Comparative Dosimetric & Clinical Evaluation of Gamma Knife and Versa HD SRS for Multiple Brain Metastates

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Background & Objective

Why compare GK and Versa HD?

SRS is standard of care for brain metastases. Both GK and Linac-based platforms achieve high local control, but direct single-centre dosimetric and clinical comparisons — particularly for patients with multiple metastases — remain limited.

METHODS and Design Study

Retrospective patient data set treated with:

- GK Icon™: 18–24 Gy, 0 mm GTV–PTV margin
- Versa HD: 6MV FFF, ExacTrac, MC Elements VMAT/DCA-SRS, 1–1.5 mm margin

Review and compare:

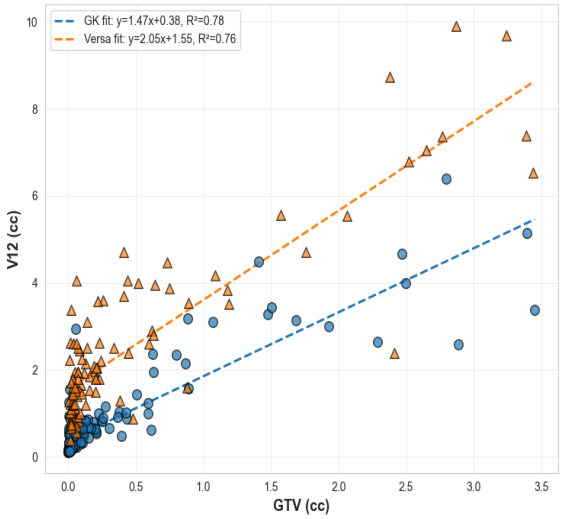
- V12 vs GTV · 279 lesions (GTV <3.5 cc)
- CI & GI analysis · 258 lesions (0.01–3.5 cc)
- Progression Free Survival (local/brain failure)
- Radionecrosis and neurotoxicity per patient

TABLE 1 — PATIENT CHARACTERISTICS

	GK (N=44)	VERSA (N=33)
Total Lesions	208	83
Lesions/pt, mean(range)	3 (1–23)	1 (1–12)
Breast	47.7%	21.2%
Melanoma	18.2%	18.2%
Colorectal	6.8%	24.2%
Lung	11.4%	12.1%
Concomitant SACT	54.5%	45.5%
Prior WBRT	9.1%	3.0%
Dex during SRS	72.7%	97.0%

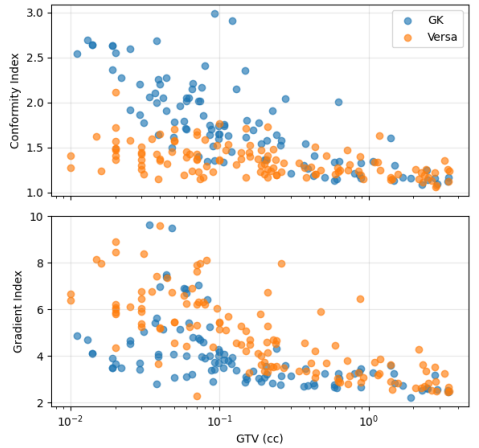
V12 vs GTV Volume — Dose Spillage

GK delivers consistently lower peripheral dose across all target sizes · 279 lesions (GTV <3.5 cc) · GK n=177, Versa n=102



Conformity Index & Gradient Index vs GTV

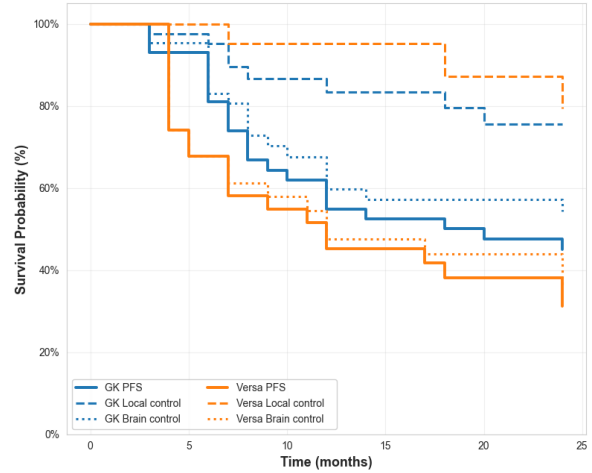
Complementary platform strengths: Versa wins on CI (coverage); GK wins on GI (falloff) · 258 lesions · log scale GTV



GK CI MEDIAN	VERSA CI MEDIAN	GK GI MEDIAN	VERSA GI MEDIAN
1.78	1.34	3.72	4.55

Progression-Free Survival, Local/Brain Control

Event = local OR brain failure · n=77 patients (GK=44, Versa=33)



MEDIAN PFS — GK	MEDIAN PFS — VERSA	12-MO PFS
20 months	12 months	54.9% vs 45.2%

Results

Mean GTV and V12 were smaller for GK plans (0.35 cc and 0.89 cc) than for Versa (1.39 cc and 4.67 cc). The V12–GTV relationship was steeper for Versa reflecting greater dose spill in linac-based plans. CI and GI also differed between systems, with GK showing higher median CI and broader variability, while GI medians were lower for GK.

Median PFS was 20 months on GK vs 12 months on Linac. PFS rates favoured GK at every timepoint (12-month: 54.9% vs 45.2%; 24-month: 45.1% vs 31.3. The consistent ~10–14 percentage-point absolute advantage for GK is clinically meaningful and concordant with the lower rates of brain failure and salvage treatment observed in this cohort. Local control curves nearly overlap while brain control curves diverge. For GK, 19% of patients had radionecrosis reported versus 34% for patients treated with Versa HD.

Toxicities

Grade I & II neurotoxicity occurred in 81.8% of patients (GK 72.7% vs Linac 93.9%). No grade III toxicity was recorded. Tiredness was the most common symptom on both platforms (~50%). The most striking platform-level difference was nausea, 36.4% on Versa vs 9.1% on GK. Headache was numerically more common on GK (27.3% vs 18.2%); other symptoms (balance, vomiting, seizure) occurred at low rates with no platform asymmetry.

Conclusions

GK demonstrated dosimetric and toxicity advantages in this cohort, particularly for small metastases, including substantially lower V12 volumes and a lower observed radionecrosis rate. These differences reflect GK's sharper dose fall-off and margin-less planning.