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# Mitigating Radiotoxicity in the Central Nervous System: Role of Proton Therapy

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## Abstract

Central nervous system (CNS) radiotoxicity remains a challenge in neuro-oncology. Dose distribution advantages of protons over photons have prompted increased use of brain-directed proton therapy. While well-recognized among pediatric populations, the benefit of proton therapy among adults with CNS malignancies remains controversial. We herein discuss the role of protons in mitigating late CNS radiotoxicities in adult patients. Despite limited clinical trials, evidence suggests toxicity profile advantages of protons over conventional radiotherapy, including retention of neurocognitive function and brain volume. Modelling studies predict superior dose conformality of protons versus state-of-the-art photon techniques reduces late radiogenic vasculopathies, endocrinopathies, and malignancies. Conversely, potentially higher brain tissue necrosis rates following proton therapy highlight a need to resolve uncertainties surrounding the impact of variable biological effectiveness of protons on dose distribution. Clinical trials comparing best photon and particle-based therapy are underway to establish whether protons substantially improve long-term treatment-related outcomes in adults with CNS malignancies.

**Keywords:** Adult patients; Complications; Neurotoxicity; Protons; Radiation injury; Radiotoxicity.

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