

Gamma Knife Clinical Dose Profile for Extensive Metastatic Brain Disease

Bowden GN², Kim J¹, Faramand A¹, Fallon K³, Flickinger J¹, Lunsford LD¹

¹ - University of Pittsburgh,
² - University of Alberta,
³ - Medical university of South Carolina



Introduction

- Stereotactic radiosurgery is increasingly utilized for extensive metastatic disease
- Dosimetry studies consistently demonstrate that Gamma Knife has the lowest gradient index
- It is necessary to understand the impact on normal brain tissue if assessing management strategies.

Methods

- Retrospective study at the University of Pittsburgh on 42 patients with extensive metastatic disease (≥ 15 tumors) (Table 1.)
- Utilized Gamma Plan dose analysis for each patient
- Anatomical modelling was fused onto the treatment MRI scan to calculate brain and hippocampal structure volume

Table 1. Tumor and treatment data

	N	Median # tumors	Median Margin dose (Gy)	Median aggregate tumor volume (cc)
Breast	9	19 (15-26)	15 (14-16)	1.5 (0.5-6.9)
Melanoma	11	21 (15-35)	16 (15-19)	4.0 (0.1-9.8)
SCLC	6	18 (15-26)	15 (14-16)	1.5 (0.4-4.0)
NSCLC	16	21 (15-39)	16 (14-18)	1.1 (0.2-7.5)
All	42	20 (15-39)	16 (14-19)	3.1 (0.1-13.3)

Results

Dose to whole brain:

- Median 2.58 Gy (range 0.95-3.67) (Figure 1 & 2)
- 79% of patients had a brain dose < 3 Gy

Median brain volume receiving 12 Gy:

- 12.45cm³ (0.9% of the brain)

Median brain volume receiving 5Gy:

- 91.04cm³ (6.7% of the brain)

Median brain volume receiving 3Gy:

- 306.33cm³ (20.4% of the brain)

Hippocampal Dose:

- Median dose 2.3Gy (1.7Gy in patients without tumors in direct contact with Hippocampus)

Figure 1. Number of metastases vs dose to whole brain - No Correlation (p=0.8)

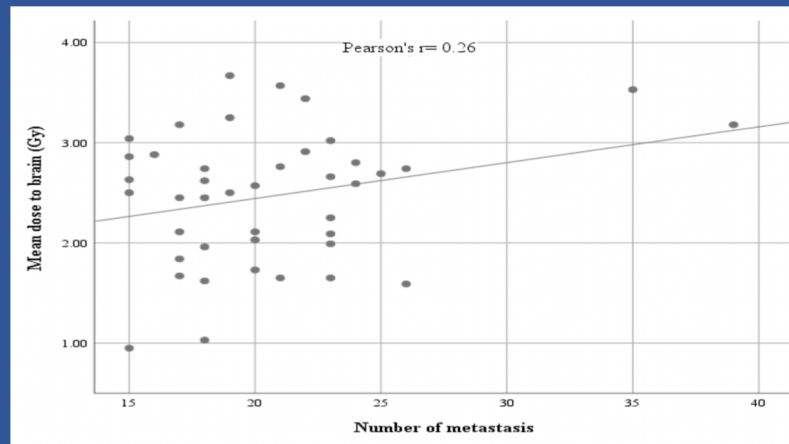
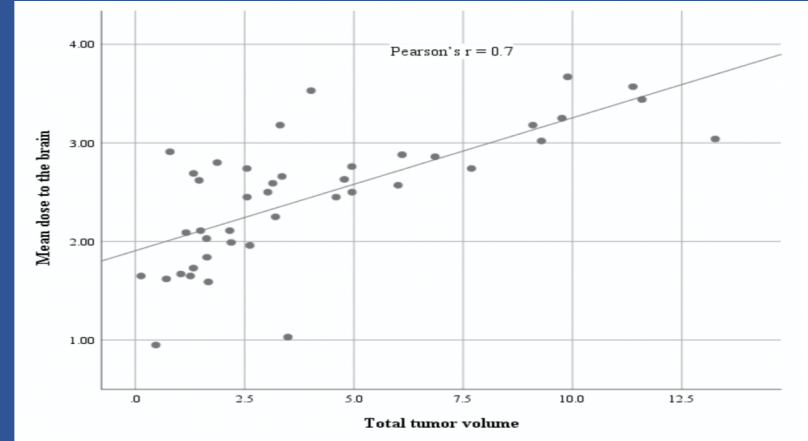


Figure 2. Volume of metastases vs dose to whole brain - Correlation (p<0.001)



Leukoencephalopathy

- Present in 57% of WBRT patients at treatment
- Developed in 2 patients with Gamma Knife alone

Additional Gamma Knife Procedures

- 16 patients (38%) had additional Gamma Knife procedures (additional 300 tumors)
- Median brain dose of 2nd procedure: 1.4Gy
- Control rate was 96.6%.

Conclusion

- Gamma Knife is a viable means of managing extensive metastatic disease.
- Gamma Knife appears to provide a relatively low dose to normal brain tissue.