

The Role of Treatment-Related Parameters and Brain Morphology in the Lesion Volume of Magnetic-Resonance-Guided Focused Ultrasound Thalamotomy in Patients with Tremor-Dominant Neurological Conditions

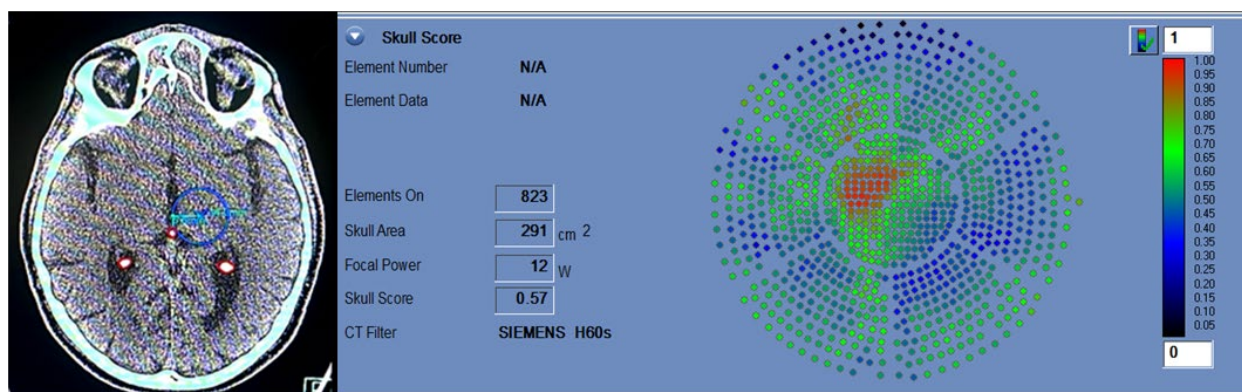


Figure S1. CT imaging. SDR, Skull Area and numbers of elements in use were calculated to evaluate treatment eligibility.

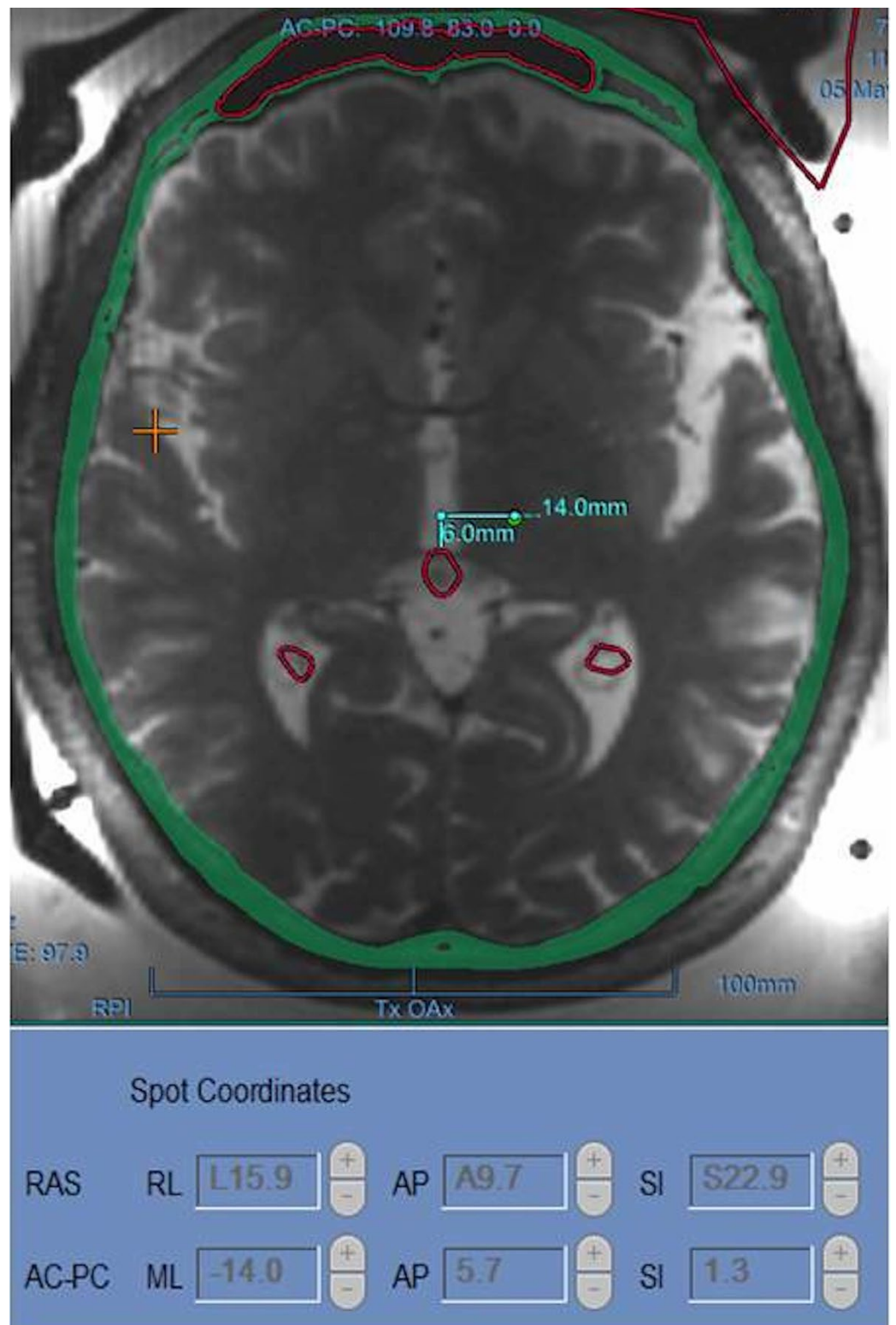


Figure S2. MRgFUS: Target position on the T2-weighted image.

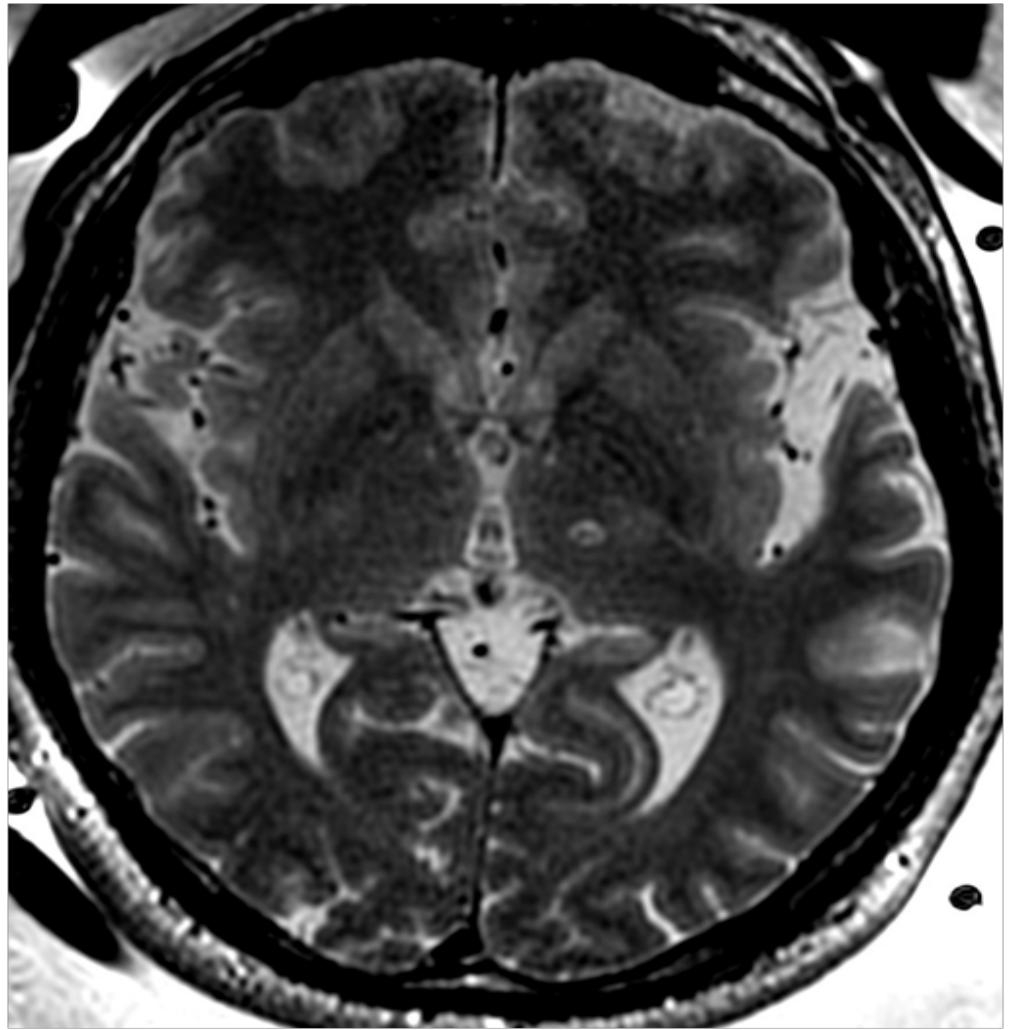


Figure S3. Axial FRFSE T2-weighted images after MRgFUS. The image shows the resulting thalamic lesion. The necrotic core appears hypointense and is surrounded by cytotoxic edema.

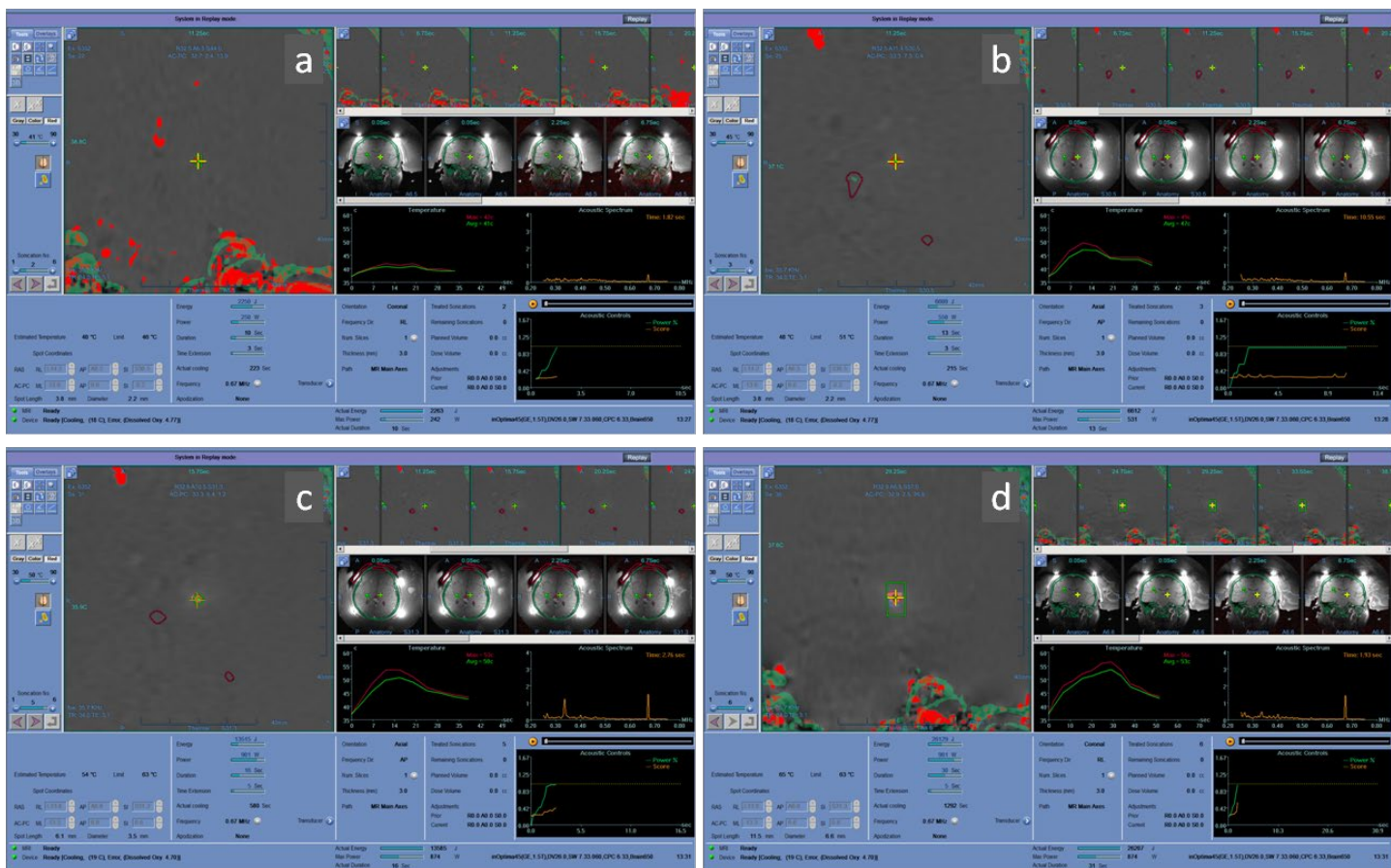


Figure S4. MRgFUS treatment- MR-thermometry procedure: a) Alignment; b) Verification; c-d) Treatment.



Figure S5. ATD is calculated from the thermometric map of the last sonication drawing a manual ROI on the target.

Table S1. Brain structural characteristics of the ET and PD population before MRgFUS treatment.

	PD (n = 19)	ET (n = 17)	<i>p-value</i> ^e
Normalized GM Volume (cm ³)	323.2 ± 34.2	329.7 ± 37.3	n.s.
Normalized WM Volume (cm ³)	296.5 ± 37.1	288.4 ± 46.3	n.s.
Normalized CSF Volume (cm ³)	378.5 ± 44.8	375.7 ± 52.8	n.s.
Normalized Brain Volume (GM+WM) (cm ³)	619.9 ± 48.4	618.2 ± 49.3	n.s.
Total Cortical Thickness (mm)	2.51 ± 0.2	2.59 ± 0.1	n.s.

Abbreviations: n.s.: not significant

Table S2. Characterization of incident Adverse Events observed during MRgFUS

	PD (n = 19)	ET (n = 17)	<i>p-value</i> ^e
Motor Fluctuations	1	3	0.999
Dyskinesias	0	1	0.999
Impulse control disorder	1	2	0.999
Nausea	0	2	0.540
Leg edema	1	1	0.999
Hypotension	0	3	0.532
Daytime sleepiness	0	4	0.272
Anxiety/agitation	0	2	0.540
Skin reaction to rotigotine	0	2	0.540
Nausea/vomit	6	NA	NA
Scalp Numbness	1	NA	NA
Dizziness	6	NA	NA
Headache	2	NA	NA
Uncomfortable heat sensation	3	NA	NA
Anxiety	1	NA	NA
Neck pain	1	NA	NA

Abbreviations: AE, Adverse Event; MRI, Magnetic Resonance Imaging; PD-FUS, NA, Not Applicable.

Table S3. Clinical changes in motor and tremor scores before and after MRgFUS treatment.

	Baseline	Post-treatment	% Improvement	p-level
Total UPDRS score (PD patients)	37.3 ± 12.5	29.7 ± 11.7	28.8 ± 15.8	p < 0.001
Hemi-UPDRS (<i>affected side</i>) (PD patients)	23.3 ± 6.6	15.8 ± 7.3	34.7 ± 16.5	p < 0.001
Total CRST score (ET patients)	58.3 ± 15.2	36.4 ± 12.1	38.7 ± 11.8	p < 0.001
Hemi-CRST (<i>affected side</i>) (ET patients)	42.4 ± 12	20.3 ± 6.8	52.6 ± 13.9	p < 0.001
% Clinical improvement for treated right-VIM ablation (n° 16)				
Total UPDRS score	36.6 ± 11.7	29.6 ± 11.7	19.1 ± 10.1	p < 0.001
Hemi-UPDRS (<i>affected side</i>)	23.1 ± 7.3	16.1 ± 8.4	30.3 ± 8.1	p < 0.001
Total CRST score	51.2 ± 22.6	30.2 ± 16.8	41.1 ± 19.9	p < 0.001
Hemi-CRST (<i>affected side</i>)	35.5 ± 17.6	16 ± 10.95	54.9 ± 16.7	p < 0.001
% Clinical improvement for treated Left-VIM ablation (n° 20)				
Total UPDRS score	38.5 ± 14.7	30 ± 12.6	22.1 ± 11.8	p < 0.001
Hemi-UPDRS (<i>affected side</i>)	23.6 ± 5.8	15.1 ± 5.9	36 ± 5.9	p < 0.001
Total CRST score	60.4 ± 12.6	38.3 ± 10.4	36.6 ± 11.9	p < 0.001

Skull Density Ratio (SDR), Max_Watt: maximum energy delivered (watt); Max_Joule: maximum power delivered (joule); Max_Time: maximum sonication time delivered; T°C_max: maximum mean temperature reached; ATD: accumulated thermic dose; N.S. not significant

Table S5. Simple linear regression among procedural MRgFUS parameters in PD patients (n°19).

	SDR	Skull area	n° of elements	n° of sonications	Max_Watt	Max_Joule	T°C_max	Max_Time	ATD	Necrosis-volume	Edema volume	Delta Total UPDRS	Delta Hemi-UPDRS
SDR		n.s	n.s	n.s	n.s	Rho = -.664; <i>p</i> = .002	n.s	Rho = -.597; <i>p</i> = .007	n.s	n.s	n.s	n.s	n.s
Skull area			Rho = .468; <i>p</i> = .043	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	Rho =-.469; <i>p</i> = .043	n.s
n° of elements				n.s	n.s	n.s	n.s	n.s	n.s	Rho = -.621; <i>p</i> = .005	Rho = -.464; <i>p</i> = .046	n.s	n.s
n° of sonications					n.s	Rho = .547; <i>p</i> = .015	n.s	n.s	n.s	n.s	n.s	n.s	n.s
Max_Watt						Rho =.729; <i>p</i> < .0001	Rho = -.558; <i>p</i> = .013	Rho = .611; <i>p</i> = .005	Rho = -.487; <i>p</i> = .035	n.s	n.s	n.s	n.s
Max_Joule							Rho = -.68; <i>p</i> = .001	Rho = .879; <i>p</i> < .0001	Rho = -.667; <i>p</i> = .002	n.s	n.s	n.s	n.s
T°C_max								Rho = -.612; <i>p</i> = .005	Rho = .715; <i>p</i> = .001	n.s	Rho = .477; <i>p</i> = .039	n.s	n.s
Max_Time									Rho = -.627; <i>p</i> = .004	n.s	n.s	n.s	n.s
ATD										n.s	n.s	n.s	n.s

Necrosis volume		Rho = -.623; <i>p</i> =.004	n.s	n.s
Edema volume			n.s	n.s
Delta_Total_UPDRS				Rho = .956; <i>p</i> <.0001
Delta_Hemi_UPDRS				

Table S6. Simple linear regression among procedural MRgFUS parameters in ET patients (n°17).

	SDR	Skull area	n° of elements	n° of sonications	Max_Watt	Max_Joule	T°C_max	Max_Time	ATD	Necrosis- volume	Edema volume	Delta Total CRST	Delta Hemi- CRST
SDR		n.s	n.s	n.s	n.s	n.s	n.s	Rho = -.528; <i>p</i> = .029	Rho = .530; <i>p</i> = .029	n.s	n.s	n.s	n.s
Skull area			Rho = .642; <i>p</i> = .005	n.s	n.s	n.s	n.s	n.s	Rho = .548; <i>p</i> = .023	Rho = .495; <i>p</i> = .043	n.s	n.s	n.s
n° of elements				n.s	n.s	n.s	n.s	n.s	Rho = .502; <i>p</i> = .040	n.s	n.s	n.s	n.s
n° of sonications					n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s
Max_Watt						Rho =.674; <i>p</i> = .003	n.s	Rho = .515; <i>p</i> = .034	n.s	n.s	n.s	n.s	n.s
Max_Joule							n.s	Rho = .502; <i>p</i> =.040	Rho = -.640; <i>p</i> = .006	n.s	n.s	n.s	n.s
T°C_max								n.s	Rho = .657;	Rho = .672;	Rho = .589;	n.s	n.s

			$p = .004$	$p = .003$	$p = .013$		
Max_Time			Rho = -.488; p = .047	n.s	n.s	n.s	Rho = -.538; $p = .026$
ATD				n.s	n.s	n.s	n.s
Necrosis volume					n.s	n.s	Rho = -.545; $p = .024$
Edema volume						n.s	n.s
Delta_Total_CRST							Rho = .793; $p < .0001$
Delta_Hemi_CRST							