

Upfront Frameless Hypofractionated Gamma Knife Radiosurgery

- [Upfront frameless hypofractionated gamma knife radiosurgery for large posterior Fossa metastases](#)
- [Feasibility of fractionated gamma knife radiosurgery in the management of newly diagnosed Glioblastoma](#)
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Upfront Frameless Hypofractionated Gamma Knife Radiosurgery

□ Clinical Applications

- Large [brain metastases](#)
- [Skull base meningiomas](#)
- [Vestibular schwannomas](#)
- Selected recurrent [gliomas](#)
- [Arteriovenous malformations](#) (AVMs)

□ Advantages

- Improved patient comfort (frameless setup)
- High conformality and dose precision
- Reduced radiation-related toxicity via fractionation
- Suitable for outpatient treatment

□ Example Case

- A 62-year-old patient with a 3.5 cm right frontal **meningioma** near the motor cortex is treated with:
 - 'Upfront frameless hypofractionated Gamma Knife radiosurgery'
 - 'Regimen': 5 sessions, 5 Gy per session
 - 'Outcome': Well-tolerated, no motor deficit or significant edema

□ Notes

- Hypofractionation is especially beneficial when the lesion is near critical structures (e.g., optic chiasm, brainstem).
- Frameless platforms rely on high-resolution MRI, cone-beam CT, and real-time motion tracking for precision.

Retrospective Single-center Observational cohort studies

A [retrospective single-center observational cohort study](#), of [Koç University Hospital](#) assesses the [efficacy](#) and [safety](#) of upfront HF-GKRS for treatment-naïve large pf-METs. 40 patients with 42 [posterior fossa metastases](#) received HF-GKRS from October 2017 to June 2024. Patients eligible for the study were 18 years or older, had histologically confirmed malignancy, large pf-METs (> 4 cm³), and a minimum of two follow-up MRI scans. The primary outcome was local control (LC), with secondary assessments of distant intracranial failure (DICF), intracranial progression-free survival (PFS), overall survival (OS), and toxicity. LC was achieved in 88.1% of pf-METs over a median follow-up of 6 months (mean: 13.7 months). LC rates at 6, 12, and 24 months were 95.8%, 95.8%, and 74.5%, respectively. Local failure (LF) occurred in 11.9% of cases, with a median recurrence time of 12 months. DICF was noted in 35% of patients, while no cases of LMD were reported. Intracranial PFS rates at 6, 12, and 24 months were 54.1%, 39.0%, and 16.7%, respectively, with a median PFS of 8 months. Symptomatic hydrocephalus developed in one patient (2.5%). Controlled primary tumor status (HR: 0.17, p = 0.036) was significantly associated with lower risk of death, while no other parameters were predictive of LC, DICF, or intracranial PFS. HF-GKRS demonstrates strong efficacy and safety as a primary treatment for selected, treatment-naïve large pf-METs over a relatively short follow-up duration. Further studies are warranted to refine patient selection, fractionation, and dosing strategies for this challenging population ¹⁾.

□ Strengths Focused population: Patients with large (>4 cm³) and untreated pf-METs—a subgroup typically excluded or underserved in many radiosurgical trials.

Use of modern frameless HF-GKRS: Demonstrates applicability of advanced mask-based Gamma Knife systems in posterior fossa tumors.

Well-defined outcomes:

Local Control (LC) was primary,

DICF, PFS, OS, and toxicity as secondary outcomes.

Reasonable follow-up for local control metrics, with:

LC at 6 and 12 months = 95.8%,

LC at 24 months = 74.5%.

Low toxicity: Only one patient (2.5%) developed symptomatic hydrocephalus.

Relevant statistical analysis: Hazard ratio (HR) used to identify prognostic factors—controlled primary tumor was statistically significant (HR: 0.17, p = 0.036).

△ Limitations

[Retrospective study design](#): Prone to selection and reporting biases; causal inference is limited.

Small [sample size](#): 40 patients with 42 lesions restricts statistical power, especially in multivariate analyses.

Single center: Results may not generalize to other institutions with different patient populations or radiosurgical techniques.

Short median [follow-up](#) (6 months) for assessing long-term outcomes like radionecrosis or brainstem toxicity.

No [control arm](#): No comparison with surgery, whole-brain RT, or single-fraction GKRS.

Incomplete exploration of dosimetric variables (e.g., dose per fraction, BED, target coverage, OAR sparing).

□ Clinical Implications

This study supports frameless hypofractionated GKRS as a feasible upfront treatment for:

Large posterior fossa metastases,

Patients unsuitable for surgery or single-fraction SRS due to size/location.

Importantly:

High local control can be achieved,

Toxicity is low, despite the critical location,

Patient selection (primary tumor control) remains key to outcome.

□ Conclusion

This retrospective analysis offers promising evidence that upfront frameless HF-GKRS is an efficacious and safe non-invasive treatment for large, treatment-naïve posterior fossa metastases. However, due to design and size limitations, prospective multicenter trials with longer follow-up and comparative arms are needed to optimize fractionation schedules, patient selection criteria, and outcome prediction models.

¹⁾

Samanci Y, Aydin S, Düzkalir AH, Askeroglu MO, Peker S. Upfront frameless hypofractionated gamma knife radiosurgery for large posterior Fossa metastases. *Neurosurg Rev.* 2025 May 15;48(1):418. doi: 10.1007/s10143-025-03572-4. PMID: 40372490.

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