Research

Research, put in context. Every statement leads to the original paper; the decision in the individual case rests with the treating professional.
ih-research.com/en/knowledge/transcranial-pulse-stimulation/ · Last updated 2026-10-15