Brain Metastases Radiosurgery

Brain metastases are the most common intracranial tumors in adults, occurring in up to 50% of cancer patients, depending on the primary tumor type.

Stereotactic radiosurgery (SRS) has become a standard of care for selected patients with brain metastases due to its **non-invasive**, **highly focused**, and **repeatable** nature.

Indications

- Patients with 1-10 brain metastases (oligometastatic disease)
- Lesions \leq 3-4 cm in diameter
- Good performance status (KPS \geq 70)
- Controlled or controllable systemic disease
- Postoperative treatment (adjuvant SRS)
- Emerging use in **neoadjuvant setting** (pre-resection)

Advantages of SRS

- Preserves cognitive function better than whole brain radiotherapy (WBRT)
- Can be **repeated** for new lesions
- Integrated with systemic therapies, including:
 - Targeted therapy
 - Immunotherapy

Techniques

- Single-fraction SRS for small, well-delineated lesions
- Hypofractionated SRS (e.g., 3-5 sessions) for:
 - Larger lesions
 - Lesions near eloquent cortex or critical structures
- Frameless vs. frame-based systems (e.g., LINAC, CyberKnife, Gamma Knife)

Limitations and Risks

- Radiation necrosis
- Leptomeningeal spread (especially post-surgery if no cavity coverage)
- Limited efficacy for large or infiltrative lesions
- Requires high-quality imaging and multidisciplinary planning

Controversies

- Optimal number of lesions treatable with SRS remains debated
- Role of neoadjuvant SRS under investigation
- Long-term benefit of combining SRS with immune checkpoint inhibitors is still unclear

Related Pages

- Stereotactic Radiosurgery
- Radiation Necrosis

Key Point: SRS has shifted the paradigm in managing brain metastases—**focusing on preserving function**, **delaying cognitive decline**, and **individualizing care**.

Narrative Reviews

In a narrative review Pikis et al. from the Radiation Oncology and Stereotactic Radiosurgery Center, Mediterraneo Hospital, Athens, Greece, Department of Neurological Surgery, University of Virginia Health System, Charlottesville, VA, United States ¹⁾ reviewed current evidence and emerging developments in the use of stereotactic radiosurgery (SRS) for the treatment of brain metastases, including:

Established indications (e.g., oligometastatic disease)

New techniques (e.g., frameless SRS, neoadjuvant SRS)

Integration with systemic therapies (e.g., immunotherapy, targeted therapy)

This review article discusses the current and emerging indications of stereotactic radiosurgery (SRS) for brain metastases, highlighting the increasing role of frameless SRS, neoadjuvant approaches, and integration with systemic therapies such as immunotherapy.

▲ Critical Weaknesses

1. \land Lack of Original Contribution

Despite being a review article, the authors offer little in the way of **critical synthesis** or **novel insight**. Most of the content is a **reiteration of known data** repackaged with generalized optimism:

"Substantial opportunities remain..." *"Promising results..."* These are platitudes, not analysis.

2. 🛛 Redundancy and Vagueness

Key terms like "substantial improvement," "growing evidence," or "novel techniques" are used **without concrete references or quantitative benchmarks**. The article lacks **hard data** and gives no **critical discussion of failure rates**, **selection bias**, or **heterogeneity in treatment protocols**.

3. Absence of Risk-Benefit Evaluation

No rigorous analysis of:

- Radiation necrosis incidence
- Cognitive impairment from multiple SRS rounds
- Survival trade-offs versus whole brain radiotherapy (WBRT)

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The tone is **uncritically promotional**, especially regarding:

- Neoadjuvant SRS (with no phase III data yet)
- Concurrent SRS + immunotherapy (still experimental)

4. 🛛 Overreliance on Narrative Review Format

The article is a classic example of academic repackaging:

No structured methodology, no PRISMA, no tabulated comparisons, and no grading of evidence.

This reduces its **utility for clinicians** who must weigh options with real-world constraints.

5. Underexplored Topics

Several high-yield areas are superficially addressed or ignored:

- SRS for >10 metastases only briefly mentioned, despite ongoing trials.
- Cost-effectiveness and health policy impact
- Integration with advanced imaging (e.g. perfusion MRI, radiomics)
- Al-based treatment planning in SRS totally absent.

Useful Points (Briefly)

- Highlights the evolution of frameless SRS and its potential to reduce complications near eloquent brain areas.
- Notes the emerging concept of **neoadjuvant SRS**, although prematurely.
- Mentions the synergy between systemic therapies and SRS, though data is sparse.

Message for Neurosurgeons

While the article attempts to update readers on evolving practices in SRS for brain metastases, it fails to deliver a critical roadmap for surgical decision-making. The neurosurgeon seeking clarity on indications, patient selection, risk stratification, or survival outcomes will find this review underwhelming and overly optimistic.

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Final Verdict

A **polished academic brochure**, not a clinically actionable review. Promotes trends without weighing consequences, and confuses **evolution in technology** with **evidence-based advancement**.

Recommendation: Read with skepticism. Complement with high-quality meta-analysis and trial data.

Pikis S, Protopapa M, Mantziaris G, Osama M, Sheehan J. Stereotactic radiosurgery for brain metastases. Adv Cancer Res. 2025;165:115-143. doi: 10.1016/bs.acr.2025.04.001. Epub 2025 Apr 24. PMID: 40518188.

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