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# 3D-TSE Imaging at Time of Radiosurgery Predicts Distant Intracranial Failure in Lung Cancer Patients with Brain Metastases

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**Published 03/05/2025**



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**Categories:** Medical Physics, Radiation Oncology
**Keywords:** 3d-tse, brain metastases, imaging, intracranial, radiosurgery

**How to cite this abstract**
Kotecha R, Akdemir E Y, Gurdikyan S, et al. (March 05, 2025) 3D-TSE Imaging at Time of Radiosurgery Predicts Distant Intracranial Failure in Lung Cancer Patients with Brain Metastases. Cureus 17(3): a1367

## Abstract

Objectives:

Integrating 3D-TSE with MPRAGE sequences in stereotactic radiosurgery (SRS) planning improves imaging sensitivity for lesion detection. However, the outcomes of patients in whom new lesions were detected by adding the 3D-TSE sequence to MPRAGE, compared to those in whom 3D-TSE did not reveal additional lesions has not been well studied. This study evaluates the prognostic significance of detecting additional lesions with 3D-TSE sequences and identifies factors associated with distant intracranial failure (DIF) in a cohort of patients with lung cancer brain metastases.

Methods:

The outcomes of whole brain radiation therapy-naïve brain metastasis patients treated with SRS between January 2019 and February 2024, using both MPRAGE and 3D-TSE sequences were evaluated. The primary cohort consisted of patients who had additional lesions found on the 3D-TSE sequence (at least one), and the control cohort consisted of those in whom 3D-TSE sequence did not detect additional lesions over MPRAGE alone. Median time to DIF was estimated using the Kaplan-Meier method with group comparisons via the log rank test. Chi-square/Mann-Whitney U and Cox Regression was used to compare groups and to identify factors associated with DIF.

Results:

118 patients underwent 176 SRS sessions for 771 brain metastases using MPRAGE and 3D-TSE sequences. The median number of BM treated per session was 5 (IQR: 1–6), and the median time between the diagnostic and SRS planning MRIs was 12.5 days (IQR: 7.0–19.8 days). The time between diagnostic MRI and treatment planning MRI was not significantly different between cohorts; yet, the incorporation of 3D-TSE at the time of treatment planning identified 195 additional lesions in the primary cohort (71 out of 176 sessions). The frequency of uncontrolled extracranial disease (45.1% vs. 29.5%, p=0.039), widespread extracranial disease burden (41.0% vs. 63.4%, p=0.006), and median lesion number treated per session was higher (6 [IQR: 3-10] vs.2 [IQR: 1-3], p< 0.001) in the primary cohort compared to control cohort, respectively. The median time to DIF was significantly shorter in the primary cohort (additional lesions identified) compared to the control cohort (no additional lesion) (5.6 vs. 22.6 months, p< 0.001). When factors influencing DIF in the entire cohort were analyzed in multivariable Cox Regression, detecting additional lesions by 3D-TSE was significantly associated with shorter time to DIF after accounting for the effects of other known risk factors (increasing number of lesions treated per session, Karnofsky performance status 70 or lower, and uncontrolled extracranial disease), HR:1.74, p=0.031.

Conclusion(s):

In lung cancer patients receiving SRS for brain metastases, 3D-TSE detected additional lesions in the primary cohort that were not visible on MPRAGE alone, leading to a shorter time to DIF. This suggests that 3D-TSE may have identified truly favorable patients (the control cohort) by confirming the absence of additional lesions. Adding this sequence into clinical practice may aid in the management of brain metastases patients receiving SRS.