# Team Approach Improves Targeting of Focused Ultrasound Treatment for Essential Tremor

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Pharmacotherapies have shown only limited success in the treatment of essential tremor, and while deep-brain stimulation of the ventral lateral nucleus of the thalamus has been available for decades, many patients still do not receive adequate care for the condition, significantly affecting their quality of life. MRI-guided focused ultrasound (MRgFUS) is now also being used to treat essential tremor with unilateral thalamic ablation. Whereas earlier ultrasound equipment required a craniotomy to create a window for the acoustic waves, modern ultrasound transducers and techniques eliminate the need to open the skull, allowing for a noninvasive procedure that can be used in treating essential tremor.
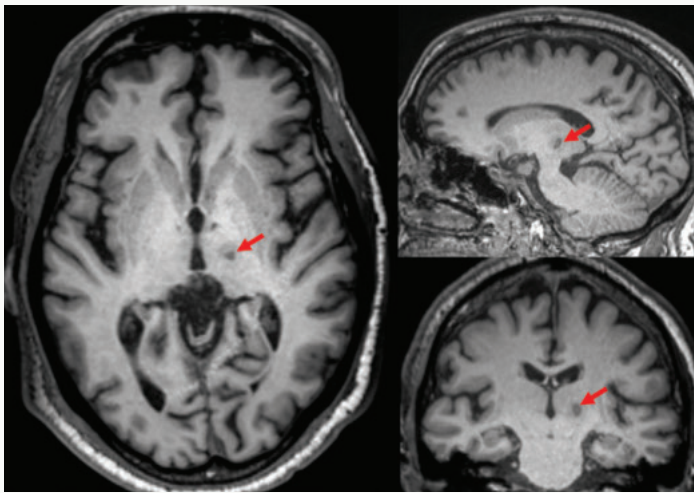
T1 axial, coronal and sagittal imaging after the MRg FUS. Red arrow shows ablation area in the left Vim nucleus. The patient's symptom significantly improved during the MRgFUS.

Computed tomography (CT) is used to assess the skull thickness, with CT data being registered with magnetic resonance (MR) images to allow proper targeting through the skull. Real-time MR imaging and thermometry improve target accuracy as ultrasound energy is concentrated at the target location from an ultrasound helmet with a multielement hemispheric phased array transducer. The procedure ablates the target tissue, creating a lesion at the site while sparing adjacent tissue.

Results of a clinical study comparing MRgFUS thalamic ablation to a sham procedure indicated that the ablation procedure improved tremor symptoms (expressed on a scale of 0 to 32 using the Clinical Rating Scale for Tremor) by an average of 47 percent at three months. This compares to an improvement of just 0.1 percent for the sham procedure.

Anatomical Targeting

Precise targeting is a key to achieving optimal clinical outcomes. "The target is a very tiny structure," notes Noriko Salamon, MD, PhD, professor of radiology and neuroradiology at the David Geffen School of Medicine at UCLA. "When precision is not perfect, outcomes will vary among patients."

Targeting thalamic ablation is sometimes done based solely on a series of measurements from the center of the thalamus. Because the size of the thalamus is relatively consistent from person to person, and the sizes and locations of its internal components also vary only slightly, this system produces a moderately accurate treatment target. This has led some to believe that the procedure can be performed without information on the individual's specific anatomy provided by a neuroradiologist. "Measurements usually get you close, but I think we do better having an anatomical specialist — the neuroradiologist — contribute to targeting. Subtle technical differences can make a big difference in outcomes," states Dr. Salamon.

One technique that UCLA neuroradiologists use to more precisely locate the ventral lateral nucleus and asses its connectivity is diffusion tensor imaging. Because structures deep in the brain are connected to the superficial cortex by a series of white matter fibers, the fibers can be traced from the cortex to their corresponding deep-brain structures.

"Fiber tractography is a 3D reconstruction technique used to assess white-matter tracts using diffusion tensor imaging data," explains Dr. Salamon. "It reveals the fiber connections allowing me to avoid motor fibers and pick up the exact tract responsible for the tremor."

Integrated, Interdisciplinary Care

The integrated interdisciplinary approach to neurological disorders at UCLA ensures these crucial collaborations take place. But interdisciplinary collaboration isn't just a byproduct of UCLA's clinical structure, it's woven into the institutional fabric. "Experts from many areas come together and exchange ideas before making a decision," states Dr. Salamon. "That's part of the culture at UCLA, which is not easy to accomplish." Dr. Salamon believes that these collaborations have been important in making her a better, more effective clinician. Working in isolation, she can extract from an image what is meaningful to her, but her regular exchanges with physicians in other specialties have taught her to recognize what in an image will be most meaningful to them as well. ®