

# Navigating the Thalamus: Role of Stereotactic Radiosurgery in the Management of Brain Metastases — A Retrospective Study From a Single Institution

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## INTRODUCTION

- The thalamus, known as the neural processor and integrator for forebrain activities, is an uncommon site for metastatic lesions. Stereotactic radiosurgery (SRS) has become a key non-invasive treatment for brain metastases.

## OBJECTIVES

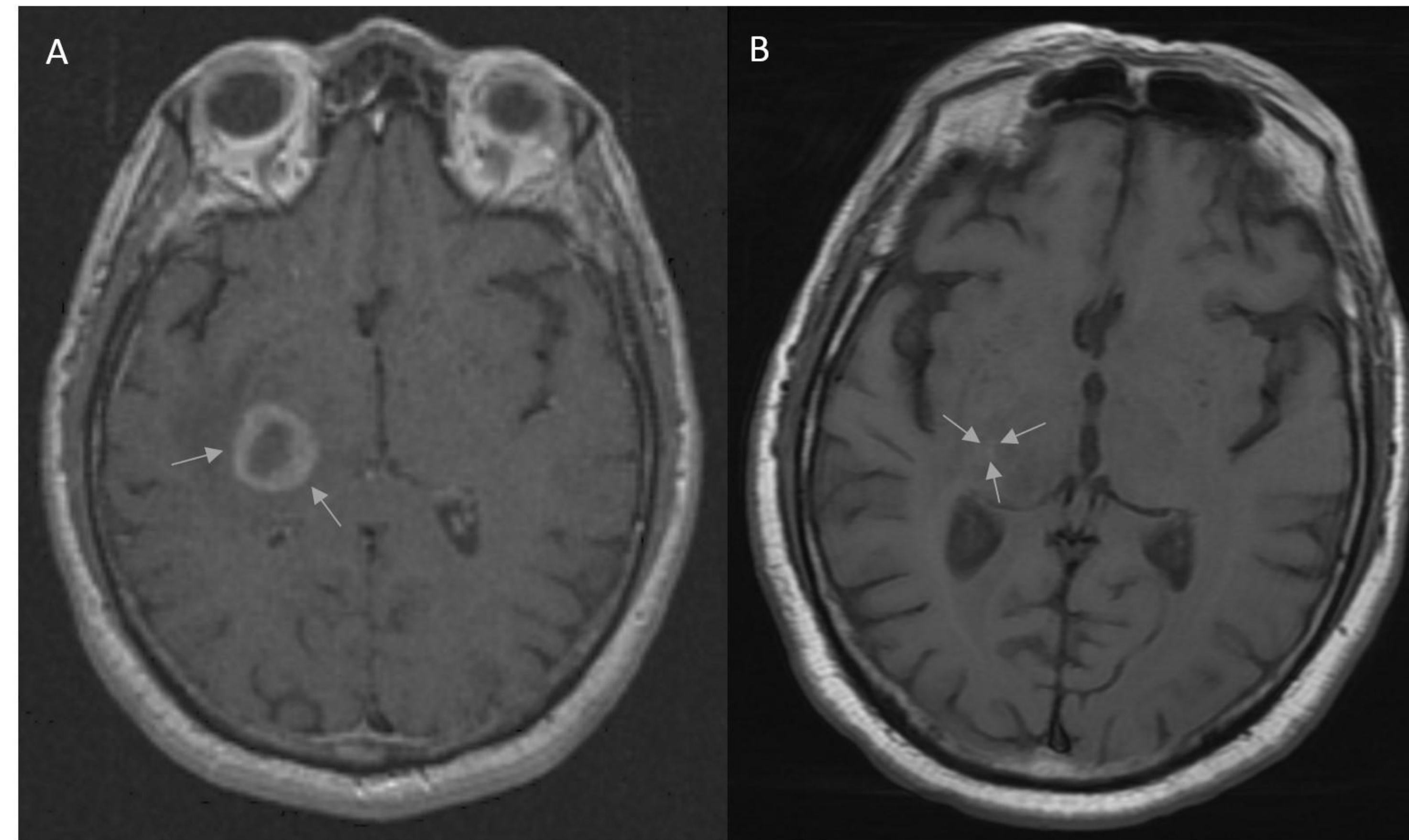
- This study aims to assess the efficacy, safety, and clinical outcomes of SRS in patients with thalamic metastases, focusing on local control, overall survival, neurological outcomes, and factors influencing treatment response

## METHODS

- We retrospectively reviewed cases of BM in thalamus treated with SRS at our institute between 2002 and 2024. A total of 49 lesions from 47 patients were included. Demographic, clinicopathologic, radiologic and treatment data were collected. Statistical analyses included binomial Logistic Regression, Chi-square test, independent t-test, and Mann-Whitney U test where appropriate. Survival outcomes were assessed using Kaplan-Meier analysis, and model performance was evaluated using receiver operating characteristic (ROC) analysis.

**Table 4. Outcomes of SRS for patients with thalamic brain metastasis**

Cumulative local control rates	Value
6-month	100%
9-month	90%
12-month	82.5%
24-month	77.6%
Progression free survival rates	
6-month	83.8%
9-month	72.2%
12-month	60%
24-month	45.3%
Overall survival rates	
6-month	91.4%
12-month	89.1%
16-month	84.0%
24-month	68.3%
Post-SRS complications	
CTCAE grade 1	97.9%
CTCAE grade 2	2.1%
Overall survival (months)	
Mean ± SD	38.8 ± 7.82



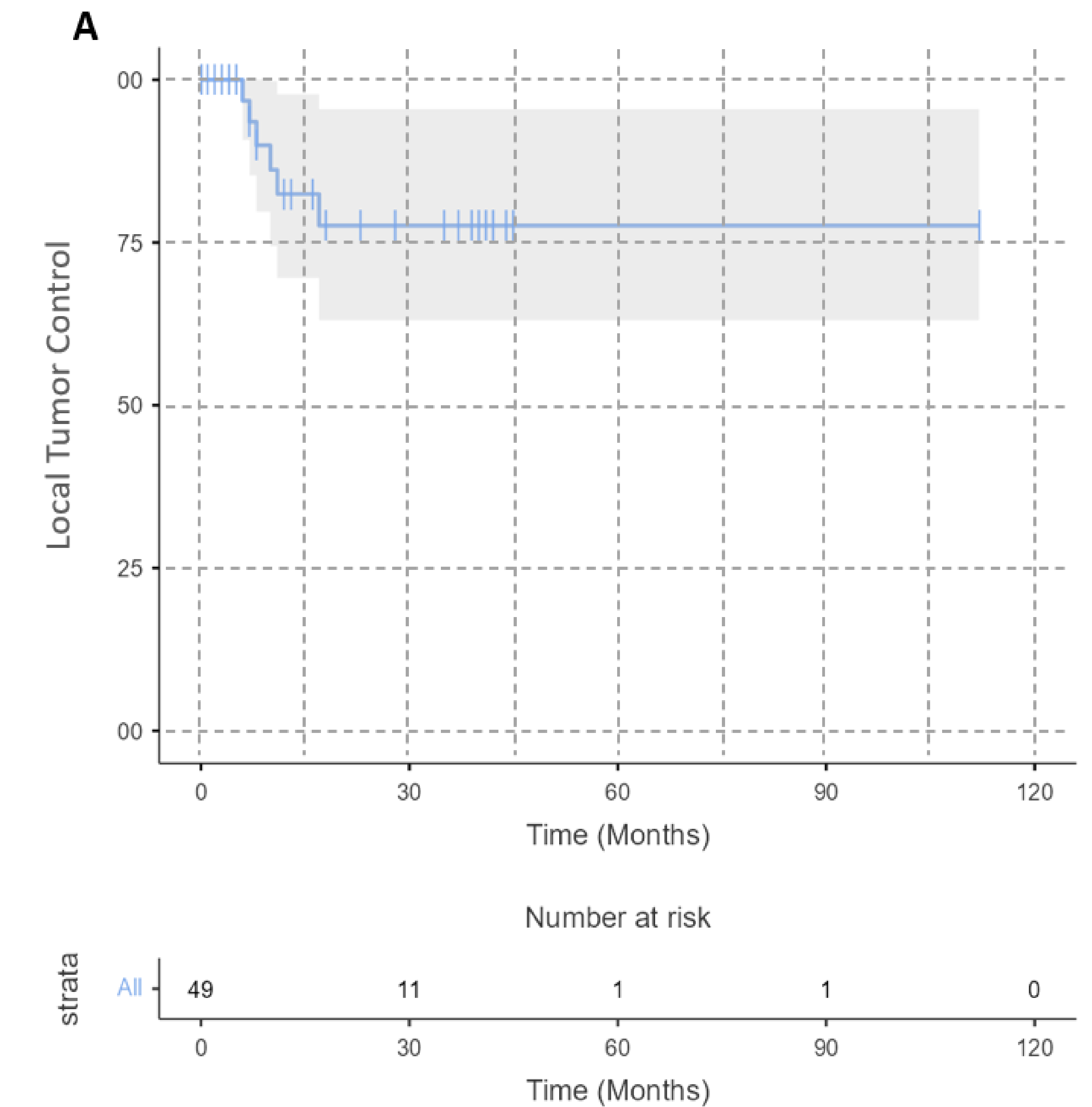
**Figure 1. MRI studies of patient #43**

**A:** CyberKnife radiosurgery plan for the left thalamic lesion. The tumor volume was 6.78 cc. A marginal dose of 18 Gy, with the maximum dose of 25 Gy, was delivered in one fraction to 72% isodose line (T1-Weighted with Contrast Enhancement).

**B:** MRI study of 35-month follow-up demonstrates no residual of the right hypoglossal canal and infra-temporal fossa lesion where SRS was delivered (AX T1 post contrast).

## RESULTS

- The mean follow-up was 18.92 months (SD: 20.95 months). The mean overall survival was 38.8 months (95% CI: 23.5 to 54.1). The mean age at diagnosis was 58.49 years (SD: 13.53 years) and 59.2% were female.
- Primary tumor origins for thalamic metastases included NSCLC (44.9%), breast cancer (14.3%), and SCLC (10.2%), with other cancers.
- The median size of the BM was 1.0 cm (IQR: 0.50 - 1.95 cm) with the mean volume of 2 cm<sup>3</sup> (SD: 3.16 cm<sup>3</sup>). The median dose delivered was 22 Gy (IQR: 20– 24 Gy).
- The patients without a genetic mutation had pre-SRS thalamic aphasia more frequently than those with a genetic mutation (25.9% vs. 4.5%, p = 0.044).
- Larger thalamic tumors are significantly associated with increased local recurrence (p = 0.025).
- Higher maximum radiation doses are significantly associated with reduced tumor recurrence (P= 0.042).
- Pre-SRS thalamic aphasia (p = 0.019) is significantly associated with reduced symptom resolution following treatment.
- The cumulative 6-months, 9-months, 12-months and 24-months local control rates were 100%, 90%, 82.5%, and 77.6% respectively.
- The overall survival rates were 91.4% at 6 months, 89.1% at 12 months, 84.0% at 16 months, and 68.3% at 24 months.



## CONCLUSIONS

Our results showed the sufficient local control following the treatment. SRS demonstrates efficacy and safety in managing thalamic brain metastases, with high cumulative control rates sustained over time, supporting its role as an effective treatment option for these metastases. Achieving a Dmax of 24 Gy may be predictive of better local tumor control for these complex pathologies.