

Anatomical and Clinical Correlates in MR-Guided Focused Ultrasound for Movement Disorders: A Prospective Cohort Analysis

WSSFN 2025 Interim Meeting. Abstract 0094.

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How to Cite: Rivera F, Quintanal Cordero NE, Pampin S, Barbosa N, Etcheverry JL, David T, et al. Anatomical and Clinical Correlates in MR-Guided Focused Ultrasound for Movement Disorders: A Prospective Cohort Analysis: WSSFN 2025 Interim Meeting. Abstract 0094. NeuroTarget. 2025;19(2):68-9.

Abstract

Introduction: Magnetic resonance-guided focused ultrasound (MRgFUS) has emerged as a noninvasive alternative for the treatment of movement disorders such as Parkinson's disease (PK) and essential tremor (ET). Understanding the relationship between patient age, gender, anatomy, targeting parameters, and clinical outcomes is key to optimizing therapeutic efficacy.

Method: We prospectively analyzed 48 consecutive patients who underwent MRgFUS for functional neurosurgery, at our center in Argentina, between December 2024 and June 2025. Patient demographics, anatomical measurements, targeting coordinates, and clinical outcomes were collected. Pearson correlation and regression analyses were conducted to explore associations between variables. ($p < 0.05$ considered statistically significant). Patient consent was obtained to share this information.

Results: The cohort consisted of 26 males (54.2%) and 22 females (45.8%) patients with a mean age of 69.2 ± 11.6 years (range: 25–88). Age did not differ significantly between diagnostic groups (PD: 68.4 ± 6.8 vs ET: 70.9 ± 13.0 years, $p = 0.437$) or targeting strategies (ventral intermediate nucleus-VIM: 70.5 ± 10.9 vs. nucleus subthalamicus-NST: 66.4 ± 6.4 years, $p = 0.147$), but was slightly positively correlated with AC-PC distance ($r = 0.304$, $p = 0.04$). No significant correlations were found between age and targeting coordinates or clinical outcomes. Males had significantly larger AC-PC distances than females (25.8 ± 1.3 mm vs 24.3 ± 1.1 mm, $p < 0.001$), though gender was not associated with clinical outcomes. The anterior AC-PC distance demonstrated a negative correlation with the Y-coordinate ($r = -0.303$, $p = 0.048$) and a positive correlation with the Z-coordinate ($r = 0.450$, $p = 0.002$), suggesting that individual anatomical variation influences target localization. Finally, a moderate but statistically significant positive correlation was confirmed between objective and subjective improvement measures ($r = 0.474$,

$p = 0.001$), validating the consistency between physician assessment and patient-reported outcomes.

Discussion: The reported clinical outcomes from a single Argentinian center highlight the importance of systematically recording variables such as age, sex, anatomical characteristics, and targeting parameters, and of incorporating these factors into the analysis to optimize outcomes and enhance the effectiveness of the procedure. Our results show a correlation between age and AC-PC distance, indicating that older patients have larger anterior commissure-posterior commissure measurements. The correlation between objective and subjective clinical improvement measures that we obtained validates the consistency between physician assessment and patient-reported outcomes.

Conclusions: Our findings emphasize key anatomical and clinical correlations influencing MRgFUS targeting and possibly also clinical outcomes. These insights may guide personalized targeting strategies and improve outcome prediction in functional neurosurgery.

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