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Patterns of failure among low-grade glioma patients treated with proton radiotherapy.

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PURPOSE: Proton treatment may be a useful radiation therapy (RT) modality for long-term surviving glioma patients to reduce normal tissue toxicities. Photon studies demonstrate that most low-grade glioma (LGG) failures occur within the radiation field, supporting the use of more conformal treatment plans, yet it is unclear whether this can be translated to proton RT (PRT). Our objective is to examine our institutional experience to determine patterns of failure in LGG patients with respect to the irradiated volume with PRT.

METHODS AND MATERIALS: Patients with WHO 2007 grade I-II or IDH1-positive mutation grade III LGG treated with PRT between 2005-2015 were retrospectively reviewed. Patients with documented local recurrences on MRI after receipt of PRT underwent comparison with initial treatment plan dosimetry to evaluate patterns of failure. A total of 141 patients were included in the final cohort.

RESULTS: Median follow-up time was 46.7 months (range: 2.8-144) and five-year overall survival (OS) was 84%. Median PRT dose delivered was 54 Gy (RBE) (range, 45-60). There were 42 failures after PRT (30%). Median time to progression after treatment was 32.7 months (range, 4.8-93.6). Thirty-one patients (74%) failed in-field (defined as within the 95% isodose volume), five (12%) failed out-of-field, and five (12%) patients had marginal failures (defined as within 50-95% isodose volume). Five-year freedom from progression after PRT was 60.1% (95% CI 48.7-70.0). Five-year cumulative incidence of OS among those with recurrence after PRT was 33% and 96% among those without recurrence after PRT, $p < 0.001$.

CONCLUSION: Of the LGG patients who had documented failures after PRT, most recurred within the radiation field, with few marginal failures, indicating that even with proton radiation, which can often have steeper dose gradients, coverage is adequate. Survival was poor for patients whose tumors recurred.

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