

Radiosurgery for Multiple Brain Metastases: is lesion count no longer the limiting factor in Radiosurgery

Diana Grishchuk, Ana Luis, Ian Paddick

Queen Square Radiosurgery Centre, National Hospital of Neurology and Neurosurgery, London, UK

Introduction

Advances in imaging, delivery, and planning optimisation have expanded the role of stereotactic radiosurgery (SRS) for patients with multiple brain metastases. Historically, lesion count limited eligibility due to concerns about normal brain dose and treatment practicality. Gamma Knife radiosurgery, with steep dose gradients and no planning target volume (PTV) margins, enables treatment of numerous metastases while maintaining acceptable V12 and total irradiated brain volume. This study evaluates the evolution toward higher lesion count and examines associated dosimetric parameters relevant to toxicity.

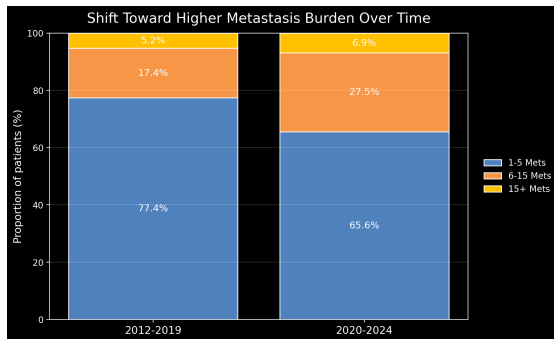


Fig 1. Patients distribution per number of lesion for two time periods

Methods and Materials

Patients treated over two time periods (2012–2019 and 2020–2024) at our institution were compared to assess trends associated with contemporary planning tools and workflows.

Dosimetric analysis was performed in a representative cohort of 120 patients, divided into three groups based on lesion count (1–5, 5–15 and ≥ 16 targets). Total tumour volume, V12 and normal brain dose exposure were evaluated to determine whether treating higher lesion numbers resulted in increased normal tissue irradiation.

Results

The mean number of lesions treated per session increased from 4.3 (max 48) to 5.9 (max 54) between the two eras. Despite treating more lesions, mean total tumour volume per session remained below 4 cc across all three lesion-count groups (2.31 cc vs 3.75 cc vs 2.51 cc).

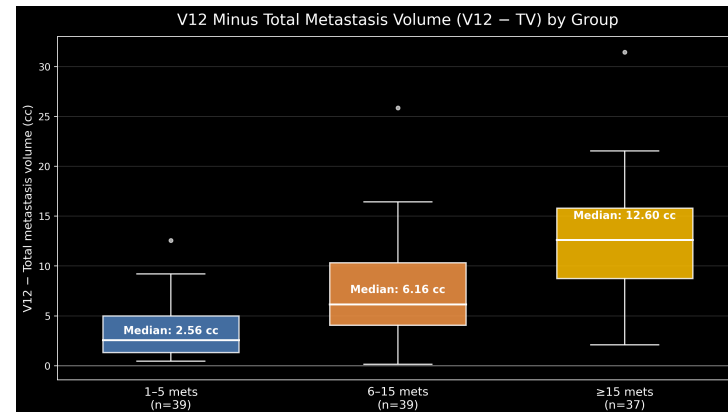
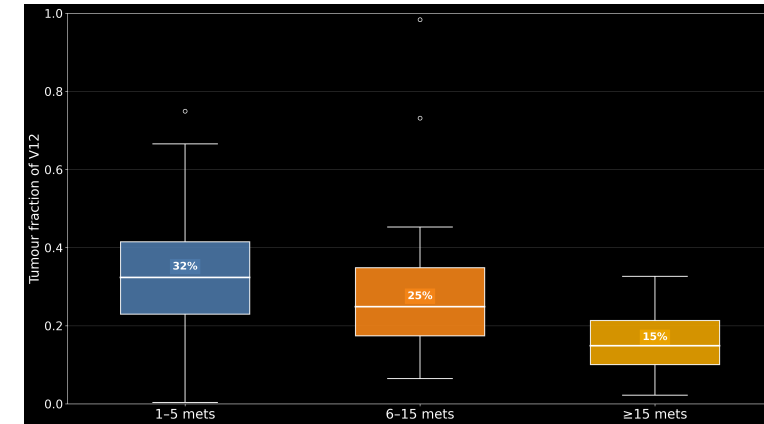


Fig 2. Normal brain V12 by Group

Mean V12 minus total tumour volume remained below 13 cc (3.52 cc vs 7.48 cc vs 12.88 cc).

Although total brain V12 sometimes exceeded the commonly referenced <10 cc threshold, this represented composite whole-brain dose. When partitioned by anatomical region, V12 values remained within accepted limits, supporting the safety of treating multiple metastases using modern Gamma Knife workflows.



Tumour volume comprises ~30% of V12 for low lesion counts, but falls to ~15–20% in patients with many metastases.

Conclusion

Modern Gamma Knife workflows safely and efficiently treat patients with many brain metastases. Dosimetric risk correlates primarily with total tumour volume rather than lesion count, supporting the evolving paradigm that high-lesion-count SRS is feasible and appropriate.