

Introduction to MRgFUS for the Treatment of Essential Tremor

Essential tremor (ET) is one of the most common movement disorders, affecting many people worldwide. It is characterized by tremor on action (posture and movement). An abnormality at the output of the cerebellum to the thalamus is suspected, linked to a loss of Purkinje-type cells, creating hyperactivity in the thalamus and motor cortex leading to tremor. The tremor usually concerns the hands, but can affect also the lower extremities, the head or voice. ET can significantly impact daily activities such as writing, eating, or speaking. While medications and physical therapies offer relief for some, many patients with severe or medication-resistant tremors require more advanced treatment options.

Magnetic Resonance-guided Focused Ultrasound (MRgFUS) has emerged as a revolutionary, incisionless technique for managing essential tremor. Using high-frequency ultrasound waves precisely guided by MRI, this cutting-edge technology targets specific brain regions responsible for tremor generation, offering rapid and effective symptom relief.

How It Works

- **Targeting Precision:** MRI imaging allows for accurate visualization of brain structures, enabling precise focus on targeted areas
- **Controlled Energy Delivery:** Ultrasound energy is applied in a controlled manner to achieve therapeutic effects without damaging surrounding tissues.
- **Real-time Monitoring:** MR thermometry monitors temperature changes during the procedure to ensure safety and efficacy.

Advantages

1. No incision and no penetration: Eliminates risks of infection and significantly reduces the bleeding risk (e.g., 0 > 650 targets performed in the clinic SoniModul).
2. No implanted material
3. Accuracy in targeting (0.5–1 mm) thanks to the absence of brain penetration (no shift).
4. Intraoperative targeting and monitoring options via MRI.
5. No general anesthesia required.
6. No ionizing radiation used.

Our approach, inherited from Sonimodul and many other pioneers in functional neurosurgery, does not target the thalamus, but the nerve fibers coming from the brain before reaching the thalamus. This approach, in our view, is more sparing on the nervous system, as it does not directly affect the thalamus, leaving it free to reconnect as it sees fit, after having freed it from the now deleterious afferences of the cerebello-thalamic pathway, an overactive pathway indirectly targeted by the thalamic approach, which targets the ventral part of the lateral ventral nucleus (VLpv), aka Vim nucleus. This is not, as is sometimes claimed, a basal thalamotomy, but another target located a few millimeters below the thalamus.

MRgFUS offers a life-changing option for those living with essential tremor, providing relief from symptoms that medications or other treatments may not address effectively. This innovative therapy is transforming the landscape of movement disorder management, empowering patients to regain control over their lives.

Example of a 72 year-old Patient with Left dominant Essential Tremor drawing a spiral without resting his arm on the table at baseline and 1 year after right-sided cerebellothalamic tractotomy with the MRgFUS (MRgFUS CTT) as well as straight lines :

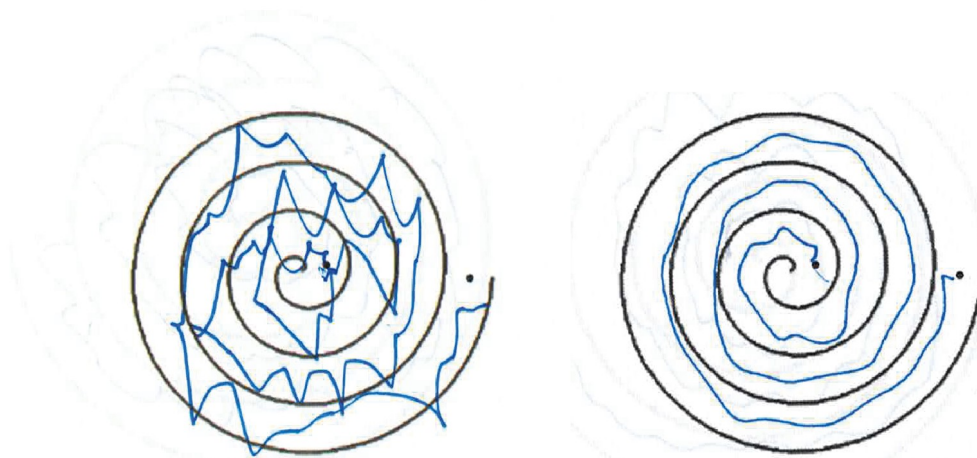
Baseline

1 Year after Right CTT

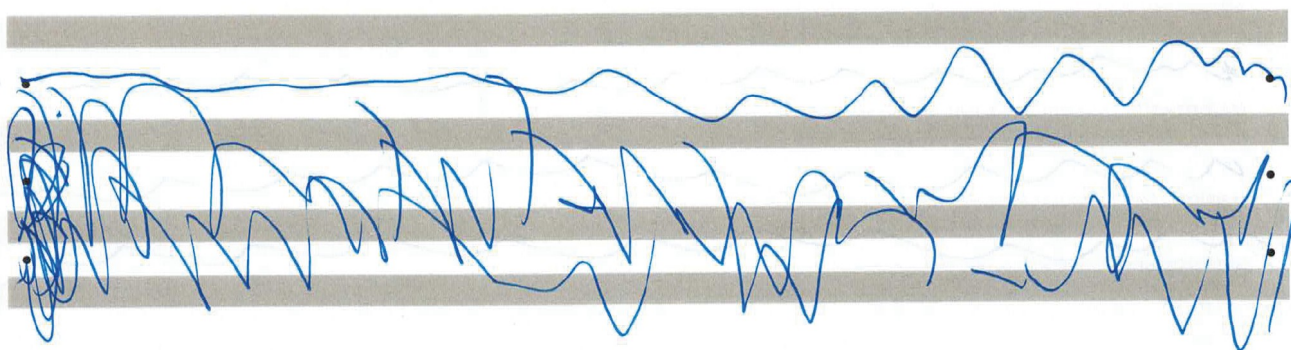
X Left Hand

Right Hand

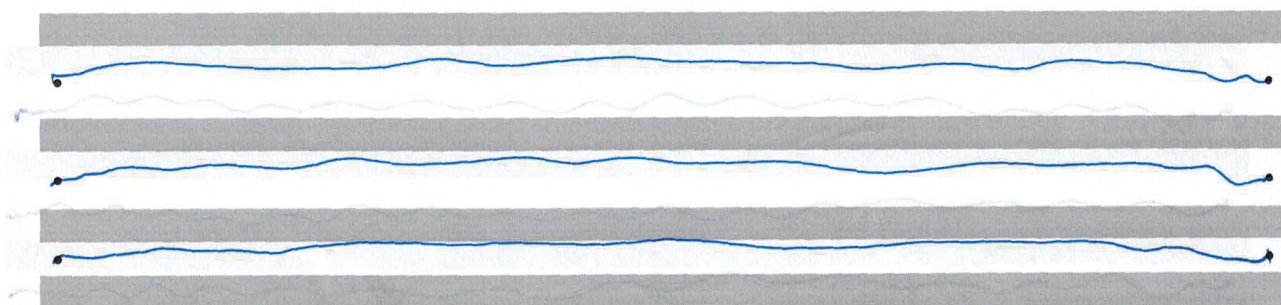
DRAWING B



DRAWING C



DRAWING C



Candidacy and Next Steps

MRgFUS is suitable for patients with:

- Essential tremor unresponsive to medication or experiencing side effects.
- Moderate to Severe tremor significantly impacting daily life.
- No major cognitive impairments or contraindications for MRI.

Further reading: [Section three of the *Habilitation – thesis* «Incisionless transcranial MR-guided focused ultrasound functional neurosurgery»](#), written by PD Dr. med. Marc Gallay

How to Proceed

You can contact us either through your treating physician or by sending us a request at info@sifus.ch.

Peer-reviewed articles about how we treat Essential tremor with the MRgFUS technology:

1. [Gallay MN, Moser D, Jeanmonod D. MR-guided focused ultrasound cerebellothalamic tractotomy for chronic therapy-resistant essential tremor: anatomical target reappraisal and clinical results. J Neurosurg. Published online February 7, 2020:1-10.](#)
2. [Gallay MN, Jeanmonod D, Liu J, Morel A. Human pallidothalamic and cerebellothalamic tracts: anatomical basis for functional stereotactic neurosurgery. Brain Struct Funct. 2008;212\(6\):443-463. doi:10.1007/s00429-007-0170-0](#)
3. [Gallay MN, Moser D, Rossi F, et al. Incisionless transcranial MR-guided focused ultrasound in essential tremor: cerebellothalamic tractotomy. J Ther Ultrasound. 2016;4:5.](#)
4. [Gallay MN, Moser D, Jeanmonod D. Safety and accuracy of incisionless transcranial MR-guided focused ultrasound functional neurosurgery: single-center experience with 253 targets in 180 treatments. J Neurosurg. 2019;130\(4\):1234-1243. doi:10.3171/2017.12.JNS172054](#)