



## Advancements in Radiation Therapy: Revolutionizing Neuro-oncology Treatment

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### DESCRIPTION

Radiation therapy has long been a cornerstone of treatment for patients with brain tumors, providing effective local control and symptom relief. Over the years, significant advancements in radiation therapy techniques and technologies have transformed the landscape of neuro-oncology, offering more precise, targeted, and personalized treatment options. These innovations have revolutionized the way brain tumors are treated, improving outcomes and quality of life for patients facing these challenging diseases. One of the most significant advancements in radiation therapy for neuro-oncology is the development of stereotactic radiosurgery (SRS) and stereotactic radiotherapy (SRT). Unlike conventional radiation therapy, which delivers radiation over multiple sessions, SRS/SRT delivers a high dose of radiation to the tumor target in a single or few fractions, while sparing surrounding healthy tissue. This precision is achieved through the use of advanced imaging techniques, such as magnetic resonance imaging (MRI) and computed tomography (CT), coupled with sophisticated treatment planning systems.

SRS/SRT is particularly well-suited for the treatment of small, well-defined brain tumors, such as metastases, meningiomas, and acoustic neuromas. It offers excellent local control rates and minimal toxicity, allowing patients to receive treatment without the need for surgery or prolonged hospitalization. Moreover, SRS/SRT can be used as a boost after surgical resection to target residual tumor cells or as salvage therapy for recurrent tumors, offering a noninvasive alternative to repeat surgery. PBT has shown promise in the treatment of pediatric brain tumors, where minimizing radiation dose to normal brain tissue is critical to reducing long-term neurocognitive sequelae. Additionally, PBT may offer advantages in the treatment of large or irregularly shaped tumors, where conventional radiation techniques may result in higher doses

to surrounding normal tissues. While PBT requires specialized equipment and expertise, its potential to improve treatment outcomes and reduce long-term toxicity makes it an important tool in the neuro-oncologist's armamentarium. Furthermore, advancements in radiation therapy have extended beyond delivery techniques to include novel treatment modalities such as hypofractionated radiation therapy and radiosensitizers. Hypofractionated radiation therapy delivers radiation over a shorter period and fewer fractions than conventional therapy, offering convenience and potentially improved outcomes for patients with limited life expectancy or poor performance status. Radiosensitizers, such as temozolomide and bevacizumab, enhance the sensitivity of tumor cells to radiation, allowing for lower radiation doses and improved treatment efficacy.

Despite these advancements, challenges remain in the field of radiation therapy for neuro-oncology, including treatment resistance, tumor heterogeneity, and the development of late radiation-induced toxicities. Moreover, disparities in access to specialized radiation therapy centers and high-cost technologies may limit the widespread adoption of these innovative approaches. Addressing these challenges requires continued research, collaboration, and investment in infrastructure and training to ensure that all patients have access to the most advanced and effective radiation therapy options. Advancements in radiation therapy have revolutionized the treatment of brain tumors, offering more precise, targeted, and personalized treatment options for patients with neuro-oncological diseases. From stereotactic radiosurgery and proton beam therapy to hypofractionated radiation therapy and radiosensitizers, these innovations have improved outcomes and quality of life for patients facing brain tumors. Through continued research and innovation, we strive to further advance the field of radiation therapy and improve outcomes for patients with neuro-oncological diseases.

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## CONFLICT OF INTEREST

The author's declared that they have no conflict of interest.