

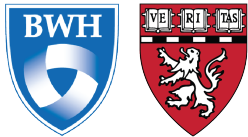
# Lesion Characteristics and Evolution Following Focused-Ultrasound Thalamotomy for Essential Tremor

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## Introduction

MRI-guided focused ultrasound (FUS) is a new technique that allows for the creation of lesions in the brain non-invasively. FUS thalamotomy targeting the ventral intermediate nucleus of the thalamus (Vim) has been shown to be an effective treatment of medication-resistant essential tremor. This project aimed to measure the location, volume and evolution of the FUS thalamotomy lesion and correlate it with clinical outcome.

## Methods

Immediate and 24-hour post-treatment MRI studies were analyzed for 7 patients treated at Brigham and Women’s Hospital. Imaging studies were analyzed using open-source software Slicer 3D. Each patient’s studies were registered to each other using ACPC registration. Distances were measured on thin-slice T2-weighted images and volumetric segmentation was measured on T2 and FLAIR studies. Bivariate Pearson Correlation statistical analysis was done on SPSS. Clinical outcome was assessed using the CRST.

## Results (I)

- Lesion locations in the LR and AP plane were within 1mm of each other on the immediate and 24-hour post-op MR studies

## Results (II)

- Volume of necrosis, cytotoxic edema and perilesional edema increased by an average of 0.018cc, 0.135cc and 0.852cc, respectively over 24 hours; constituting a percent change of 239%, 393% and 355% respectively
- Total signal (lesion+edema) was on average 0.4cc larger on FLAIR imaging compared to T2-weighted imaging, constituting a 27% difference in volume
- Improvement in the motor component of the CRST score in the treated upper extremity (contralateral to thalamotomy) at one month was correlated with immediate post-op volumes of necrotic core (r=-0.860, p=0.028) and cytotoxic edema (r=-0.841, p=0.036), but not with their volumes at 24 hours
- No correlation was seen for the tremor component of the CRST score of the treated upper limb or either component of the untreated side

## Conclusions

- Post-treatment lesion location was stable on all images but volumes of the necrotic core and surrounding edema increased substantially in the 24hour post-treatment period
- Thin-slice T2-weighted imaging underestimates the extent of edema 24-hour post-op relative to FLAIR studies
- There was a statistically significant correlation between improvement in the motor component of the CRST score for the treated upper extremity with the volume of necrotic core and cytotoxic edema immediately post-op
- The predilection for inferior extension of edema should be taken into account in target planning

Immediate Post-Treatment

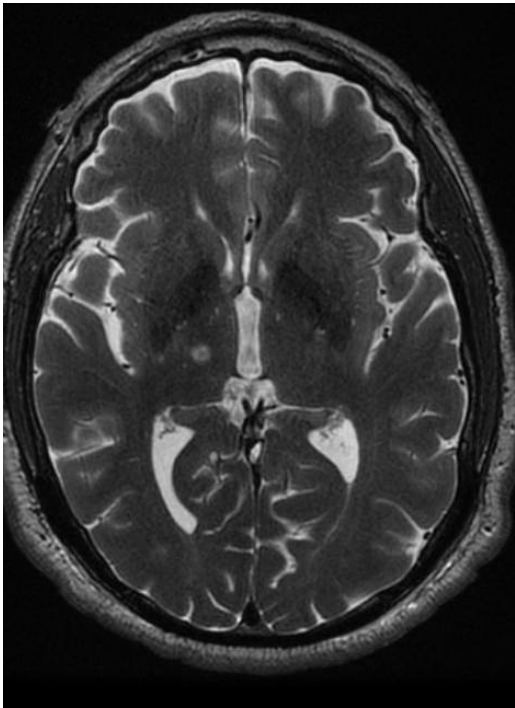


Figure 1 -T2 axial image of R-sided thalamotomy lesion immediately post-treatment



**Video** - 3D-model of R-sided thalamotomy lesion at 24HR post-treatment. Necrotic core (orange), cytotoxic edema (yellow), perilesional edema (blue)

24-Hours

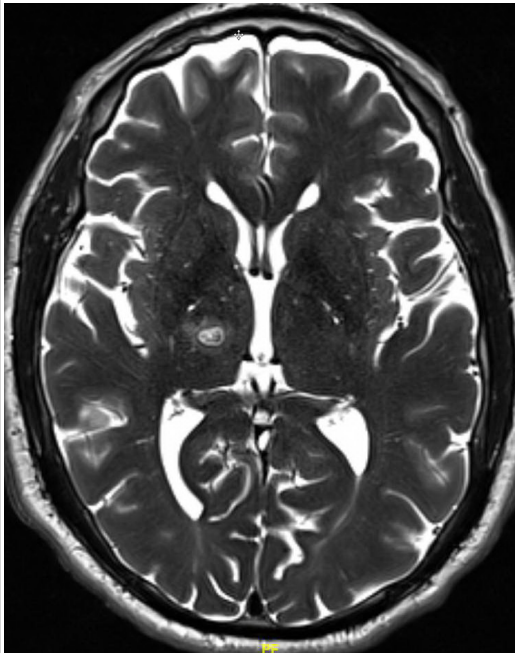


Figure 2- T2 axial image of R-sided thalamotomy lesion at 24HR post-treatment

## References

- Elias WJ, Lipsman N, Ondo WG, et al. A Randomized Trial of Focused Ultrasound Thalamotomy for Essential Tremor. New England Journal of Medicine. 2016;375(8):730-739.
- Jolesz FA, McDannold N. Current status and future potential of MRI-guided focused ultrasound surgery. Journal of magnetic resonance imaging : JMRI. 2008;27(2):391-399
- Wintermark M, Druzgal J, Huss DS, et al. Imaging findings in MR imaging-guided focused ultrasound treatment for patients with essential tremor. AJNR Am J Neuroradiol. 2014;35(5):891-896.