

## **Predicting Patient-Initiated Procedural Stoppages during Focused Ultrasound Thalamotomy for Essential Tremor**

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Magnetic resonance imaging-guided focused ultrasound thalamotomy (FUS) is an incisionless neurosurgical technique to treat medically refractory essential tremor and parkinsonian tremor, often serving as an alternative to deep brain stimulation. FUS uses precisely targeted ultrasound energy to heat and ablate brain tissue. The procedure is performed in stages, known as sonications, lasting 10-30s with the patient awake inside an MRI scanner; with each sonication, it becomes more difficult to achieve the temperatures required for tissue ablation. During treatment, the patient can voluntarily halt the procedure if adverse effects, such as headache/head pressure, vertigo, and nausea, become intolerable. These patient-initiated procedural stoppages (PIPS) challenge treatment completion and may result in suboptimal outcomes.

This study aims to develop a predictive model for risk of PIPS using variables available to the operator preoperatively or prior to each sonication. A retrospective analysis was conducted on 50 patients who underwent FUS at IU, each with multiple treatment sonications. The primary outcome was whether a procedure was voluntarily halted due to sonication effects. Pretreatment factors include age, sex, skull density ratio, skull area available for treatment, and number of ultrasound transducer elements; intraoperative factors include sonication number, prescribed power and duration, maximum lesion temperature achieved, and dose area.

A multivariate logistic regression was created using a bidirectional stepwise selection fitted for the Akaike Information Criterion. Model performance was evaluated using receiver operating characteristic (ROC).

Increased input duration was significantly associated with increased odds of PIPS (OR 1.14, 95% CI: 1.05-1.22,  $p < 0.001$ ), while higher maximum lesion temperature approached significance for a risk-reducing effect (OR = 0.84, 95% CI: 0.71-1.00,  $p = 0.051$ ). ROC analysis revealed an AUC of 0.85 (95% CI: 0.74-0.95), indicating strong predictive accuracy. As a preliminary model, further data collection and validation are needed to improve stability and confirm clinical applicability.