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Dosimetric Evaluation of Large-area Proton Minibeam Radiation Therapy System for Clinical Applications

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Methods: The large-area (30x40 cm2) pMBRT system was designed to encompass the entire brain in CSI. The system included a multi-slit collimator(MSC), a depth-dose modulator(lead scatterers), a neutron absorber, a range shifter, and a rectangular snout. The MSC generates a set of narrow minibeams due to 1.5 mm-wide slits, and the depth-dose modulator converts minibeams into a broad beam in the tumor. The peak dose uniformity and the peak-to-valley dose ratio(PVDR) values of the minibeams were measured using radiochromic films with air gap 1 cm and 11 cm from the isocenter. the depth-dose modulator was evaluated with varying the scatterer thickness, such as 0.5 mm and 1 mm to adjust PVDR value in a phantom.
Results: The pMBRT system was successfully installed into a pencil beam scanning nozzle at our proton therapy facility. It showed wide lateral beam profiles over 38 cm. The measured peak dose uniformity of the minibeams was less than 7% at overall phantom depth and air gap. PVDR values exceeding 15 were measured at the phantom surface with 170 MeV pMBRT case without scatterer. As the scatterer was thicker, the PVDR was decreased at shallower depth. The depth-dose modulator adjusted the PVDR in depth to achieve uniform dose in the target region.
Conclusions: The pMBRT system with a large-area MSC has been developed and its dosimetric properties have been evaluated. Its field size was large enough to cover the entire brain in CSI. The peak dose uniformity of the large-area pMBRT system showed good dose uniformity across the entire beam irradiation area. The large-area pMBRT system showed high PVDR values at the phantom surface, and the depth-dose profile could be modulated to form a uniform dose in the target with the scatterer and
air gap between the phantom surface and the front end of the system

Paper submission Plan

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Contribution track

ICABU WG4. Applications of Particle Beams

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